Section III

Description of the Affected Environment

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III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

Preview of this Section

Section I and Section II reviewed administrative elements relating to this IAP/EIS, possible management strategies for the Northwest NPR-A Planning Area, and how laws, directives, and advisory recommendations will play a part in future management decisions. Section III portrays the Planning Area's physical, biological, and social features. This section:

- depicts the land, the water, the climate, the plants and animals both onshore and offshore, and the threatened and endangered species in the area;
- describes interrelated features such as subsistence, the economy, and socioeconomic conditions of the area's communities, land use and ownership patterns, coastal management issues, and any natural recreation and visual resources;
- describes Special Areas, Wilderness Units, and potential additions to the National Wild and Scenic Rivers System; and
- profiles the area's transportation systems and their potential ties to existing Prudhoe Bay/Kuparuk facilities east of the NPR-A.

After reading this section, you will understand how these interconnected features collectively define the nature and character of the Northwest NPR-A Planning Area.

A. PHYSICAL CHARACTERISTICS

1. Terrestrial Environment

The following references describe the physical geography of the Northwest National Petroleum Reserve-Alaska (Northwest NPR-A) Planning Area (especially physiography, topography, climate, and general geology: USDOI, 1973, 1979, 1985, 1995; USDOI, BLM, 1979; USDOD, Department of the Navy, 1975; and USDOI, MMS, 1996a). The contents of these references are summarized below and incorporated here by reference.

a. Geology

This subsection describes the mineral potential, petroleum geology, and oil and gas resource assessment of the Northwest NPR-A Planning Area.

(1) Mineral Potential

(a) Hardrock Mineral Potential

The coastal plain of the NPR-A contains no identified hardrock mineral potential. The NPR-A's hardrock mineral potential occurs south of the Colville River, extending into the northern flank of the Brooks Range and including the Drenchwater and Story Creek deposits (Meyer, 1995).

(b) Clay Potential

The NPR-A Planning Area has no known bentonite deposits. Bentonite is used in drilling muds, civil engineering and sealing applications, pet-waste absorbents, and iron-ore pelletizing.

(c) Uranium Potential

Potential uranium deposits may occur along Alaska's North Slope, including the coastal plain of the NPR-A; however, the NPR-A has no known deposits.

(d) Coal Resources

Alaska's North Slope is a large resource-rich basin. In addition to its oil and gas resources, coal-bearing rocks underlie approximately 58,000 square miles (mi^2) of this basin. Merritt and Hawley (1986) cite identified coal resources of 150 billion tons and hypothetical coal resources of about 4 trillion tons. This is approximately one-third of the nation's estimated coal endowment. Most of this coal is from the Nanushuk Group (Cretaceous) that underlies the NPR-A (Map 93). By far, most of this potential coal is west of the Ikpikpuk River. The Northwest NPR-A Planning Area includes the eastern and northern extent of this coal-bearing stratigraphic sequence. The entire Nanushuk depositional sequence is about 8,000 feet (ft) thick near the Tunalik well on the west and thins to about 3,000 ft thick near the Ikpikpuk River (Bird, 1988a).

Well log analyses of oil and gas exploration drilling suggest there are 28 coal beds thicker than 5 ft in the Tunalik #1 well area. (Note: Well logs can resolve thinner coal beds, but these thinner beds are not typically utilized in determining known recoverable coal resources). Additional geophysical logging of shallow seismic shot holes suggests that the coal bearing strata are widespread across the western NPR-A (Callahan and Martin, 1981). Subsurface logging and field mapping show that individual Nanushuk coals can exceed 20 ft in thickness. The thickest coal is in the western section of the Northwest NPR-A Planning Area where the Nanushuk Group consists of predominantly non-marine sediments. According to Tyler, Scott, and Clough (1998), the Tunalik, Kaolak, and Meade wells define an elliptical-shaped coal depositional center southwest of Atqasuk. Total coal thickness in the Nanushuk Group exceeds 300 ft but thins toward the north and east. Analyses of the coal in this region show that it is low sulfur, low ash, and sub-bituminous. Coal rank increases to bituminous toward the south, coincident with the folding and faulting of the Brooks Range. Consequently, the southeastern portion of the Northwest NPR-A Planning Area near the Colville River is expected to have comparatively less coal, but of higher rank than the coal in the northern portion of the NPR-A.

Although an Arctic Slope Regional Corporation (ASRC) pilot project demonstrates that shallow coal beds from the Nanushuk can be mined in Arctic environments, the Naval Petroleum Reserves Production Act (1976) or NPRPA, currently prohibits coal mining within the NPR-A. However, these coals probably hold greatest potential as sources and reservoirs for coal bed methane; coal bed methane is considered to be an unconventional gas resource. Most Nanushuk coals occur between the surface and depths of 6,000 ft. These depths are optimal for producing coal bed methane. Quantitative gas desorption data is not available, however the Nanushuk coals were deposited peripherally to the Western Cretaceous Seaway and consequently share characteristics such as rank, sulfur content, ash content, depositional environments, and tectonic histories with the coals of the San Juan Basin where coal bed methane is currently being produced. While the North Slope coal bed methane resources are strictly speculative at this time, the Alaska Division of Geological and Geophysical Survey estimates there are up to 700 trillion cubic feet (Tcf) of North Slope coal bed methane, based on simple basin calculations determining coal volumetrics and conservative estimates of gas yield. This estimate greatly exceeds the 33 Tcf of booked natural gas reserves and 64 Tcf of estimated onshore undiscovered conventional gas resources currently cited (Sherwood and Craig, 2001).

(2) Petroleum Geology

Northern Alaska is a very rich petroleum province, with an estimated in-place endowment of oil and gas equivalent to 77 billion barrels (Bbbl) and proven original oil reserves exceeding 20.5 Bbbl (ADNR, 2002), of which over 13 Bbbl have been produced. Exploration in northern Alaska has located at least 38 oil and gas fields, but most reserves are in a few, very large oil fields near Prudhoe Bay (Map 25). The essential oil source-rock and reservoir sequences creating these commercial oil fields extend across much of the North Slope, including the NPR-A. Because of these geologic trends and the abundance of untested potential traps, northern Alaska and the adjacent continental shelf are considered to hold high potential for new oil and gas fields.

This subsection describes the past exploration efforts in northern Alaska and discusses important aspects of the geology pertaining to the NPR-A. New stratigraphic play concepts for the Jurassic system, as revealed by the Alpine discovery, have already led to the discovery of fields in areas of the NPR-A overlooked in the past. Advancements in technology have progressively lowered the field-size threshold for commercial development. These two factors have prompted a renewed interest in exploration of the NPR-A.

(a) Petroleum Activities in Northern Alaska

1) Past Exploration Efforts

Petroleum exploration in northern Alaska began in the early 1900's with field parties sponsored by the USGS. Prompted by reports of oil seeps in the Cape Simpson area and concerns about domestic fuel supplies, President Warren Harding established Naval Petroleum Reserve No. 4 (PET-4) in 1923. In 1977, management of PET-4 was transferred from the Navy to the U.S. Department of the Interior (USDOI) and the area was renamed the National Petroleum Reserve-Alaska or NPR-A.

Fuel shortages during World War II prompted the first intensive government-funded exploration program in the NPR-A by the Navy from 1944 to 1952. The first 81 exploration wells were mostly shallow (less than 3,000 ft) core holes drilled near oil seeps and on surface anticlines. This drilling produced eight oil and gas discoveries: Umiat, Fish Creek, South Barrow, Simpson, Meade, Wolf Creek, Gubik and Square Lake (Table III-01). Umiat was the first oil field discovered in northern Alaska (1946), although it remains undeveloped. The South Barrow gas field was the first significant gas discovery (1949) on the North Slope. It was developed in 1958 by the federal government to supply fuel to the community of Barrow. The Naval program also collected 3,300 miles (mi) of seismic data as well as limited gravity and magnetic data during this period.

With Alaska statehood in 1959, petroleum exploration shifted to state lands selected on the North Slope in the corridor between the NPR-A on the west and the Arctic National Wildlife Refuge (ANWR) on the east. State lease sales in 1964 and 1965 were followed by the discovery of the super-giant Prudhoe Bay field in 1968. With 13.7 Bbbl of original oil reserves, Prudhoe Bay is the largest oil field ever found in North America. Four other giant oil fields were soon discovered near Prudhoe Bay, including the Kuparuk River field (2.6 Bbbl, 1969) the Milne Point field (404 million barrels [MMbbl], 1970), the Endicott-Duck Island field (582 MMbbl, 1978), and the Point McIntyre field (549 MMbbl, 1988) (ADNR, 2000). These five fields account for 92 percent of North Slope oil and nearly 16 percent of all U.S. oil production (5.88 million barrels per day [MMbpd]; AEO, 2000:table B11). Known North Slope natural gas deposits are also huge, with original proven reserves in the Prudhoe Bay field of 26 trillion cubic feet (Tcf) and about 35 Tcf for the North Slope.

In response to oil shortages related to the 1973 embargo by the Organization of Petroleum Exporting Countries (OPEC), government-sponsored exploration of the NPR-A resumed in 1973 following a two-decade hiatus. The reserve (then Naval Petroleum Reserve 4 or PET-4) exploration program was transferred from the U.S. Department of the Navy to the USDOI and the reserve was re-designated "National Petroleum Reserve-Alaska," as directed by the Naval Petroleum Reserves Production Act of 1976 (NPRPA) (Schindler, 1988, p. 32-33). The post-1973 phase of PET-4/NPR-A exploration resulted in 28 exploration wells (Bird, 1988a:table 15.2) and 13,085 mi of seismic data (Schindler, 1988:table 2.1). Numerous oil and gas shows were reported, but no commercial fields were discovered. Government subsidies funded development of the gas fields near Barrow (Barrow and Walakpa) that are currently producing for local use.

These petroleum reserve exploration programs produced well data (126 wells, 32 deep tests with modern log data) (Bird, 1988a:table 15.2), seismic data (16,479 mi), and a sizeable assemblage of scientific reports and maps that have provided the foundation for ongoing evaluations of petroleum resources in the NPR-A (Gryc, 1988). The NPR-A oil and gas fields discovered in NPR-A are identified in Figure III-01.

Construction of the Trans-Alaska Pipeline System (TAPS) began in 1974. In 1977, the first oil pumped through the pipeline arrived at the ice-free port of Valdez for shipment to markets on the U.S. West Coast and the U.S. Gulf Coast. The TAPS throughput peaked at 2.0 MMbpd in 1988 and by 2002 production throughput was down to 1.0 MMbpd. From 1977 to 2001, over 13.6 Bbbl of oil passed through the TAPS.

The Alpine discovery played a significant role in re-igniting exploration interest in the NPR-A. ARCO and partners discovered the Alpine field in the winter of 1994-1995 (*Alaska Report*,1996). Appraisal drilling at Alpine field suggested a reserve potential of 365 MMbbl in 1997 (*Alaska Report*, 1997), but by 1999 the estimate was increased to 429 MMbbl (*Anchorage Daily News*, 1999, p. B-6). In a 2001 presentation, Gingrich (2001) reported a reserve estimate of 500 MMbbl for Alpine field. The Alpine field is the largest field discovered in Alaska since the Point McIntyre field and one of the largest U.S. fields in recent decades. It is particularly significant that the Alpine discovery has revealed a new geologic play in previously unknown sands of the Jurassic Kingak Formation (Figure III-01). The Alpine play extends westward into the NPR-A and it has been the principal target for exploration on leases acquired in the Northeast NPR-A Planning Area.

Thirteen exploration wells (including one sidetrack well) were drilled in the Northeast NPR-A Planning Area on leases acquired in 1999. Seven of these 13 wells (including a sidetrack well) encountered oil or gas and condensate. Long-term flow testing at the Spark 1A well produced 1,550 barrels of liquid hydrocarbons and 26.5 million cubic feet per day (MMcfd) of gas. Long-term flow testing at the Rendezvous "A" well produced 360 barrels per day of liquid hydrocarbons and 6.6 MMcfd of gas. Flow tests at the Lookout 2 well recovered 4,000 barrels per day of liquid hydrocarbons and 8 MMcfd of gas. All of these exploration wells targeted the Alpine field reservoir formation, which occurs within the "Beaufortian" play group. These wells are located 15 to 25 mi southwest of the 500-million-barrel Alpine field that is now producing more than 100,000 barrels of oil per day (*PI/Dwight's Plus Drilling Wire*, 2001c). Locations of recent exploration wells are depicted on Map 26, which also lists the wells and public announcements of test results.

2) Leasing and Development

Petroleum leasing activities began in northern Alaska shortly after statehood in 1959. In the years following the 1968 Prudhoe Bay discovery, 43 State lease sales have been held on Alaska's North Slope and State waters of the Beaufort Sea (State of Alaska, 2003:p. 68-69). The ongoing State leasing schedule proposes 15 sales between 2003 and 2007 (State of Alaska, 2003:p. 17).

A series of Federal lease sales in the NPR-A occurred in the early 1980's. The first NPR-A sale (Sale 821) was conducted in January 1982. A total of 1.5 million acres was offered and 653,436 acres were leased (44%) for total high-bonus bids of $57.1 million. The second NPR-A sale (Sale 822) was held in May 1982. A total of 3.5 million acres was offered and 252,000 acres were leased (7.2%), with total high-bonus bids of $9.7 million. The third NPR-A sale (Sale 831) was held in July 1983. A total of 2.195 million acres was offered and 419,018 acres were leased (19%), for total high-bonus bids of $16.657 million. A fourth NPR-A lease sale (Sale 841) was held in July 1984. No industry bids were received for the 1.6 million acres offered. A fifth sale (Sale 851) scheduled for 1985 was canceled because of legal challenges and an apparent lack of industry interest. Overall, 1982-1985 NPR-A leasing resulted in the drilling of a single well (Brontosaurus, ARCO) that was abandoned as a dry hole in 1985. One other industry well was drilled in 1982 on private in-holdings at Cape Halkett (Livehorse, Chevron), but information from the well remains confidential.

The fifth lease sale in NPR-A (Sale 991) was rescheduled and held in May 1999. The BLM offered 425 tracts (approximately 3.9 million acres) within the Northeast Planning Area. A total of 133 leases (867,000 acres) were leased, with winning bids totaling $104,635,728. Six oil companies (British Petroleum, Anadarko Petroleum, Chevron, Phillips Petroleum, ARCO Alaska, and R3 Exploration Corp) submitted 174 bids that concentrated in the northeast corner of the Northeast Planning Area. The highest bid for a single tract (5,756 acres) was $3,655,100, offered by ARCO Alaska and Anadarko Petroleum. Since 1999, 14 wells have been drilled on leases acquired in Sale 991 (Map 26).

The BLM conducted a sixth lease sale in June 2002, again within the Northeast Planning Area. The 2002 lease sale generated winning bids totaling $63,811,496 on 60 tracts totaling 579,269 acres. Phillips Alaska and Anadarko Petroleum, the companies that have been most active in NPR-A, were awarded 34 tracts, with winning bids of $9.6 million. Two companies that have not been active in the NPR-A to date also submitted winning bids. TotalFinaElf E&P USA was awarded 20 tracts with winning bids totaling $53,532,000. TotalFinaElf submitted the six highest bids of the sale, bidding more than $10 million on each of two tracts and more than $7 million on a third. EnCana Oil and Gas (USA) Inc. also submitted winning bids for leases in the 2002 sale.

The first offshore lease sale in northern Alaska offered nearshore tracts near Prudhoe Bay and was conducted jointly in 1979 by the State of Alaska and the Federal Government. This lease sale attracted more than $1 billion in high-bonus bids. Since 1979, six additional outer continental shelf (OCS) sales in the Beaufort Sea and two lease sales in the Chukchi Sea have offered most of the OCS off northern Alaska (MMS, 2003). These seven offshore sales, offering 5.5 million acres of Federal lands, generated total high-bonus bids of $4.03 billion. The most recent OCS sale was held in August 1998 (Sale 170) and fetched $6.2 million in high bids on 28 lease blocks in the Beaufort Sea. Three lease sales are scheduled for the Beaufort Sea and two lease sales are scheduled for the Chukchi Sea/Hope Basin (USDOI, MMS, 2001) from 2003 to 2007.

As a result of the OCS leasing program, 35 exploratory wells were drilled in Arctic Federal waters between 1980 and 2003 (30 Beaufort Sea wells, 5 Chukchi Sea wells). The 35th exploration well was drilled by Encana in the winter of 2002-2003 at the McCovey prospect in the Beaufort Sea. MMS classifies nine of these wells as capable of producing paying quantities (sufficient to pay for operating costs; not necessarily sufficient for commercial development). Five prospects have been unitized for possible development (Northstar, Sandpiper, Hammerhead, Kuvlum, and Liberty) and commercial oil production began at Northstar in October 2001. In January 2002, BP-Amoco postponed commercial development at Liberty (Tern) pending project design changes.

Historical leasing patterns offer a perspective on the possible scale of activities associated with future NPR-A lease sales. In the previous NPR-A leasing programs, nearly 20.5 million acres were offered and 3.61 million acres were leased (approximately 18%). Currently, private companies have drilled fifteen exploratory wells with fourteen wells drilled on 1999 leases within the Northeast NPR-A Planning Area. In the OCS, 35 exploration wells were drilled from a lease inventory of 5.5 million acres (averaging 1 well per 27 leased tracts). There have been significantly higher levels of drilling on State leases, where it is estimated that approximately half of all the offered tracts have been leased during the more numerous State sales (Kornbrath, 1994). Approximately 10 percent of the available prospects have been tested. Historically, the success rates for commercial fields on the North Slope have been slightly less than 5 percent. That is, 1 in 20 tested prospects is likely to become a commercial field. Petroleum exploration in Alaska has located some of the largest oil fields in North America and can be a high-reward venture, but the chances for commercial success for any particular exploration well are small.

(b) Geologic History and Stratigraphy

Sedimentary rocks representing approximately 360 million years of geologic time (Figure III-01) underlie northern Alaska and the adjacent continental shelf. Three thick stratigraphic sequences were deposited in overlapping geologic basins now lying beneath Alaska's North Slope.

The older Arctic Alaska Basin (shown in Map 27) flanked a now-vanished continental landmass that was located north of the present-day Beaufort coastline. This landmass was split away from northern Alaska during rifting that created the modern Arctic Ocean. The Ellesmerian Sequence was deposited in the Arctic Alaska Basin and consists of sediments shed southward from the former landmass to the north. The Ellesmerian sequence is composed of rock units that grade from proximal facies (near source terrane) in the north to distal facies (deepwater marine) in the south.

The onset of rifting severed the northern landmass from the Arctic Alaska basin and terminated the deposition of the Ellesmerian sequence. Following the terminology of Hubbard, Edrich, and Rattey (1987), sedimentary rocks associated with the rifting here are called the "Beaufortian" sequence. The Beaufortian sequence therefore marks a transitional period between the Ellesmerian and Brookian cycles of basin filling. The Beaufortian sequence overlies northern parts of the older Arctic Alaska basin, but achieves maximum thicknesses in small, faulted basins (graben) north of the Barrow Arch and beneath the modern Beaufort continental shelf.

The Colville basin was formed as a deep trough on the north side of a mountain belt whose present expression is the Brooks Range. The Brookian Sequence, deposited in the younger basin, contains deltaic and marine deposits shed northward off the mountain belt into the Colville Basin.

The primary structural features (major sedimentary basins and tectonic features) of northern Alaska and contiguous offshore continental shelves are displayed on Map 27. The Brooks Range, Colville Basin, Arctic Alaska Basin, and Barrow Arch (progressing south to north) are particularly important to later discussions of petroleum potential. Numerous literary references describe the stratigraphy and tectonic evolution of northern Alaska and its adjacent continental margins. For additional information, see: Brosge and Tailleur (1971); Grantz and May (1982); Craig, Sherwood, and Johnson (1985); Hubbard, Edrich, and Rattey (1987); Kirschner and Rycerski (1988); Bird, 1991; and Moore et al. (1994).

1) Franklinian Sequence

In many areas throughout the Arctic, sedimentary rocks rest uncomfortably upon a highly deformed, low-grade metamorphic complex containing rocks from Precambrian to early Paleozoic age. In northern Alaska, these metamorphic rocks were formed from sedimentary rocks of the Franklinian Sequence. Franklinian rocks are less deformed (and not metamorphic) in northern Canada, where they host oil and gas deposits (Stuart Smith, and Wennekers, 1977). In Alaska, Franklinian rocks are considered as economic basement.

2) Ellesmerian Sequence

The Ellesmerian Sequence in northern Alaska ranges in age from mid-Paleozoic to mid-Mesozoic (Figure III-01). These sedimentary rocks were once part of a continuous "supercontinent" with a system of connected basins extending across wide areas of the present Arctic (Jackson and Gunnarsson, 1990; Embry, 1990). This supercontinent was fragmented in early Cretaceous time by the rifting that created the modern Arctic Oceanic Basin (Grantz and May, 1982). Now, correlative rocks are found on several circum-Arctic continents ranging from eastern Siberia (Chukotka) to near Greenland (Canadian High Arctic). The rocks recording the pre-breakup basin in northern Alaska are grouped under the name "Ellesmerian" Sequence because of their similarity to rocks of the same age that are exposed on Northern Canada's Ellesmere Island (Lerand, 1973). The Ellesmerian Sequence in northern Alaska contains several productive reservoirs, including the Kekiktuk Formation (Mississippian, Endicott Group) in the Endicott/Duck Island and Liberty/Tern Island fields; the Lisburne Group (Mississippian-Pennsylvanian); and the Ivishak Formation (Permian-Triassic, Sadlerochit Group) in the Prudhoe Bay and Northstar fields.

3) Beaufortian Sequence

The breakup of the preexisting landmass and associated Ellesmerian rocks is represented by marine sedimentary rocks ranging from Middle Jurassic to Early Cretaceous (175 to 115 million years ago [Ma]) (Figure III-01). These strata are referred to as the "Beaufortian" Sequence, a name applied by Hubbard, Edrich, and Rattey (1987) to rift zone deposits along the Beaufort Sea continental margin. The Beaufortian Sequence contains rocks correlative to reservoirs in five major commercial fields on the North Slope, including the Kuparuk, Point McIntyre, Alpine, Milne Point, and Niakuk fields. Beaufortian Sequence sandstones contain gas reserves at the South Barrow, East Barrow, Sikulik, and Walakpa fields near Point Barrow.

4) Brookian Sequence

With continental breakup from seafloor spreading in the Arctic Oceanic Basin, crustal movements caused collisions along plate margins between fragments of the original continent and outlying, independent continental masses. These collisions caused uplift of new mountain belts and complementary foreland sedimentary basins (Bird and Molenaar, 1992). The actively subsiding basins flanking the mountain belts received clastic debris that eroded from the adjacent mountains. In northern Alaska, the rocks recording this collision are termed the "Brookian" Sequence in deference to their association with the Brooks Range. Rocks correlative to the Brookian Sequence are found on all circum-Arctic continents but are highly variable because of their independent source terranes and basin types. Brookian rocks in northern Alaska include nonmarine, deltaic, and deep-marine strata, ranging from Early Cretaceous (about 115 Ma) to the present. To date, Brookian reservoirs have not contributed significantly to North Slope production. However, numerous marginally commercial discoveries are in early phases of production or planned production, including the West Sak/Kuparuk, Schader Bluff/Milne Point, Tarn, Meltwater, Nanuq, Tabasco, and Badami fields.

(c) Petroleum Potential

The TAPS is currently shipping nearly 380 MMbbl of oil annually from fields on the North Slope to outside markets. Most of this oil (80%) is produced from reservoirs in the Ellesmerian Sequence. Fields in the Beaufortian Sequence account for slightly less than 20 percent of North Slope production. At present, Brookian Sequence reservoirs contribute less than one percent of the total TAPS throughput, although this proportion may increase in the future with new development activities at West Sak, Milne Point (Schrader Bluff pool), Tarn, Meltwater, Badami, Nanuq, Tabasco, and other Brookian-Sequence fields.

Most oil production has been associated with Ellesmerian formations largely because of the exceptional reservoir qualities in the Sadlerochit (Ivishak Formation) and Endicott (Kekiktuk Formation) sandstones in this sequence (Figure III-01). Because of their proven performance as commercial petroleum reservoirs, Ellesmerian prospects have traditionally formed the chief exploration objectives in northern Alaska. Reservoir qualities comparable to the Ellesmerian reservoirs are rarely found in the younger Beaufortian and Brookian Sequences. These younger reservoirs are typically thinner and more laterally discontinuous, with lower porosity and permeability. For this reason, these sequences have been viewed as secondary objectives in the past. That focus is now changing however, in light of the recent discoveries in Beaufortian rocks in the Colville delta area and Northeast NPR-A. Since 2000, Beaufortian Sequence reservoirs, particularly the Alpine sandstone, have formed the chief exploration target for the wells drilled in the Northeast NPR-A (*PI/Dwight's Plus Drilling Wire*, 2001c).

1) The Ellesmerian Petroleum System

The geologic events creating the giant oil fields in northern Alaska are straightforward. During several intervals between Triassic and Early Cretaceous time (230 to 115 Ma), fine-grained marine sediments, rich in organic matter, were deposited across northern Alaska. Uplift and northward thrusting of the ancestral Brooks Range loaded the crust and formed a deep foreland trough (the Colville Basin) filled with more than 20,000 ft of deltaic and marine sediment. These younger strata were piled on top of the older organic-rich shales. By mid-Cretaceous time (about 100 Ma) the source-rocks had reached burial depths and temperatures at which organic matter was converted to oil. The oil was expelled into porous carrier beds and migrated northward toward a structural ridge called the Barrow Arch, trending northwest-southeast along the present coastline (Figure III-02). A portion of this oil ultimately invaded geologic traps to form fields along the Barrow Arch trend, most notably at Prudhoe Bay.

Organic-rich shales and limestones within the Ellesmerian and Beaufortian Sequences are the sources for 98 percent of the oil endowment in northern Alaska (Bird, 1994). Bird (1994) has termed this oil generation, migration, and entrapment system the "Ellesmerian" petroleum system and has estimated its total generative potential at 8 trillion bbl of oil. Only about 1 percent (70 Bbbl) of the oil generated by the Ellesmerian petroleum system is accounted for (as in-place oil) in northern Alaska (Bird, 1994). In the NPR-A, other petroleum-generating systems associated with Cretaceous deposits in the Colville Basin probably generated the various oil types found at Umiat and Simpson and the gas found at Wolf Creek, Square Lake, and Gubik (Magoon and Claypool, 1988). These prolific oil-generation and trap-charging systems are among the chief attractions to petroleum exploration in northern Alaska.

2) Future Petroleum Exploration

Although the Ellesmerian Sequence has a strong tradition of exploration success onshore and offshore, it is interesting to note that the most spectacular failure in Alaska's history of petroleum exploration is also an Ellesmerian test. The Mukluk prospect was initially thought to contain from 1.5 to 10 Bbbl of recoverable oil. It was leased in 1982 for total high bids exceeding $1.5 billion, with the highest single bid of $227 million for one OCS tract (nearly $40,000/acre). The Mukluk well was drilled in 1983 at a cost of $120 million and then plugged and abandoned as a dry hole. To this day, it remains the most expensive dry exploration well ever drilled.

The failure at Mukluk soured the oil industry's enthusiasm for exploring northern Alaska and was shortly followed by a collapse in oil prices in the mid-1980's. Before the Mukluk experience, many industry explorers felt that another field the size of Prudhoe Bay would surely be found on the North Slope or Beaufort Sea. Mukluk proved how risky that notion could be and presaged a decade-long crash in oil exploration in Alaska.

With passing time and improving financial conditions, industry's interest in exploring northern Alaska rebounded in the 1990's. Although few geologists genuinely expect to find more Prudhoe Bay-sized fields in northern Alaska, many see a high potential for undiscovered fields of more modest sizes. Today, oil fields of 100 to 200 MMbbl are routinely developed and satellite fields (sharing existing infrastructure) of only 30 to 50 MMbbl are seriously considered for commercial development. With the minimum commercial-field thresholds lowered to these levels because of technological advances in drilling and reservoir development, it is clear there are abundant exploration opportunities throughout northern Alaska. This perception will likely encourage exploration for decades to come.

Industry strategy has also shifted from exploring completely untested (wildcat) geologic plays in remote areas to detailed re-examination of proven plays in areas near existing infrastructure. This strategy is based on two assumptions: (1) exploration that focuses on proven plays is more likely to be successful; and (2) the economics for development are more favorable if existing infrastructure is used. Consequently, new development is likely to expand incrementally from current North Slope infrastructure rather than appear as widely scattered startup projects.

The Alpine field is clearly a key factor in the resurgence of industry's interest in the NPR-A. The Jurassic reservoirs constitute a new exploration play that is likely to extend over the northern third of the Northwest and Northeast NPR-A Planning Areas. Although the reservoirs are modestly thick (averaging 50 ft at Alpine field), new technology will allow the economic recovery of 500 MMbbl of the total estimated in-place volume of 800 to 1,000 MMbbl at Alpine. Alpine-sized fields in remote areas might have been considered sub-economic as recently as a decade ago. Several new commercial fields in the Alpine area are listed in Table III-01. The Alpine facilities in the Colville delta and the sales-oil pipeline installed under the Colville River have pioneered the infrastructure on the eastern border of the NPR-A. New design concepts could provide the template for future fields in other environmentally sensitive areas in northern Alaska. The new Alpine infrastructure (processing, support facilities and pipeline) will undoubtedly fit into plans for future developments of commercial discoveries in the northeastern NPR-A. It is quite likely that fields similar in size and stratigraphy were overlooked by previous exploration efforts elsewhere in the NPR-A. Earlier NPR-A exploration programs focused on the Barrow Arch in the north or on the foldbelt structures in the south.

The previous discussion briefly describes the long and complex geologic history of Alaska's North Slope. The tectonics and associated stratigraphic sequences combined to create a diverse and highly successful commercial petroleum province. Seismic mapping and well data have established that many of the key reservoir- and source-rocks forming the present commercial fields also are found beneath the NPR-A. The following subsection presents the results of a recently completed resource assessment of the undiscovered hydrocarbon potential in the Northwest and Northeast NPR-A Planning Areas.

(3) Oil and Gas Resource Assessment

(a) Overview

Assessments of undiscovered oil and gas resources help to identify areas with a high potential for leasing and eventual development. The consequences of oil and gas leasing, including economic benefits and environmental impacts, are based on estimated volumes of commercial oil and gas fields that could be discovered and produced from the leased area. Before environmental effects analysis can proceed, scientists review the geology and engineering characteristics of the area, integrate new information, and update past resource estimates. Computer simulation models then generate statistical estimates of the hydrocarbon resource potential. Additional discussion of the geologic and economic assessments completed in support of the Northwest NPR-A IAP/EIS are provided in Appendix 7.

Two computer models, developed by MMS for offshore resource assessments, were used in evaluating the combined Northwest and Northeast NPR-A Planning Areas. Descriptions of these computer models are provided in USDOI, MMS (1996e) and Sherwood (ed.) (1998). Appendix 7summarizes the application of these two computer programs.

Estimating undiscovered resources is a complex and subjective process because of many inherent uncertainties. Seismic survey data are interpreted to identify subsurface features capable of forming hydrocarbon traps. The size, number, and locations of undiscovered pools are inferred from the seismic interpretations. Well logs are used to evaluate the characteristics of potential reservoirs, source rocks, and seals. Analogs from comparable geologic settings can be applied to untested areas having little or no data. However, uncertainty in resource assessments is a fundamental problem because it is impossible to verify the presence of petroleum accumulations without exploration drilling. Additionally, the actual volumes of reserves in discovered pools are not completely known until the pools are depleted, often decades after discovery. To accommodate these uncertainties, the assessment results are typically reported as ranges of volumes with associated probabilities. Single-number representations of oil or gas potential are usually reported as the mean of the probability distribution. The results of the assessments are summarized below.

The assessment of oil or gas potential in the combined Northwest and Northeast NPR-A Planning Areas evaluates two general categories of hydrocarbon resources:

- *Conventionally recoverable resource potential*, including pooled oil and gas accumulations recoverable by current technology without regard to economic viability; and
- *Economically recoverable resource potential*, including pools that could be developed and produced profitably under a given set of engineering and economic assumptions.

(b) Summary of Assessment Results

The 2002 petroleum resource assessment of the combined Northwest and Northeast NPR-A Planning Areas was focused on 22 recognized geologic plays. Three plays consist entirely of gas reservoirs and the remaining 19 plays consist of mixed oil and gas reservoirs. The conventionally recoverable resources amount to a total oil potential ranging from 6,817 million barrels (MMbbl) to 11,817 MMbbl (95% and 5% probability levels), with a risked mean estimate of 9,101 MMbbl. Conventionally recoverable gas resources range from 23.002 trillion cubic feet (Tcf) to 56.213 Tcf (95% and 5% probability levels), with a risked mean estimate of 37.309 Tcf.

The estimates for the risked mean economically recoverable oil resources for the combined Northwest NPR-A and Northeast NPR-A Planning Areas range from 134 MMbbl to 5,697 MMbbl ($18.00 and $30.00 prices, respectively, for crude oil plus gas liquids). The risked mean economically recoverable gas resources range from 0.212 Tcf to 15.830 Tcf ($2.56 and $4.27 prices for non-associated gas plus associated/dissolved gas). The fraction of the conventionally recoverable resource volume that could be economic to produce, if discovered, rises from about 1 percent at the lower price to 63 percent (oil) and 42 percent (gas) at the high price.

The resource potential is not uniformly distributed throughout the NPR-A area and only a few plays hold a majority of the undiscovered resource potential. The highest conventionally recoverable and economic potential lies in the northern third of the coastal plain above the Barrow Arch. This structural ridge has been a focal point for regional oil and gas migration, and all currently producing fields on the North Slope are located on or near the Barrow Arch. The high oil potential of plays along the Barrow Arch in the NPR-A is recognized in this assessment as well as all previous petroleum assessments of the North Slope.

The oil and gas potential of the combined Northwest and Northeast NPR-A Planning Areas is dominated by the Beaufortian or "Alpine"-correlative play (Play 8. Beaufortian-Barrow Arch-East) that contains 52 percent of the undiscovered conventionally recoverable oil resources and 84 percent of the economically recoverable oil resources. The geologic conditions that led to the 500-MMbo Alpine field are expected to persist across the northern NPR-A. Stratigraphic traps similar to Alpine field are likely to be the principal targets for future exploration in the NPR-A.

In the south, two plays are identified with significant oil and gas potential: Play 14 (Brookian Foldbelt) and Play 23 (Fortress Mountain Formation-Deep Detached Foldbelt). However, because these plays are gas-prone they offer modest-sized oil pools. Plays 14 and 23 are far from existing infrastructure and therefore hold limited economic potential for oil. In the high price case ($4.27/Mcf) for gas, the two plays contain 32 percent of the economic gas resources (5.0 Tcf) in the combined Northwest NPR-A and Northeast NPR-A Planning Areas.

(4) Some Aspects of Regional Geology

(a) Coastal Erosion

The Beaufort Sea coastal area is a low wave energy environment (USDOI, MMS, 1996). Tides along the Beaufort Sea coast are very small, mixed semidiurnal tides, with a mean height of about 0.5 ft waves that are generally from the northeast and east and limited to the open-water season. Wave heights are usually less than 1.6 ft but may exceed 13 ft. Summer and fall storms frequently generate storm surge rises in sea level along the coast. Storm-surge rises of about 3 ft are common while surges greater than 10 ft have been observed.

Tides along the Chukchi Sea coast are somewhat larger than tides in the Beaufort Sea. Chukchi Sea tides are semidiurnal with a mean height of about 1.0 ft. Like the Beaufort Sea, waves in the Chukchi Sea are limited to the open-water season. Winds are generally from the north and northwest (Selkregg, 1975). Wave heights along the coast are usually less than 4 ft but may exceed 17 ft during summer storms.

The rates of coastal erosion vary from year to year and depend on four factors:

1. timing of the sea-ice breakup;
2. variations in the size of the open-waters areas (exposure to the sea);
3. timing of late summer and autumn storms; and
4. composition of the coastal bluffs, beach width, and morphology of the adjacent seafloor (USDOI, MMS, 1996a).

Most of the erosion occurs in the late summer and autumn. In the western third of this area, the coastal plain deposits are fine-grained muds and the average erosion rate is about 17.5 ft/yr. Coastal deposits in the rest of the area consist of sandy to gravelly sediments and the average erosion rate is about 4.5 ft/yr.

(b) Seismicity (Earthquakes)

The NPR-A is not located near tectonic plate boundaries where the relative motion between plates may generate earthquakes (USDOI, BLM, 1978a). Most earthquake activity in Alaska occurs along an arc extending east from the western edge of the Aleutian Islands, through Southcentral Alaska and into the central part of Interior Alaska. From 1960 through 2000, no earthquakes of 4.0 magnitude or greater (Modified Mercalli Intensity Scale of 1931) have been reported in the NPR-A. Areas east and south of NPR-A have reported many earthquakes of 4.0 magnitude (http://www.giseis.alaska.edu/Seis/html_docs/db2catalog.html).

The Modified Mercalli Intensity Scale of 1931 classifies earthquakes on a scale of I to XII. A magnitude IV earthquake would be felt indoors by many people and outdoors by a few. The vibrations would be similar to those caused by the passing of a heavy truck. In a magnitude V earthquake, buildings tremble and the earthquake would be felt indoors by practically all people and outdoors by most. The Alaska earthquake of March 28, 1964, had a magnitude of 8.3.

(c) Sea Ice

From November through May/June, sea ice covers 90 to 100 percent of the Beaufort and Chukchi Seas north of the Planning Area (USDOI, MMS, 1996a). Formation of first-year sea ice, signaling the start of freezeup along the Beaufort coast, may begin in early September or as late as December. During the first part of freezeup, nearshore ice is susceptible to movement and deformation by modest winds and currents. Movement may be a mile or more per day, and deformation may appear as ice pileups, beach rideups, offshore rubble fields, hummocks, and small ridges. Onshore ice pileups frequently extend 65 mi inland. Ice rideups occur when a whole ice sheet slides in a relatively unbroken manner over the ground. Rideups greater than 160 ft are infrequent. By late winter, first-year sea ice is about 6 to 7 ft thick. In waters 6 to 7 ft deep, the ice freezes to the seafloor and forms the bottomfast-ice subzone of the landfast-ice zone. The landfast-ice zone may extend from the shore to depths of 45 to 60 ft. Ice in water depths greater than about 6 to 7 ft is floating ice that forms the floating fast-ice subzone. As the winter progresses, extensive deformation within the landfast-ice zone generally decreases as the ice thickens and strengthens, making it more resistant to deformation.

Seaward of the landfast-ice zone is the stamuhki, or shear zone. This is a region of dynamic interaction between the relatively stable ice of the landfast-ice zone and the mobile Arctic pack ice. This interaction creates ridges and leads for areas of open water. The plowing action of drifting ice may cut linear depressions, or ice gouges, into the seafloor sediments. The dominant orientation of these gouges is generally parallel to the coast. The Beaufort Sea has the most intense ridging, where gouging occurs in water depths of 50 to 100 ft. In water depths of less than 30 ft, the maximum gouge depths are generally less than 1 ft (Weeks et al., 1984). Ice ridges with keels deep enough to become grounded help stabilize the landfast ice.

Along the Beaufort and Chukchi Sea coasts, breakup generally begins about mid-July but may occur in mid-June or late August (USDOI, MMS, 1996a). River ice begins to melt before the sea ice. During early stages of breakup, water from rivers may temporarily flood ice that has formed on deltas. The floodwater will drain through openings in the ice and the force of the water may be great enough to scour depressions, or strudel scours, on the seafloor. As breakup continues, open-water areas increase as the ice moves farther offshore. During the summer and fall, shifting winds and currents can move the pack ice toward or away from the coast. In some years, the pack ice may remain along or very near the coast. This movement along the coast may cause some pieces to become grounded in shallow waters, where they may remain for the summer.

b. Physiography

The large landforms of the Northwest NPR-A Planning Area include two of the three primary physiographic regions of the NPR-A: the Arctic Coastal Plain and the Arctic Foothills (Map 28) (Wahrhaftig, 1965).

(1) The Northwest NPR-A Planning Area Boundaries

The NPR-A contains the farthest northern public land in the United States and includes approximately 23 million acres on the northwestern quarter of Alaska. Approximately 9.4 million acres are included in the Northwest NPR-A Planning Area. The boundaries of the Northwest NPR-A Planning Area are shown on Map 01.

(2) The Arctic Coastal Plain Province

The Arctic Coastal Plain (ACP) Province covers approximately 35 percent of the Northwest NPR-A Planning Area (Map 28). Periglacial features, providing little topographic relief and poor drainage, dominate the ACP. These features include thaw lakes, marshes, and polygonal patterned ground. Polygonal patterned ground forms from ice wedges that freeze within contraction cracks of the soil. Throughout the year, these cracks fill with water and snow, then freeze and expand. During the warmer months, the surface ice melts and water remains. This process repeats annually resulting in a polygon-patterned surface. The Aeolian sands blanketing the Planning Area can bury ice wedges. This ancient fossil ice, as well as ice-rich frozen soils and more recently formed ice, are susceptible to thawing whenever ground insulation, such as vegetation, is removed. When thawed, these soils can slump severely. Permanently frozen ground, or permafrost, underlies nearly 100 percent of the Planning Area.

The Barrow Peninsula extends into the Arctic Ocean and separates the Chukchi Sea from the Beaufort Sea. The barrier islands, with prevailing northeast winds, support little vegetation and frequent ice buildups. The shoreline is a mix of low bluffs, generally 10 to 20 feet (ft) high, interspersed with low wet areas and shallow valleys where streams enter the ocean. Numerous bays and inlets provide access to the interior of the area. In areas of coastal erosion, freshwater lakes drain when their borders collapse from thawing and erosion. Over the last 100 years, numerous oil and gas seeps have been identified in the area. Some of these seeps are large, such as the Simpson Seep complex, while others are visible only periodically, such as those at Skull Cliff where natural oil seeps appear at the ocean's edge.

The ACP extends southward from the shoreline approximately 50 mi as coastal lowlands. The lowlands are a vast treeless area of tundra, meandering streams, drained and undrained lagoons, and thousands of shallow thaw lakes. The most prominently oriented thaw lakes are south of Barrow. These lakes orient to the northwest because of erosion from waves and ice resulting from the predominant northeast winds. For this reason, thaw lakes are usually very shallow and generally longer than wide. Freshwater lakes cover approximately 15 percent of the ACP lying within the Planning Area (USDOI, BLM, 1979b). The ACP in this area is characterized by numerous bays narrowing to wide rivers: Avak Inlet and Avak River; Wainwright Inlet and Kuk River; Kugrua Bay and Kugrua River; Dease Inlet opening into Admiralty Bay and the Chipp, Topagoruk, Meade, and Inaru Rivers; Walakpa Bay and Walakpa River; Iko Bay and Avak Creek; Smith Bay and the Ikpikpuk River. Some large bays, such as Dease Inlet and Admiralty Bay, appear to have been formed from ancient thawed lakes. In the nearby low and poorly drained areas, waterbodies appear to cover more surface area than does "dry" land, and rivers have been known to change routes, dissecting the area and connecting lakes to one another. Rivers in the Northwest NPR-A Planning Area tend to be very long, providing drainage far into the Interior.

The lake-filled coastal plain fades into an area of large rounded lakes and very small lakes at an elevation of around 100 ft (roughly 10 mi inland in the far western edge and up to 60 mi on the eastern side). Dunes and sandy ridges exist along river channels. At an elevation of 150 ft, more defined streams begin to replace the smallest lakes, again varying widely across the Planning Area.

(3) The Arctic Foothills Province

The Arctic Foothills Province (AFP) is approximately 80 mi inland and south of the coast (Map 28). Elevations start at around 4,600 ft. While the AFP extends to the Brooks Range (about 180 to 200 mi), the Northwest NPR-A Planning Area boundary extends about 50 mi south of the coast on the Planning Area's western edge. Thus, the AFP lies within the eastern half of the Planning Area.

This physiographic unit consists of tundra-covered rolling hills, low east-west trending ridges, and occasional small pingos, or frost mounds. The highest elevation within the Northwest NPR-A Planning Area is along Lookout Ridge at 1,588 ft. Lakes in the Foothill Province cover about 6.3 percent of the area. The Utukok Special Area is the southern boundary of the Planning Area. There are fewer and deeper lakes in this designated area than in the coastal plain. Although there are no glaciers, continuous permafrost underlies the area. Ice wedges, stone strips, polygonal ground, solufluction lobes, and other permafrost features are common here.

(4) Surficial Deposits

The surficial deposits of the NPR-A are generally fine-grained deposits of clay, silt, and sand. Gravel is scarce and confined to riverbeds and the southern mountains. Sand dunes are common and stabilized by vegetation. It is generally agreed that the area north of the Brooks Range was not glaciated during the Pleistocene Epoch; however, glacial-eroded material was transported north from the mountains to the coastal areas and deposited by wind and streams. There are many vertebrate-animal remains frozen in the Quaternary soils.

c. Soils

The information in the soils subsection was extracted from *Exploratory Soil Survey of Alaska* (Rieger, Schoephorster, and Furbush, 1979). In addition, the soil classification in the Northwest NPR-A Planning Area is identical to that in the Northeast NPR-A Planning Area. See the Northeast NPR-A IAP/EIS for additional information.

Exploratory survey and field mapping of the Northwest NPR-A Planning Area was initiated in 1967 and completed in 1973. Field mapping was done at a scale of 1:500,000 (1 inch $\geq$ 8 mi). All existing soil maps and reports were used, but the exploratory soil map was based largely on observations made from a small helicopter that landed frequently in roadless areas. Distinctive landscape patterns were identified from the air and delineated on the map. Soils within each landscape segment were described and classified; relationships between the soils, the native vegetation, and landforms were noted; the proportion of the area occupied by each major type of soil was estimated. Each map unit in this survey was an association of soils arranged in a consistent pattern.

(1) Major Land Resource Areas

Two major land resource areas (MLRA's) have been identified in the Northwest NPR-A Planning Area: the Arctic Foothills and the Arctic Coastal Plain (Sec. III.A.1.b and Map 28). Each MLRA has a unique pattern of topography, climate, vegetation, and soils.

(2) The Soil Classification System

The *Soil Taxonomy of the National Cooperative Soil Survey*, adopted in 1965, defines soils by their properties rather than by external environmental factors such as climate and vegetation. In the *Exploratory Soil Survey of Alaska* (Rieger, Schoephorster, and Furbush, 1979), the soils of Alaska are classified at the subgroup level and placed in distinct map units. Five map units occur in the Planning Area (Map 32).

(a) Map Unit IQ2

Map Unit IQ2 occupies most of the northern part of the AFP. It is extensive and widespread in all regions of the permafrost zone. Although the dominant soils have similar characteristics, there are some differences in associated soils of relatively minor extent, soil patterns, landforms, and landscape features. This unit occupies broad valleys, basins, foot slopes, and low rolling piedmont hills. Most areas are patterned with polygons, stripes, and some circular frost scars. Elevations range from 300 ft above sea level near the coastal plains to 3,000 ft on foot slopes of the Brooks Range. Most of the soils are silty colluvial and residual material weathered from fine-grained, nonacid sedimentary rocks. The vegetation consists of tundra dominated by sedges, mosses, lichens, and low shrubs.

(b) Map Unit IQ8

Map Unit IQ8 occupies most of the southern part of the AFP featuring the hills and ridges of the Planning Area. It also occupies extensive parts of the foothills north of the Brooks Range. Broad sloping valleys, separated by steep ridges, hills, and knolls dominate the landscape. Elevations range from near sea level on a few foot slopes to about 3,000 ft on hills and ridges near the Brooks Range. Permafrost underlies all areas. The dominant soils in valleys and long foot slopes were formed from loamy colluvial sediment. Most of the soils on hills and ridges consist of very gravelly material weathered from sedimentary rock. A few soils near the Brooks Range were formed from very gravelly glacial drift. The vegetation consists of tundra made of mosses, sedges, lichens, grasses, dwarf shrubs, and small forbs. Vegetative patterns commonly stripe the long slopes and many frost-scarred areas mar hills and ridges. A few windswept peaks are nearly bare. Caribou and other wildlife use the vegetation, which is also suitable for reindeer grazing.

(c) Map Unit IQ6

Map Unit IQ6 occupies most of the eastern part of the ACP occurring in the Planning Area. With few exceptions, the soils of this unit are shallow and constantly wet as they lie over the area's thick permafrost. Elevations range from sea level to about 400 ft. Many small thaw lakes characterize this treeless area. Low terraces, broad shallow depressions, and floodplains are typical. It is common to find frost features, including polygons, hummocks, frost boils, and pingos. The dominant poorly drained soils have developed principally in deep loamy sediment under a thick cover of sedge tussocks, low shrubs, forbs, mosses, and lichens. Very poorly drained fibrous peat soils, commonly under a cover of sedges, occupy broad depressions, shallow drainage ways, and lake borders. These types of soils are cold and wet. Caribou and a few moose, wolves, and small furbearing animals use the area. It is also a major nesting ground for migratory birds.

(d) Map Unit IQ21

Map Unit IQ21 occupies most of the western part of the ACP in the Planning Area. The landscape is dominated by nearly level, low tundra, dotted by shallow thaw lakes. There are many undulating and rolling sand dunes, especially in areas bordering the floodplains of major streams and some of the larger lakes. Most of the dunes are stabilized by vegetation, though some dunes adjacent to streams are active. Elevation ranges from a few feet above sea level near the coast to about 150 ft inland. Sedges, mosses, grasses, lichens, and low shrubs and forbs dominate the arctic tundra in the area. Most of the soils consist of sandy aeolian, alluvial, and marine deposits, but a few soils were formed in loamy material. Poorly drained soils with a shallow permafrost table occupy most of the nearly level areas and the broad swales between dunes. The soils on dunes consist of aeolian sand and, although they are perennially frozen below a depth of 30 to 40 in, they seldom retain enough moisture to form large ice crystals. Soils of this unit provide wildlife habitat for species frequenting the arctic tundra, including migrating herds of caribou and nesting waterfowl. The area is potentially suitable for reindeer grazing.

(e) Map Unit IQ22

Map Unit IQ22 occupies much of the area along the Colville River through the Arctic Foothills and the ACP. It occupies low terraces, braided floodplains, and broad alluvial fans bordering the Colville River. Elevations range from sea level on the plains bordering the coast to about 2,000 ft in the Brooks Range. The dominant soils consist of very gravelly stream deposits underlain by permafrost. Low parts of the unit are commonly flooded by runoff from spring snowmelt and heavy summer rainstorms in the mountainous watershed areas. The vegetation consists of arctic tundra dominated by sedges, mosses, and low shrubs and they are potentially suitable for reindeer grazing. Soils of the association provide habitat for wildlife on the arctic tundra.

d. Sand and Gravel

The surface materials of the Northwest NPR-A Planning Area include marine silts, sands, clays, beach and deltaic deposits, thaw lake deposits, alluvium and fluvial-lacustrine deposits, eolian sands and upland silts, as well as sandstones and shales. The following documents describe the sand and gravel resources and construction techniques relevant to oil and gas exploration and other construction projects in the NPR-A: *Engineering Considerations for Gravel Alternates in NPR-A* (USDOI, BLM, 1981a); *An Environmental Evaluation of Potential Petroleum Development of the National Petroleum Reserve in Alaska* (U.S. Geological Survey, 1979); *The National Petroleum Reserve in Alaska, Earth Science Considerations* (U.S. Geological Survey, 1985); and *Geology and Exploration of the National Petroleum Reserve in Alaska, 1974-1982* (U.S. Geological Survey, 1988). There are many valuable information sources relating to earth sciences in the NPR-A, in particular, the USGS *Open File Reports*, *Engineering Geologic Maps of Northern Alaska* for the Teshekpuk (83-634), Harrison Bay (85-256), Ikpikpuk River (88-375), and Umiat (86-335) Quadrangles. A summary of these sources, augmented by additional material as cited, follows.

(1) Materials

The presence of large amounts of ice in the soils and underlying materials of the Planning Area makes mineral materials difficult to use. When heated, ice-rich silts slump, collapse, and liquefy. Sand and gravel in permafrost areas may contain ice, but still provide substantial strength upon thawing. Gravels are found specifically in floodplains and low terraces.

Alluvium, which consists of deposits of fine to medium sand, silty sand, gravel, and gravelly sand, is probably no more than 15 ft thick along modern channels and it includes floodplain and alluvial terrace deposits up to 24 ft above modern streams. Terrace drainage is generally poor and subject to flooding between 18 and 24 ft above low water in some streams. The entire area is in a zone of continuous permafrost except for an unfrozen area 6 to 18 ft thick beneath larger channels and lakes. It is typical for deposits to be frozen 1.5 ft beneath the active layer during the summer months, while the lower depth of permafrost is measured in hundreds of feet. The value of construction materials is related to the levels of organics and silts and the amount of water frozen in the deposit. The materials in channel and bar areas, where alluvium is composed of medium to coarse sand gravelly sands gravel, provide good foundation stability. Areas with low silt content may be suitable for fill.

Deposits in the ACP (Map 28), or northern portion of the Planning Area, are composed of marine sands and silts 20 to 180 ft deep. The marine deposits are two types of silts and clays, or sand over silts and clay, both with high ice content. Beach deposits contain gravelly sand and sand with areas of high organic content (wood and peat) that may be well drained when found along low beach ridges. Active ice wedges are well developed and fossil ice wedges occur locally at depths of a few feet.

Interstitial ice content exceeding natural voids produces settlement upon thawing. Similar deposits near Barrow are supersaturated with ice to about 18 to 24 ft, with ice content of 75 percent by volume at a depth of 3 ft, exclusive of wedge ice. The sediments are highly frost susceptible and not suitable for foundations because of excessive differential settlement of ice-rich permafrost, with the silt having a high liquefaction potential when thawed. Sands may be suitable for fill, base source, or surfacing if silt content is low and stable.

Thaw-lake deposits vary, depending upon the underlying lithology. For example, lakes underlain by marine silts and clays have silt and clay deposits; lakes underlain by eolian sands have fine sand deposits. These materials are generally unsuitable for construction because of their high organic and silt content. The alluvium deposits found along the major rivers contain fine to medium sand and silty sand with some organic materials in areas such as abandoned river channels. Fluvial-lacustrine deposits are undifferentiated alluvial and lacustrine sands and silty sands, which are ice-rich and poorly drained. Eolian sands cover a large portion of the Planning Area. For example, eolian sands cover approximately the southern half of the Teshekpuk quadrangle. These sands are a few feet to more than 100 ft thick and they are underlain by permafrost. The sands may be adequate for natural foundations but require stabilization for use as a surface material or fill. Sand dune ridges can reach 100 ft and they are generally well drained, making excavation relatively easy.

The surficial deposits of the AFP (Map 28), or southern portion of the Planning Area, are composed of eolian sand and upland silts and undifferentiated bedrock of sandstones, shales, and conglomerates. As in the coastal plain, alluvium is found along the river systems. Eolian sand and upland silts (also wind-blown) are the most widespread unconsolidated sediments in the entire NPR-A. A band of upland silt stretches from east to west across the NPR-A. The material may contain a high amount of interstitial ice and may not be suitable for construction use except as binder material. The material is not suitable for foundations because of excessive differential settlement when ice-rich permafrost thaws. Locally, the deposits may liquefy when thawed.

(2) Regulatory Environment

There was concern that sand and gravel resources would become scarce in certain areas of the ACP as early as 1974 (U.S. Army Corps of Engineers, 1974:123). This concern is reflected in the 1976 Naval Petroleum Reserves Production Act (NPRPA). Because sand and gravel have economic value, BLM regulates the sale of mineral materials (43 Code of Federal Regulations [CFR] 3600), defined generally as common varieties of sand, stone, gravel, clay, etc.

Sand and gravel in the NPR-A are treated as subsurface-mineral resources. Unlike other states, Alaska's mineral-material resources are not conveyed with the surface lands. Until the recent transfers of subsurface estate, specifically Nuiqsut subsurface to ASRC, the Federal Government controlled all mineral materials in the NPR-A. The BLM issued mineral-material permits to the four villages or cities of the NSB for dredging sand and gravel as part of the Borough's Capital Improvement Projects (CIP) in the 1980's. Nuiqsut dredged material from the Colville River bottom, while Atqasuk used material from the Meade River and the bottom of an adjacent lake. Materials from rivers, ocean beaches, and reserve pits were used in the 1970's and 1980's for well site pad, road, and airfield construction.

(3) Engineering Techniques

The 1975-1982 NPR-A exploration program involved not only oil and gas exploration, but also engineering research related to construction in the NPR-A. This period reflected an interest in cold regions mineral development worldwide. New techniques currently offer alternatives and supplements to the use of sand and gravel. These techniques include the use of pilings, insulated pads, geotextiles, elevated or reinforced pads, ice pads, and roads. The latter part of the NPR-A exploration program used reduced gravel in conjunction with insulation in pads, ice-reinforced silt pads, and ice roads and airstrips (Kachadoorian, Reuben, and Crory, 1988, as cited in Gryc, 1988). The U.S. Army Cold Regions Research Laboratory, an early engineering contributor and researcher, continues to monitor sites in the NPR-A for long-term changes.

Generally, the high cost of obtaining aggregates (sand and gravel) in the arctic makes them useful for permanent facilities, whereas other less expensive options, such as ice techniques, are used for temporary or seasonal needs. Whether to use ice, sand and gravel transported over long distances, or enhanced local materials as construction materials is a decision driven by economics. Mineral materials along beaches were used in the past and, depending upon the specific needs and location, materials extraction may occur with minimal concern. In some instances, mineral materials found in relation to streams and rivers could use the flowing water to recharge extracted material. Materials might be found elevated on ridges and hillsides in the middle to southern section of the NPR-A. If material is removed from ridges or hillsides, possible debris flow and thawing of ice-rich materials becomes a consideration. Development of gravel roads on the ACP may affect habitat. This requires a good understanding of road-tundra interactions and well-devised mitigating measures to minimize future impacts.

Pits are difficult to fill because water in a pit or the removal of the natural insulating vegetative mat can cause the pit to deepen over time. As the ice melts, the volume of the material removed from the pit shrinks, so it may take much more material to fill the pit than the amount extracted. Experience suggests it is better to design the pit to conform to natural features, reclaim the material that is available, and allow the pit to remain.

All of the NPR-A is underlain by permafrost. Thus, all of the engineering and geotechnical problems associated with sand and gravel excavation and use in construction can potentially disturb the thermal regime of the ground surface, thus impacting the environment.

e. Paleontological Resources

Sedimentary rocks, typical of petroleum producing formations, underlie most of the NPR-A. As a result, the bedrock formations contain a wide array of plant and animal fossils. To date, the earliest reported fossil from within the NPR-A is the tooth plate of a lungfish recovered from a Middle Devonian formation about 380 million years old (Lindsey, 1986). Most subsequent rock formations in the NPR-A exhibit some evidence of a fossil record.

Most of the limestone, sandstone, siltstone, conglomerate, and shale underlying the NPR-A have marine origins, as reflected by their fossils. By far, the most common fossils are brachiopods, cephalopods, gastropods, pelecypods, sponges, bryozoans, corals, and crinoids. Terrestrial plant fossils originate in the middle part of the Jurassic Period, roughly 160 million years ago. This indicates at least a temporary retreat of the ancient seas that had previously covered most of the region. Following this period, the seas repeatedly advanced and retreated over most or all of the NPR-A.

One-hundred-million-year-old lower Cretaceous rocks in the NPR-A produce some of the best examples of that period's flora found anywhere in North America (Lindsey, 1986). These plant fossils also document a change from a warm to a cool climate. It is at this time that modern conifers begin to appear on the North Slope.

Late Cretaceous vertebrate fossils from 70 to 65 Ma are also common. Significant world-class dinosaur remains lie within the Northwest NPR-A Planning Area along banks of the Colville and other major river drainages. These remains represent the farthest north occurrence of dinosaurs in North America. Data gathered through research of this fossil evidence have challenged long-held theories concerning dinosaur physiology and extinction (Brouwers et al., 1987; Paul, 1988; Clemens and Nelms, 1993; Gangloff et al., 2002). Most of the bones are beautifully preserved with varying degrees of mineralization. Some exhibit few void fillings and approach the low density of nonpermineralized, or petrified, bone. The bone is often encapsulated with iron oxide, sulfide, and quartz. This unusual preservation and entombment in permafrost offers the possibility of DNA and other bimolecular extraction that has not been attainable in fossils this ancient before now (Gangloff, 1997).

Mollusks, ostracods, brachiopods, and bryozoans primarily represent Tertiary (65 to 1.6 Ma) fossils, although the record is incomplete because of a period of nondeposition and/or erosion that occurred during the Late Tertiary (Lindsey, 1986). Fossil remains from 50,000 to 10,000 years ago, the latest portion of the Pleistocene (the last Ice Age), are also abundant in Quaternary deposits across the Northwest NPR-A Planning Area (Hamilton and Ashley, 1993; Guthrie and Stoker, 1990). The bones of horses, camels, mammoths, and bison are important data sources reflecting the climate, environment, and ecosystem that existed when the first humans entered the

Western Hemisphere from the Old World (Kunz and Mann, 1997). Primary sources for these fossils are the Ikpikpuk, Colville, and other major river drainages.

Most of the paleontological resources in the NPR-A are, by virtue of their isolation and remoteness (Map 87), protected from most types of impact, other than those caused by natural forces. The bulk of the deposits are deeply buried and the landscape is covered by snow and remains frozen nine months of the year. It is therefore, adequately protected by nature. However, most of the major known deposits are somewhat vulnerable, because they are most often exposed in an eroding bluff face. In fact, were it not for these exposures, most paleontological deposits in the area would not be discovered. However, the circumstance that led to their discovery also allows unauthorized collection and loss of valuable and important scientific and educational material. Most exposed bluff faces are formed through river and stream erosion. Fossils are commonly exposed or washed from these bluff faces during annual high-water events. Even in a place as remote as the NPR-A, a river may allow access by boat or by small aircraft. Currently, unauthorized collection occurs at several locations in the Northwest NPR-A Planning Area. A visible presence, such as active research rather than irregular law-enforcement patrols, is the best deterrent to unauthorized collection (Gangloff, 1997).

These paleontological resources are nonrenewable and contain a wealth of information about life forms, geography, and environments of the past, and they must receive adequate protection. Most of the paleontological resources of the NPR-A are yet to be located and work toward that end is another important step in the protection of this resource.

f. Hazardous Materials

Industrial development and activities within the Northwest NPR-A Planning Area include Department of Defense facilities, oil and gas exploration, and limited coal mining. The population is sparse and concentrated near Barrow, Wainwright, and Atqasuk. Because of the geographic isolation, introduction of potential hazardous materials is generally associated with industrial use. Whatever is brought to the area generally stays in the area.

(1) Department of Defense Facilities

The Defense Early Warning (DEW)-Line System was developed in the early 1950's as a first line radar defense warning system for North America. The DEW-Line defense region in the Planning Area includes Peard Bay and Cape Simpson. Also within the Planning Area are the abandoned Skull Cliff Long Range Aid to Navigation (LORAN) station and an abandoned U.S. Navy materials storage site at Elson Lagoon. Cape Simpson and Elson Lagoon are located on Native corporation lands within the Planning Area. Other military facilities on corporation lands include the Naval Arctic Research Lab (NARL)/Point Barrow Air Force Station and Wainwright Station.

The Peard Bay DEW-Line station and Skull Cliff LORAN sites are part of the Former Used Defense Site (FUDS) Program, managed by the COE. The lands were transferred to the BLM and cleanup occurred at both sites under the FUDS Program. The BLM had listed these sites on the Federal Facility Docket for potential hazardous materials and completed assessments of the sites in 1993 and 1994 under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendment and Reauthorization Act of 1986 (SARA). The U.S. Environmental Protection Agency (EPA) has issued a determination of "No Further Remedial Action" for both sites.

(2) Oil and Gas Exploration Activities

The two major activities associated with oil and gas exploration are the winter seismic exploration mapping by private companies under permit by the BLM and oil and gas exploratory test-well drilling. The U.S. Navy and the USGS monitored the drilling program for test wells as the operations spanned a 31-year period from 1926 to 1957. Abandoned wells are listed in Table III-02.

From 1976 to 1978, the USGS directed a cleanup program through contract with Husky Oil NPR Operations, Inc. Information on this activity is documented in the FY'78 *Annual Report of Environmental Cleanup of Solid Wastes*. The report was abandoned during the early years of exploration on the NPR-A by Husky Oil, but lists activities at the major sites and only refers to other cleanup at incidental well sites and seismic trails.

(a) Skull Cliff

The cleanup operations for Skull Cliff started in 1978. The LORAN tower was dismantled and the 40-person camp was cleaned. Barrels were crushed and combustible wastes were burned at the site. The non-combustible debris was moved to the beach for later removal. The beach was used as a staging area for other solid wastes and crushed drums that were transported from other well locations.

Several solid waste landfills used in association with military operations, were identified at the site. A third landfill was found directly adjacent to the former communications tower pad. This site is suspected to contain the solid wastes from the exploration activities staged on the beach site. According to documents from the COE, the landfill was built around 1983. Sampling was conducted by BLM as part of the preliminary assessment. This area contained low concentrations of petroleum hydrocarbons and the pesticide d-BHC, with a concentration level of 15 parts per billion (ppb) in 1 sediment sample.

(b) Topagoruk Test Well #1

The area of cleanup included a drilling rig site, two dumpsites, a debris pile, and two piles of drilling cement sealed in steel containers. Solid waste was accumulated in stockpiles during 1976 and 1977. In 1978, combustible and non-combustible solid wastes were removed and staged at the Skull Cliff beach site.

(c) East Topagoruk Test Well #1

The area of cleanup was approximately 1 mi^2 and consisted of empty fuel barrels, steel containers, and drilling debris. A drum crusher was brought on site and wastes were transported and stockpiled at Cape Simpson.

(d) Square Lake Test Well #1

Waste streams were consolidated and piled. Barrels of fuel were transported to the Wolf Creek site to be burned in 1979.

(e) Titaluk

The cleanup at Titaluk consisted of stockpiling solid wastes. Combustibles were burned in 1979. Old fuel barrels were transported to the Wolf Creek stockpile.

(f) Knifeblade

Solid wastes were picked up and the site cleaning was completed in 1978.

(g) East Oumalik

Solid wastes were scattered over a 2-mi radius. Debris was accumulated, crushed, and stockpiled. Wood and steel pilings that were driven into the tundra were cut off at ground level. Collapsed buildings and a 30-ft utility tower were dismantled and removed. Combustibles were burned in 1979 and the stockpiled barrels crushed.

(h) Inactive Reserve Pits

In January of 1995,the Alaska Department of Environmental Conservation (ADEC) approved "as is" closure for the following inactive reserve pits in the Planning Area: East Simpson #1, East Simpson #2, Kuyanak, Peard Bay, South Meade #1, South Simpson #1, Tulageak #1, Tunalik #1, and West Dease #1. It was determined that even at those limited sites where water may not have met state drinking water standards, there is negligible risk warranting additional corrective actions.

(3) Coal Mining

Coal mining has been limited in the Northwest NPR-A Planning Area. Several old outcrops on the east side of Wainwright Inlet were used historically. There was coal mining in the 1940's around Atqasuk. The Abandoned Mine Land Program of the Alaska Department of Natural Resources (ADNR) identified two sites in the Kuk and Meade river areas where the agency removed barrels and closed portals.

(4) Other Solid Waste Issues within the Planning Area

Major and minor transportation corridors and trails serving North Slope communities interlace the Northwest NPR-A Planning Area. Fuel management or the storage and transportation of materials are a concern in these areas. Minor fuel spills have inevitably occurred within these areas, however, there are no reports of any major spills.

Human waste is an additional issue of concern. Increased cabin development and human activities along some of the essential waterways constitute a potential public health and environmental problem.

(5) Miscellaneous Issues

Recent scientific information suggests that atmospheric contaminants are being deposited in the Arctic, impacting the Northwest NPR-A Planning Area. The Soviet Union, Asia, and other countries are the source of these contaminants. The contaminants of greatest concern are persistent organic pollutants (POP's) and heavy metals. The POP's are manufactured chemicals that are highly resistant to breakdown by natural processes. These include industrial chemicals such as polychloronated biphenyls (PCB's) and hexachlorobenzene (HCB), industrial waste byproducts such as dioxins and furans, and pesticides, such as DDT and chlordane. Heavy metals such as mercury, arsenic, cadmium, selenium, and lead are also a concern. The Arctic environment acts as a cold air sink, or settling area, for airborne and ocean carried contaminants. (For a list of the potential hazardous materials sites and abandoned well sites in the Planning Area, see Table III-02).

g. Fire

Wildland fires are uncommon to the North Slope, but they do occur. Large wildland fires are rare; most are small and burn less than one square kilometer (km^2) of land (USDOI, BLM, 1978b). As recently as 1993, a lighting-caused fire burned 82,370 acres south of Wainwright.

The tundra ecosystem has had few studies and it is difficult to document North Slope fire history and fire return intervals. Fire history databases are incomplete because detection flights are not flown north of the Brooks Range. Commercial flights typically discover fires, thus there is documentation on only those fires occurring along flight paths in and out of villages. Still, fire on the North Slope is an important change mechanism. It regenerates old vegetation, increases the active layer depth, and releases vital nutrients (Verick et al., 1990).

For fire management considerations, the vegetation in the Northwest NPR-A Planning Area can be divided into two categories: tundra and tussock tundra (Verick et al., 1992). Fire behavior is of low to moderate intensity under both categories, with low to moderate rates of spread and flame length under both categories. The severity of burns in both vegetative communities depends on the amount of moisture in the organic layer. Most fires will be low-severity surface fires. However, a long period of dry conditions can produce fires that remove most to all of the organic layer, resulting in moderate- to high-severity fire. The tussock tundra communities will burn with higher intensity and rate of spread and flame length because of the large amount of dead and dry grass. Regeneration in burned areas is fast, with the burned area becoming indistinguishable from the surrounding area in 2 to 3 years. However, it may take lichen decades to recover in areas of moderate to high burn severity (USDOI, BLM, 1978b).

2. Aquatic Environment

a. Water Resources

The aquatic environment of the Northwest NPR-A Planning Area includes freshwater and estuarine resources. (For a discussion of wetlands, see Section III.B.2). Freshwater resources are limited to surface-water streams, lakes, and ponds since ground water supplies are very limited and springs are absent. Climate and permafrost are the dominant factors limiting water availability.

(1) Climatic Factors

Because winters in the Planning Area are long, most streams and lakes are frozen for much of the year. Summers, while short and relatively cool near the coast, are longer and warmer inland. The onset of snowmelt and subsequent runoff often begins earlier in the foothills than in the rest of the area and moves north as the summer progresses. Similarly, freezeup usually begins first on the coastal plain and proceeds southward. The Planning Area is generally snow covered from October through May. Prevailing winds blow cold air off the largely frozen Arctic Ocean, often creating blizzards that drift and compact the snow (Sloan, 1987). Slightly more than half of the annual precipitation occurs as snow during winter (U.S. Dept. of Agriculture, 2001). Late winter snow pack in the Planning Area is greatest in the foothills north of the Colville River and decreases northward to the coast. Snowmelt is a dominant factor in arctic hydrology because it contributes the majority of the annual runoff for lakes and streams. While rainfall is usually light during the short summers, heavier rainstorms can occur in July and August, especially in the foothills.

(2) Groundwater

(a) Permafrost

The absence of important groundwater on the North Slope is due largely to permafrost (Williams, 1970). Permafrost is defined as soil, sand, gravel, or bedrock that has remained below 32°F for two or more years (Muller, 1945). Almost continuous throughout the North Slope, permafrost can exist as massive ice wedges and lenses in poorly drained soils or as a relatively dry matrix in well-drained gravel or bedrock. Permafrost forms a barrier that prevents infiltration of surface water, maintains a saturated layer of surface soils, and restricts groundwater sources to shallow unfrozen material beneath deep lakes and rivers or very deep wells. Melting ice-rich permafrost can cause surface subsidence, or thermokarst, resulting in thaw lakes, ponds, or beaded stream channels.

(b) Shallow Groundwater Sources

Lakes and rivers deeper than about 6 ft do not generally freeze to the bottom in winter. This creates a layer of unfrozen sediments, or taliks, beneath the permafrost (Sloan, 1987). When the sediments are porous materials, such as sand or gravel, an aquifer suitable for pumping groundwater may exist. Shallow groundwater wells, or galleries, were installed in the bed of the Sagavanirktok River during construction of the TAPS. While wells in the lower river generally provided adequate water supply, others in the upper river did not. Nelson and Munter (1990) describe taliks beneath deep pools of arctic rivers as a series of discrete units separated by permafrost barriers. The barriers result from the riverbed freezing beneath shallow riffles. This suggests that the supply of groundwater is directly related to the size of the pool in the river (Sloan, 1987). Williams (1970) reported finding water in one of several boreholes in river-valley alluvium about 1 mi northeast of Umiat. Shallow groundwater in the Planning Area is likely to collect beneath the Colville River and the deep large lakes that do not freeze solid.

(c) Deep Sources

Deep wells drilled through the permafrost near Barrow have encountered highly mineralized groundwater at depths of 1,600 to 2,500 ft (Kharaka and Carothers, 1988). Temperature logs from 25 wells drilled across the North Slope indicate that the depth to the base of permafrost, and consequently the sub-permafrost water, is generally shallower to the west. Though the presence of deep lakes or seas that do not freeze to the bottom can increase permafrost temperatures, variability between wells indicates that other factors may be controlling permafrost depth (Lachenbruch et al., 1988).

(d) Springs

LandSat-imagery analysis has located numerous groundwater springs on the North Slope by identifying the large overflow icings, or aufeis, created downstream from the springs during the winter. However, none of these springs was located in the Planning Area (Sloan, 1987).

(3) Surface Water

(a) Streams

While hydrologic data for the North Slope is sparse (Brabets, 1996), all streams where data is available share streamflow characteristics that are somewhat unique. Flow is generally nonexistent or so low as to not be measurable most of the winter. Streamflow begins during breakup in late May or early June as rapid flooding that, when combined with backwater from ice and snow jams, can inundate extremely large areas in a matter of days. More than half of the annual discharge for a stream can occur during a period of several days to a few weeks (Sloan, 1987). Most streams continue to flow throughout the summer but at relatively lower discharges. Runoff is confined to the upper organic layer of soil, as the mineral soils are saturated and frozen at depths of 2 to 3 ft (Hinzman, Kane, and Everett, 1993). Rainstorms can increase stream flow but they are seldomly sufficient to cause flooding. Stream flow ceases in most streams shortly after freezeup in September. Streams on the North Slope are generally divided into three types, based on the physiography of their origin: those that originate on the 1) coastal plain, 2) foothills, or 3) in the Brooks Range (Map 30).

1) Arctic Coastal Plain

The ACP is a mosaic of tundra wetlands with extremely low relief (Map 28). Because the permafrost prevents water from entering the ground and the low relief limits runoff, the coastal plain is covered with lakes, ponds, and generally slow-moving streams. Aquatic vegetation chokes many of the smaller drainages. Shallow-water tracks may result from snowmelt draining through the permafrost features, often conveying significant discharge where surface relief is limited (Hinzman, Kane, and Everett, 1993). (Note: a significant discharge is one that contributes enough to the stream flow that it must be examined when doing any flow analysis.) Streams originating in the coastal plain generally have the latest breakup and earliest freezeup. While coastal plain streams have the lowest average runoff, the peak unit runoff is among the highest (Sloan, 1987). The only long-term stream-gaging records in the Planning Area are from Nunavak Creek, a small coastal stream near Barrow (Map 30). From 1972 to the present, the average annual discharge is 1.05 cubic feet per second (cfs), or 5.12 inches (in) of annual runoff. The maximum-recorded peak flow is 131 cfs, a peak unit runoff of 47 cubic feet per square mile (cfsm) (U.S. Geological Survey, 2001). The larger rivers originating in the Planning Area's coastal plain are the Avak, Tunalik, Ivisaruk, Kungak, Kugrua, Kuk, Nigisaktuvik, and Inaru rivers.

2) Foothills

The foothills comprising the southern portion of the Planning Area are a series of low, tundra-covered hills seldom exceeding an elevation of 1,000 ft (Map 30). Streams originating in these foothills have a steeper gradient and consequently more gravel-bar and cut-bank features than those of the coastal plain (Table III-40). These streams tend to break up earlier, freeze up later, and have a slightly higher average unit runoff than streams of the coastal plain.

The Ikpikpuk River forms the eastern boundary of the Planning Area. The Chipp and Alaktak, large distributary channels that separate from the main stem and drain into Admiralty Bay, are unique features of this river. The Ikpikpuk River continues into a separate delta at Smith Bay. Other large rivers originating in the foothills of the Planning Area include the Avalik, Ketik, Uskuktuk, Meade, Topagoruk, Oumalik, Titaluk, and Kigalik rivers. While the headwaters of these streams share characteristics, the lower reaches especially near the coast, become more sluggish and exhibit features similar to the coastal plain streams. In the summer of 1977, a stream gage at Atqasuk recorded the Meade River peak flow at 24,500 cfs and a peak unit runoff of 14 cfsm (U.S. Geological Survey, 2001), while the maximum evident flood was 105,000 cfs, or 58 cfsm runoff (Childers, Kernodle, and Loeffler, 1978).

3) Brooks Range

The Colville River forms a small portion of the southern boundary of the Northwest NPR-A Planning Area. It is the largest river on the North Slope and intercepts all of the streams originating in the Brooks Range that flow northward toward the Planning Area (Map 30). As the only river that includes mountainous and glacial drainage, the Colville carries the highest sediment load and exhibits the greatest range of geomorphic features of any river in the area (Table III-40). Steep cut-bank cliffs, deep pools, and large gravel bars are common to most of the rivers adjoining the Planning Area. Breakup and freezeup are more complex along the Colville River because of the extreme length and range of elevations. Flow generally persists later in the winter on the Colville than on most other North Slope rivers. While no long term stream gaging has been done on the Colville River adjacent to the Planning Area, the maximum evident flood at the Killik Bend was determined to be 236,000 cfs, or 29 cfsm runoff (Childers, Kernodle, and Loeffler, 1978).

(b) Lakes

Lakes and ponds are the most common feature on the ACP within the Planning Area (Map 89). Unlike streams, which only hold large quantities of water during breakup, lakes store water year-round and are the most readily available water source on the North Slope (Sloan, 1987). The origin of most lakes and ponds on the coastal plain is in the thawing of ice-rich sediments (Sellman et al., 1975). This thawing results in a continuum known as the thaw lake cycle, by which lakes form, expand, and then drain in response to disturbances of the permafrost. These lakes and ponds are often elongated with a strong north-south orientation. This generally results from preferential erosion caused by wind-generated waves, leeward end currents, and associated higher water temperatures that melt the ice at the narrower ends of the lakes (Carson and Hussey, 1960). Since waterbodies less than 6 ft deep generally freeze to the bottom most winters, lake depth is the primary factor in winter water supply. Lakes can then be classified by depth, as either shallow lakes or deep lakes.

(c) Shallow Lakes and Ponds

Seasonally flooded wetlands, ponds, and shallow lakes (< 6 ft deep) dominate the coastal plain of the Planning Area (Map 89). These wetlands, lakes, and ponds are thought to originate in the thawing of the shallowest, ice-rich permafrost layer. The top 3 ft of this permafrost may contain more than 70 percent segregated ice near the coast (Sellmann et al., 1975). Any disturbance of the tundra vegetation mat could initiate melting of the subsurface ice. Subsequent water or wind erosion would result in shallow ponds. The shallow lakes and ponds freeze in mid-September and become ice-free in mid-June, about a month earlier than the deep lakes (Hobbie, 1984). While ponds and shallow lakes generally lack fish since they usually freeze solid, they do provide important habitat to emergent vegetation, invertebrates, and migratory animals because of the earlier availability of ice-free areas.

(d) Deep Lakes

The coastal plain within the Planning Area contains numerous deep-lake basins (Map 11 and Map 89) (Mellor, 1987). Most of these lakes are concentrated within a roughly triangular area from Teshekpuk Lake on the northeast, south to the foothills just north of the Colville River and west to the Meade River. This area roughly coincides with a field of relic Pleistocene eolian sand dunes whose gentle rolling terrain apparently promotes formation of these deep lake basins (Sloan, 1987). Most deep lakes are less than 20 ft deep, since the depth of thaw lakes appears to be controlled by the ice volume and porosity in the original sediments, which decrease with increasing depth (Sellman et. al., 1975). The hydrodynamics of the deep lakes are often complex. Some very deep lakes are dimictic, exhibiting a bi-annual turnover and temperature stratification (Hobbie, 1973), but others show temporary stratification only during calm periods. When strong winds occur--often the norm on the coastal plain--the wind-generated currents induce mixing of the entire lake (Moulton, 2001). Because they do not freeze to the bottom, deep lakes provide an overwintering area for fish and aquatic invertebrates and are the most readily available winter water supply.

b. Surface Water Quality

Most freshwaters in the Planning Area are pristine. Lakes that are more inland contain soft, dilute calcium-bicarbonate waters; lakes near the coast hold sodium chloride (salt) concentrations that predominate over bicarbonate concentrations (Prentki et al., 1980; USDOI, BLM, 1978a). The ionic composition of the coastal lakes results from sea spray and atmospheric input. The ionic composition of the more inland lakes is influenced only slightly from precipitation; rather, it results from the solution weathering of local bedrock that is subsequently carried into the lake by surface runoff (Kling et al., 1992). Permafrost is also a dominant factor in determining the biogeochemistry of freshwater lakes since the permafrost isolates the lakes and ponds from groundwater sources and limits reactions with the shallow unfrozen soils (Kling et al., 1992).

The freeze/thaw cycle in the Arctic plays a controlling role in water quality. In winter, surface waters less than 6 ft deep will freeze solid (Hobbie, 1984). In such waters, major ions and other "impurities" are excluded from downward-freezing ice in fall and forced into the underlying sediment. Most of the ions remain trapped in the sediment after the next spring's meltout, giving these waters a very low dissolved-matter concentration. During the summer, dissolved-matter concentrations slowly increase as ice in the bottom sediment melts and the sediments compress (Miller, Prentki, and Barsdate, 1980).

In waters deeper than 6 ft, ions are forced into the deeper water column with a proportionate increase in concentrations of dissolved materials. As a result, distinct off-flavor and saline taste affect the potability of water from shallower "deep-water" lakes and river pools by late winter. Despite the high dissolved-material concentrations and marginal potability, these deeper waters are the basis for fish-overwintering habitat and the primary sources of winter water supply.

During snowmelt, the lakes form moats, or a ring of water at the shoreline. For deeper lakes, the winter ice cover persists through spring snowmelt and protects the winter-formed pycnocline (the plane separating two layers of different density). Snowmelt waters flow just below the ice (O'Brien et al., 1995) or along the moated margins of the lakes, but above the pycnocline. These snowmelt waters pass through and exit over flooded tundra in sheet flow or through shallow outlets without contributing to lake chemistry. Only after peak snowmelt and waterflow does the protective ice cover of deeper lakes melt and allow the wind to mix the water column, destroying the pycnocline. The net result of this flow regime in deeper lakes is to preserve their existing water chemistry from that of snowmelt waters.

(1) Potability

Ponds and local streams are highly colored from dissolved organic matter and iron; the water tastes fine but is considered marginally potable to unpotable because of iron staining and fecal contamination in areas with dense avian (Ewing, 1997, pers. comm.), caribou, and lemming populations. Lemming fecal material generally is abundant in upper coastal tundra soils (Gersper et al., 1980). During periods of high concentrations of lemmings, winter accumulation of lemming fecal material is sufficient to affect both minor and major ion chemistry of early snowmelt waters (Chapin, Barsdate, and Barél, 1978; Barsdate and Prentki, 1973). Cold temperatures, a characteristic of tundra soils and waters, tend to prolong the viability of fecal coliform (FC), the standard water-quality measure for fecal contamination. Thus, some smaller waterbodies in the NPR-A may exceed State of Alaska standards for FC in drinking water or water recreation as a result of local wildlife abundance. (Note: There is no State standard applicable to growth and propagation of natural aquatic life or wildlife). Lakes and larger rivers tend to be less colored and would be less likely to be contaminated with FC. The lower portion of the Colville River and Ikpikpuk River however, may be at risk from FC contamination because of the increase in unregulated long-term campsites and cabins, all without adequate sewage disposal.

(2) Turbidity

Most NPR-A freshwaters have low turbidity or suspended-solid concentrations. The exceptions are the larger rivers, possibly shallow floodplain lakes, and waters from thermokarst erosional features. Thermokarst is an altering of the terrain caused by melting permafrost that results in subsidence and water poolings.

Approximately 70 percent of the sediment load for the Colville River is carried during breakup, with suspended-sediment concentrations reaching 870 parts per million (ppm) (USDOI, BLM, 1978a). Later in summer, suspended-sediment concentrations decrease to as low as 3 ppm. The Colville River, with its origins in the foothills of the Brooks Range, carries a greater suspended load than rivers originating within the coastal plain and is the most turbid river in the coastal plain of the NPR-A. Other rivers in the NPR-A range from about 100-ppm suspended sediment at peak-flow rates down to 3 to 10 ppm at lower rates. In the Imnavait Creek watershed in the foothills along the Dalton Highway, late-summer suspended-sediment concentrations were on the order of 4 to 6 ppm in sheet, water-track, and stream flow (Everett, Kane, and Hinzman, 1996).

In arctic-river floodplains, the more turbid snowmelt runoff funnels through the moats and surface layer above the pycnocline of deeper lakes, greatly limiting their post-runoff turbidity. However, shallower lakes lose ice cover during runoff. Without the moat system to deflect turbid waters, these shallower, floodplain lakes can become and remain turbid throughout the summer.

(3) Alkalinity and pH

Alkalinity and pH are important parameters in controlling the susceptibility of freshwaters to acid rain or acid snowmelt. Alkalinity is a measure of the acid-buffering capacity of the water. The pH is a measure of how acid the water is. A pH of 7 indicates a neutral balance of acid and base; a pH below 7 indicates acid water. The State considers a pH range within 6.5 to 9.0 necessary to protect aquatic wildlife.

In NPR-A coastal tundra, freshwaters are weakly buffered (Prentki et al., 1980; O'Brien et al., 1995; USDOI, BLM, 1978a; Hershey et al., 1995). In ponds, alkalinities during snowmelt are about twofold lower than the midsummer alkalinities of 0.4 milliequivalent per liter (meq/l). Lake alkalinities also are low, approximately 0.5 meq/l. Alkalinities in individual NPR-A coastal rivers are higher, ranging from about 0.3-0.4 to 1.3-1.6 meq/l in summer, with higher values at lower flow rates. In NPR-A rivers, winter alkalinities in unfrozen pools are on the order of 3 to 4 meq/l.

In ponds, pH is depressed to below pH 7 as snowmelt runoff enters them, and the pH then rapidly increases to between 7 and 7.5 after snowmelt (Prentki et al., 1980). The initial low pH is due to acidity of snow on the North Slope, with a median pH of 4.9 (Sloan, 1987). This low pH, lower than the pH 5.5 expected for uncontaminated precipitation, is thought to be a result of sulfate fallout from industrially contaminated arctic air masses. In lakes, pH's are near neutral, about pH 7 (O'Brien et al., 1995). In tundra brown-water streams and some foothill streams, the pH can be less than 6 (Milner, Irons, and Oswood, 1995; Hershey et al., 1995; Everett, Kane, and Hinzman, 1996). The acidity in at least the brown-water streams is attributable to naturally occurring organic acids. In tundra rivers, pH's are higher, seasonally ranging between 6.4 and 8.2 in the Colville, Meade, Chipp, and Miguakiak rivers (USDOI, BLM, 1978a).

(4) Oxygen

Most of the world's surface waters are near saturation with dissolved oxygen. Because of this tendency toward saturation, the absolute concentration of dissolved oxygen in arctic waters tends to be higher than in other waters since the solubility of oxygen increases with decreasing water temperature. This generality applies to clear-water streams and clear-water (i.e., larger) lakes in the Planning Area. Summer concentrations of dissolved oxygen in NPR-A rivers range from 9 to 12 ppm by weight (USDOI, BLM, 1978a).

However, colored-water streams, ponds, and lakes in the Arctic and elsewhere generally are undersaturated with respect to oxygen. Oxygen-saturation values in open ponds in the NPR-A generally fall below 100 percent, although a range between 60 and 118 percent has been observed (Prentki et al., 1980). Oxygen values can be much lower (<10% saturation) in vegetated shorelines or in water pooled on wet tundra. In these locations, respiration in the underlying sediment is depleting oxygen from the water as rapidly as the water can take up oxygen from the air.

In winter, waters remaining beneath the ice in deeper NPR-A coastal plain lakes tend to become supersaturated with oxygen (Prentki et al., 1980; USDOI, BLM, 1978a; O'Brien et al., 1995). During ice formation, dissolved oxygen is excluded from the ice into the water column. Exclusion adds more oxygen than underwater respiration removes. In Ikroavik Lake near Barrow for example, saturation was 120 to 140 percent in December; by early June when 5.2 ft of ice had formed in the 7.9-ft-thick water column, saturation had reached 174 percent. During late winter in Teshekpuk Lake in 12 ft of water underneath 7.9 ft of ice, oxygen has been measured at 19.0 ppm, equivalent to about 140 to 150 percent saturation. The winter oxygen regime can be different in foothill lakes, where a more complex bathymetry can inhibit mixing. For example, in Toolik Lake, in the foothills to the east of the NPR-A, late-spring dissolved-oxygen concentration decreased to 1.4 ppm in an isolated 82-ft-deep basin. However, detailed sediment chemistry has established that Toolik Lake bottomwaters do not go anoxic.

Late-winter measurements of oxygen in unfrozen pools in smaller NPR-A rivers (Avalik, Meade, and Chipp rivers; USDOI, BLM, 1978a) indicate high residual oxygen ($\geq$9 ppm) and 70 to 99 percent saturation. The Colville River, with deep, connected channels in its delta, also maintains adequate to supersaturated winter oxygen concentrations (Reynolds, 1995; USDOI, BLM, 1978a).

(5) Sources of Surficial Oil and Hydrocarbons in the NPR-A

The NPR-A, including the Planning Area, has several known oil seeps (McCown, Brown, and Barsdate, 1973; Barsdate, Alexander, and Benoit, 1973; Magoon and Claypool, 1988; Becker and Manen, 1989; Steinhauer and Boehm, 1992). These include multiple seeps on Cape Simpson and the Oil Lake and Fish Creek seeps. The peat that underlies the North Slope carries a high hydrocarbon content. This content is evidenced by natural sheens that occur in ponds or flooded footprints in the tundra, in the foam on the downwind shoreline of lakes on windy days, and by elevated hydrocarbon levels in sediments with peat. The Colville River drainage includes coal and oil-shale outcrops, the oil seeps, and peat. An oil seep at Umiat along the Colville River led to early Navy exploration at that site.

(6) Indicator Hydrocarbons

Pond waters away from development in the Prudhoe Bay area contain 0.1 to 0.2 parts per billion (ppb) total aromatic hydrocarbons, similar to concentrations in pristine marine waters (Woodward et al., 1988). Concentrations in NPR-A waters are likely to be similarly low. Hydrocarbons derived from the various sources are detectable as elevated levels of saturated and polycyclic aromatic hydrocarbons (PAH) in Colville River sediment and downriver, in Harrison Bay sediment (Boehm et al., 1987). Additional pyrogenic PAH signals are present in tundra soils and form a depositional record of atmospheric fallout from tundra fires. Concentrations of indicator hydrocarbons from these multiple sources are both high and chemically similar to those found in petroleum and make it difficult to detect or distinguish any nonpoint-source anthropogenic contamination from natural background. Similarly high levels of hydrocarbons have been found in other major Beaufort Sea rivers and also attributed to natural sources (Boehm et al., 1987; Yunker and MacDonald, 1995).

(7) Trace Metals

The NPR-A and other pond and lake waters on the North Slope are, in general, low in trace metals compared with most temperature freshwaters (Prentki et al., 1980). In measurements made in ponds near Barrow in 1971 and 1972, dissolved copper concentrations were on the order of 1.0 ppb, dissolved lead 0.7 ppb, and dissolved zinc 5.0 ppb. These concentrations are an order of magnitude higher than values for the same dissolved metals in the spring 1994 snowpack on the Arctic Wildlife Refuge (Snyder-Conn et al., 1997). The relatively low trace metal concentrations for both data sets suggest that on a regional basis, the North Slope is relatively pristine.

(8) Federal Contaminated Sites

There are multiple Department of Defense (DOD) hazardous-waste sites and Federal drill sites within the NPR-A (see Sec.III.A.1.f, Hazardous Materials) that may be point sources for contamination. The Federal Government has drilled at least 126 wells within the NPR-A (Bird, 1988c). When these wells were drilled, it was common practice to discharge and leave drilling fluids in open reserve pits. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft (but not at greater distances) were found to be toxic to a sensitive zooplankton species in bioassays.

c. Estuarine Waters and Water Quality

The Northwest NPR-A includes several estuaries: the northeast portion of Kasegaluk Lagoon, the Kuk River, Peard Bay, Elson Lagoon, Dease Inlet, and Admiralty Bay (Map 10). This subsection summarizes the hydrographic and oceanographic characteristics of these estuaries.

The basic characteristics of the bays and coastal waters are summarized in reports by Barnes, Schell, and Reimnitz (1984), and the Outer Continental Shelf Environmental Assessment Program (USDOC, NOAA, OCSEAP, 1978, 1984, 1987, and 1988). These reports explain that all of the NPR-A bays and lagoons are very shallow, and all are shoreward of the 10-m isobath (line of equal bathymetry or water depth). The circulation in this shallow water during the summer is wind-driven and rapid. Circulation is very slow under the winter ice cover. When seawater freezes, only the water molecules form ice; the salt is cast-off as brine into the underlying water column. The brine does not drain or flush out of the shallow bays. Instead, the brine collects on the seafloor, gradually raising the salinity level from 32 to over 100 parts per thousand (ppt) in some seafloor depressions (Schell, 1975; Newbury, 1983). The coastal waters off the Northwest NPR-A, like all of the Alaska coastal waters, have pristine water quality in the estuaries (Arctic Monitoring and Assessment Programme, 1997). Robilliard et al. (1985) describe the shorelines around the lagoons and bays and classify the shoreline morphology and environmental sensitivity. The sensitivity of the adjacent wetlands is described in Section III.B.2 of this IAP/EIS.

Other sections of this IAP/EIS describe some of the biological resources in the bays and Craig et al. (1984) summarize the basic trophic dynamics. The dense concentration of phytoplankton near the shore (Map 31 and Map 33) illustrates the biological production of the coastal waters. These satellite images of the chlorophyll-a pigment concentration illustrate, in a sense, the "greenness" of water. The red/orange colors correspond to relatively high concentrations of phytoplankton; the yellow/green colors correspond to moderate concentrations; and the blue/purple colors correspond to offshore areas of relatively low phytoplankton concentrations. The black areas correspond to areas with clouds, sea ice, or coastal waters with high sediment concentrations. The black area, resulting from high sediment concentrations, includes the NPR-A bays. The area of high concentration forms a band along the coast, especially in the Beaufort Sea. The following lists a few characteristics and unique features of the NPR-A bays.

(1) Kasegaluk Lagoon

The northeastern part of this enclosed body of water is part of the Northwest NPR-A Planning Area. The maximum depth is about 10 ft (3 m). The lagoon is usually ice covered from mid-September through mid-July. Many animals concentrate around the passes, including Akoliakatat and Pingorarok Pass. The shoreline includes recurve spits and low-energy beaches at the passes and Avak Inlet where spilled oil would likely persist for many years (Nummedal, 1980; USDOI, MMS, Alaska OCS Region, 2002a:Sec. IV.C.9.a(2)(a)). The persistence of oil spilled in 1989 by the *Exxon Valdez* is still being measured; ongoing studies have shown that the oil has persisted in some Prince William Sound shoreline sediments for more than a decade www.oilspill.state.ak.us/facts/lingeringoil.html).

(2) Wainwright Inlet and Kuk River

The northern part of this enclosed body of water is within Native lands, but the southern part is within the Northwest NPR-A Planning Area. The maximum depth is about 12 ft (3.5 m). The water is relatively brackish and warm in summer. The river is surrounded by low-energy beaches where spilled oil would likely persist for many years.

(3) Peard Bay and Kugrua Bay

This semi-enclosed body of water rests inside Pt. Franklin and Seahorse Island. Walakpa Bay is northeast of Peard Bay. The center of Peard Bay is about 20 ft (6 m) deep and adjacent Kugrua Bay is about 12 ft (3.5 m) deep. The island and a shoal protect the deep bay waters from ice gouging so kelp grows on the bottom of the bay. This kelp has been described as a large amount of sea lettuce (*Ulva*) on sand; a thick drift line of red, green, and brown algae; or a thick green mat of *Ulva*-like algae. Peard Bay was the focus of a special ecosystem study under the Outer Continental Shelf Environmental Assessment Program (Kinney, 1985). Spilled oil would likely persist for many years on the low-energy sand beaches and wetlands around Kugrua Bay. Northeast of Peard Bay, there is a small natural oil seep in Skull Cliffs (Becker and Manen, 1988:Fig. App-05 and p. 46).

(4) Elson Lagoon, Dease Inlet, and Admiralty Bay

The lagoon, inlet, and bay rest within the Plover Islands. A small bay is located along the west side of Smith Bay east of the lagoon. The maximum depth of the lagoon is less than 10 ft (3 m); the maximum depth of the inlet is less than 9 ft (approximately 3 m). Schell (1975) analyzed the hydrographic characteristics of the area, including the unusual under-ice features. There is a natural oil seep on the eastern shoreline of Dease Inlet (Becker and Manen, 1988:table 1). Another, larger seep occurs east of the lagoon at Cape Simpson (Becker and Manen, 1988:Fig. App-02, p. 38).

3. Atmospheric Environment

a. Climate and Meteorology

The climate of the Northwest NPR-A Planning Area can be divided into the Arctic Coastal, Arctic Inland, and Arctic Foothills zones (Zhang, Osterkamp, and Stamnes, 1996). The Arctic Coastal Zone is characterized by cool summers and relatively warm winters because of its proximity to the ocean. Precipitation is lowest in this region and less than 50 percent falls as snow. The Arctic Inland Zone has the warmest summers and coldest winters in the region. Precipitation is higher here than in the Arctic Coastal Zone, and approximately 40 to 45 percent occurs as snow (Zhang, Osterkamp, and Stamnes, 1996). The Arctic Foothills Zone has the warmest winters. Summer temperatures are cooler than the Arctic Inland Zone temperatures. Precipitation in the Arctic Foothills Zone is the highest of the three zones, and 40 percent occurs as snow (Zhang, Osterkamp, and Stamnes, 1996). The climatic conditions found in the three zones are summarized in Table III-03. Air temperatures generally remain below freezing for nine months of the year. Average monthly temperatures range from -20 to +40°F at Barrow on the coast to -25 to +53°F at Umiat in the foothills (Leslie, 1986).

Of all the factors contributing to variations in surface conditions, snow cover experiences the largest fluctuations by location and time. Not only does the snow cover have a large seasonal cycle, but it also exhibits a substantial interannual variability. The timing of the seasonal snow cover on the North Slope varies from late September to early October, while the date on which seasonal snow cover disappears ranges from late May through mid-June (Zhang, 1993; Zhang, Stamnes, and Bowling, 1996). Interannual variations in the timing of snowmelt are attributed mainly to changes in the incoming longwave radiation (Zhang, Bowling, and Stamnes, 1997). The average snow depth from January through April is 10 and 15 in for Barrow and Umiat, respectively.

The USGS collected snow-survey data in the NPR-A from 1977 to 1979 and from 1982 to 1983. Snow depths ranged from 0.85 to 1.4 ft and water-equivalent from 3.5 to 5.1 in (Sloan, 1987). This compares to the long-term (1961-1990) averages of winter precipitation of 3.6 and 4.5 in collected from Wyoming windshield total precipitation gauges at Barrow and Sagwon, respectively (USDA, 1996). Rainfall is usually light during the short summers, but heavier rainstorms occasionally occur, most commonly in the foothills. Summer precipitation, generally greatest in July and August, ranges from 3.6 to 4.5 in, collected from these same gauges at Barrow and Sagwon, respectively (USDA, 1996). However, different types of precipitation gauges can exhibit large variations in catch efficiency in windy environments, so the actual water-equivalent in the snow pack can vary considerably from that reported by weather stations (Kane et al., 1992).

Prevailing winds are from the east-northeast, blowing cold air off the largely frozen Arctic Ocean. The windiest months are in winter, often creating blizzard conditions, eroding the snow from ridges, and drifting the snow into protected side slopes and valley bottoms (Sloan, 1987). Occasional southerly winds and somewhat moderate temperatures break this pattern, but these winds seldom reach much beyond the foothills (Benson, 1987). Besides redistributing snowfall, the strong winds can alter the snow pack by re-depositing and compacting it. The snow pack can also decrease considerably through sublimation, or the direct change from snow to water vapor that dissipates in the air (Kane et al., 1992). In the summer, strong winds may increase evaporation and generate water currents in ponds and lakes.

b. Air Quality

North Slope air quality exceeds the standards set by the National Ambient Air Quality Standards and Alaska air-quality laws and regulations. Concentrations of regulated air pollutants are far less than the maximum allowed levels. The EPA calls this an attainment area because it meets the standards of the Clean Air Act. The Prevention of Significant Deterioration (PSD) Program of the Clean Air Act places additional limitations on nitrogen dioxide, sulfur dioxide, and total suspended particulate matter. The ambient air-quality standards for the North Slope are listed in Table III-04; measured air pollutants at Prudhoe Bay are listed in Table III-05.

Throughout the onshore area, there are only a few small, scattered emissions from widely scattered sources. The Prudhoe Bay/Kuparuk/Endicott oil-production complex is the sole major local source of industrial emissions. This area was the subject of monitoring programs during 1986-1987 (ERT Company, 1987; Environmental Science and Engineering, Inc., 1987) and 1990 through 1996 (ENSR, 1996, as cited in U.S. Army Corps of Engineers, 1999). Five sites were monitored; three were subject to maximum air-pollutant concentrations and two were more representative of the air quality of the general Prudhoe Bay area. The more recent observations are summarized in Table III-05. All values meet the State and Federal ambient-air-quality standards. The results demonstrate that most ambient pollutant concentrations, even for sites subject to maximum concentrations, generally meet the ambient-air-pollution standards. This is true even if the baseline PSD program concentrations (determined on a site-specific basis) are assumed to be zero, limiting the allowable increase in concentrations. Although the measurements do indicate that air-quality standards are being met, some pollution has occurred. Hattie Long has stated: "We get a lot of yellow haze out of Prudhoe all year long...since the time that the haze started hovering over Nuiqsut" (U.S. Army Corps of Engineers, 1996).

During the winter and spring, winds transport pollutants from industrial Europe and Asia to arctic Alaska, crossing the Arctic Ocean (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze. Pollutant sulfate, due to arctic haze in the air in Barrow (that in excess of natural background), averages 1.5 micrograms per cubic meter. The concentration of vanadium, a combustion product of fossil fuels, can average 20 times the background levels in the air and snow pack. Based on recent observations of the Canadian Arctic snow pack, there is evidence of long-range transport of small concentrations of organochlorine pesticides (Gregor and Gummer, 1989). Concentrations of arctic haze during winter and spring at Barrow are similar to those over large portions of the continental U.S., but they are considerably higher than levels south of the Brooks Range. Any ground-level effects of arctic haze on the concentrations of regulated air pollutants in the Prudhoe Bay area are included in the monitoring data in Table III-05. Model calculations indicate that less than 10 percent of the pollutants emitted in the major source regions are deposited in the Arctic (Pacyna, 1995). Observers measured maximum concentrations of some pollutants (sulfates and fine particles) during the early 1980's; however, they found decreased levels at select stations by the end of the decade (Pacyna, 1995). Despite this seasonal long-distance transport of pollutants into the Arctic, regional air quality is still far better than standards require.

There is growing concern about the potential effects of primary greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, ozone, water vapor, and chlorofluorocarbons) on global climate. Through many complex interactions on a regional and global scale, the lower layers of the atmosphere experience a net warming effect. These trends could be caused by greenhouse warming or by natural fluctuations in the climate. This is an ongoing scientific debate.

The assessment of the impacts of climate change is in its formative phase, and it is not yet possible to know with confidence the net impact of such change. The potential effects of a global climate change could alter water supply, food security, sea-level fluctuations, and natural variances in the ecosystem. Global climate change may affect surface resources in the Northwest NPR-A. Possible impacts of global climate change include effects on the ecology of the artic tundra and changes in the permafrost depth. Reduction in sea ice as a result of global climate change would affect marine mammals (particularly polar bears), fish, and birds, with related implications for Native subsistence harvests. In addition, potential sea-level rise and increases in severe weather could have adverse effects on oil- and gas-related infrastructure.

In its *Draft Guidance Regarding Consideration of Global Climate Change in Environmental Documents Prepared Pursuant to the National Environmental Policy Act,* October 8, 1997, the CEQ recommends addressing this issue at the program level rather than at the project level.

B. BIOLOGICAL RESOURCES

1. Special Areas and Special Management Zones

The 1976 Naval Petroleum Reserves Production Act (NPRPA) authorizes the Secretary of the Interior (Secretary) to designate areas within the NPR-A "containing any significant subsistence, recreational, fish and wildlife, historical, or scenic value." During exploration these areas are to be managed to:

> ...assure the maximum protection of such surface values to the extent consistent with the requirements of the Act for exploration of the NPR-A.

Under 43 CFR 2361.1(e)(1), Federal regulations state that such values may be protected by limiting, restricting, or prohibiting the use of and access to appropriate lands.

The NPRPA specifically identifies the Utukok River and Teshekpuk Lake areas as "special areas." In a 1977 Federal Register (FR) notice, the Secretary describes these two special areas and designates a third (Map 34)--the Utukok River Uplands Special Area (URUSA). The URUSA, consisting of about 4 million acres, contains crucial calving habitat for caribou. The Teshekpuk Lake Special Area (TLSA), consisting of approximately 1.7 million acres, includes important nesting, staging, and molting habitat for a large number of ducks, geese, and swans. The Colville River Special Area (CRSA), consisting of approximately 2.3 million acres, includes the bluff and riparian habitats of the Colville River, which are biologically and geologically unique in the Alaskan Arctic (Koranda and Evans, 1975). Since the 1950's, the CRSA has been recognized as one of the most significant regional habitats for raptors in North America (Kessel and Cade, 1956, 1958; Cade, 1960; White and Cade, 1971). Nowhere else do raptors enjoy such a favorable juxtaposition of abundant nest sites with diverse and plentiful prey. The Secretary has designated no additional special areas since 1977.

The URUSA is adjacent to but outside the Northwest NPR-A Planning Area. The Planning Area, however, contains the middle third of the CRSA and a small portion of the TLSA (along the western edge, west of the Ikpikpuk River) (Map 34).

The Record of Decision (ROD) on Oil and Gas Leasing and Development in NPR-A (May 1983) describes the preferred alternative and four Special Management Zones (SMZ's) (Map 35). Three of these SMZ's are similar to the existing three special areas. The SMZ near the Utukok River includes values for grizzly bear habitat and caribou. The SMZ around Teshekpuk Lake includes values for caribou and waterfowl. Within each of these SMZ's is an area that would be unavailable for oil and gas leasing. The SMZ's around Teshekpuk Lake and Utukok River lie entirely outside the Northwest NPR-A Planning Area (Map 35). The SMZ established for waterbirds in coastal areas is divided into five segments. Three of the five segments of the waterbird SMZ are within the Northwest NPR-A Planning Area; portions of two of these segments are included in lands conveyed to the local Native corporations (Map 35). The fourth SMZ lies along the Colville River (Map 35) and was established to protect raptor habitat. The middle portion of this SMZ lies within the Northwest NPR-A Planning Area. The 1983 ROD requires the lessee to research and show that any proposed exploration or development within an SMZ would have little or no permanent adverse effects on the values within the zone.

The special areas are authorized by law and codified by the Secretary. These designations remain in effect until the law is amended or repealed, or until the Secretary changes the regulations that codify them. The SMZ's are products of a final EIS and ROD and as such, can be directly changed by the ROD resulting from the current IAP/EIS. The No Action Alternative would retain the SMZ's. However, because they protect resources from oil and gas leasing-related activities and no such activities would occur under the No Action Alternative, the SMZ's have no practical effect.

2. Vegetation, Wetlands and Floodplains

Efforts to map the vegetation of Alaska's North Slope first occurred in 1944 (Spetzman, 1959). Early activities used aerial photography and ground reconnaissance, while more recent studies have used digital satellite data. For a bibliography of the earlier efforts and a more extensive listing of recent studies, see Talbot (1996).

The studies using satellite data concentrated on three areas of the North Slope. At the eastern end of the studies area, three vegetation-mapping studies (Walker et al., 1982; Markon, 1986; Jorgenson et al., 1994) were completed in the Arctic National Wildlife Refuge (ANWR). The two earlier studies used Landsat Multispectral Scanner (MSS) data, while the more recent study used the next-generation Landsat Thematic Mapper. The highest intensity vegetation studies occurred on the central North Slope near the Prudhoe Bay oil fields. Here, Walker and associates (e.g., Walker and Acevedo, 1987; Muller, Racoviteanu, and Walker, 1998) produced a number of vegetation maps and reports that describe the vegetation of the area and provide techniques showing changes over time resulting from oil field development. Using Landsat MSS data, Morrissey and Ennis (1981) produced a vegetation map for all of the NPR-A west of Prudhoe Bay. A portion of the current Planning Area north and east of Teshekpuk Lake was mapped again (Markon and Dirksen, 1994); this mapping used data from the French satellite-borne sensor Systeme Pour l'Observation de la Terre (SPOT).

The vegetative cover of the NPR-A has been summarized most recently in a map of the entire North Slope (Muller et al., 1999). This map was extrapolated from a map of the Kuparuk River basin (Mullerm Racoviteanu, and Walker, 1998), which used MSS data collected from 1979 to 1986. Although published before Muller et al., (1999), a land-cover classification of the NPR-A developed by BLM from 1994 to 1997 in cooperation with Ducks Unlimited, the FWS, and the NSB (Ducks Unlimited, 1998) used a more recent generation of satellite data. This classification was developed primarily using Landsat Thematic Mapper (TM) satellite imagery collected from 1992 to 1995, with some minor gaps in coverage filled with SPOT XS data collected in 1994. The TM data has a ground picture element (pixel) resolution of 30 m by 30 m and measures the spectral reflectance in several frequency bands. With the aid of field-verification and computer analysis, each pixel was classified as 1 of 7 major and 17 minor land-cover classes. These classes were distinguished from one another based on their relative composition of water coverage, bare ground, and different plant species (Table III-06).

Carex aquatilis (water sedge) is the dominant species in the Wet Tundra class, both Flooded Tundra classes, and one Aquatic class, which bears its name. The other Aquatic class is dominated by *Arctophila fulva*. Other common graminoid species occurring most prominently in the Moist Tundra classes are: *Arctagrostis latifolia, Deschampsia caespitosa, Poa lanata, Eriophorum angustifolium, Eriophorum russeolum,* and *Eriophorum vaginatum*. *Eriophorum vaginatum*, commonly referred to as tussock cotton grass, is the dominant species of the Tussock Tundra class.

Some of the commonly occurring herbaceous species are *Caltha palustris, Cochlearia officianalis, Epilobium latifolium, Petasites frigidus, Potentilla palustre*, and species of the genera *Draba, Papaver, Pedicularis, Polygonum, Ranunculus, Rumex, Saxifraga, Senecio*, and *Stellaria*.

Common shrub species include *Alnus crispa, Betula nana, Cassiope tetragona, Empetrum nigrum, Ledum palustre, Rubus chamaemorus*, *Vaccinium uliginosum, Vaccinium vitis-idaea,* and species of the genera *Andromeda, Arctostaphylos, Dryas,* and *Salix*. *Salix* and to a much lesser extent *Alnus*, are the dominant species of the Low and Tall Shrub classes. With the exception of *Betula*, the remaining shrub species are Dwarf shrubs.

The NPR-A can be divided into three physiographic provinces occurring roughly as latitudinal bands (Map 28) (Wahrhaftig, 1965). From north to south, they are the Arctic Coastal Plain (ACP), the Arctic Foothills, and the Brooks Range. Most of the described species occur in these three provinces, so the relative frequency of occurrence of each species is a better distinction among provinces. Such frequency differences primarily result from differences in moisture levels. Many lakes and very poorly drained soils dominate the ACP; whereas, the Brooks Range has few lakes and some well-drained soils.

The Northwest NPR-A Planning Area includes only two of these physiographic provinces. The larger, northern portion of the Planning Area lies within the ACP; the smaller, southern portion of the Planning Area is in the Arctic Foothills. Thus, many lakes and plant species found in saturated or poorly drained soils cover much of the Planning Area. The remainder of the Planning Area has few lakes and better-drained soils. The proportion of all pixels in the Planning Area classified under the 17 minor land-cover classes are shown in Table III-06.

Table III-06 shows that 15.7 percent of the Planning Area is open water, while another 17.9 percent (Aquatic, Flooded, and Wet classes) has standing water with varying proportions of plant cover. The single most common cover type is the dwarf shrub class (29.9%); the tussock tundra class is the second most prevalent class (23.3%). The cotton grass form is more prevalent than it first appears from the table because the dwarf shrub class commonly includes tussocks as well. The distinction between the Tussock Tundra and Dwarf shrub classes is based on the relative proportion of shrubs, a dominant life form. Combining these two classes suggests that tussocks cover as much as 53.2 percent of the Planning Area.

The definition of the term "wetland" may vary. Through its National Wetlands Inventory (NWI) program, the Fish and Wildlife Service (FWS) uses ecological characteristics to define wetlands (Cowardin et al., 1979). According to this protocol, the essential attributes of wetlands are the presence of wetland plants (hydrophytes), or the presence of wet soils (hydric soils), or soil saturation, or flooding. To date, the NWI program has classified little of the NPR-A. In implementing the Clean Water Act, the U. S. Army Corps of Engineers (COE) also classified wetlands. According to the COE, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328.3). The definitions of wetlands used by the two agencies are similar; a comparison of these definitions with the land cover classification for NPR-A in Table III-06 provides a first order approximation of the amount of the Planning Area that either agency would classify as wetlands.

With the exception of thaw bulbs under larger lakes and streams, permafrost is continuous under the Planning Area. Since permafrost forms an impenetrable barrier to water percolation, the soils of the active layer above it remain saturated during summer in all but a few cases. Even "moist tundra" over these saturated soils would be classified as wetlands. Because of their high shrub component, the dwarf and low subclasses are separated from the "moist tundra" subclasses (see Table III-06). The dwarf and low shrub subclasses also exist on saturated tundra (Kempka et al., 1995; Pacific Meridian Resources, 1996) and much of the dwarf shrub subclass exists on areas of sedge tussocks. Certain areas of lichen-covered rocks or bare rocks or sand may not qualify as wetlands; however, the remainder of the Planning Area would qualify as wetlands. This suggests that more than 95 percent of the Planning Area would be classified as wetlands by at least one of the three sets of criteria.

In describing plant taxa, Lipkin and Murray (1997) have defined the term "rare." Rare taxa, known in 20 or fewer locations throughout Alaska, are included in this assessment. There are three species of rare vascular plants known to occur in the Planning Area (Lipkin, 1997). *Mertensia drummondii* G. Don has been found on sand dune habitats along the Meade River and east of the Planning Area along the Kogosukruk River. These are the only Alaskan locations for this rare bluebell that is otherwise known from locations near Union Straits in Canada's Northwest Territories. Near Barrow, *Draba micropetala* Hook (*D. adamsii sensu* Mulligan *pro parte*) has been found in eroding coastal bluffs and turfy polygons by streams. It is otherwise known to be from Canada's Northwest Territories. Because it has adapted to low temperatures this species may be precluded from growing in areas farther south. *Poa hartzii* ssp. *alaskana* Soreng is an endemic grass known only from sites along the Meade River and possibly from one site within ANWR. It occurs on active sandbars of the Meade River. Because relatively little plant-survey work has been done on Alaska's North Slope, these three species may occur at additional unsurvyed sites within and outside the Planning Area.

In addition to the above rare plant species, four other rare species are known to occur on the North Slope but have not been found in the Planning Area (Lipkin, 1997). *Potentilla stipularis* L. has been found at a site near the Colville River, 4 mi south of the southern boundary of the Planning Area. It has been found at Umiat as well; and it likely occurs within the Planning Area. This Asian species is found in sandy substrates, such as sandy meadows, and riverbank silts and sands other than dunes. *Pleuropogon sabinei* R. Br. is an aquatic grass that occurs between the *Arctophila* and *Carex* zones in lakes and ponds. This species is known in Alaska from only a few locations north and northeast of Teshekpuk Lake. *Erigeron muirii* Gray is endemic to northern Alaska and may occur on dry sites, such as ridges and outcrops in the foothills region. Other rare plant species known from sites east and west of the NPR-A include *Aster pygmaeus* Lindl, from mudflats and saline soil, and *Pedicularis hirsuta* L., from moist tundra by lake and riverbanks.

a. Wetlands and Floodplains

In compliance with Executive Order 11990, Protection of Wetlands, the BLM has prepared a comprehensive description and impact analysis on those areas within the Planning Area that are considered to have the function and value of wetlands that fall under the following legal definition:

> The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33CFR328.3(b);1984).

Analyses of impacts from activities under the various alternatives as well as a cumulative assessment of impacts from the proposed action are discussed in Section IV and Section V and include the following resources:

- Vegetation
- Soils
- Water Resources (Rivers and Lakes)
- Freshwater Quality
- Estuarine Water Quality

The Preferred Alternative and associated stipulations and required operating procedures provide a range of protections for the above mentioned habitats (see Section II.C.5 and Section II.C.6).

(1) Distribution of Arctic Wetlands

The Arctic has been defined as the region lying poleward of 66° 33' N., as the region lying north of the polar timberline, or as the "treeless zone with a southern boundary approximately parallel with the mean summer position of the arctic front" (Young, 1989; Pruitt, 1978:2; Dahl, 1986; Tarnocai and Zoltai, 1988; Young, 1989; Chapin and Shaver, 1985a). The last definitions at times overlap with "tundra" (Post, 1990), although tundra also includes naturally treeless alpine areas as well as ice-free areas of the Antarctic (Wielgolaski, 1986).

The north-polar region is subdivided into the Low Arctic and High Arctic and into vegetation types described as tundra, polar semi-desert, and polar desert (Bliss, 1981). The High Arctic encompasses the Canada Arctic Archipelago (with the exception of the most southerly portion of Baffin Island) as well as a portion of the Canadian mainland northwest of Hudson Bay and the most northerly portion of Alaska (e.g., Point Barrow and vicinity). The Low Arctic lies between the High Arctic and the taiga, encompassing nearly all of Alaska's North Slope and a broad band of the northern Canadian mainland. Polar semi-desert and polar desert characterize the vegetation of the high Arctic, although wet sedge-moss tundra also occurs in patches (Chapin and Shaver, 1985a). A Mid-Arctic Region, almost parallel with the distribution of polar semi-desert vegetation (Tarnocai and Zoltai, 1988), has been identified by some.

The Low Arctic is characterized by tundra vegetation that is often underlain by peat and provides 80 to 100 percent ground cover. Many arctic-tundra sites have been identified as wetlands. Arctic-tundra wetlands form because permafrost is a relatively impermeable barrier to water movement into the ground, confining flow to a shallow "active layer" or zone of seasonal thaw (Kalff, 1968). Precipitation is sufficient to maintain soil moistures ranging from standing water to moist (Hobbie, 1984; Chapin and Shaver, 1985a). Also, low temperatures reduce rates of evapotranspiration (Ryden, 1981; Hobbie, 1984). Soil moisture in the High Arctic ranges from moist to very dry during summer, which favors polar semi-desert or polar desert vegetation rather than wet tundra except in localized sites of poor drainage. Because of its Low Arctic location and relief, Alaska's Arctic Coastal Plain is a broad expanse of tundra wetlands.

(2) Function and Value of Arctic Wetlands

Tundra wetlands share many of the attributes of temperate wetlands. The differences between types of temperate wetlands are as great as the differences between temperate and arctic wetlands (Post, 1990; Racine, 1994). The majority of species of arctic wildlife are ultimately controlled by the availability of their habitats in the same way that wildlife species are controlled in other regions of the globe.

Arctic wetlands also share most of the hydrologic function characteristics of temperate-zone wetlands. The various ponds, lakes, tundra and beaded drainages of the Coastal Plain regulate runoff through storage in the active layer, depression storage, detention, and velocity reduction, and by slow release of water to streams over extended periods, similar to temperate wetlands during summer months. Arctic wetlands generally are not sites of discharge or recharge for subpermafrost aquifers, but suprapermafrost groundwater can influence wetland communities beneath arctic slopes in ways comparable to aquifer discharge in temperate regions. Also, tundra vegetation insulates thaw-unstable, ice-rich solids, which prevents thermal erosion; the tundra mat insulates and stabilizes the bottoms of these thaw lakes, and emergent aquatic vegetation may reduce wave erosion in large arctic lakes.

Arctic-tundra wetlands are reasonably productive and can transform or retain sediment, nutrients, and toxicants similar to many temperate wetlands. They inhibit generations of inorganic particulates by maintaining the thermal equilibrium of ice-rich, thaw-unstable soils in the watersheds of tundra systems. At breakup, streams flood adjacent tundra creating extensive wetland complexes that provide sites for suspended solids to settle, and sediment is trapped by riparian wetlands along large arctic rivers with mountain headwaters. Microbes and plants contribute to nutrient and contaminant retention or transformation in tundra wetlands since arctic-tundra species are adapted to low temperatures, are biologically active even under harsh conditions, and respond to nutrient input. Tundra ponds show chemical responses to nutrient input, reach temperatures as high as 16°C, have a high ratio of sediment surface to water volume, contain fine inorganic and organic sediment, and experience wind-driven circulation that oxygenates sediment. Nutrient concentrations may vary by an order of magnitude between adjacent microhabitats, a characteristic ensuring that waterborne nutrients and contaminants contact a variety of potential reaction sites during period of high water.

Net primary production, nutrient export, and food-chain support are important functions of arctic wetlands and qualitatively similar to those of temperate regions. Tundra production is remarkably high--approximately one-half that of temperate grasslands--and supplies the energy (plant biomass) on which animals exist. Nutrient export is an important function of arctic wetlands. Arctic-tundra wetland supports food chains, both through the herbivore-based trophic system (from living plant tissues to rodents and ungulates and their predators) and through the detritus-based trophic system (from dead plant tissue to invertebrate to shorebirds and their predators). Alaska's ACP is largely wetland and supports both herbivore-based and detritus-based trophic systems (Hobbie, 1984; Batzli et al., 1980). Near Barrow and Prudhoe Bay, brown lemming and caribou are major primary consumers, respectively, with the muskoxen playing an important role elsewhere on arctic ranges (White et al., 1981).

The habitat function of wetlands is their preeminent value as far as fish and wildlife resources are concerned. Subsistence uses of wetlands by Alaska Natives provide an additional reason to value wetland habitat.

3. Fish

This discussion incorporates by reference the description of fish resources contained in the Sale 124 final EIS (USDOI, MMS, Alaska OCS Region, 1990), Sale 126 final EIS (USDOI, MMS, 1991), and the Northeast NPR-A IAP/EIS (USDOI, BLM and MMS, 1998). The discussion also summarizes fisheries-related information from available research pertinent to this IAP/EIS. For more detailed information concerning species' descriptions, distributions, and collection sites/methods, please see the research cited here. Subsistence use of fish is described in Section III.C.3. Many of the fish species found in the arctic environment are depicted in Figure III-25. Descriptions of the physical characteristics of rivers, lakes, and marine areas found in the NPR-A are contained in Section III.A.2.a.3, "Surface Water."

a. Overview

Fish inhabiting the Arctic must cope with harsh environmental conditions not required by their counterparts to the south. For example, during the 8- to 10-month winter period, freezing temperatures reduce stream habitat by more than 95 percent. A large portion of the low salinity near-shore coastal habitat freezes. The average annual temperature of the water in large rivers is 2.5° C and 1° C in coastal waters. Food is plentiful only during the short, 3-month summer (Craig, 1989a). Fish cope with reductions in available habitat, the effects of cold water, and the brief period of biological productivity in several ways. Some fish move from freshwater habitats to estuarine waters during the short arctic summer to take advantage of the increased food supply. However, the salinity of marine waters poses an additional problem for migratory fish. Some species conform, or enter only low-salinity waters, while others have the osmoregulatory capabilities to regulate salt balance (Gallaway, 1990). Adaptations to the cold-water environment include feeding in warmer near-shore coastal waters and migrating to freshwater in the winter to avoid the super cooled marine waters. Fish migrate to limited deepwater sites in lakes and rivers during the winter to avoid freezing. Fish also time their migration and subsequent spawning to ensure egg and fry survival.

Despite the conditions, several types of fish reside year round in the Northwest NPR-A Planning Area. In this section, the discussions of fish species focus on three categories:

1. freshwater fish that spend either their entire life or most of it in freshwater, except for brief periods in brackish coastal waters;
2. marine fish that spend either their entire life or most of it in marine waters, except for brief periods in brackish coastal waters; and
3. anadromous and amphidromous fish that routinely move between fresh, brackish, and marine waters for various purposes (see the fish species section for definitions of these terms).

Understanding how arctic fish species use the lake, river, and marine environments of the Northwest Planning Area provides insight into their ability to survive, grow, and reproduce. Each of these aquatic environments is described here as a setting for a discussion of species found in the Planning Area.

b. Freshwater Environs

Fish require a healthy, functioning aquatic ecosystem, consisting of a biological community and proper physical and chemical attributes. The aquatic habitat of the Northwest NPR-A Planning Area has not been greatly impacted by humans and it should be considered a properly functioning habitat. Some of the more important attributes, such as stream banks and channels, lakeshores, substrates, water quality and quantity, floodplains, and riparian areas are generally unaltered from their natural condition. Each of these habitat features has an important role in maintaining a stable aquatic environment that allows fish to live and reproduce (USDOI, BLM, 2000).

Given this lack of habitat degradation, a functioning and natural state is anticipated for that portion of the biological community that includes aquatic plants (producers), bacteria and fungi (decomposers), and invertebrates (consumers). As part of the biological community, fish are harvested in select areas. Currently, fish populations appear to be sustaining themselves, though population data is limited.

(1) Rivers

The Planning Area is composed of an extensive freshwater environment that includes numerous rivers and lakes (Map 30 and Map 89). The location and size of these rivers and lakes, combined with the extreme Arctic environment, control the diversity and distribution of fish. Though the freshwater component covers a large portion of the Planning Area, relatively few studies have been conducted within its drainages.

The physiographic features of the region influence river systems (Map 30). Physiographic provinces in the Northwest NPR-A Planning Area are the Arctic Coastal Plain and the Arctic Foothills (Wahrhaftig, 1965) (Map 28). Waterbodies originating in each of these regions have distinct hydrologic properties influenced by topography and other physical environmental factors, such as permafrost and climate. The coastal plain and foothills regions provide a useful tool for dividing streams into discussion categories.

There are five major rivers flowing from the Arctic foothills to the Chukchi Sea or Bering Sea. These include the Ikpikpuk, Kuk, Meade, Topogoruk, and Chipp river drainages. These rivers provide fish with migratory pathways between the marine and foothill areas, serve as spawning and rearing areas, and contain limited overwintering habitat. Specific examples illustrate their use. Life history data presented by Sekerak et al. (1985) suggests that least cisco and humpback whitefish spawning near Atqasuk use the Meade River to migrate to the nearshore areas of the Beaufort Sea to feed. Though outside the area, a study of coregonid species in the lower Mackenzie River by Reist and Bond (1988) documents life history patterns showing movement between freshwater and marine habitat for feeding, spawning, and overwintering. Some fish species, such as arctic grayling, utilize only the freshwater portion of these rivers. Grayling overwinter in deeper rivers and lakes and migrate to spawning and rearing habitats in the spring.

Data collected during the NPR-A 105c studies (Netsch et al., 1977; Hablett, 1979) reveal similar habitat composition in the Planning Area's foothill rivers. The headwaters occupy the upper one-third of the watershed. This reach of the rivers is typically less than 2 ft deep and approximately 50 ft wide, with a rubble substrate. Riparian vegetation includes willows to 8 ft. The middle portion of the rivers consists of larger pools, some of which are 1 mi long, 100 yards (yds) wide, and 9 ft deep. These pools are interspersed with wide, shallow sections (< 5 ft) of river with a sand bottom. Fish appear to use this section of the river to migrate. The lower portions of the rivers meander, with sandbars and dunes commonly on the inside bends, and with steep cut banks more than 30 ft high. Riparian willows are short (< 1 ft) and the substrate is mainly shifting sands.

Bendock and Burr (1985) investigated several rivers originating in the foothills of the Planning Area. Their study focused on freshwater fish distribution in the waters between the Topagoruk and Ikpikpuk rivers. They describe the streams as meandering and low gradient, with braided deltas, predominantly fine sand and silt streambeds and banks and sparse vegetation. They found some evidence of spawning (i.e., fish in pre-spawning or spawning condition or juveniles) by grayling, broad and humpback whitefish, least cisco, northern pike, juvenile burbot, and longnose suckers. Based on their aerial flights and ground sampling, the Titaluk, Oumalik, Chipp, and Ikpikpuk rivers were considered deep enough to provide overwintering habitat. Investigation of the Ikpikpuk River by Bendock and Burr (1984) identifies this river as uniformly shallow with well-separated pools interspersed near cutbanks. The deepest pool (18 ft) was near the mouth of the Titaluk River.

Fisheries investigations of the Meade River near Atqasuk were conducted in relation to a gravel extraction program in 1983 and 1984 (Sekerak, Griffiths, and Stallard, 1985). Fish resources were most abundant in the major rivers surrounding Atqasuk. Deepwater areas of the Meade River are thought to be critical for spawning whitefish and cisco. Grayling use the small streams in the area for spawning and summer feeding and then return to the Meade River for overwintering. It is suspected that year-round habitat use in smaller streams and most lakes in the Planning Area is limited because of total freezing in the winter.

To determine the reduction in habitat that would be available to fish in the winter, Craig (1989a) calculated potential overwintering habitat for North Slope coastal plain streams (main channel only) draining the foothills and coastal plain provinces. He estimated that an average of 15 percent of the total stream length would be useable in the winter. The lower half of these river types was calculated to provide approximately 80 percent of the potential habitat. Spawning areas harboring overwintering eggs into freezeup must have an adequate supply of flowing water to oxygenate eggs and remove metabolic waste. Thus, available spawning habitat is as limited as overwintering habitat under winter conditions.

Flowing waters also consist of slow-moving coastal plain rivers and the maze of interconnecting channels meandering between numerous lakes. These waterbodies are often referred to as tundra rivers (USDOI, BLM, 1978g). Their origin in the coastal plain determines their definition. Some rivers flow directly into marine waters, while others are tributaries of larger rivers. Flow is often seasonal and depends on spring breakup conditions and summer precipitation. These streams provide migration corridors for fish but they are less likely than foothill streams to be used as overwintering and spawning habitat since many are shallow and completely frozen in the winter. Studies near the mouth of the Mackenzie River by Reist and Bond (1988) found movements of juvenile coregonids to be complex in this type of habitat. Juvenile movements included travel into streams, between channel-connected lakes, and within near-shore areas of the Beaufort Sea and lakes of the Tuktoyaktuk Peninsula. Spring movements start near ice breakup and include upstream movement of juveniles and downstream movement of juveniles and spawners of that year dispersing to feeding grounds, with fall movements back to overwintering grounds.

Craig (1989a) further distinguishes small streams (30 to 70 km long) as a habitat unit. These streams are supplied with tundra runoff and flow directly into the coastal waters. Most of these streams freeze solid in the winter so their contribution to fish habitat is limited. Grayling, slimy sculpin, and ninespine stickleback may use these streams; however, there is minimal use by anadromous fish.

(2) Lakes

The coastal plain of the Planning Area is inundated with arctic lakes (Map 89), an important component of the freshwater environment. In the broadest sense, arctic lakes are oligotrophic, cold, isothermal in the open water season, and ice covered for much of the year. Area, volume, climate, and exposure contribute to arctic lake conditions (Power, 1997). Because of the cold climate, ice is a prominent feature of arctic lakes and it affects chemical and biological processes. One example includes the limits that ice cover imposes on gas exchange with the air. This is a potential problem for fish, especially in shallow lakes, because of the possibility for reduced oxygen levels and resultant winterkill. Arctic lakes are also sensitive to eutrophication (increase in mineral and organic nutrients) from pollution. Eutrophication increases plant production and the chances for winter oxygen depletion and winterkill (Schindler et al., 1974). Overall, fish have adapted to the low temperatures and productivity and long periods of ice cover and darkness in arctic lakes. Given an adequate supply of clean water, they are able to survive under these conditions.

From a fish resource and impact perspective, discussions of arctic lakes often center on their depth. The NPR-A 105c investigations (USDOI, BLM, 1978g) noted distinct physical differences between lakes on the coastal plain. A north-south line, extending from approximately Barrow to the foothills, separated lakes into east and west groupings. Lakes west of this line have elevations of 0 to 50 ft and depths ranging from 3 to 20 ft. Most are reported to be about 3 ft deep. Lakes in the eastern coastal plain have elevations of 50 to 400 ft and depths ranging from 3 to 60 ft; most are less than 30 ft deep.

Shallow lakes (< 6 ft) provide limited habitat because of complete freezedown during the long winter season. Many of the lakes found in the western part of the coastal plain fit this description. They provide potential summer rearing areas and are used as migration corridors where they have inlets and outlets. Further limiting their use is the fact that some of these lakes are connected only seasonally or sporadically. Seasonally connected lakes are flooded during breakup, while sporadically connected lakes are flooded only during high-water years (U.S. Army Corps of Engineers, 1997).

A large proportion of the deep lakes in the NPR-A lies south and southwest of Teshekpuk Lake (USDOI, BLM, 1978g). Many of these lakes are in the Ikpikpuk/Chipp drainage. Characteristics of NPR-A deep-water lakes, as reported by Bendock (1982), include extensive unvegetated shoal areas upon which ice remains grounded through much of the winter. Aquatic vegetation is sparse and sand is a common substrate. These lakes are primarily important to fish as spawning and overwintering habitat. Since the deep basin portion of these lakes is often a small portion of the total surface area, surface area alone is not a good indicator of lakes that support fish populations. Sampling of NPR-A lakes by Hablett (1979) revealed that lakes greater than 6 ft deep, with suitable spawning substrate, appeared to support the largest and most diverse populations of fish.

c. Marine Habitat

The marine environment consists of inlets, lagoons, bars, and numerous mudflats (USDOI, BLM, 1978a). These waters are inhabited by anadromous, amphidromous, and marine fish, and to a limited extent by freshwater fish, feeding on the abundant food supply (Craig, 1984b). During the open-water period, the nearshore is dominated by a band of relatively warm, brackish water extending across the Beaufort Sea coast and to a lesser extent, along the Chukchi Sea coast. The diminished nearshore zone along the Chukchi Sea coastline is attributable to fewer inlets and only one major river (Kuk) discharging freshwater to the sea. The summer distribution and abundance of coastal fish (marine and migratory species) is strongly affected by this band of brackish water, which typically extends from 1 to 6 mi offshore. It is formed after breakup by freshwater input from the larger foothill rivers, such as the Ikpikpuk. It has its greatest extent off river-delta areas, with a plume extending 15 mi offshore of some North Slope rivers. Reist and Bond (1988) further defined the nearshore area, at least for coregonids in the lower Mackenzie River, as being within the 5-m-depth contour.

Data suggests that near shore use correlates with warmer water temperatures and lower salinities than farther offshore. In their study of fish distribution in Simpson Lagoon, Craig et al. (1985) found two trends related to amphidromous species' use of nearshore habitat. First, fish preferred the warmer nearshore waters to the cooler marine waters; and second, within the brackish waters, fish preferred the mainland shoreline edges. Catch data detected a particular affinity for nearshore habitat by least cisco and broad and humpback whitefish. In their study of amphidromous fish of Dease Inlet and Admiralty Bay, Philo et al. (1993) noted a difference in distribution and relative abundance of fish captured between sampling near river mouths and those farther away from a freshwater source. Differences were attributed to temperature or salinity, or a combination of the two parameters. In their Mackenzie River studies, Reist and Bond (1988) surmised that preference for low salinity is the factor limiting distribution to near shore. Though amphidromous fish are abundant along the mainland and island shorelines, they also inhabit the central waters of bays and lagoons. Larger fish of the same species tolerate colder water (e.g., arctic char and arctic and least ciscoes) and range farther offshore (Moulton, Fawcett, and Carpenter, 1985; Thorsteinson, Jarvela, and Hale, 1991).

As summer progresses, the number of freshwater fish entering the nearshore zone decreases, and nearshore waters become colder and more saline. From late summer to fall, migratory fish return to rivers and lakes to overwinter and to spawn (if sexually mature). In winter, nearshore waters less than 6 ft deep freeze to the bottom. Before they do so, marine fish continue to use the nearshore area under the ice, but eventually move into deeper offshore waters when the ice freezes to the bottom (Craig, 1984).

d. Fish Species

Sixty-two species of fish have been collected from the coastal waters of the Beaufort Sea offshore of Alaska (69% marine, 26% anadromous and amphidromous, 5% freshwater). With the exception of salmon, all species are typical of fish that reside in arctic coastal waters from Siberia to Canada (Craig, 1984). Thirty-seven species were collected in the warmer nearshore brackish waters, and 40 species were collected in the colder marine waters farther offshore (some use both habitats). The final *EIS for OCS Oil and Gas Lease Sale 126* (USDOI, MMS, 1991) reports there are 72 species of fish in the northeastern Chukchi Sea. Twenty-five species of fish are reported to be in the freshwaters of the Chukchi Sea coast. Thirteen of these species are anadromous. Many of these species are displayed in Figure III-25.

(1) Freshwater Fish

Freshwater fish in the Northwest NPR-A Planning Area include: lake trout, arctic grayling, Alaska blackfish, northern pike, longnose sucker, round whitefish, burbot, ninespine stickleback, and slimy sculpin (Morrow, 1980). Arctic char have been encountered infrequently. These species feed on terrestrial and aquatic insects and their larvae, zooplankton, clams, snails, fish eggs, and small fish (Bendock and Burr, 1984). Except for burbot, which spawn under ice in late winter, freshwater fish spawn from early spring to early fall.

The freshwater fish studies that have been done in the Northwest NPR-A Planning Area have focused on species occurrence. Population estimates of freshwater species are lacking. Most of the studies have occurred during the summer, which influences species found and habitats used.

The NPR-A 105c investigations (USDOI, BLM 1978g) provided the first NPR-A wide reconnaissance for freshwater fisheries resources. Eighty-eight lakes and 132 streams were sampled (Hablett, 1979). Freshwater species in the Planning Area included lake trout, arctic grayling, Alaska blackfish, northern pike, longnose sucker, burbot, ninespine stickleback, and slimy sculpin. Ninespine stickleback and grayling were the most abundant freshwater species captured. Grayling were captured throughout the area, though they were most prevalent in the upper river sections and in the eastern half of the NPR-A. Ninespine stickleback and slimy sculpin were widely distributed in lakes and rivers.

Drainage specific studies have yielded similar species compositions. Investigations of the Ikpikpuk River (Bendock and Burr, 1984) found arctic grayling, burbot, ninespine stickleback, and slimy sculpin to be distributed throughout the drainage. Longnose suckers were prevalent in the middle reaches of the river. Northern pike were captured above the mouth of the Price River. Gill net sampling of the Chipp, Topagoruk, upper Ikpikpuk drainages (Titaluk and Kigalik Rivers, Bronx Creek), and 26 lakes between the Topagoruk and Ikpikpuk Rivers was conducted by Bendock and Burr (1985). Captured freshwater species included lake trout, arctic grayling, northern pike, longnose sucker, round whitefish, burbot, ninespine stickleback, slimy sculpin, and Arctic char. Capture of char is noteworthy since the samples were taken from an isolated lake population near the Chipp River.

(2) Anadromous and Amphidromous Fish

Anadromous fish (e.g., salmon) breed in freshwater, migrate to the sea as juveniles (smolts), and return to freshwater as adults to spawn and die. Amphidromous fish (i.e., many whitefish spp.) inhabiting the arctic are long-lived, slow-growing, and become sexually mature much later in their life than their southern counterparts.

Unlike anadromous fish, they do not make one far-ranging ocean migration and return years later to freshwater to spawn and die. Instead, they make many migrations between freshwater and the sea for purposes other than spawning; spending much more time in brackish coastal waters than in marine waters. Additionally, they return to freshwater to overwinter but not necessarily to spawn. In fact, they typically return many times to freshwater before spawning. Even after reaching spawning age, spawning occurs only if their nutritional requirements are met during the brief arctic summer. When they do spawn, they do not necessarily die; many return years later to spawn again before dying. Despite these major differences, the term "amphidromous" seldom has been used in the literature when referring to the indigenous migratory fish of the arctic environment (Craig, 1989a). Much of the past literature uses the term "anadromous" in its broadest sense to describe those arctic fish that migrate between the sea and freshwater.

Anadromous and amphidromous fish inhabit many of the lakes, rivers, streams, interconnecting channels, and coastal waters of the Planning Area (see the freshwater environs and marine habitat sections for habitat description). Amphidromous species include arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, Dolly Varden, and inconnu (Morrow, 1980). All of these species are fall spawners except for smelt, which spawn in the spring. It should be noted that some populations of Dolly Varden/arctic char, least cisco, and broad and humpback whitefish never leave freshwater (Craig, 1989a). Pacific salmon species (anadromous fish) are not abundant in the waters of the Northwest NPR-A (Craig, 1989b). Small runs of pink and chum salmon occur in several rivers, and chinook salmon occur infrequently. Salmon species captured during the NPR-A 105c investigations (Hablett, 1979) included chum salmon in the Kuk, Kungok, Kugrua, and Inaru rivers and pink salmon in the Kugrua, Meade, Chipp, Kungok, Kuk, and Ketik rivers. One chinook salmon was captured in the Kuk River. The Alaska Department of Fish and Game (ADF&G) *Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes* lists pink salmon as occurring in the Ikpikpuk, Kugrua, and Chipp rivers. Chum salmon are listed as occurring in the Kugrua and Meade rivers (ADF&G, 1999). No other salmon streams in the Planning Area are noted in the catalog. Map 86 synthesizes the catalog data to depict habitat use by salmon and whitefish in the Planning Area.

As discussed in the freshwater species section, the NPR-A 105c investigations (USDOI, BLM, 1978g) provided the first NPR-A-wide reconnaissance of fisheries resources. Based on these 105c investigations, anadromous and amphidromous species found in the Planning Area include arctic cisco, least cisco, humpback whitefish, broad whitefish, and pink, chum, and chinook salmon. Least cisco was the most abundant species captured in the NPR-A 105c study. Least cisco and broad whitefish dominated lower river catches, and humpback whitefish were commonly captured in the lower river reaches. Broad and humpback whitefish captures were limited to the Ikpikpuk River and Admiralty Bay drainages. Arctic cisco were captured infrequently.

Other fish utilization studies in near-shore waters of the Planning Area provide further insight into species occurrence and relative abundance in Northwest NPR-A. Twenty species of fish were captured in Dease Inlet/Admiralty Bay in a study conducted by Philo, George, and Moulton (1993). Least cisco was the most abundant species captured in marine and freshwater sampling sites. Broad and humpback whitefish were also collected each year of the study, but in much smaller numbers than least cisco. Arctic and Bering cisco, Dolly Varden, pink salmon, and rainbow smelt were infrequent captures. Threespine stickleback was also captured in small numbers. Freshwater and anadromous forms of this species are known to exist. Kinney (1985) conducted studies of fish utilization of Peard Bay in the eastern Chukchi Sea. Four marine species accounted for 99.6 percent of the catch. The only captured anadromous and amphidromous species included least cisco, rainbow smelt, Bering cisco, and pink salmon. Low catch numbers of anadromous and amphidromous species are attributed to suspected lack of spawning and overwintering habitat in the Chukchi coastal rivers.

Amphidromous fish species are relatively abundant and an important food source in the Northwest Planning Area. Their migration behavior and feeding habits are complex and warrant further discussion. Amphidromous fish move out of freshwater rivers and lakes and into coastal waters during spring breakup to take advantage of the abundant food supply needed for growth and to accumulate energy reserves needed for overwintering and spawning. Some fish disperse widely from their streams of origin (e.g., arctic cisco and some arctic char). Others, like broad and humpback whitefish and least cisco, do not disperse widely and they are seldom found anywhere but near the mainland shore (Craig, 1984). Nearly all of the growth for these fish occurs during this summer feeding period. In addition, adults attempting to spawn must attain adequate energy reserves by early summer or they will forego spawning for that year. Most amphidromous fish return to freshwater habitats in the late summer or fall to overwinter and, if sexually mature, to spawn. Others, like cisco, have been known to return much earlier, arriving 6 to 10 weeks before spawning; thus, forfeiting half the nearshore-feeding period (Craig, 1989a). This early migration may be attributed to higher migratory energy expenditures at low water temperature during autumn and the fact that coregonids are not strong swimmers compared with other salmonids (Bernatchez and Dodson, 1985). For fall spawners, reproducing in the arctic environment can occur only where there is an ample supply of oxygenated water for egg survival during winter. Since areas of winter water availability are limited, adults often overwinter near the spawning grounds (Craig, 1989a).

Infaunal prey density in the nearshore substrate is very low and provides little or no food for amphidromous fish. However, prey density in the nearshore water column is high (five times that of freshwater habitats on the Arctic Coastal Plain). The nearshore feeding area is also much larger than that of freshwater habitats on the coastal plain (Craig, 1989a). For these reasons, fish come to feed on the relatively abundant prey found in nearshore waters during summer. Amphidromous fish feed on epibenthic mysids and amphipods (often greater than 90% of their diet) and on copepods, fish, and insect larvae (Craig and Haldorson, 1981; Craig et al., 1984; Craig, 1989a). Little dietary overlap is observed in early to midsummer when amphidromous fish are most abundant in nearshore waters. However, in late summer when they are less abundant and their prey is more abundant, dietary overlap is common in nearshore waters (Moulton, Fawcett, and Carpenter, 1985). Marine birds also compete for the same food resources during this time. While migrating to freshwater and spawning habitat, amphidromous fish do little or no feeding. However, they resume feeding during winter.

(3) Marine Fish

Marine, anadromous, and amphidromous fish inhabit the coastal waters bordering the Northwest NPR-A Planning Area. Over 60 fish species occur in the coastal waters of the Beaufort Sea, however, only a few are commonly captured inshore (Jarvela and Thorsteinson, 1999). Some representative marine fishes include arctic cod, saffron cod, twohorn and fourhorn sculpins, Canadian eelpout, arctic flounder, capelin, Pacific herring, Pacific sand lance, and snailfish (Fig. III-25) (Craig, 1984; Moulton and Carpenter, 1986; Jarvela and Thorsteinson, 1999). Marine fishes prefer the colder, more saline coastal water masses seaward of nearshore brackish-water masses. As summer progresses, nearshore waters becomes more saline as freshwater input from rivers and streams decreases. During this period, marine fishes often share nearshore waters with anadromous and amphidromous fishes, primarily to feed on the abundant epibenthic fauna or to spawn (Craig, 1984). In autumn, after anadromous and amphidromous fishes have departed nearshore waters for freshwater waterways to spawn or overwinter, marine fishes remain in the nearshore waters to feed.

Fourhorn sculpin and capelin are common marine fishes in nearshore waters (Schmidt, McMillan, and Gallaway, 1989; Thorsteinson, Jarvela, and Hale, 1991). Saffron cod, arctic flounder, and snailfish also use nearshore waters; however, their occurrences are sporadic and variable and in much lower numbers than those of the fourhorn sculpin and capelin. Common marine fishes in offshore waters include arctic cod and kelp snailfish (Craig, 1984; Schmidt, McMillan, and Gallaway, 1989; Thorsteinson, Jarvela, and Hale, 1991). Arctic cod are more concentrated along the interface between warmer nearshore water masses and colder offshore water masses. With its moderate salinity, the warmer nearshore zone is thought to be an essential nursery area for juvenile arctic cod (Cannon, Glass, and Prewitt, 1991). Arctic cod are abundant and contribute extensively to productivity in arctic coastal waters. Due to their substantial contribution to the diets of marine mammals, birds, and other fishes, arctic cod are regarded as a "key species in the ecosystem of the Arctic Ocean" (Craig, 1984). They are believed to be the most important consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry, 1983); and, they may influence the distribution and movements of some marine mammals and seabirds (Craig, 1984, citing Finley and Gibb, 1982).

Marine fishes feed primarily on marine invertebrates. They prey heavily on epibenthic and planktonic crustacea such as amphipods, mysids, isopods, and copepods. Flounders also feed heavily on bivalve mollusks, and fourhorn sculpins supplement their diets with juvenile arctic cod. Because the feeding habits of marine fishes are similar to those of amphidromous and anadromous fishes, some marine fishes are believed to compete with some amphidromous and anadromous fishes for the same prey (Craig, 1984; Fechhelm et al., 1996). Competition of prey resources is most likely to occur in nearshore brackish-waters, particularly in or near larger river deltas, such as the Ikpikpuk and Colville river deltas. As nearshore ice thickens in winter, marine fishes feed under the ice until being forced to depart as the ice freezes to the sea floor. Seaward of the bottomfast ice, marine fishes feed and reproduce in nearshore waters all winter (Craig, 1984). Most spawn during winter, some in shallow coastal waters and others in offshore waters. Between November and February, Arctic cod spawn under ice (Craig and Haldorson, 1981). Snailfish spawn farther offshore, attaching their adhesive eggs to rocks or kelp.

e. Essential Fish Habitat

(1) Regulations Enacting the Sustainable Fisheries Act

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Along with reauthorizing the Magnuson-Stevens Fishery Conservation and Management Act Reauthorization (16 U.S.C. 1801-1882), one of those added measures is to describe, identify, and minimize adverse effects to essential fish habitat. The regulations defining essential fish habitat are in 50 CFR 600.910. Essential fish habitat is defined as habitat necessary to the species for spawning, breeding, feeding, or growth to maturity. Those habitats include: aquatic areas and their associated physical, chemical, and biological properties that are used by fish; sediment, hard bottom, and structures underlying the waters; and associated biological communities.

The Act also requires Federal agencies to consult with NOAA Fisheries (formerly NMFS) on activities in this case, non-oil and gas activities and oil and gas leasing and development that may adversely affect the essential fish habitat. That consultation should be consolidated with environmental review required by other statutes, such as the National Environmental Policy Act (50 CFR 600.920(e)). Therefore, sections entitled essential fish habitat are included in this EIS.

The potentially impacting activities may have effects on essential fish habitats that are direct effects (e.g., physical disruption) or indirect (e.g., loss of prey species that are necessary for feeding). Those effects can be site-specific, habitat-wide, individual, cumulative, and/or synergistic.

The only essential fish habitat designated in the Northwest NPR-A Planning Area is for salmon. Salmon includes all five species of Pacific salmon: chinook or king(*Oncorhynchus tshawytscha*), coho or silver (*O. kisutch*), pink or humpy (*O. gorbuscha*), sockeye or red (*O. nerka*), and chum or dog (*O. keta*) (North Pacific Fisheries Management Council, 1997).

Geographically, the salmon essential fish habitat is not defined by whether it is currently used by salmon but rather by whether it could ever be used, given climate change, seismic changes, etc. Salmon essential fish habitat in freshwaters of Alaska is designated as virtually all the coastal streams to about 70° N. latitude. The southern point of the coastal portion of the Northwest NPR-A Planning Area (Icy Cape) is located at about 70° 15' N. latitude. Salmon essential fish habitat in marine waters of Alaska formally is designated as the area within the 320-km exclusive economic zone boundary of the United States down to a depth of 500 m (North Pacific Fisheries Management Council, 1999).

Habitat Areas of Particular Concern also must be identified in the fishery-management plans (50 CFR 600.815). The Habitat Areas of Particular Concern for salmon include all anadromous streams, lakes, and other freshwater areas used by Pacific salmon and other anadromous fish (such as smelt), especially in urban areas and in other areas adjacent to intensive human-induced developmental activities (North Pacific Fisheries Management Council, 1999).

The salmon themselves also are to be evaluated (NOAA Fisheries, 2002). Generally, there is little evidence of viable self-sustaining salmon populations in the Beaufort and the northern (north of 70° N. latitude) Chukchi Sea. Present salmon "populations" have a very difficult time establishing and persisting, most likely because of the marginal habitats (Craig, 1989; Fechhelm and Griffiths, 2001). Conclusions based on a survey of available information describing salmon stocks in the Beaufort Sea (Fechhelm and Griffiths, 2001) indicate only a few isolated spawning stocks of chum and pink salmon that might occur in the Beaufort Sea area, primarily the Sagavanirktok and Colville rivers. Their database shows only 1 to 2 chum per year--on average--caught in sampling gear in the last 30 years. These authors believe chum and pink taken in the Chipp River and Elson Lagoon near Point Barrow could be either individuals of small runs or an overshoot of spawning salmon from near Point Hope and along the Chukchi Sea coast. Sockeye, coho, and king salmon are even rarer than pink and chum salmon in the Beaufort Sea and that portion of the Chukchi Sea adjacent to the Northwest NPR-A Planning Area. For example, no sockeye or coho salmon and only a single chinook salmon were collected during 17 seasons of intensive sampling in Prudhoe Bay (Babaluk et al., 2000). Salmon generally make up less than 1 percent of the subsistence fish catch with spikes of 3 to 4 percent in a few years (ADF&G, 1995b; North Slope Borough, 2000).

Recent occurrences raise the question of whether significant temperature increases in arctic areas caused by climate change indicate a significant change in salmon distribution in the future. Local residents have noticed increases in salmon occurrences over the past 10 to 20 years (Pedersen, 1995; Napageak, 1996). Several published journal notes of first records of salmon in the Canadian Beaufort Sea watershed that occurred in the past decade (Babaluk et al., 2000) also indicate the increasing but still rare incidence of salmon in the Beaufort Sea.

Ecologically, the Beaufort Sea and northern (north of 70° N. latitude) Chukchi Seas can be considered a population sink for salmon rather than a source, drawing excess salmon from other areas rather than producing a surplus that colonizes new areas. The scarcity of salmon documented in the Beaufort Sea and the fact that it is at the northern boundary of the geographic distribution support the population sink theory. Additionally, while still uncommon across the Beaufort Sea, more salmon have been documented more frequently in the west than in the east. This seems to reflect locations nearer the sources of the larger and more concentrated salmon populations in the Bering and southern Chukchi seas.

Beyond the physical proximity to source populations, ocean currents tend to bring more nutrients to the western portion of the Beaufort Sea, making potential habitat better in the west than in the east. Other physical differences such as temperature and salinities seem to differ little east to west (Okkonen and Stockwell, 2001). Thus, effects of the same type and size of disturbance (e.g., seismic activity, turbidity from construction, or an oil spill) or the same size of deferral at the same distance from the shoreline can be expected to have a slightly greater effect in the western Beaufort than in the central and eastern Beaufort.

(2) Salmon Essential Fish Habitat Components and Seasons

Freshwater overwintering habitat, including spawning gravel that does not freeze and kill spawned fish eggs, is extremely limited in the Beaufort and northern Chukchi Sea coast area and probably is the largest controlling factor limiting the viability of Beaufort and northern Chukchi Sea salmon stocks at present (Craig, 1989; Fechhelm and Griffiths, 2001). Most benthic invertebrates, such as insects living on the stream bottom and insects and many zooplankton living in the water column (such as copepods), are freshwater prey for one or another species of salmon.

For salmon, these freshwater overwintering areas compose spawning habitat primarily, which also is the egg and larvae habitat for up to 11 months after spawning. For this analysis, the egg-through-alevin stages of all five species of Pacific salmon are combined. Juveniles of pink and chum salmon, the most common and most adapted salmon to the Beaufort and northern Chukchi environment, do not require juvenile freshwater rearing habitat because the young hatch in early spring and soon after migrate to saltwater. Coho, sockeye, and king salmon require year-round juvenile rearing habitat for 1 to 3 years. Sockeye require freshwater lake rearing habitat for 18 months to 2 years.

Habitat Areas of Particular Concern are designated by regulation to be all freshwater anadromous streams and lakes. For purposes of analysis, anadromous freshwater habitat is calculated by summing the total length of State-identified anadromous streams and lakes. The Planning Area has approximately 985 km of anadromous streams and rivers, of which 340 km are known salmon habitat (ADF&G, 1999).

A 5-mile-wide region of brackish or less salty water, called the estuarine habitat, supports young salmon as they exit freshwater for life in the sea. In early summer (i.e., mid-June to mid-July) (Niedoroda and Colonell, 1988), significant inputs of freshwater from coastal runoff lower the salinity in these waters to 28 physical salinity units (Weingartner and Okkonen, 2001) compared to 33.1 physical salinity units farther out from the coast (Lewbel and Gallaway, 1984; Okkonen and Stockwell, 2001; Pickart, 2001). Temperature and salinity differences within the estuarine belt are primarily due to winds. As freshwater discharge becomes low by late summer, brackish water becomes saltier. In October, landfast ice begins forming. From November to June, this 5-mile wide estuarine zone is frozen solid to the ocean floor (Nukapigak, as cited in USDOI, MMS, 1995a).

This estuarine zone is used primarily by juvenile salmon smolt during physiological adaptation from the freshwater to the saltwater environment. This outmigration takes place from the time the ice moves out through August. Feeding during this time, especially the first few days, is thought to be especially critical to survival. Salmon smolt must catch and eat prey within just a few days or die. Thus, prey and prey habitat are an important part of this particular habitat. Once they enter the ocean, pink and chum salmon hug the shore. Pink salmon spend the first few weeks in water only a few centimeters deep; thus, prey living in the gravel substrate (benthic insects and zooplankton) are their food source. Chum salmon use intertidal areas (i.e., estuarine waters in the Beaufort and Chukchi Sea) for months before migrating to the outside waters. They move offshore from July to September. Sockeye juveniles also tend to stay close to the shore during their first summer (North Pacific Fisheries Management Council, 1997).

For purposes of analysis, the estuarine habitat is defined as an approximately 5-mi wide zone adjacent to the Beaufort and Chukchi Sea coast. Adults returning to spawn will transit the estuarine zone and may wait there while their osmoregulatory system adapts from saltwater back to freshwater for spawning. Otherwise, the salinity is not an important aspect for adults returning to spawn between June and September. Individual fish probably will take only a few days to a week to transit this estuarine area. Marine essential fish habitat technically extends north to the exclusive economic zone from the estuarine zone. The marine salmon essential fish habitat associated with this EIS extends from the estuarine band (to 5 mi from the coast) to the northern and western NPR-A boundary.

The marine juvenile stage is the principal growth period of salmon and can last from 1 to 6 years. During this lifestage, prey and prey habitat are the most critical components of the marine essential fish habitat. Prey commonly consist of animals near the water surface (epipelagic zooplankton), particularly copepods. Given their differences in size, this is a surprising overlap with the bowhead whale, which strains plankton through baleen. Chinook (king) salmon and larger sockeye coho and chum salmon also consume fish. However, according to the preliminary assessment report for essential fish habitat, this stage historically does not involve the Beaufort and northern Chukchi Sea. Pink salmon occupy marine waters south of 60° N. latitude, coho salmon south of 64° N. latitude, chinook salmon in the Bering Sea 70° N. latitude and south, chum salmon south of the Bering Straight (about 65° N. latitude), and sockeye salmon in the larger Gulf of Alaska and the Pacific Rim.

4. Birds

About 70 species of birds occur annually in Beaufort and Chukchi Sea offshore and nearshore marine habitats, and Arctic Coastal Plain (ACP) aquatic and terrestrial habitats (Audubon Alaska, 2002; BP Exploration (Alaska), Inc., 1998a; Cotter and Andres, 2000; Dau and Anderson, 2001, 2002; Dau and Hodges, 2003; Derksen, Rothe, and Eldridge, 1981; Dickson, Balogh, and Hanlan, 2001; Fair, 2002; Fischer, 2002; Fischer, Tiplady, and Larned, 2002; Gotthardt, 2001; Johnson and Herter, 1989; Johnson et al., 2003; Lanctot, et al., 2001; Larned, Platte, and Stehn, 2001; Larned, Stehn, and Plattee, 2003; Larned et al., 2001; Mallek, 2001; Mallek and King, 2000; Mallek, Platte, and Stehn, 2002, 2003; Pitelka, 1974; Ritchie, 1996; Ritchie and Wildman, 2000a, 2000b; Ritchie, Lovely, and Knoche, 2002; Troy Ecological Research Assocs. [TERA], 1993a, 1995a; USDOI, BLM and MMS, 1998; USDOI, MMS, 1998a; USDOI, MMS, Alaska OCS Region, 2002a; Wilbor, 1997). A substantial proportion of those nesting on the ACP do so in the Northwest NPR-A Planning Area (Larned, Stehn, and Plattee, 2003; Larned et al., 2001; Mallek, Platte, and Stehn, 2002, 2003). Waterfowl and shorebirds compose the majority of species in ACP and coastal habitats. Other groups represented by one or more species include loons, seabirds, raptors (hawks, eagles, owls), ptarmigan, and songbirds (Table III-07). Nearly all species are migratory, occurring in the area for some portion of the period May to early November. Important features of various species' annual events are presented in Table III-08 and discussed below. Steller's and spectacled eiders are discussed in Section III.B.6 , Endangered and Threatened Species.

During the breeding season Pacific loon, greater white-fronted goose, Canada goose, northern pintail, greater scaup, king eider, long-tailed duck, and arctic tern are present in relatively large numbers in the Northwest NPR-A Planning Area (Table III-07). Substantial numbers of tundra swan, brant, and glaucous gull, as well as several shorebird species (Table III-09) also are present in the Planning Area. Several species of songbirds, in addition to the abundant Lapland longspur are likely to occur, as well as five species of raptors.

Aerial surveys on the ACP in late June-early July of 1986-2002 (Mallek, Platte, and Stehn, 2003) and early to mid-June of 1992-2002 (Larned, Stehn, and Platte, 2003) indicate that several species, including Canada goose, long-tailed duck, jaegers, common raven, and snowy owl, have declining populations. Pacific loon, yellow-billed loon, and northern pintail populations are relatively stable, and upward trends are shown for red-throated loon, glaucous gull, Sabine's gull, arctic tern, brant, greater white-fronted goose, tundra swan, greater scaup, small shorebirds, and short-eared owl. King and common eider populations declined substantially (50% or more from Point Barrow in spring) beginning in the mid-1970's (Suydam et al., 2000), but regional populations appear to be increasing in recent years (Dau and Anderson, 2002; Larned, Stehn and Platte, 2003).

Obtaining clear-cut trends for some species has been difficult. For example, results of the mid-June eider surveys and aerial breeding-pair surveys flown in late June/early July indicate opposite trends for several species over the past 10 to 15 years. Various factors probably explain apparent differences in trends for certain species populations between the two surveys, such as: 1) the earlier Eider Survey flown before the bulk of a species' ACP population arrives; 2) the later ACP Breeding Pair Survey flown when birds become increasingly secretive and difficult to see as the season progresses and the more obvious seaduck males have departed (resulting in variation in bird detection between the two surveys); 3) the Eider Survey specifically targeting eider habitats over only about half the area covered by the ACP survey; and 4) variations in the methods and analysis used in the two surveys. Although the density of each species varies over the Planning Area (Map 36, Map 37, Map 38, Map 39, Map 40, Map 41, Map 42, Map 43, and 46), especially prominent overlaps of areas where two or more species occur in relatively high densities exist surrounding Dease Inlet/Admiralty Bay and south of this area (USDOI, BLM, 1998:Fig. III.B.4-1), in the west-central portion of the Planning Area to Peard Bay, and in the Kuk River estuary/Wainwright Inlet area.

Because most of these species migrate along the Pacific and mid-continent flyways and other major corridors to areas where they spend most of the year, numerous stakeholder groups in Alaska south of the ACP, the lower 48 states, and elsewhere, are interested in their conservation and management. These groups include consumptive and non-consumptive users and wildlife managers. Stakeholder interest-areas include northern and western Alaska, northern and prairie Canada, northwestern U.S., California, Montana, North Dakota to Texas and

Louisiana, Maryland, Virginia, North Carolina, and Mexico. One or more national conservation plans or international agreements signed by the U.S. address most stakeholder interests. These include the Migratory Bird Treaty Act conventions with Mexico, Canada, and Russia; the North American Waterfowl Management Plan; Partners in Flight Bird Conservation Plans; the Arctic Goose Joint Venture; U.S. National Shorebird Plan; the North American Colonial Waterbird Plan; North American Bird Conservation Initiative; and the Conservation of Arctic Flora and Fauna.

a. Habitats

Derksen, Rothe, and Eldridge (1981) examined the relationship of bird distribution to habitat use based on the wetland classification system of Bergman et al. (1977), further refined by Markon and Derksen (1994) and Kempka et al. (1995). Ponds and lakes are classified by water depth and presence of emergent sedge *Carex aquatilis* and emergent grass *Arctophila fulva*. Shallow-*Carex* ponds are less than 30 centimeters (cm) deep and lack *Arctophila*; shallow-*Arctophila* ponds contain this species and are typically less than 50 cm deep, whereas the central zone of deep-*Arctophila* ponds (more than 40 cm deep) has no vegetation. Deep-open lakes lack substantial emergent vegetation. In the BLM and Ducks Unlimited (BLM/DU) land-cover classification scheme (Table III-06), the Aquatic and Flooded categories include wetlands with the emergent sedge/grass species listed above, beaded stream, aquatic sedge or grass marsh, and wetter portions of the cover type termed "saltmarsh" by some authors (e.g., Derksen, Rothe, and Eldridge, 1981; Johnson et al., 1996). These deep-open lakes also would be classified as aquatic. Portions of ponds and lakes (and tidal sloughs) without emergent vegetation are categorized as Water in the BLM/DU scheme. Bergman et al. (1977) also recognize basin-complex wetlands as partially drained basins containing a mosaic of wetland types. Nonaquatic habitat types of other classification systems, such as moist sedge-grass meadows and tussock tundra, are in the BLM/DU Moist tundra category; shrub communities in the various schemes are equivalent; salt-killed tundra and wet sedge-willow are included in the Wet Tundra category; and tidal flats are included as a type of Barren Ground. Barrier island-lagoon systems and other coastal habitats along the Beaufort and Chukchi Sea coasts, including Kasegaluk Lagoon in the latter (Johnson, Wiggins, and Wainwright, 1993), provide important habitat for breeding, staging and migrating waterfowl and shorebirds, some of which occur in substantial numbers. The diversity of bird species is high in such habitats (highest in Kasegaluk Lagoon; Johnson et al., 1992), although numbers present often are heavily dominated by a single species.

b. Habitat Characteristics

Habitat characteristics attractive to loon, goose, duck, and shorebird species include:

1. presence of large deep lakes with persistent ice flows providing refuge from terrestrial predators;
2. availability of shorelines with relatively low relief allowing predator detection;
3. presence of an extensive peat/mud zone for resting and presence of extensive meadows of high-quality sedges, grasses, and mosses for feeding;
4. occurrence of low predator populations;
5. occurrence of low levels of human disturbance; and
6. proximity to coastal staging areas (Derksen, Eldridge, and Weller, 1982; Derksen, Weller, and Eldridge, 1979; Weller et al., 1994).

Bergman et al. (1977) found that waterbirds near Prudhoe Bay used deep-*Arctophila* ponds and lakes, drained-lake basin-complex wetlands, and coastal wetlands (saline influenced habitats) most intensively. Derksen, Rothe, and Eldridge (1981) also observed that various waterbirds (e.g., loons, brant, long-tailed duck, scoter, king eider) made greater use of wetlands containing *Arctophila* than other habitats at study sites in the NPR-A. *Arctophila* habitats, scattered widely in the NPR-A area, account for only 0.6 percent of the Planning Area (Table

III-06), suggesting that their importance is much greater than their presence indicates (for a discussion of vegetation, see Section III.B.2). Deep-open lakes are important to diving species that nest in the Planning Area (loons, long-tailed duck, scaup) because of the availability of prey (invertebrates and fish). Coastal wetlands are an important habitat for staging shorebirds, waterfowl, and longspurs (Andres, 1994; Bergman et al., 1977; Martin and Moiteret, 1981; TERA, 1994).

The Colville River corridor, south of the Northwest NPR-A Planning Area boundary, contains the most extensive tall shrub stands on the Arctic Slope. This habitat type, representing almost none of the Planning Area, is essential for a variety of passerine species, most of which have a limited distribution on the Arctic Slope. Major rivers also provide essential habitat for eagles, hawks, and falcons. Dry tundra, usually limited in distribution at coastal plain sites, is used preferentially by some species, such as golden-plovers and buff-breasted sandpipers (Lanctot and Laredo, 1994; TERA, 1994).

c. Bird Species

(1) Loons and Waterfowl

Among the 22 species of loons and waterfowl occurring on the coastal plain, 15 are common or abundant breeders in the Planning Area. Substantial proportions of coastal plain pacific loon, red-throated loon, yellow-billed loon, tundra swan, greater white-fronted goose, Canada goose, northern pintail, long-tailed duck, king eider and common eider breed in the Northwest NPR-A Planning Area.

(a) Loons

Pacific and red-throated loons are common breeders on the ACP while yellow-billed loons are uncommon breeders (Johnson and Herter, 1989). Population estimates derived from aerial breeding-pair surveys between 1992 and 1996 indicate that Pacific loons are the most abundant species, representing about 82 percent of all observed loons (Table III-07). Depending upon the species, loons arrive in early-melting areas off river deltas from late May to early June, (Table III-08; Bergman et al., 1977; Johnson and Herter, 1989; North, 1994; Schamel, 1978); moving to the nesting areas as soon as the areas are free of ice and snow. Most loons have completed nesting by early August. Post-breeding loons move to the coast in late August and depart for wintering areas along coastal routes through September (Johnson and Herter, 1989; North, 1994; North and Ryan, 1988).

The primary nesting area for the U.S population of yellow-billed loons (world population estimated at less than 20,000) is within the NPR-A, extending generally between Teshekpuk Lake and the Meade River, with highest densities between Smith Bay and the Alaktak River and along the Ikpikpuk River (Map 37) (Fair, 2002; King and Brackney, 1997; Larned, Stehn and Platte, 2003; Larned, et al., 2001; Mallek, Platte, and Stehn, 2002, 2003). Some sightings south and southeast of Barrow have been made during eider surveys (Ritchie and King, 2002). Using data from 1992 to 2001, Larned et al., (2001) estimated Eider Survey area density, which includes the northern Northwest NPR-A Planning Area, to average about 0.03 birds/km² (Table III-07). Deep-*Arctophila* lakes greater than 50 cm deep and ranging in size from 74.1 to 123.5 acres (30-50 hectares) are used most frequently by nesting yellow-billed loons (North and Ryan, 1989).

Pacific loons are widespread on the ACP, with most higher-density areas located west of the Ikpikpuk River. From 1992 to 2001, density on the ACP averaged about 0.68 birds/km² (Map 38). This species also prefers deeper *Arctophila* wetlands, using deep-open lakes for brood rearing.

Red-throated loons are present between the Meade and Ikpikpuk rivers, east and west of Dease Inlet, in the Kuk River estuary, and near Icy Cape (Mallek, Platte and Stehn, 2003). Density in the Eider Survey area averaged 0.09 birds/km² from 1992 to 2001 (Table III-07). For nesting, red-throated loons prefer shallow-*Arctophila* lakes that are smaller than those used by other loon species (<3 acres). These loons also prefer beaded stream habitat (Bergman and Derksen, 1977).

(b) Tundra Swan

Recent (1992-2001) aerial eider and breeding-pair surveys on the ACP (Larned, Stehn and Platte, 2003; Larned et al., 2001; Mallek, Platte, and Stehn, 2002, 2003; Ritchie and King, 2002) indicate there are relatively high average densities of tundra swans during the breeding period (about 0.20 birds/km² in the Eider Survey area) east, south, and west of Dease Inlet/Admiralty Bay (Table III-07; Map 39). Spring-migrant swans that will nest along the coastal plain follow the Beaufort Sea coast from the east, arriving from middle to late May and remaining until early October (Table III-08; Hawkins, 1986; Renken, North, and Simpson, 1983; Wilk, 1987). While they use a variety of aquatic habitats for nesting, the most important appear to be deeper *Arctophila* wetlands (Derksen, Rothe, and Eldridge, 1981). Both parents attend the young. The *Arctophila* and *Carex* wetlands and deeper open lakes appear to be the most important brood rearing habitats (Johnson et al., 1996) for this species. Family groups move considerable distances (>1 km) between lakes (Scott, 1972). Fall-staging flocks of 350 to 400+ have been observed in this area (Johnson et al., 1996). Adult molt occurs on deeper open lakes from the middle of July through August (Table III-08), with a flightless period of about 33 days (Earnst, 1992).

(c) Brant

Although the world brant population may be declining slightly, the ACP population appears to be stable or increasing somewhat (Derksen, 2002, pers. comm.; Larned, Stehn and Platte, 2003; Larned et al., 2001; Mallek, Platte, and Stehn, 2002, 2003). The brant occupy coastal and inland habitats in the Northwest NPR-A Planning Area during nesting, brood-rearing, and molting (Ritchie, Lovely, and Knoche, 2002; Sedinger and Stickney, 2000; Stickney and Ritchie, 2000; Map 40). Recent population estimates based on aerial surveys (Table III-07) include nesting birds and probably non-breeders and failed breeders.

Breeding pairs arrive in late May to early June and begin the nesting cycle in early June (Table III-08). Elevated densities of brant have been found just east of Dease Inlet and west of Admiralty Bay in mid-June (Larned et al., 2001). Although higher densities appear to be scattered around the inlet and bay later in June (Ritchie, Lovely, and Knoche, 2002), they may persist into July, mainly east of the inlet (Mallek, Platte, and Stehn, 2003). Average density in the Eider Survey area from 1992 to 2001 was about 0.12 birds/km² . Brant breed in traditional colonies (two or more nests per colony) primarily within 5 km of the coast, but they also breed in colonies up to 30 km inland (Reed et al., 1998). From 1994 to 1998, nests and/or adults were counted in 135 nesting locations between Point Lay and the Fish Creek entrance to Harrison Bay (Ritchie and Rose, 1996; Ritchie, Burgess, and Suydam, 2000). Most sites were in small clusters east of the longitude of Point Barrow. The number of nests per site at sites surveyed in 2000 and 2001 ranged from 0 to 35 and 0 to 33 (most with 10 or fewer nests), respectively (Ritchie, Burgess, and Suydam 2000; Ritchie, Lovely, and Knoche, 2002). Derksen, Rothe, and Eldridge (1981) found brant using deep-*Arctophila* lakes on the NPR-A for nesting. Stickney and Ritchie (1996) found that this species preferred the moist sedge-grass meadow tundra in drained lake basins on the central coastal plain for nesting. On the Colville delta, brant preferred the sedge meadows, brackish water habitats, saltmarsh, and aquatic grass marsh or *Arctophila* wetland (Johnson et al., 1997).

Brood rearing brant use larger lakes without emergent vegetation and coastal fringe areas, particularly tidal slough, salt marsh, and tide flat habitats. Adults with young remain in these areas until early September. In July, molting birds may concentrate in these same areas. Molt lasts about 3 weeks, with most individuals initiating July 4 to 10, although some may begin as late as July 25. Numbers of birds in molt peak about the third week in July, and few molting (flightless) birds are present after the first week in August (Derksen, Rothe, and Eldridge, 1981; Taylor, 1995). In other areas, molting brant have been associated primarily with deep-open thaw lakes. An unknown number of birds from a variety of areas outside the Planning Area (including the Y-K Delta, Russia, and Canada) are present during the molt period. Individual brant tend to return to the same lake in successive years (Bollinger and Derksen, 1996). After the brant molting at inland lakes regain flight, they move to coastal habitats. Fall-staging flocks of brant concentrate in Beaufort Sea lagoons, bays, and deltas (Derksen, Eldridge, and Weller, 1982), and large numbers also stage in Kasegaluk Lagoon on the Chukchi Sea coast (Johnson, 1993) where they feed on the abundant algal vegetation.

(d) Greater White-fronted Goose

Although this species is widespread at low to moderate densities on the ACP (average about 2.20 birds/km^2 in the Eider survey area; Larned et al., 2001), some higher concentrations are found south of Admiralty Bay, southwest of Smith bay, southeast and south of Peard bay, and southeast of Point Lay (Mallek, Platte, and Stehn, 2003) (Map 40). Johnson et al. (2003) recorded average nest densities of 3.5/km^2 on the Colville River delta. This probably includes molting individuals. Abundance of the greater white-fronted goose on the coastal plain is substantially greater than the other species, representing about 81 percent of all individuals observed on aerial breeding-pair surveys (Table III-07). Arrival on nesting areas occurs from the second or third week in May to early June (Johnson and Herter, 1989). Adults are accompanied by the previous year's young that remain with the family group until late in the incubation period (Ely and Dzubin, 1994). Earliest clutches are initiated in late May (Table III-08). Whitefronts generally nest in small, loose colonies farther inland than brant. Preferred nesting habitat includes elevated sites near shallow-*Carex* and *Arctophila* wetlands. Beaded streams are a favored habitat for pairs and pairs with broods (Derksen, Rothe, and Eldridge, 1981; Johnson et al., 1996). Following hatch, primarily the males care for the young for about 6 weeks until they fledge in mid- to late August. Studies in the Teshekpuk Lake area indicate that post-breeding birds favor deep-open lakes during the molt. In high-density areas, many thousands of white-fronted geese may be molting in flocks of up to about 600. Unlike brant and Canada geese, most whitefronted geese do not shift to coastal areas following wing molt (Derksen, Rothe, and Eldridge, 1981).

(e) Other Geese

Canada geese are scattered in relatively low density throughout the Planning Area. Following the flightless period in late July to early August, most Canada geese move from lakes to coastal wetlands (Derksen, Weller and Eldridge, 1979). A small nesting colony of snow geese with 40 to 60 pairs (200 birds and 60 pairs in 1992) occurs adjacent to the Planning Area on the Ikpikpuk River delta (Johnson et al., 1996; Ritchie and Burgess, 1992).

(f) Ducks

Of 15 duck species expected to occur on the Northwest NPR-A Planning Area, the average numbers for 4 species exceeded 10,000 in the aerial breeding-pair-survey area (Table III-07). Abundance of the northern pintail and long-tailed duck on the coastal plain is substantially greater than other species, representing about 84 percent of all individuals observed on surveys.

Wetland habitat use varies among species in this group, but appears to be strongly related to the abundant food associated with emergent vegetation in aquatic habitats (Derksen, Rothe, and Eldridge, 1981; Gilliam and Lent, 1982). The most preferred habitat types include shallow-*Carex* and *Arctophila* wetlands, deep-*Arctophila* lakes, beaded streams, and deep-open lakes.

1) Northern Pintail

The largest northern pintail concentrations recorded on aerial breeding-pair surveys of the Planning Area are east and west of Dease Inlet/Admiralty Bay, southeast and southwest of Admiralty Bay, in a broad band east and southeast of both Peard Bay and Wainwright (Map 41). Numbers may vary by as much as 62 percent between low and high population years, probably as a result of a northward displacement from southern nesting areas during drought years (Derksen and Eldridge, 1980). Average density in the Eider Survey area from 1992 to 2001 (Table III-07) was about 1.77 birds/km² (Larned et al., 2001). The population is stable or increasing somewhat (Larned, Stehn ,and Platte, 2003; Mallek, Platte, and Stehn, 2003). Pintails arrive in late May and remain through mid-September (Table III-08). Nesting pintails prefer shallow ponds with *Arctophila* or *Carex* vegetation, and beaded-stream habitat with *Arctophila* (Derksen, Rothe, and Eldridge, 1981). Males leave the females early in the incubation period, forming flocks - possibly with nonbreeding and failed breeding individuals. Molting birds (possibly molt-migrant individuals) have been observed on barrier islands in July (Hanson, Queneau, and Scott, 1956; Johnson and Herter, 1989; Kunakanna, 1979). They begin departing the Beaufort Sea area in early July.

2) Long-tailed Duck

Highest concentrations of the widespread long-tailed duck are east of Dease Inlet, Admiralty Bay, and south and southwest of Peard Bay (Map 42). Spring migrant long-tailed ducks follow leads eastward along the Beaufort coast, arriving in late May (Renken, North, and Simpson, 1983). Inland routes also are used. Aerial surveys flown in mid-June (Eider Survey) have indicated an upward population trend (Larned, Stehn and Platte, 2003), while those done in late June/early July (ACP Survey) suggest a downward trend (Mallek, Platte, and Stehn, 2003). This difference may result from survey timing, methods, analysis, and habitat and areal coverage. In Alaskan areas outside the ACP, the latter negative growth rate trend may be more typical. Average density on the ACP, determined from mid-June aerial surveys in the Eider Survey area, was about 1.08 birds/km² (Larned, et al., 2001; Table III-07).

Long-tailed ducks disperse to shallow-*Carex* and *Arctophila* ponds, and deep-*Arctophila* ponds for nesting, frequently in clusters or colonies (Alison, 1975). Egg laying is not initiated until late June (Table III-08). Males leave the nesting area during hatch, moving to large coastal plain lakes and Beaufort Sea lagoon and nearshore waters with non breeders and failed breeders to molt (Derksen, Rothe, and Eldridge, 1981; Flint et al., 2003; Garner and Reynolds, 1986). They often form large flocks during the molt period. Shortly after hatch, females lead the young to deep-*Arctophila* , deep-open, or shallow-*Carex* lakes with open water, and molt on deep-open lakes when the young are almost ready to fly (Derksen, Rothe, and Eldridge, 1981; Johnson, 1984; Johnson and Richardson, 1981). Following molt they occupy coastal lagoons for staging, including substantial numbers in Kasegaluk Lagoon (Johnson, Wiggins, and Wainwright, 1993), until migration begins in late September (Table III-08).

3) King Eider

The Planning Area contains some of the highest breeding densities of king eider in Alaska (Martin, 2002, pers. comm.; Table III-07). According to aerial survey counts during the early breeding season, the king eider population increased on the coastal plain from 1992 to 2001 (Larned, Stehn and Platte, 2003; Larned et al., 2001); although prebreeding counts at Point Barrow suggest a decline in the eiders entering the Beaufort Sea as noted above(Suydam et al., 1997). Higher density areas are observed broadly southeast of Peard Bay and southwest of Admiralty Bay in mid-June (Map 43) (Larned, Stehn, and Platte, 2003). Later in June however, densities appear lower (or higher density areas more constricted) in the same areas, and higher east of Atqasuk and southeast of Barrow, Peard bay, and Wainwright (Mallek, Platte and Stehn, 2003, aerial survey data; Ritchie and King, 2002), when most individuals are cryptically-patterned females. Derksen, Rothe, and Eldridge (1981) report that the preferred nesting habitat at Storkersen Point during nesting in June was shallow-*Arctophila* wetland, with deep-*Arctophila* chosen half as often. Nesting occurs from mid-June to late July (Table III-08). Males remain with the females for just a few days after the eggs are laid. Brood rearing takes place primarily in deep-*Arctophila* lakes, with some use of deep-open lakes and beaded streams. Females move their young extensively between water bodies. Males and females stage for two-three weeks in the Beaufort Sea before migrating to molting areas in the Bering Sea in August. Staging areas are in Elson Lagoon/Dease Inlet in the Beaufort Sea and from Peard Bay and south in the Chukchi Sea (Dickson, Suydam, and Balogh, 2000; Dickson, Balogh, and Hanlan, 2001). One male molting area is south of Icy Cape in Kasegaluk Lagoon. Males depart in mid-July, females in late July-early August.

4) Common Eider

Common eiders nest in loose aggregations or small colonies on barrier islands and a few coastal areas of the Beaufort and Chukchi Seas (Map 44). Breeding-pair or eider aerial surveys flown annually by FWS do not detect many common eiders because these surveys do not include offshore barrier islands. During breeding-pair surveys on the ACP, numbers of common eiders have exceeded 1,000 individuals (1,956) just once (Mallek, Platte, and Stehn, 2003). Nearshore surveys along the Beaufort and Chukchi shorelines and barrier islands in 2002 (Dau and Anderson, 2002) recorded 1,524 common eiders from Icy Cape north to Point Barrow and east to Smith Bay; however, the average occupancy of this area is much lower (Table III-07). In the Peard Bay area, 279 eiders were counted, and survey segments north of Icy Cape adjacent to the Planning Area contained 26 to 183 birds. Arrival in the area is in late May/early June, and nesting begins in mid to late June. Eiders select nest sites on sand and gravel islands where driftwood and *Elymus* grass is most dense (Johnson, Herter and Bradstreet, 1987). Brood rearing takes place in nearshore coastal habitats or on lakes. A westward molt migration of males takes place in late June and early July; a majority of these birds migrate within 50 km of the coast (Bartels, 1973). Females and young from across the Arctic migrate westward through the Beaufort Sea in late August and early September. Substantial numbers stage in coastal lagoons, including Kasegaluk Lagoon in the Chukchi Sea, from late July to September (Johnson et al., 1993).

(2) Shorebirds

High-density shorebird areas are scattered throughout most of the Planning Area, especially in the northern section (Map 36). Shorebirds, together with the most abundant passerine species (see Sec. (3) below), are expected to numerically dominate Planning Area bird communities. Overall shorebird densities vary considerably between sites and years, estimates of the larger species ranging from about 20 to 185 birds/km^2 . Based on observations near Barrow, 13 shorebird species could be expected to breed in the Planning Area, three species (pectoral sandpiper, dunlin, and red phalarope) in substantial abundance (Table III-09), although the dunlin appears to have declined throughout northern Alaska since the 1970's (Troy, 2000). At the opposite extreme, several species--such as the buff-breasted sandpiper--have relatively small ACP and total populations (estimated 15,000 to 20,000; Brown et al., 2001). Degradation and/or loss of migration and winter habitats are suspected of causing population decreases in recent years (Lanctot and Laredo 1994).

Shorebirds arrive at ACP nesting areas from late May to early June, and nesting occurs in June and July. In most species, female and male share incubation duties after the clutch is laid, although the male contribution may vary considerably among species. Likewise, both sexes care for the young in most species, with varying constribution by the male and female. In pectoral and buff-breasted sandpipers, the female alone incubates and cares for the young, and only male phalaropes incubate and attend the young. Among the various species, departure for wintering areas occurs on a variable schedule. In general, for species where both parents attend the young until fledging, adults depart from mid-July to mid-August, and juveniles depart from early August to early September. In species where only the male attends the young (phalaropes), females depart from late June to late July, males from late July to August, and juveniles from late August to September. Where only the female attends (pectoral and buff-breasted sandpipers), males depart late June to July, females from late July to early August, and juveniles from late August to early September.

Seasonal habitat use within the shorebird group is variable, but there is a marked general post-breeding movement by many species from tundra habitats occupied for nesting to marine littoral zone, saltmarsh, and barrier-island habitats for staging in late summer and migration into early September (Andres, 1994; Connors, Connors, and Smith, 1981; Rothe et al., 1983; Smith and Connors, 1993; Troy, 2000). For some species, this may result in rapid post-breeding population increases in these habitats. Connors, Myers, and Pitelka (1979) identified several habitat use patterns, including (1) use of tundra for breeding and post-breeding (adults and juveniles) activities by golden-plovers and pectoral sandpipers; (2) use of tundra for breeding and use of tundra and littoral habitat types during the post-breeding period (adults and juveniles) by such species as dunlin and long-billed dowitcher; (3) use of tundra and littoral habitat types for breeding (nesting on tundra and foraging in littoral habitats) and post-breeding periods, by species such as semipalmated and Baird's sandpipers; and (4) those species with pronounced age-sex differences in timing and habitat use, such as that seen in phalaropes. All species studied by these authors occupied tundra in substantial numbers from late May/early June until early September, but by early August a marked movement from tundra to marine littoral habitats is under way which lasts until early/mid-September. Shorelines of coastal lagoons in the Beaufort and Chukchi Seas, particularly Kasegaluk Lagoon, are used by substantial numbers of shorebirds in August and September (Johnson et al., 1992).

(a) Plovers

Plovers nest on drier upland sites than most other shorebirds (Johnson and Herter, 1989). Their presence in the Northwest NPR-A Planning Area ranges from 1.3 to 6.3 birds/km^2 (Table III-09) (Derksen, Rothe, and Eldridge, 1981). Eggs are laid through mid-June and hatch in late June through mid-July (Parmalee, Stephens, and Schmidt, 1967). Young are led to moist or wet tundra habitats soon after hatching (Johnson and Connors, 1996). Adults leave the young and gather into flocks before fall migration; most have departed by mid-August. The post-fledging young gather into flocks and remain in the Planning Area until late August or early September.

(b) Sandpipers and Phalaropes

Densities of the most common breeders observed by Derksen, Rothe, and Eldridge (1981) at the Meade River delta and on one inland site in the Planning Area (Table III-09) were: semipalmated sandpiper (6.9 to 7.0 birds/km^2), pectoral sandpiper (22.9 to 24.1 birds/km^2), red-necked phalarope (4.2 to 9.7 birds/km^2), dunlin (0.5 to 21.1 birds/km^2), and red phalarope (4.0 to 20.6 birds/km^2).

Although most species have been recorded nesting in habitats ranging from dry to wet tundra, those such as the semipalmated sandpiper appear to prefer moist or wet tundra foraging habitat (e.g., shorelines of shallow-*Carex* ponds) adjacent to a nest site on well-drained ridges (Troy, 1988). Egg laying in this species begins in early June, with peak hatching typically in mid-July (Norton, 1973; Gratto and Cooke, 1987; Gratto-Trevor, 1992). Females desert the brood within two weeks and males leave them about a week later (Gratto-Trevor, 1991). After flocking in tundra pond and littoral habitats, adults initiate southward migration in mid-July with maximum departure in late July to mid-August (Gratto-Trevor, 1992). Juveniles gather in large flocks on inland wetland areas and along marine beaches and salt marshes before peak departure in August (Connors, Myers, and Pitelka, 1979). Thus, there is a buildup of adult semipalmated sandpiper migrants in coastal habitats in late July, followed by a sharp peak of migrating juveniles in early August.

Phalaropes prefer wet marshy areas for nesting, with access to open water, where they typically forage. Egg laying occurs from the second week in June to early July. Females gather in flocks on tundra ponds in late June and early July after egg laying while the males incubate the eggs and care for the young after hatching. All age-sex classes stage in large groups on NPR-A lagoons. During migration, a succession of females, males, and juveniles depart from mid-July to early September (Gilliam and Lent, 1982). Adult females depart beginning in mid-July, and males gather in shoreline habitats prior to departing in early to mid-August after the young have fledged. Juveniles move to shore habitats in large numbers from early August to early September when they depart.

(3) Passerines

Of the 10 to 12 passerine species expected to occur regularly in the Planning Area, 6 (including Lapland longspur, savannah sparrow, redpoll, snow bunting, yellow wagtail, and American tree sparrow) may be common to abundant breeders. Overall abundance of the widespread Lapland longspur often is greater than that of all other species combined (Derksen, Rothe, and Eldridge, 1981; Johnson and Herter, 1989). The common raven, though not abundant, is the only resident species in this group; all others are migrants. Passerine species richness is highest in riverine and upland shrub habitats (Cade, Kessel, and Schaller, 1958; White and Cade, 1971). For most species occurring in the area, tall shrub habitat, in particular, is important for nesting, foraging, and escaping from predators.

Derksen, Rothe, and Eldridge (1981) reported Lapland longspur breeding densities ranging from 24.1/km² to 42.3/km² (Table III-07) at study sites in the Planning Area. Longspurs typically arrive in mid-May (North, Schwerin, and Hiemenz, 1984). Nesting begins in early June, with nests constructed on tussock-heath tundra or polygon ridge. Hatching occurs in middle to late June. Flocks of post-breeding longspurs begin forming in late July and gradually depart from the Beaufort Sea area by the end of August or early September (Martin and Moiteret, 1981).

(4) Raptors

The Colville River and adjacent wetlands provide the most important raptor-nesting habitat on the ACP with large proportions of several Alaskan species populations occupying bluffs and cliffs along its shoreline. Only the southeast portion of the Planning Area lies adjacent to this river. The arctic peregrine falcon, gyrfalcon, and rough-legged hawk are regular breeders on cliffs along this and other rivers in the Planning Area. Merlins also nest in small numbers along larger rivers in the southern Planning Area. The golden eagle occurs regularly in the Planning Area. The snowy owl, short-eared owl, and northern harrier are widely dispersed and nest irregularly in the Planning Area (Ritchie and King, 2002).

(a) Arctic Peregrine Falcon

The arctic peregrine falcon world population is estimated at a few thousand pairs and probably increasing (Swem, 1997, pers. comm.). This species was removed from ESA threatened status in 1999. There are an estimated 260 pairs in Alaska (Swem, 2002, pers. comm.). About half of these nest in the NPR-A. Ritchie and Wildman (2000a) observed 67 adult pairs or single birds during aerial surveys in the NPR-A in 1999; 63 individuals were seen in the Northwest NPR-A. Nest sites were most numerous along several meandering rivers in an east-west band north of the Colville River (Map 45), including the upper Ikpikpuk River along the eastern boundary of the Planning Area (Ritchie and Wildman, 2000a; Swem, 1996; Swem, 1997, pers. comm.). This species has increased in numbers in the NPR-A; however, productivity along the Colville River apparently has declined recently (Ted Swem, 2002, pers. comm., cited in Audubon Alaska, 2002). Arctic peregrine falcons are in Alaska from about mid-April to mid-September. Nesting begins in mid-May on the Arctic Slope, and the young fledge from the end of July to mid-August (USDOI, FWS, 1982). Immature peregrines use coastal habitats in some areas from late August through mid-September (Johnson and Herter, 1989).

(b) Gyrfalcon

The gyrfalcon is a common resident of the northern foothills and mountainous areas of the Arctic Slope but is relatively uncommon on the coastal plain. Ritchie and Wildman (2000a) observed five sites with birds in the Northwest NPR-A (Map 45), though numbers fluctuate considerably between years. Most of the 41 nest sites observed by Ritchie and Wildman (2000a) were outside the Planning Area. Gyrfalcons initiate nesting in early spring and brood-rearing occurs from May to mid-August (Swem, 1997, pers. comm.). Gyrfalcons are non-migratory if their prey remains abundant throughout the winter.

(c) Rough-Legged Hawk

Rough-legged hawks are most abundant and successful breeders in years when their prey (microtine rodents) is abundant. Rough-legs arrive at their northern breeding grounds by early May, and remain there until late September. Swem (1997, pers. comm.) estimated that 300 to 500 pairs might nest in the NPR-A in some years (Table III-07), with many pairs nesting along the Colville River (24 in 1999). As many as 35 pairs may nest upriver along the Etivluk River (14 sites on the Etivluk in 1999), and 5 to 10 pairs probably nest along each of the Colville River tributaries (Ritchie, 1979). Ritchie and Wildman (2000a) observed many of these hawks in NPR-A; 17 of 109 occurred in the Northwest NPR-A Planning Area (Map 45).

(d) Other Raptors

Golden eagles primarily visit the foothills of the Brooks Range and coastal plain, but breed regularly only in the mountains (Johnson and Herter, 1989). They may breed occasionally in the NPR-A. Ritchie and Wildman (2000a) observed three pairs in the Northwest NPR-A Planning Area. One nest was found along the Colville River close to or within the Northeast NPR-A Planning Area boundary in 1997 (Swem, 1997, pers. comm.). However, most are outside the Northwest NPR-A Planning Area. Juvenile golden eagles have been tracked from Denali Park and Preserve to the NPR-A using satellite telemetry. One spent over two months in northwestern NPR-A (McIntyre, unpublished data, 2003). Two others spent less than a month in southern NPR-A.

Ground-nesting species that occur in the Planning Area include snowy and short-eared owls, northern harrier, and merlin (Swem, 1997). Snowy owls are common residents in the Beaufort Sea area, breeding occasionally in coastal areas east of Barrow (Johnson and Herter, 1989). The short-eared owl also is an occasional breeder; like snowy owls and other raptors, the short-eared owl is most common in areas and years when microtine rodent numbers are high (Martin, 1997, pers. comm.). Northern harriers occasionally breed in the northern foothills of the Brooks Range and merlins occasionally nest in the NPR-A (Swem, 1997, pers. comm.).

(5) Seabirds

Seabirds occurring in or adjacent to the Planning Area include three jaeger species, glaucous gull, Sabine's gull (Map 46), Ross's gull, arctic tern, and black guillemot. Glaucous gulls and parasitic jaegers prey on the eggs and the young of other bird species. Glaucous gulls are widespread with low density on the coastal plain. However, they nest in higher densities along the coast and in colonies on barrier islands and river deltas. Large concentrations of several hundred birds often gather at landfill sites. Jaegers nest on the tundra, generally nesting more abundantly in areas and years of microtine rodent abundance. From late September to early-October, most of the world population of Ross's gull (4,500 to 16,000 individuals) migrates eastward from the Russian Chukchi Sea, occupying shoreline habitats from Wainwright to Point Barrow and eastward to the Plover Islands, with highest densities from Point Barrow to Tangent Point (Divoky et al., 1988). These birds, probably foraging on zooplankton concentrations, make a return westward migration to the Chukchi Sea ending in mid-October.

A black guillemot colony (several hundred individuals) is located on Cooper Island in the Plover Islands off Point Barrow (Divoky, 1984; Divoky, Watson, and Bartonek, 1974). Guillemots forage near colonies from June to early September when the chicks fledge. Guillemots winter in Beaufort Sea leads.

(6) Ptarmigan

Derksen, Rothe, and Eldridge (1981) found the density of willow ptarmigan to range from 0.1 on the Meade River delta to 1.1 bird/km² at Singiluk. Typical habitat is upland heath-tussock tundra. Onset of breeding is middle to late May (Martin and Moitoret, 1981), followed by hatch in late June. The young develop quickly, becoming independent by late August or early September (Cramp and Simmons, 1980).

5. Mammals

a. Terrestrial Mammals

Among the terrestrial mammals in the Northwest NPR-A Planning Area, the species that could be most affected by development are the barren-ground caribou, musk ox, moose, grizzly bear, wolf, wolverine, arctic fox, and red fox. Other species such as the arctic ground squirrel and lemming are less likely to be impacted by development.

(1) Caribou (Rangifer tarandus)

The Western Arctic herd (WAH) and Teshekpuk Lake herd (TLH) use habitats adjacent to and within the Planning Area (Map 47and Map 54). Scatter plots for WAH and TLH satellite collars show that caribou from these herds are relatively discreet on the North Slope during summer, although they frequently mix on winter range in the central Brooks Range (Dau, In press). The Central Arctic herd (CAH) uses habitats to the east of the NPR-A (Map 47). While the CAH does not use the Planning Area, there is the potential that off-site facilities, such as pipelines, could be constructed in habitats used by this herd.

(a) Population Status and Range

In the early 1970's, the WAH population was estimated at 243,000 animals. By 1976, it had declined to an estimated 75,000 animals. From 1976 to 1990, the herd grew by about 13 percent annually. From 1990 to 1996 the population remained relatively stable, with a 2 percent growth rate (Dau, 1999a). Census data indicates that the herd may have peaked in 1996 at 463,000 caribou; a 1999 photocensus resulted in a population estimate of 430,000 caribou, an apparent decline of 2 percent annually since 1996 (Dau, In press). However, Dau (In press) speculates that the 1999 estimate is conservative and the population may have remained stable for the past decade. The WAH ranges over about 140,000 mi² in northwestern Alaska, from the Chukchi coast east to the Colville River, and from the Beaufort Sea coast south to the Kobuk River. In winter, the range extends as far south as the Seward Peninsula and Nulato Hills, and as far east as the Sagavanirktok River north of the Brooks Range and the Koyukuk River south of the Brooks Range (Map 47).

The TLH population was estimated at 11,800 in 1984; 16,600 in 1988; and 27,700 in 1993; yielding average annual increases of 7.1 percent from 1984 to1988 and a 14 percent average annual increase from 1989 to 1993 (Carroll, 1999). While the 1995 census shows an apparent decline to 25,000 animals, possibly because of the previous severe winter (Prichard, Murphy, and Smith, 2001), a 1999 photocensus produced a population estimate of 28,600 caribou (Carroll, In press). Overall, the herd's population has remained relatively stable since 1993. The TLH is found primarily within the NPR-A, although seasonal ranges of some animals extend east to the Dalton Highway and south to the Seward Peninsula (Prichard, Murphy, and Smith, 2001). In 1990, a cooperative satellite-tracking project evaluated annual movements, seasonal ranges, and habitat use by the TLH caribou. Results of this study indicate that the herd is more widely distributed with more variable movements than previously thought (Prichard, Murphy, and Smith, 2001).

The CAH was estimated to number 23,000 in 1992, but declined to about 18,100 animals in 1995 (Lenart, 1999a). Photocensuses conducted in 1997 and 2000 resulted in population estimates of 19,700 and 27,100 caribou, respectively (Lenart, In press). The 2002 population estimate for the herd is 31,857 caribou (Pers. comm. ADF&G). The CAH range extends from the Colville River east to the Canning River and from the Beaufort coast south into the Brooks Range (Lenart, 1999a).

(b) Migration

To take advantage of seasonally available forage, caribou migrate between their calving areas and summer and winter ranges. If movements are greatly restricted, caribou are more likely to over-graze their habitat, possibly leading to a population decline. Caribou diets shift seasonally and depend upon the availability of forage within seasonal ranges. In general, the winter diet of caribou consists predominantly of lichens, with a shift to vascular plants during the spring (Thompson and McCourt, 1981). Composition of plant fragments in caribou fecal pellets collected in the winter range of the WAH averaged 83 percent lichen (Jandt, Meyers, and Cole, 2003). However, when TLH caribou winter near Teshekpuk Lake, where relatively few lichens are present, they likely consume more sedges and vascular plants than is typical of the WAH caribou wintering in lichen-rich ranges south of the Brooks Range.

(c) Calving Grounds

Calving takes place in the spring, generally from late May to late June (Hemming, 1971). Calving areas for the WAH, CAH, and TLH are shown on Map 47 and Map 48. Calving grounds may shift gradually over years or change abruptly because of environmental conditions, so the areas shown in these figures may not fully represent future concentrated calving areas. Since the mid-1970's, the WAH primary calving area has been in the Utukok Hills, south and west of the Planning Area (Dau, In press). However, since the late 1980's calving appears to be more dispersed and not confined to the Utukok Hills. For example, in 1997 many cows calved in or north of the Meade River drainage (Dau, 1999a). The central TLH calving area has been located generally on the east side of Teshekpuk Lake and near Cape Halkett, adjacent to Harrison Bay. According to Prichard, Murphy, and Smith (2001), the primary calving area from 1990 to 1999 was southeast, and to a lesser extent, northeast of Teshekpuk Lake. Caribou were reported to calve south and west of the lake before 1978 (Davis and Valkenburg, 1978). During calving, the CAH caribou are found on the coastal plain between the Colville and Canning rivers. In the 1980's, calving was relatively common in the Kuparuk oil field. The proportion of CAH calving southwest of the Kuparuk oil field appears to have been higher in the 1990's than in the 1980's (Lenart, In press).

Spring migration of parturient female caribou from the overwintering areas to the calving grounds occurs in April and May. Often the most direct routes are used; however, certain routes may be used during calving migrations because they tend to be snow-free or snow-shallow corridors (Lent, 1980). Bulls and non-parturient females generally migrate later, with some remaining on winter ranges until June. Severe weather and deep snow can delay spring migration, with some calving en route. This occurred with the WAH in 2000, when approximately 22 percent of the radio-collared cows with calves were observed south of the Brooks Range (Dau, In press). Cows calving en route usually proceed to their traditional calving grounds (Hemming, 1971), although calf survival may diminish.

Spring migration to traditional calving grounds consistently provides high nutritional forage to lactating females during calving and nursing periods, which is critical for the growth and survival of newborn calves. Eriophorum buds (tussock cotton grass) appear to be very important in the diet of lactating caribou cows during the calving season (Thompson and McCourt, 1981; Eastland, Bowyer, and Fancy, 1989), while orthophyll shrubs (especially willows) are the predominant forage during the post-calving period (Thompson and McCourt, 1981). The availability of high quality and high quantity desired forage species--which apparently depends on temperature and snow cover--probably affects specific calving locations and calving success. Kellyhouse (2001) looked at habitat selection by the WAH and TLH based upon rates of increase in green plant biomass. She found that the WAH selected habitats with high relative green plant biomass (quantity) during calving and at peak lactation, while the TLH selected habitats with high quality forage.

The evolutionary significance of the calving grounds may relate directly to the avoidance of predation on caribou calves, particularly by wolves (Bergerud, 1974, 1987). Caribou calves are very vulnerable to wolf predation, as indicated by the documented account of surplus predation by wolves on newborn calves (Miller, Gunn, and Broughton, 1985). By migrating north of the tree line, caribou leave the range of the wolf packs, since wolves generally remain on the caribou winter range, or in the foothills, or along the tree line during the wolf-pupping season (Heard and Williams, 1991; Bergerud, 1987). By calving on the open tundra, the cow caribou also avoid ambush by predators. Snow-free tundra also helps camouflage the newborn calf from other predators, such as golden eagles (Bergerud, 1987). Sequential spring migration, first by cows and later by bulls and the rest of the herd, is believed to be a strategy for optimizing the quality of forage as it becomes available from snowmelt on the arctic tundra (Whitten and Cameron, 1980). The earlier migration of parturient cow caribou to the calving grounds also could reduce forage competition with the rest of the herd during the calving season. Russell, Martell, and Nixon (1993) found that staggered migration allowed both parturient females and bulls to maximize body weight by late June.

During calving and post-calving periods, cow/calf groups are most sensitive to human disturbance. Many cow/calf groups join to form increasingly larger groups, foraging primarily on the emerging buds and leaves of willow shrubs and dwarf birch (Thompson and McCourt, 1981). In the post-calving period (July through August) caribou attain their highest degree of aggregation. Members of the WAH may be found in continuous herds of more than tens of thousands, and portions of the WAH may be found throughout their summer range.

(d) Summer Distribution and Insect-Relief Areas

Insect-relief areas become important during the late June to mid-August insect season (Map 91) (Lawhead, 1997). Insect harassment reduces foraging efficiency and increases physiological stress (Reimers, 1980). Caribou use various coastal and upland habitats for relief from insects, including areas such as sandbars, spits, river deltas, some barrier islands, mountain foothills, snow patches, and sand dunes where stiff breezes prevent insects from concentrating. Summer is also the time when caribou cows must concentrate on foraging to meet the energy demands of lactation and still gain enough weight to enable conception in the fall. In early July, the TLH caribou generally aggregate to the north and west of Teshekpuk Lake for insect relief (Prichard, Murphy, and Smith, 2001) (Map 50). In late July, caribou spread out to the east and west of the Lake and move farther inland (Map 49). Some small groups gather in other cool, windy areas, such as the Pik Dunes about 30 km south of Teshekpuk Lake (Hemming, 1971; Philo, Carroll, and Yokel, 1993). Caribou aggregations move frequently from insect-relief areas along the arctic coast (WAH, CAH, and especially the TLH) and in the mountain foothills (some aggregations of the WAH), to and from green foraging areas. For many years,the WAH has exhibited a consistent pattern of movement during the summer (ADF&G comments on Draft IAP/EIS). After calving in the Utukok Uplands, the herd moves west into the Lisburn Hills (west of the Planning Area). During the height of the insect season (early July), 80 to 90 percent of the herd forms into large aggregations in the western DeLong Mountains and western North Slope (south of the Planning Area). During late July through early August, they move rapidly back east toward Howard and Anaktuvuk Pass (south of the Planning Area) and then disperse north and west onto the North Slope and the Planning Area during late August and early September.

(e) Winter Range Use and Distribution

Caribou of the WAH generally reach their winter ranges in early to late November and remain on the range through March (Hemming, 1971). Since the mid-1970's, the primary winter range of the WAH has been south of the Brooks Range along the northern fringe of the boreal forest (Map 47). During winters of heavy snowfall or severe ice crusting, caribou may overwinter within the mountains or on the Arctic Slope (Hemming, 1971). Even during normal winters, some caribou of the WAH overwinter on the ACP. Before the mid-1970's, a substantial portion of the WAH wintered north of the Brooks Range, or near Wiseman and Anaktuvuk Pass (as cited in Dau, In press). In many years since the mid-1980's, up to 30,000 caribou have wintered in the Wainwright-Atqasuk-Umiat area (ADF&G 2003 comments on Draft IAP/EIS).

The TLH was believed to reside year-round in the Teshekpuk Lake area (Davis, Valkenburg, and Boertje, 1982); however, satellite collar data from TLH caribou indicate that some animals travel south to the Seward Peninsula (Carroll, In press). Fixed kernel analysis identified two high-use winter areas for the TLH, one near Atqasuk and the other southeast of Teshekpuk Lake (Prichard, Murphy, and Smith, 2001) (Map 54). Low-use wintering areas include Anaktuvuk Pass, Kobuk, Point Hope, Noatak, and the eastern Seward Peninsula.

In early fall, the CAH moves from the coastal area toward the foothills of the Brooks Range to areas around Toolik Lake, Galbraith Lake, Accomplishment Creek, Ivishak River, and the upper Sagavanirktok River (Lenart, In press). Some animals migrate to the south side of the Brooks Range (Map 47). There is occasional mixing of the CAH with the WAH during fall and winter (Lenart, 1999a). The CAH also probably mixes with the TLH during late summer, fall, and winter (Lenart, In press).

The movement and distribution of caribou over the winter ranges reflect their need to avoid predators and to protect themselves from wind and snow conditions (snow depth and density) that greatly influence the availability of winter forage (Henshaw, 1968; Bergerud, 1974; Bergerud and Elliot, 1986). The number of caribou using a particular portion of the winter range varies greatly from year to year. Distribution of preferred winter forage (particularly lichens), weather conditions, and predation pressure affect winter distribution and movements (Roby, 1980; Miller, 1974; Bergerud, 1974).

(2) Muskoxen (Ovibos moschatus)

Indigenous populations of muskoxen were exterminated in northern Alaska in the 1800's (Smith, 1989). Muskoxen were reintroduced east of the NPR-A on the ANWR in 1969 and in the Kavik River area, between Prudhoe Bay and ANWR, in 1970. They were reintroduced west of the NPR-A near Cape Thompson in 1970 and 1977 (Smith, 1989). The eastern reintroductions established the ANWR population, which grew rapidly and expanded east and west of ANWR (Reynolds, 1998). This population is gradually expanding west into the NPR-A. In 1999, 96 muskoxen were observed in the western part of Game Management Unit (GMU) 26B (Map 53), between the Colville River and the Dalton Highway (Lenart, 1999b). In 2001, several breeding groups were found in the eastern part of GMU 26A (Map 53), along the Colville River and Fish Creek. These are the known breeding groups nearest the Planning Area (Carroll, 2002, pers. comm.). The Cape Thompson population ranges from the mouth of the Noatak River to Cape Lisburne within about 20 mi of the coast. It has grown at about 8 percent annually since 1970. The most recent census counted 374 muskoxen in this area (Dau, 1999b). A transitory number of lone bulls probably frequents the Planning Area, coming primarily from populations breeding east of the Planning Area. In addition, animals from the Cape Lisburne area may occasionally wander into the western part of NPR-A (Carroll, 2002, pers. comm.). The most important habitats for muskoxen in the Colville River delta are riparian, upland shrub, and moist sedge-shrub meadows (Johnson et al., 1996). The best potential habitat for muskoxen in the Planning Area is shown on Map 55.

(3) Moose (Alces alces)

Moose have been documented on the North Slope since the 1800's and breeding populations have been reported on the western North Slope since the 1920's (Coady, 1980). The Alaska Department of Fish and Game (ADF&G) GMU 26A covers the western North Slope, including the NPR-A (Map 53). Complete surveys of all major drainages in GMU 26A were completed in 1970, 1977, 1984, 1991 and 1995 showing counts of 1,219, 1,258, 1,447, 1,535, and 757 moose, respectively. Between 1970 and 1991, the population increased slowly. Between 1991 and 1995 however, the population declined by about 50 percent with trend counts indicating a further sharp decline in 1996. Trend counts indicate that the population decline began in 1992/1993 and continued until 1996 (Carroll, 2000a). Natural mortality appears to have been the major cause of the population decline. Fall surveys in 1993-1995 indicated low calf survival while spring trend counts from 1993 to 1997 indicated high adult mortality. The decline was probably the result of a combination of several factors including poor nutrition, disease, high predator populations, weather, and hunting pressure (Carroll, 1998a). The population began to increase in 1997 with improved calf survival, and continued to increase from 1998 through 2000, with an apparent population increase of 21 percent annually during that period (Carroll, 2000a).

Moose disperse widely during the summer, ranging from the foothills of the Brooks Range north to the coast. In the fall, animals move to riparian corridors along the large river systems (Map 55). During the winter months, most moose are found in the inland reaches of the Colville River drainage (Carroll, 2000a). The primary moose habitat along these drainages is riparian flood plain. The plain's tall shrubs are the predominant and preferred species for browsing by moose (Mould, 1979).

(4) Grizzly Bear (Ursus arctos)

According to Carroll (1998b), the grizzly bear population on the western North Slope was considered stable or slowly increasing in 1998. Densities were highest in the foothills of the Brooks Range and lowest in the northern portion of the NPR-A. There were an estimated 900 to 1,120 bears in GMU 26A (Map 53). Of this number, ADF&G estimated that 400 bears were in the western part of GMU 26A and 500-720 bears were in the eastern part of the subunit.

In 1992, a mark-recapture study was done in the Utukok and Kokolik drainages using radio-collared bears as the "marked" animals. The density was estimated at 7.7 bears/100 mi^2 (Machida, 1994). In 1998, bear densities were estimated for broad habitat zones in GMU 26A using subjective comparisons to areas of the North Slope with known bear densities (Map 109). Densities were estimated at 0.5 to 2 bears/1,000 km^2 on the coastal plain, 10 to 30 bears/1,000 km^2 in the foothills, and 10 to 20 bears/1,000 km^2 in the mountains (Carroll, 1998b). The number of grizzly bears using the Prudhoe Bay and Kuparuk oil fields east of the NPR-A has increased in recent years; 27 bears were captured and marked by ADF&G in studies of bear use of the oil fields (Shideler and Hechtel, 1995). These bears have very large home ranges (2,600 to 5,200 km^2) and travel as many as 50 km/day (Shideler and Hechtel, 1995). On the North Slope, grizzly dens occur in pingos, banks of rivers and lakes, sand dunes, and steep gullies in uplands (Harding, 1976; Shideler and Hechtel, 1995). For at least part of the year, brown bears use some areas in GMU 26A--particularly east-west oriented ridges--more heavily than the surrounding area. According to Carroll (1998b), these areas should be considered important habitat and be given special protection.

Grizzly bears are opportunistic, omnivores whose food sources vary by region, season, and year. Bears prey on ungulates and scavenge their carcasses. When caribou are calving, some bears may specifically select for caribou calves. For these bears, caribou calves are an important early season food.

(5) Wolf (Canis lupus)

Following the prohibition of aerial wolf hunting (1970) and land-and-shoot hunting (1982), wolf populations have increased in the Brooks Range (Carroll, 1994). Wolves are less abundant on the coastal plain because of the seasonal scarcity of caribou, periodic outbreaks of rabies, and hunting pressure (Carroll, 2000b). Although the wolf population of the GMU 26A (Map 53) has not been determined since 1982, more recent sample surveys (1993) estimate the population at 240 to 390 wolves in 32 to 53 packs (Carroll, 2000b). The highest abundance of wolves within the NPR-A occurs generally along the Colville River. Densities in this area were estimated at about 4.1 wolves/1,000 km² in 1994. By 1998, the population had apparently declined to about 1.6 wolves per/1,000 km² . This decline can likely be attributed to a decreased prey base, as the GMU 26A moose population declined by 75 percent between 1992 and 1996 (Carroll, 2000b). Even lower densities are expected to occur on the coastal plain, as wolves tend to prefer upland and mountain habitats where they can find alternate prey species and better denning habitat. Wolf distribution and density within the Planning Area are not shown on a map because sufficient data is not available. Wolves are carnivores, and in most of Alaska moose and/or caribou are their primary food. During the summer, small mammals and occasionally birds and fish supplement their diet.

(6) Wolverine (Gulo gulo)

Wolverines occur throughout the North Slope, but are more common in the Brooks Range and foothills (Map 53 and Map 55). Wolverines require large territories and have a relatively low reproductive rate (Reardon, 1981). A minimum wolverine population for the western North Slope (GMU 26A) was estimated at more than 820 animals, based on a density of one wolverine/54 mi² (Carroll, 1995). Wolverines use tussock meadows, riparian willow, and alpine tundra as major habitats (USDOI, BLM, 1978a). Wolverines are omnivorous (Reardon, 1981) and prey upon and scavenge for caribou. They are found in association with caribou calving and post-calving areas. Stomach contents of wolverines harvested in the northern NPR-A have consisted primarily of caribou (USDOI, BLM, 1978b). Locations of wolverine sightings in the NPR-A are shown on Map 55. Because its fur is used in Native parkas, the wolverine is important as a subsistence species (Reardon, 1981; Carroll, 1995).

(7) Arctic Fox (Alopex lagopus)

With the decline of the value of white fox pelts and their reduced harvest rates since 1929 (Chesemore, 1967), the arctic fox population on the North Slope has probably increased. Peak fox populations are associated with abundant lemming populations, their primary prey. Other food sources include ringed seal pups and the carcasses of other marine mammals and caribou, which are important throughout the year (Chesemore, 1967; Hammill and Smith, 1991). Tundra-nesting birds form a large part of their diet during the summer (Chesemore, 1967; Fay and Follmann, 1982; Quinlan and Lehnhausen, 1982; Raveling, 1989). The availability of winter food sources has a direct impact on fox abundance and productivity (Angerbjorn et al., 1991). Arctic foxes in the Prudhoe Bay oil field area readily use development sites for feeding, resting, and denning, and their densities are greater in the oil fields than in surrounding undeveloped areas (Eberhardt et al., 1982; Burgess et al., 1993). Arctic foxes are particularly subject to rabies. Their populations tend to fluctuate with the occurrence of the disease and with changes in food availability. No quantitative population information is available for arctic foxes in GMU 26A (Map 53). In general, arctic foxes are abundant on the coastal plain. Local hunters and trappers harvest arctic foxes; but, since there is no sealing requirement, harvest information is not collected (Carroll, 1995).

(8) Red Fox (Vulpes vulpes)

The red fox is found throughout Alaska but is more abundant in the interior than in coastal areas (Reardon, 1981). It is present in tundra regions, which it shares with the arctic fox. The red fox is dominant wherever the ranges of the two species overlap. In these areas, red foxes have been observed digging arctic foxes from their dens and killing them (Jennings, 1994). Red foxes are omnivorous, eating a variety of items including insects, small mammals, birds, eggs, berries, and carrion (Reardon, 1981). No quantitative population information is available for red foxes in GMU 26A (Map 53), although they are fairly abundant in the interior portions of the unit. Local hunters and trappers harvest red fox, however harvest information is not collected (Carroll, 1995).

(9) Other Small Mammals

Other small mammals found in the Planning Area include ground squirrels, hares, lemmings, voles, and shrews. Arctic ground squirrels (*Spermophilus parryii*) are widely distributed in both arctic and alpine tundra habitats where they feed on seeds, mushrooms, and berries. They dig dens in areas with well-drained soils such as stream banks, sand dunes, and pingos where they hibernate during the winter. Since they den in habitats similar to those of grizzly bears and emerge from hibernation at about the same time, arctic ground squirrels are an important food source for grizzly bears, especially in the spring and fall (Shideler and Hechtel, 2000).

There are two species of hare, the snowshoe hare (*Lepus americanus*) and the Alaskan hare (*Lepus othus*). Snowshoe hares occur in the Brooks Range while the Alaskan hare has a spotty distribution along the Arctic coast and the north slopes of the Brooks Range (ADF&G, 1989). Snowshoe hares are found in mixed spruce forests, wooded swamps, and brushy areas, where they feed on a wide variety of plant material. The Alaskan hare is generally found on windswept rocky slopes and upland tundra. They feed on willow shoots and various dwarf arctic plants.

Several species of lemmings (*Lemmus sibericus*, *Dicrostonyx* spp.) and voles (*Microtus* spp.) may be found in the Planning Area (ADF&G, 1994a). Lemmings are known for their wide fluctuation in population numbers, reaching peak abundance in some areas every 3 to 5 years. The causes of population fluctuations are unclear, although some combination of predation, forage availability, and weather is probably involved. Both lemmings and voles are prey for many larger animals, including foxes, wolves, wolverines, owls, and hawks. Voles live in all habitats in Alaska except on bare rocks and glaciers. There are seven species of vole in Alaska, the distribution of which are not well-known (ADF&G, 1994b). Both the barren ground shrew (*Sorex ugyunak*) and tundra shrew (*S. tundrensis*) occur on the North Slope (ADF&G, 1994b). Shrews are mainly terrestrial, and live under the grass and leaf litter. Most species are insectivorous although some species are dependant upon plant matter. Lemmings, voles and shrews are active throughout the year and burrow through the snow during the winter.

b. Marine Mammals

Marine mammals that commonly occur in the Alaskan Beaufort Sea and may be affected by activities in the Northwest NPR-A Planning Area include the ringed, bearded, and spotted seal; polar bear; and beluga and gray whale (excluding endangered whales). Other species occasionally occurring in small numbers (< 10) offshore of the Planning Area include the walrus, harbor porpoise, killer whale, narwhal, and hooded seal. Because of the relative numerical insignificance of the latter species, experts do not expect them to be exposed to or affected by any activities associated with development and therefore, are not discussed further.

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act (MMPA) of 1972, in which Congress clearly intended that marine mammals:

be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem.

The marine mammal habitat adjacent to the Planning Area is depicted on Map 57, Map 58, Map 59, Map 60, and Map 61.

(1) Ringed Seal

The ringed seal, widely distributed throughout the Arctic, is the most abundant seal in the Beaufort Sea. In the Alaskan Beaufort, the estimated summer population is 80,000 seals, while the estimated winter population declines to 40,000 (Frost and Lowry, 1981). Ringed seal densities adjacent to the Northwest NPR-A Planning Area may depend on a variety of factors, such as food availability, proximity to human disturbance, water depth, and ice stability. Densities of ringed seals in the floating shorefast-ice zone of the Beaufort Sea range from 2.8 to 4.4 seals per square kilometer (seals/km^2) (1.5 to 2.4 seals per square nautical mile) (Frost, Lowry, and Burns, 1988a). Surveys in May 1996 recorded densities of 0.30 to 0.62 seals/km^2 in the fast-ice habitat of the Beaufort Sea (Frost et al., 1997). Surveys in 1999 recorded an average of 0.64 seals/km^2 (Frost, Pendleton, and Hessinger, 2002). Currently there is no reliable estimate for the Alaskan stock of ringed seals but there is no reason to believe the minimum abundance is below 50,000 animals (Ferrero et al., 2000). Although ringed seals do not occur in large herds, loose aggregations of tens or hundreds of animals do occur, likely associated with abundant prey.

Probably a polygamous species, sexually mature ringed seals establish territories during the fall, which they maintain during the pupping season. Pups are born in late March and April in lairs the pregnant females have excavated in snowdrifts and pressure ridges. During the pupping and breeding season, adults on the floating shorefast ice (Map 56) are generally less mobile than individuals in other habitats since they depend on a relatively small number of holes and cracks in the ice for breathing and foraging. During nursing (4 to 6 weeks), pups are largely confined to the birth lair. This species is a major subsistence resource, comprising as much as 58 percent of all seals harvested by subsistence hunters in Alaska.

Map 57 displays recorded ringed seal sightings in the Beaufort Sea area from 1979 to 1999 during bowhead whale aerial surveys conducted by MMS and Naval Ocean Systems Center (NOSC). Most of the sightings were recorded during the fall (September through October). Their distribution is widely dispersed across the Planning Area.

(2) Bearded Seal

The bearded seal is found throughout the Arctic and generally prefers areas where seasonal broken sea ice occurs over waters less than 200 m deep. The bearded seal is primarily restricted to the moving ice in the Beaufort Sea. Densities of bearded seals in the western Beaufort Sea adjacent to the Planning Area are greatest during the summer and lowest during winter. Active ice (flaw-zone), shown on Map 56, is their most important winter and spring habitat. The bearded seal is an important subsistence species and subsistence users prefer it. Estimates on the abundance of bearded seals in the Beaufort Sea and in Alaska waters are currently unavailable. However, the minimum population in Alaska waters is expected to be 50,000 animals (Ferrero et al., 2000).

Locations of recorded bearded seal sightings in the Beaufort Sea area from 1979 to 1999 during bowhead whale aerial surveys conducted by MMS and Naval Ocean Systems Center (NOSC) are displayed on Map 58. Most sightings were recorded during the fall (September through October). Their distribution is widely dispersed across the Planning Area. More bearded seals were observed in the eastern half of the Beaufort Sea than in the west.

(3) Spotted Seal

The spotted seal is a seasonal visitor to the Beaufort Sea. This species appears in low numbers along the coast in July (approximately 1,000 for the Alaska Beaufort coast), hauling out on beaches, barrier islands, and remote sandbars on the river deltas. Ferrero et al. (2000) estimated the 2000 population at 59,000. Beaufort Sea coastal haulout and concentration areas near the NPR-A include the Colville River delta and Oarlock Island in Dease Inlet/Admiralty Bay (Map 59). Recently, these seals frequented Smith Bay at the mouth of the Piasuk River, just west of the Planning Area. Spotted seals often enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Spotted seals leave the Beaufort Sea in the fall (September to mid-October) as the shorefast ice re-forms and the pack ice advances southward. They spend winter and spring along the ice front in the Bering Sea, where they pup, breed, and molt.

In the Chukchi Sea spotted seals are common seasonal residents along the western coast of the Northwest NPR-A Planning Area. The summer population was estimated at between 30,000 and 37,000 seals (Burns, 1981). Icy Cape-Kasegaluk Lagoon, the Kuk River, and Peard Bay are important spotted seal haulout and concentration areas (Map 59).

(4) Pacific Walrus

The current size and trend of the Pacific walrus population is unknown (USDOI, FWS Stock Assessment, 2002). In general, most of this population is associated with the moving pack ice year round. Walruses spend the winter in the Bering Sea and the majority of the population summers throughout the Chukchi Sea, including the westernmost part of the Beaufort Sea. Although a few walruses may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open-water season, the majority of the Pacific population occurs west of 155° W. Longitude, north and west of Barrow. The highest seasonal abundance is along the pack-ice front (Map 52).

Nearly all of the adult females with dependent young migrate to the Chukchi Sea during the summer, while a substantial number of adult males remain in the Bering Sea. Spring migration usually begins in April and most of the walruses move north through the Bering Strait by late June. Females with calves compose most of the early spring migrants. During the summer, two large Arctic areas are occupied--from the Bering Strait west to Wrangell Island and along the northwest coast of Alaska from Point Hope to north of Point Barrow. With the southern advance of the pack ice in the Chukchi Sea during the fall (October-December), most of the walrus population migrates south of the Bering Strait. Solitary animals may occasionally overwinter in the Chukchi Sea and in the eastern Beaufort Sea.

Walrus calves are born from mid-April to mid-June during the northward migration; mating takes place from January to March. The gross reproductive rate of walruses is considerably lower than that of seals. Prime reproductive females produce one calf every two years rather than one every year as do other pinnipeds. Although bivalve mollusks, such as clams, are the primary food of walruses, some walruses eat seals (Sease and Chapman, 1988; Lowry and Fay, 1984; Herman Rexford of the village of Kaktovik, as cited in UAA, ISER, 1982). In Barrow, walruses are a very important cultural and subsistence resource constituting the third most important species (by weight) of harvestable meat (Residents of Barrow, as cited in S.R. Braund and Assocs. and UAA, ISER, 1993).

Locations of recorded walrus sightings in the Beaufort Sea from 1979 to 1999 during bowhead whale aerial surveys conducted by MMS and NOSC are displayed on Map 52. Most of the walrus observations were in the far western part of the Planning Area. Few walruses were seen to the east.

(5) Polar Bear

The Southern Beaufort Sea polar bear stock (from Point Hope to Cape Bathurst, Northwest Territories) is currently estimated to be between 2,272 and 2,500 bears (USDOI, FWS, 2002). This population has increased over the past 20 to 30 years at 2 percent or more per year and is believed to be increasing slightly, or stabilizing near its carrying capacity (Amstrup, 1995; USDOI, FWS, 1995). Their seasonal distribution and local abundance vary widely in the Alaskan Beaufort Sea. For example, Amstrup, Durner, and McDonald (2000) assumed a bear density of 1 bear/25 km^2 in seasonal concentration areas with lower densities beyond 100 mi. Another study estimated their overall density from Point Barrow to Cape Bathurst at 1 bear every 141 to 269 km^2 (54 to 103 mi^2) (Amstrup, Stirling, and Lentfer, 1986). Sea ice and food are the two most important natural influences on their distributions. Polar bears in the Alaskan arctic prey primarily on ringed seals and (to a lesser extent) on bearded seals, and come to shore to scavenge and feed on marine mammal carcasses during the fall open-water period. They also take walruses and beluga opportunistically (Amstrup and DeMaster, 1988).

Drifting pack ice off the coast of the Alaskan Beaufort Sea probably supports more polar bears than either shorefast ice or polar pack ice; likely because young seals are abundant in this habitat. For hunting and resting, polar bears prefer rough sea ice, floe-edge ice, and moving ice over smooth ice (Martin and Jonkel, 1983; Stirling, Andriashek, and Calvert, 1993). Polar bears sometimes concentrate along Alaska's coast when pack ice drifts close to the shoreline, at whale carcass locations, and when shorefast ice forms early in the fall. Polar bears can swim great distances and they are very curious animals (Adams, 1986, pers. comm.). Recently the number of polar bears occurring along the coast of the NPR-A has increased, particularly in the Point Barrow area. This increase in number of bears along the coast be may be related to a decrease in sea ice during the fall and the retreat of the pack-ice farther offshore during the open water season. The increase in numbers of polar bears may also be related to the availability of whale carcass remains at subsistence harvest sites.

Pregnant and lactating females with newborn cubs are the only polar bears occupying winter dens for extended periods. Dens are typically sparser in the Alaskan coastal zone than in areas of concentrated use, such as Wrangell Island, Russia, Hudson Bay, and James Bay, Canada. Pregnant females move to coastal areas in late October or early November to build maternity dens. Most onshore dens are close to the seacoast, usually not more than 8 to 10 km inland (Map 51). Offspring are born from early December to late January, and females and cubs leave their dens in late March or early April.

Polar bear dens have been found on riverbanks in northeast Alaska and on shorefast ice close to islands east of the mouth of the Colville River. Dens have also been found recently in the Dease Inlet area. Topographic relief--such as hills, banks, and other terrain features--provides areas where enough snow accumulates for building dens. Polar bear hunters from Nuiqsut and Kaktovik identified several of the coastal dens shown on Map 51 (USDOI, FWS, 1995; Kalxdorff, 1997). In and adjacent to the NPR-A, dens have been reported to occur in the following locations: Colville River Delta, Atigaru Point, Cape Halkett, Smith Bay, Point Poleakoon, Lonely, Admiralty Bay, Bluffs Lake, Sungovoak, Point Barrow, Nunuval Bay, Hollwood, Walakpa Bay, Peard Bay, Skull Cliff, Point Franklin, Point Belcher, Sinaruruk River, Point Collie, Kuk River, Kilimantavi Point, Kasegaluk Lagoon, and Nokotlek Point (USDOI, FWS Den Database, unpublished data).

Female polar bears do not usually use the same den sites each year (Ramsay and Stirling, 1990; Amstrup, Garner, and Durner, 1992), but they often do use the same substrate as their previous dens (either land, land-fast ice, or sea ice) as well as the same geographic areas (Amstrup, Garner, and Durner, 1992; Amstrup and Garner 1994). Shifts in the distribution of den locations in Canada may be related to changes in sea-ice conditions (Ramsay and Stirling, 1990). A recent trend for polar bears to increasingly use terrestrial habitat for denning along the Beaufort

Sea coast has been observed (Stirling and Andriashek, 1992; Amstrup and Gardner 1994).

In addition to the Marine Mammal Protection Act of 1972, the International Agreement on the Conservation of Polar Bears provides polar bear habitats additional protections. This 1973 agreement--shared by Canada, Denmark, on behalf of Greenland, Norway, the Union of Soviet Socialist Republics, and the United States--stipulates protections for "habitat components such as denning and feeding sites and migration patterns." More recently, a bilateral agreement between the United States and Russia to conserve polar bears in the Chukchi and Bering seas was signed in October 2000.

The North Slope Borough/Inuvialuit Game Council's management plan for polar bears in the southern Beaufort Sea includes sustainable harvest quotas based on estimated population, sustainable harvest rates for female polar bears, and information regarding the sex ratio of the subsistence harvest.

Locations of recorded polar bear sightings from 1979 through 1999 in that portion of the Beaufort Sea offshore of the Planning Area are displayed on Map 51. The MMS and the NOSC obtained these sightings during bowhead whale aerial surveys. Polar bear sightings were widely distributed and coastal concentrations were seen around Point Barrow, Pitt Point, Simpson Lagoon area, Cross Island, Flaxman Island, Barter Island, and the Beaufort Lagoon area.

(6) Beluga Whale

The beluga whale, a sub-arctic and arctic species, is a summer visitor throughout offshore habitats of the Alaska Beaufort Sea. In 2000, the Beaufort population was estimated to be more than 3,200 whales (Ferrero et al., 2000). Most of this population migrates from the Bering Sea to the Beaufort Sea in April or May. However, some whales may pass Point Barrow as early as late March and as late as July (Frost, Lowry, and Burns, 1988b). The spring migration routes through ice leads are similar to those of the bowhead whale. A major portion of the Beaufort Sea population concentrates in the Mackenzie River estuary during July and August. An estimated 2,500 to 3,000 belugas spend summer in the northwestern Beaufort and Chukchi seas, with some whales staying in coastal areas, such as Peard Bay and Kasegaluk Lagoon (Frost, Lowry, and Burns, 1988b; Frost, Lowry, and Carroll, 1993). In 2000, the eastern Chukchi Sea stock was estimated to be a minimum of about 3,700 whales (Ferrero et al., 2000) Kasegaluk Lagoon and the Kuk River estuary are important seasonal summer habitats of beluga whales (Map 60).

Fall migration through the western Beaufort Sea and offshore of the NPR-A occurs in September or October (Map 60). Although small numbers of whales have been observed migrating along the coast (Johnson, 1979), surveys of the fall distribution strongly indicate that most belugas migrate farther offshore along the pack-ice front (Frost, Lowry, and Burns, 1988b; Treacy, 1996). Beluga whales are an important subsistence resource of the Inuit in Canada and the Inupiat in Alaska.

Locations of recorded beluga whale sightings in the Beaufort Sea area from 1979 to 1999 during bowhead whale aerial surveys conducted by MMS and NOSC are displayed on Map 60. Most of the beluga sightings were recorded offshore along the shelf break or farther offshore during spring and fall migrations. Much smaller numbers of whales were seen in coastal waters near the NPR-A Planning Area.

(7) Gray Whale

Since receiving protections from the International Whaling Commission (IWC) in 1946, the eastern Pacific gray whale population has increased from a few thousand individuals (who survived commercial harvest) to over

21,000 (Breiwick et al., 1989; Withrow, 1989; USDOC, NOAA, NMFS, 1991; Buckland et al., 1993). Evidence that the population had approached and exceeded pre-exploitation levels (Rice, Wolman, and Braham, 1984) prompted the National Marine Fisheries Service (NOAA Fisheries, formerly NMFS) to issue a determination that the eastern North Pacific stock be removed from the List of Endangered and Threatened Wildlife (59 *FR* 31094-31095). The current minimum gray whale estimate is 26,635 with an estimated annual increase rate of 2.4 percent from 1967/68 to 1995/96 (Ferrero et al., 2000).

From late December to early February, most gray whales calve and breed in protected waters along the western coast of Baja California. However, recent observations suggest that some calving occurs as far north as Washington before arriving at the California calving grounds (Dohl et al., 1983; Jones and Swartz, 1987). Northward migration, primarily of females without calves, begins in February; however, some cow/calf pairs delay their departure from the calving area until well into April (Jones and Swartz, 1984). Most whales occur within 15 km of land, but they have been observed as many as 200 km offshore (Bonnell and Dailey, 1990). Much of the migration route north of Point Conception to and from summer feeding grounds in the northern Bering Sea and southern Chukchi Sea lies within a few kilometers of the coast or adjacent islands. Gray whales occur in the Gulf of Alaska in late March and April. They arrive in the northern Bering Sea in May or June and in that portion of the Chukchi Sea offshore of the Planning Area in July or August (December (Rice and Wolman, 1971; Consiglieri et al., 1982; Frost, 1994). With freezeup, gray whales migrate from the Beaufort and Chukchi seas, leaving the Bering Sea during November-December (Rugh and Braham, 1979).

A portion of the population summers along the west coast of North America south of the Bering Sea/Unimak Pass (56 *FR* 58870). Gray whales feed in the Chukchi Sea and western Beaufort Sea during the open-water months of summer (Miller, Johnson, and Doroshenko, 1985).

The majority of the eastern Pacific gray whale population feeds primarily on benthic amphipods in the northern Bering, Chukchi, and western Beaufort seas during the summer open-water months (July through October). Shallow coastal areas and offshore shoals in the Chukchi Sea and western Beaufort Sea provide rich benthic feeding habitat for gray whales during these months (Rugh et al., 1999). Gray whale feeding areas offshore of northern Alaska have low species diversity, high biomass, and the highest secondary production rates reported for any extensive benthic community (Rugh et al., 1999). The gray whales suck in fauna amphipods from the fine sand on the ocean bottom, producing an extensive record of feeding craters (Kim and Oliver, 1989). During the time spent in Alaskan waters, one gray whale is estimated to consume about 396,000 lbs (180,000 kg) of amphipod crustaceans (Frost, 1994).

Locations of recorded gray whale sightings from 1979 to 1999 in that portion of the Beaufort Sea adjacent to the Planning Area are displayed on Map 61. The MMS and NOSC obtained these sightings during bowhead whale aerial surveys. Most of the observations were west of Point Barrow, while few gray whales were seen east of Barrow.

6. Endangered and Threatened Species

The Endangered Species Act of 1973 defines an endangered species as any species in danger of extinction throughout all or a significant portion of its range. The Act defines a threatened species as one that is likely to become endangered in the near future. The endangered bowhead whale and threatened spectacled eider and Steller's eider may occur near potential oil and gas development sites in the Northwest NPR-A Planning Area.

a. Bowhead Whale

The bowhead whale was listed as endangered in June 1970. On February 22, 2000, NOAA Fisheries (formerly NMFS) received a petition to designate critical habitat for the Bering Sea stock of the bowhead whale. Following consideration of relevant population and life history information, a final determination was issued on August 30, 2002 (67 *FR* 55767), in which NOAA Fisheries elected not to propose designation of critical habitat.

Bowhead whales are not expected to be adversely affected by activities occurring in the Northwest NPR-A Planning Area. During their migration in northwest Alaska waters, cumulative median distance offshore is 17.7 km, so it is unlikely they would occur in the few nearshore areas included within the Planning Area (Map 64). However, the 2000 MMS bowhead whale survey did find whales in the western Beaufort Sea at a median distance of 11 km offshore, and several whales in the area between Dease Inlet and Smith Bay were quite near the shoreline (Treacy, 2002a). Greater relative feeding and/or milling behaviors near the mouth of Dease Inlet has been observed in six years of this 20-year study (Treacy, 2002b). In 1992, large aggregations of whales were noted in this same locality. Such behaviors have been observed in other years farther east. Thus it is possible that some whales in some years could be affected by barge traffic and, potentially, by an oil spill entering the marine environment.

(1) Population

In 1993, the Western Arctic bowhead whale stock was estimated at 7,200 to 9,400, with 8,200 as the best population estimate (Zeh, Raftery, and Schaffner, 1995). According to these authors, the Western Arctic stock increased at a rate of 3.2 percent per year from 1978 to 1993. After analyzing results of the spring 2001 census, the North Slope Borough Department of Wildlife Management suggested that the bowhead population is increasing at the rate of about 4.0 percent per year, and gave a preliminary estimate of 10,000 whales. The most recent population census shows a substantial increase over the previous count of 8,200 and indicates the number is approaching the 1848 population estimate of 10,400 to 23,000 whales (Woody and Botkin, 1993).

(2) Habitat

Bowhead whales apparently have an affinity for ice as they are found in relatively heavy ice cover and shallow continental shelf waters for much of the year. Throughout the winter, bowheads frequent the marginal ice zone and polynyas in the Bering Sea. Moore (2000) concluded that bowhead whales select shallow inner-shelf waters with moderate to light ice conditions, and deeper slope habitat in heavy ice conditions. During the summer, bowheads select continental slope waters and moderate ice (Moore, DeMaster, and Dayton, 2000).

(3) Migration

(a) Offshore Migration

The Western Arctic stock (Bering Sea stock) of bowhead whales migrates through the Alaskan Beaufort Sea semiannually between their wintering areas in the Bering Sea and summer feeding grounds in the Canadian Beaufort Sea. On the northward spring migration, bowheads pass through the Bering Strait and eastern Chukchi Sea from late March to mid-June, apparently coincident with ice breakup. Their route follows newly open leads in the shear zone between the shore-fast ice and the offshore pack ice, but they also may migrate under the ice within several kilometers of leads. They are capable of breaking through ice 14 to 18 cm (5.5 to 7.0 in) thick to breathe (George et al., 1989). The migration proceeds in pulses, with groups of whales swimming together. The first pulse usually passes Point Barrow in late April or early May, the second pulse in mid-May, and a less well-defined pulse in late May to mid-June (Moore and Reeves, 1993). After passing Barrow, they move easterly through or near leads that are quite far offshore.

Bowheads arrive near Banks Island from mid-May through June. They remain in the Canadian Beaufort Sea and Amundsen Gulf feeding until late August or early September when they begin moving westward into Alaskan waters (Moore and Reeves, 1993). Incidental sightings of bowhead from 1975 to 1991 suggest that bowheads occur regularly along Alaska's northwestern coast in late summer (Moore, 1992). These individuals could be early autumn migrants or whales that have summered nearby (Moore et al., 1995). Harry Brower, Jr., stated that he has seen whales in the Barrow area in the middle of summer (Brower, as cited in USDOI, MMS, 1995a). The major portion of the westward migration typically occurs between mid-September and mid-October and, like spring migration, may occur in pulses (Moore and Reeves, 1993). This may represent segregation by age class, with smaller younger whales migrating first, followed by large adults and females with calves. For example, Treacy (1998) reported sighting 170 whales, including 6 calves, between Cross Island and Kaktovik on September 3, 1997.

The extent of ice cover, which can vary from open water to more than nine-tenths cover, may influence the route, timing, or duration of the fall migration. Miller, Elliot, and Richardson (1996) observed that whales moving from 147° to 150° W. Longitude in the central Beaufort Sea, migrated closer to shore in light and moderate ice years (median distance offshore 30 to 40 km = 19 to 25 mi), and farther offshore in heavy ice years (median distance offshore 60 to 70 km = 37 to 43 mi). During summer, bowheads select continental slope waters and moderate ice conditions (Moore, DeMaster, and Dayton, 2000).

Likewise, comparison of bowhead sightings and ice severity in the central Beaufort Sea at 142° to 155° W. Longitude during fall aerial surveys carried out by MMS shows that the highest sighting rate during light-ice years was in shallower nearshore water and followed coastal contours. During moderate-ice years, whales occurred in mid-range waters farther offshore, and during heavy-ice years, they occupied deeper, offshore waters (Treacy, 2001). All median distances offshore greater than 42 km and the median water depths greater than 35 m in the western Beaufort Sea corresponded with medium or heavy ice years. Recent studies of whale distribution in the migration corridor in nearshore waters of the central Beaufort Sea (Miller et al., 1997; Miller, Elliot, and Richardson, 1998; Miller et al., 1999) concluded that bowheads migrate at varying distances from shore in different years. In 1996, sightings were broadly distributed between the 10-m and 50-m depth contours. In 1997, sightings were unusually close to shore and between the 10-m and 40-m depth contours. In 1998, sightings were between the 10-m and 100-m depth contours approximately 10 to 60 km offshore; generally farther offshore than in 1996 or 1997. Migrating bowheads have been radio tracked at speeds of 1.1 to 5.8 km/hr in ice-free waters (Wartzok et al., 1989, 1990; Mate, Krutzikowsky, and Winsor, 2000).

(b) Nearshore Migration

Aerial surveys near the proposed Liberty development project in 1997 (BP Exploration (Alaska), Inc., 1998a) showed that the primary fall-migration route for bowhead whales was offshore of the barrier islands, which would be outside the Northwest NPR-A Planning Area in the western Beaufort Sea. A few bowheads were observed in lagoon entrances between the barrier islands and in the lagoons immediately inside the barrier islands; but, because survey coverage in the nearshore areas was more intensive than in offshore areas, the data probably overestimates the importance of nearshore areas. Some bowheads may swim inside the barrier islands during the fall migration. Frank Long, Jr., reported that whales are seen inside the barrier islands near Cross Island nearly every year and they are sometimes seen between Seal Island and West Dock (U.S. Army Corps of Engineers, 1999). Thomas Brower, Sr., has noted that whales have been known to migrate south of Cross Island, Reindeer Island, and Argo Island during years when fall storms push ice against the barrier islands. Some bowhead whales have been observed swimming about 25 yds from the beach shoreline near Point Barrow during the fall migration (Rexford, as cited in USDOI, MMS, 1996b). And, as noted above, the 2000 MMS bowhead whale survey found whales in the western Beaufort Sea at a median distance of 11 km offshore, and several whales in the area between Dease Inlet and Smith Bay were quite near the shoreline (Treacy, 2002a).

Data is limited on the bowhead fall migration through the Chukchi Sea before the whales move south into the Bering Sea. Bowhead whales are commonly seen from the coast to about 150 km (93 mi) offshore between Point Barrow and Icy Cape. This suggests that most bowheads disperse southwest after passing Point Barrow and cross the central Chukchi Sea near Herald Shoal on their way to the northern coast of the Chukotsk Peninsula. Bowheads pass through the Bering Strait in late October through early November.

(4) Foraging

Bowheads are filter feeders, sifting prey from the water through baleen fibers in their mouths. Bowheads apparently feed throughout the water column, including bottom or near-bottom feeding. Zooplankton, including euphausiids and copepods, the primary prey groups, as well as mysids and amphipods, are the most common food items found in the stomachs of harvested bowheads.

Carroll et al. (1987) reported that during spring migration the region west of Point Barrow seems to be particularly important for feeding, at least in some years. However, whales may feed opportunistically at other locations--such as in the lead system near Point Barrow (Shelden and Rugh, 1995, 2002)--when ocean conditions produce locally abundant food. It is likely that bowheads feed opportunistically where food is available as they migrate westward across the Alaskan Beaufort Sea during fall migration. Miller, Elliott, and Richardson (1998) reported observing many clusters of feeding whales in nearshore waters near or offshore of the 10-m depth contour during late summer/autumn 1997. In some years, large groups of bowheads have been seen feeding between Smith Bay and Point Barrow. Lowry (1993) reported that the stomachs of five out of six whales taken at Point Barrow during 1976 to 1988 contained food (Lowry, 1993). In addition, carbon-isotope analysis of zooplankton, and bowhead tissues and baleen has indicated that a substantial amount of feeding may occur in areas west of the eastern Beaufort and in wintering areas, at least by subadult individuals (Schell, Saupe, and Haubenstock, 1987).

(5) Breeding

Mating behavior, time of mating, and age at sexual maturity, are not well known. Most bowheads apparently mate and calve from April through mid-June, coinciding with the spring migration. Mating may start as early as January or February, when most of the population is in the Bering Sea, but mating also has been reported as late as September and early October (Koski et al., 1993). Calving occurs from March to early August, with the peak probably in the spring migration between early April and the end of May (Koski et al., 1993). Females probably birth a single calf every three to four years.

(6) Survival and Mortality

According to the various approaches to aging bowhead whales and estimating survival rates, bowheads grow slowly, live long, and survive in large numbers. Examining baleen plates to determine the age of bowhead whales, Schell and Saupe (1993), concluded that bowheads are slow-growing mammals, taking about 20 years to reach breeding size. Zeh et al. (1993) also concluded that the bowhead is a late-maturing, long-lived animal with low mortality. Most female bowheads become sexually mature when they are 12.5 to 14.0 m long, probably at an age exceeding 15 yrs.

There is little information regarding natural mortality for bowhead whales. They have no known predators except subsistence whalers, and perhaps killer whales. Attacks by killer whales have occurred, but the frequency probably is low. Likewise, the scarcity of observations of vessel-inflicted injuries suggests that the incidence of ship collisions with bowhead whales also is quite low. Some whales likely die as a result of entrapment in ice, but the number is thought to be relatively small (Philo et al., 1993). Little is known about any mortality from microbial or viral disease agents.

b. Spectacled Eider

(1) Population Status

The spectacled eider was designated a threatened species in May 1993 (58 FR 27474) because of significant declines in the North American breeding population. A minimum (uncorrected for detection bias) of 6,896 spectacled eiders occupied the surveyed portion (limited to eider habitats) of the Arctic Coastal Plain (ACP) of Alaska in June 1993-2002 (Larned, Stehn and Platte, 2003), about 2 percent of the estimated 363,000 world population (USDOI, FWS, 1999a). Most of the world population breeds in arctic Russia. Nonbreeders are not included in the Alaska estimate. They are assumed to remain at sea throughout the year until they attempt to breed at 2 to 3 yrs. The size of this population segment is unknown, as is their location during this period. Available life history information for this species indicates they are long lived with relatively high adult survival and delayed sexual maturity. The Eider Survey area population has shown a nonsignificant decreasing trend of about 1.26 percent from 1993 to 2002 (Larned, Stehn and Platte, 2003). Additional details of population status and annual cycle may be found in Petersen, Grand, and Dau, (2000) and FWS (USDOI, FWS, 1999a).

(2) Spring Migration

Routes traveled by spectacled eiders during spring migration are not well known. Generally, they have been recorded passing Point Barrow and/or arriving at the breeding areas in late May to early June (Johnson and Herter, 1989). Few spectacled eiders have been recorded using the lead system 5-6 km offshore extending eastward from Point Barrow (Suydam, pers. comm., as cited in TERA, 1999; Woodby and Divoky, 1982). Suydam et al. (1997) recorded 55 spectacled eiders among 213,477 king and common eiders passing Point Barrow in spring 1994. Low numbers (0.5 to 0.7 birds per hour) have been recorded at several points in Simpson Lagoon (Johnson and Richardson, 1981), but some of these probably were movements of local birds rather than migrants. This species has been observed to make limited use of areas of meltwater overflow off river deltas. Thus, because relatively few spectacled eiders are seen in marine areas, spring migration may be primarily overland from the Chukchi Sea (TERA, 1999). Local observations that spectacled eiders flew inland north of Wainwright, reported by Myres (1958), support this view.

(3) Nesting

With the exception of a few scattered areas in Northwest NPR-A, spectacled eiders occur at low density on the ACP (Larned et al., 2001; Ritchie and King, 2002). The highest densities determined from FWS aerial surveys in 1998-2001 were found within 60 km of the coast between Barrow and Wainwright, with smaller areas northeast of Teshekpuk Lake (Map 62). Overall density was determined to be 0.24 birds/km^2 in the Eider Survey area, based on observations of 304 birds in 2001 (Larned et al., 2001). Before nesting, eiders occupy a variety of wetland and aquatic habitats (Anderson, Stickney, and Ritchie, 1996). Available information suggests female spectacled eiders return to the vicinity of previous nests. Spectacled eiders are dispersed nesters (Derksen, Rothe, and Eldridge, 1981; Warnock and Troy, 1992), occurring at a low density of 0.03 to 0.79 birds/km^2 (Larned and Balogh, 1997) within about 70 km of the coast. Tundra nesting habitat most often includes extensive wetlands (large shallow lakes, lake-basin wetland complexes) with emergent sedges and grasses and vegetated islands

(Larned and Balogh, 1997; Stickney and Ritchie, 1996). Nesting begins in mid-June, and eggs start hatching in mid-July. Brood rearing in the central ACP occurs primarily in waterbodies with margins of emergent grasses and sedges, basin wetlands, and deeper lakes (ARCO Alaska, Inc., 1996).

During the breeding season spectacled eiders occupy terrestrial wetlands and forage principally on tundra pond surface, edge, and bottom. They feed primarily on insects and insect larvae, crustaceans, and seeds and other plant material (Petersen, Grand, and Dau, 2000).

(4) Postnesting Period

Most male spectacled eiders depart the nesting areas from early June to early July (Median date June 22 ±11 days), typically soon after females begin incubating. They migrate a median distance of 6.6 km (average 10.1 km) offshore (Petersen, Larned, and Douglas, 1999). Locations of satellite transmitter-equipped males (Petersen, Douglas, and Mulcahy, 1995) in the Beaufort Sea have been primarily in the western Harrison Bay and western Simpson Lagoon areas (Map 63), as well as the Ledyard Bay molting area along the Chukchi Sea coast south of Point Lay (Larned, Balogh, and Petersen, 1995) and other coastal areas from the Beaufort Sea to the Yukon-Kuskokwim (Y-K) Delta, Russian Far East, and St. Lawrence Island. Initial locations for many of the birds that were instrumented in the Prudhoe Bay area have been in the Chukchi Sea, suggesting they migrated overland or occupied the Beaufort Sea only briefly (TERA, 1999). For some individuals, however, the Beaufort Sea may be an important staging and migration route for as much as a week or two (Petersen, Larned, and Douglas, 1999).

After nesting, spectacled eider females with broods leave coastal plain brood-rearing sites (lakes with emergent grasses and sedges; occasionally deep open-water lakes) for marine areas on average August 29 (±10.5 days). However, because females leave the nesting area after failing to breed or experiencing nest failure or brood loss, which may occur at different stages of the breeding period, they depart over an extended period from the third week of June through the end of August (TERA, 1999). Locations of females equipped with satellite transmitters in the Prudhoe Bay area indicate they stage and migrate in the Beaufort Sea and, like some males, use Smith and Harrison Bay. Half the tagged females were relocated twice in the Beaufort Sea, indicating a residence time of at least 4 days. Aerial surveys in late August 1999, recorded four spectacled eiders, a female with two young and an individual of unspecified sex in western Harrison Bay (Stehn and Platte, 2000). Although satellite-tagged females have been relocated more than 40 km offshore in the Beaufort Sea (TERA, 1999), the median distance for migrating individuals is 16.5 km offshore (average 21.8 km) (Petersen, Larned, and Douglas, 1999). Females use the Beaufort coastal water more commonly than males, but locations of females by satellite telemetry suggest they do not occupy nearshore waters within the Planning Area very often (Map 63). Apparently, there is considerable variation in the speed of movement from east to west across the Beaufort Sea by individual birds, as indicated by successive locations of specific satellite transmitters (Map 63). A majority of the birds detected in Harrison Bay (10 of 19) spent fewer than 3 days in the Beaufort Sea; however, 6 eiders stayed 3 or more days.

Flocks of spectacled eiders staging before southward migration are expected in offshore waters beyond the barrier islands from late June to September, although the numbers generally are unknown. Aerial surveys in the central Beaufort Sea in July 2000 by the FWS located 143 eiders in the deeper waters of Harrison Bay, including one flock of 100 birds (Fischer, Tiplady, and Larned, 2002). A less intensive FWS survey (flight lines twice as far apart), covering the entire Beaufort coastline from Point Barrow to Demarcation Point in July 2001, located 15 spectacled eiders off western Simpson Lagoon, in outer Smith Bay, and off the Plover Islands east of Point Barrow (Fischer, 2002; Map 62).

Most spectacled eiders probably move quickly through the Beaufort area, and it is likely that relatively few birds occupy this area at any given time. This is suggested by relatively low numbers of birds counted on offshore aerial surveys (estimated densities of 0.01 to 0.16 birds/km^2) (Fischer, 2001; Stehn and Platte, 2000), and the relatively low proportion of initial and repeat locations in the Beaufort Sea (once movement of an individual began) of transmitter-equipped birds that were instrumented in the central Beaufort Sea area. As a result, relatively low numbers of spectacled eiders would be expected to be typically found in offshore waters of either Beaufort or Chukchi Seas during the staging/migration period from late June to September. However, these observations may underestimate numbers because the limited aerial surveys may not accurately assess use of the entire area, and a substantial proportion of the "unidentified" eiders may have been spectacled. Observations made offshore in the Beaufort Sea by Divoky (1984) suggested that larger flocks may contain hundreds of individuals of this species. Divoky found the largest sitting flocks to contain more than 100 birds and flying flocks more than 300 individuals. During a late June-early July aerial survey in the Chukchi Sea between Peard Bay and Point Barrow, Dau and Anderson (2001) observed 40 spectacled eiders in nearshore waters.

(5) Winter

The only known wintering area lies south of St. Lawrence Island in the Bering Sea. Because few eiders are observed in marine areas along the Beaufort coast in spring, a majority may migrate to the nesting areas overland from the Chukchi Sea (TERA 1999).

During the nonbreeding season spectacled eiders occupy marine waters and forage principally by diving to obtain benthic invertebrates at varying depths <80m. They feed primarily on clams but also snails, a variety of crustaceans, and members of various other taxa (Petersen, Grand, and Dau, 2000).

c. Steller's Eider

While the majority of Steller's eiders breed in arctic Russia, a small number also breed in northwest Alaska (USDOI, FWS, 2002). They occur over a large area of the western coastal plain, mainly on the northern half of the NPR-A and private land near Barrow. Recent FWS surveys suggest the nesting range of this species may have been reduced to a core nesting area near Barrow, where in some years up to several dozen pairs breed. Nesting does not occur every year in this area, possibly because of predator presence (Quakenbush and Suydam, 1999). This species nests on low-relief tundra adjacent to small ponds or within drained lake basins. Nesting habitat is characterized by numerous lakes and ponds with *Arctophila* and *Carex* vegetation and small streams (Quakenbush et al., 1995; USDOI, FWS, 2002). Incubation lasts about 25 days. Males depart the nesting areas in late June as the eggs are hatching. Many of the Alaskan birds move south by way of the Chukotka Peninsula in Russia (P. Martin, USFWS, pers. comm., 25 April 2003). Many nests are depredated by foxes, ravens, or jaegers. Females with broods remain in nearby wetlands until late August or early September.

Following the breeding season, Steller's eiders migrate to marine areas to molt, many via Russian coastal areas. Molt occurs principally in several lagoons on the north side of the Alaska Peninsula in southwestern Alaska (e.g., Izembek, Nelson lagoons). The molt period for the species lasts from late July to late October. Wintering individuals are found in shallow waters from the Alaska Peninsula--including the molting areas until they ice over--and Aleutian Islands east to Cook Inlet. In spring, up to tens of thousands of individuals stage in Alaska Peninsula lagoons and pause to feed in Kuskokwim Bay before proceeding north to nesting areas, which for most individuals is in Russian Far East areas (P. Martin, USFWS, pers. comm., 25 April 2003). A majority of the year is spent in shallow nearshore marine water. During fall molt, winter, and spring migration, the Alaska breeders intermix with the much more numerous Russian Pacific populations in southwest Alaska. Because individuals of the two populations are indistinguishable externally, it is unknown whether the Alaska population concentrates in particular areas in winter.

Steller's eiders have been recorded at low densities (0.01/km^2) during aerial surveys of the Eider Survey area from about Point Lay east to ANWR (Larned et al., 2001; Larned, Stehn and Platte, 2003). The majority of recent sightings have occurred between the longitudes of Point Lay and Nuiqsut (on the Colville River) and within 90 km (56 mi) of the coast (Map 63). They are rare in the Colville River delta area and extremely rare farther east (Larned et al., 2001; Larned, Stehn and Platte, 2003). Surveys from 1993 to 2002 in early to mid-June yielded index estimates ranging from 20 to 785 (Larned, Stehn and Platte, 2003), while estimates from surveys flown late June-early July from 1989-2000 ranged from 176-2,543 (Mallek, 2002; USDOI, FWS, 2002). It is not clear from historical data if the species' range in northern Alaska has contracted during the period of population decline. The estimated ACP population is about 1,000. It is not possible to estimate former population size from historical data, although written commentaries suggest the Steller's eider was more common than at present. The species has been found at highest density (0-3.0 pairs/km^2) during road surveys in the core nesting area near Barrow (Quakenbush, et al., 1995; USDOI, FWS, 1999a). Intensive surveys in the area between Admiralty Bay and the Chukchi Sea from 1999-2001 recorded densities of 0.02 to 0.08 / km^2 (44 to 112 birds observed during 3 years) (Ritchie and King, 2002).

In June 1997, Steller's eider in Alaska was listed as threatened under the Endangered Species Act because of a substantial decrease in the species' breeding range and a population decline of about 50 percent from the early 1970's (62 *FR* 31748). Potential threats to the recovery of this species are discussed in the Steller's Eider Recovery Plan (USDOI, FWS, 2002), and include predation, hunting take, ingestion of lead shot, changes in the marine environment that affect food or other resources, and exposure to oil or other contaminants in the event of a spill. Thus, recovery objectives would include reduction of exposure to lead, nest predation, and hunting mortality, as well as acquisition and use of information on their ecology in population modeling efforts.

d. Critical Habitat

The U.S. Fish and Wildlife Service (FWS) designated approximately 101,000 km^2 (38,992 mi^2) on the Y-K River delta and in Norton Sound, Ledyard Bay, and the Bering Sea between St. Matthew and St. Lawrence Islands as critical habitat for the spectacled and Steller's eiders, on February 2 and February 6, 2001, respectively (66 FR 8850 and 9146). The only area designated in the arctic is Ledyard Bay, a spectacled eider molting area in the southeast Chukchi Sea, northwest of Cape Lisburne and south of Point Lay and the westernmost portion of the Northwest NPR-A Planning Area. The Bering Sea marine area, the only known wintering area for spectacled eiders (Petersen, Larned, and Douglas, 1999), includes organisms in the water column and the underlying bottom community where these bottom-feeding ducks forage in depths of at least 70 m (Petersen, Piatt, and Trust, 1998).

C. SOCIAL SYSTEMS

1. Economy

a. Revenues

(1) North Slope Borough Revenues

Since the 1980's, the North Slope Borough (NSB) tax base has consisted mainly of high-value property owned or leased by the oil industry in the Prudhoe Bay area. According to the final EIS for Sale 144, more than 95 percent of Fiscal Year (FY) 1995 revenues came from property taxes (USDOI, MMS, 1996a:Section III.C.1).

North Slope Borough revenues (exclusive of the North Slope Borough School District) were $224 to $235 million between 1992 and 1997. Revenues were $285, $266, and $245 million in 1998, 1999, and 2000, respectively

(Abbott, 2001, pers. comm.). In 1997, the assessed value of all property was $11.7 billion; in 1998, 1999, and 2000, assessed values were $11.4, $10.8 and $10.8 billion, respectively. The NSB expects the total assessed value to decline steadily from $10 billion in 2002 to $5 billion by 2013 (Wright, 2001, pers. comm.). Over 95 percent of assessed value is related to the oil and gas industry infrastructure centered at Prudhoe Bay. By most accounts, it is anticipated that production on the North Slope will decline over the coming decades and the infrastructure will go into disuse and be disassembled. The assessed value would see a corresponding decline.

In FY 1994, the NSB applied a rate of 18.5 mills to assessed property: 4.78 mills for operations and 13.72 mills for debt service. Although the mill rate for operations is at the limit allowed by Alaska statutes, the NSB's mill rate to repay bonded indebtedness is unlimited. Therefore, the NSB can raise the mill rate to repay bonds without legal restraints, and limits on short-term revenues do not drive current capital expenditures. The State has a limit of 20 mills on the rate for oil and gas property; thus, self-limitation at an 18.5-mill rate leaves the NSB a buffer to increase revenues, if assessed values fall unexpectedly (Nageak, 1998).

From funds received as a result of the 1999 Northeast NPR-A Lease Sale, the State has awarded the NSB and the cities of Atqasuk, Barrow, and Nuiqsut 24 grants totaling $28 million in FY 2000. All grants were awarded in calendar year 2000 (Hart, 2002, pers. comm.). Subsection (2) State Revenues, explains how the State manages intergovernmental fund transfers.

Between 1966 and 2002, the State allocated $420,000 for two projects under the Land and Water Conservation program to the NSB or its communities (www.ahrinfo.org). Under the Federal Coastal Impact Assistance Program, the State allocated a one-time grant of $1.9 million to the NSB (www.gov.state.ak.us/dgc/CIAP September 2001).

The NSB received no Outer Continental Shelf (OCS) revenues for the period 1995 through 2000.

(2) State Revenues

The State of Alaska receives funds from the Federal Government that are generated by oil and gas activities in Alaska. These combined revenues are small when compared with the State's overall operating budget of $3.7 billion (1998) to $4.3 billion (2001) (www.legfin.state.ak.us/BudgetReports/Operating/); however, they are important components of the economy.

The 1999 Lease Sale in the Northeast NPR-A produced $38.6 million in bonus bids and $1.7 million in rentals due the State. The Federal Government has transferred all but $3 million of these funds to the State. The $3 million is in escrow pending Kuukpik Village Corporation land selections in Northeast NPR-A. The Federal Government estimates future annual rentals to the State from the 1999 Northeast NPR-A Lease Sale to be $2 million. The 2002 Lease Sale in the Northeast NPR-A produced $31.9 million in bonus bids due the State.

The Federal Government must distribute 50 percent of all revenues from "sales, rentals, bonuses, and royalties" on oil and gas leases within the NPR-A to the State (42 U.S.C. § 6508). This requirement for transfer of funds to the State is mentioned above. The 50-percent distribution does not apply to State taxes such as severance, property, and conservation taxes.

In allocating NPR-A revenues that are received from the Federal Government under 42 U.S.C. § 6508, the State must give priority to municipalities most directly or severely impacted by oil and gas activities in the NPR-A. This is accomplished through a grant program. The State generally receives the income from oil and gas leases twice a year and makes these funds available as grants to eligible municipalities in the following State fiscal year.

The State places these revenues in the NPR-A Special Revenue Fund (AS 37.05.530). Funds not issued as grants by the end of each fiscal year are distributed in the following manner: 50 percent to the Permanent Fund, 0.5 percent to the Public School Fund, and 49.5 percent to the General Fund.

The Alaska Department of Community and Economic Development administers the NPR-A Special Revenue Fund grants under the NPR-A Impact Program (3 AAC 150). The purpose of the grants is to mitigate significant adverse impacts related to oil and gas leasing within the NPR-A. Municipalities may apply for grants each year for planning, construction, and maintenance of essential public facilities or for provision of other necessary public services. Municipalities must demonstrate the present or future impact from oil and gas exploration, production, or transportation. Municipalities applying for a grant must meet certain eligibility requirements (3 AAC 150.050).

The Federal Government distributed OCS revenues (rents, bonuses, royalties, escrow funds, and settlement payments) from Beaufort Sea Lease Sales to the State as follows: 1995--$ 9.4 million; 1996--$ 9.5 million; 1997--$17.3 million; 1998--$13.6 million; 1999--$14.7 million; 2000--$13.7 million. From 1986-2000, the Federal Government distributed $505 million to the State from all types of revenues associated with leasing on all of Alaska's OCS. State income tax and spill and conservation tax revenues related to Beaufort Sea OCS activities from 1995-1998 is zero. Between 1966 and 1995, the Federal Government allocated $20 million of OCS revenues through the Federal Land and Water Conservation Fund to the State. In turn, the State allocated these funds to local jurisdictions for eligible projects.

Congress amended the OCS Lands Act to authorize the Coastal Impact Assistance Program in 2000. This program makes a one-time allocation of $12 million to the State. Of this amount, the state retains $8 million and allocates $4 million to coastal political subdivisions according to a formula specified by the amended act (www.gov.state.ak.us/dgc/CIAP September, 2001).

(3) Federal Revenues

The 1999 Lease Sale in the Northeast NPR-A resulted in $38.6 million in first year bonus bids and $1.7 million in first year rentals for the Federal Government. The Federal Government estimates future annual rentals from the 1999 Northeast NPR-A Lease sale to be $2 million. The 2002 Lease Sale in the Northeast NPR-A resulted in $31.9 million in first-year bonus bids to the Federal Government.

Total Federal OCS revenues for the Beaufort Sea, including bonuses, royalties and rents were: 1995--$ 1.1 million; 1996--$16.1 million; 1997--$ 1.1 million; 1998--$ 7.4 million; 1999--$ 1.4 million; 2000--$ 1.4 million. Of these revenues, bonuses amounted to $14.4 million from Sale 144 in 1996 and $5.3 million from Sale 170 in 1998. From 1976 to 2000, Alaska received $6.4 billion in total OCS revenues. Federal income tax collected from workers on the Alaska OCS is estimated to have been $1.1 million for drilling and related activity on Warthog and Liberty islands in 1997. The Federal Government collected no income tax from workers on the Alaska OCS in 1995, 1996, or 1998-2000 because there was no work on the Alaska OCS.

b. Employment and Personal Income

(1) History of Employment in the North Slope Borough

Approximately 70 percent of the oil and gas industry workers on the North Slope commute to permanent residences in Alaska but outside the NSB: primarily in Southcentral Alaska and Fairbanks. Approximately 30 percent however, reside outside Alaska (Hadland and Landry, 2002; Hadland, 2002, pers. comm.). The number of those who work and live in the NSB is so small as to be negligible (see Sec. III.C.1.b.(4)). Two-hundred eighty-four thousand workers held fulltime employment in Southcentral Alaska and Fairbanks in 2000. This and other related employment data for all industries in Southcentral Alaska and Fairbanks with statewide totals during 1995-2000 are compared in Table III-10.

North Slope Borough employment data, as a whole and by sector (including the oil-industry workers at Prudhoe Bay) for years 1990 through 1998 are displayed in Table III-11. (Note: While the table includes "mining," the data for this industry is completely oil and gas employment at Prudhoe Bay and nearby facilities.) Exploration activity in Northeast NPR-A generated approximately 30 jobs between January and April 2000 and 2001. Industry anticipates similar exploration efforts there in 2002. The total NSB employment, less mining, reflects workers who reside permanently in the borough. The Borough reports:

> Since its incorporation, the North Slope Borough has expended millions of dollars for construction projects on work-force development programs to improve the living conditions, employment rates, and skills of its residents. [Since 1972,] the number of Inupiat who have skills and experience on construction projects, from training programs and most recently from educational opportunities available through Ilisagvik College, has slowly risen (North Slope Borough, 1999).

Summary descriptions of employment throughout the NSB are provided in Table III-12 through Table III-14. The 1998 employment figures by employer for the borough and its eight villages are displayed in Table III-12; 1998 employment data by employer and employee ethnicity (for residents throughout the borough) are displayed in Table III-13; and the 1998 labor force summary for the borough is displayed in Table III-14. For further details on employment, see the Final EIS for Sale 170 (USDOI, MMS, 1998:Section III.C.1) incorporated here by reference.

(2) The Borough Government as Employer

The NSB's government employs many permanent residents directly and finances construction projects under its Capital Improvement Program, which employs additional NSB residents. For details, see the description in the preceding paragraphs and in the Final EIS for Sale 170 (USDOI, MMS, 1998:Section III.C.1).

(3) Unemployment in the North Slope Borough

According to State figures, unemployment in the NSB was 3.5 to 9.4 percent from 1975-2001 (www.labor.state.ak.us/research). However, according to the 1998 NSB Census, 22 percent of the Borough's resident labor force believed it was underemployed, and 24 percent of the resident labor force worked fewer than 40 weeks in 1998 (Table III-15). According to the Alaska Department of Labor and Workforce Development, the NSB unemployment rate was 16 percent for 1998. According to the 1998 NSB Census, 13 percent of the Borough's resident labor force reported being underemployed, and 27 percent worked fewer than 40 weeks in 1998 (NSB, 1999). Total 1998 unemployment and underemployment figures for the NSB and its eight communities are listed in Table III-15. (For further discussion and details, see NSB, 1995 [NSB-28 through NSB-42, 1999:NSB-41 through NSB-54] and USDOI, MMS, 1998:Section III.C.1).

Some Alaska economists believe that Alaska's rural communities have a large percentage of "discouraged workers"--those who are involuntarily unemployed but are not counted in the State or Federal unemployment data (Windisch-Cole, 1996, pers. comm.). Other Alaska economists do not think the discouraged-worker hypothesis applies to the NSB as it is believed that in a mixed cash-subsistence economy, people who do not have cash jobs for part of the year may not take one if offered to them (Berman, 1997, pers. comm.).

(4) North Slope Oil-Industry Employment of North Slope Borough Resident Natives

A limited number of North Slope Alaska Natives has been employed in the oil-production facilities or associated work in and near Prudhoe Bay since production started in the late 1970's. In addition, Alaska Natives who reside on the North Slope are not inclined to relocate for employment (USDOI, MMS, 1993). This historical information is relevant to assessing potential economic effects of oil and gas exploration and development on the North Slope's Native population. A 1993 study contracted by MMS found that the 34 North Slope Natives who were interviewed accounted for half of all North Slope Natives who worked at Prudhoe Bay in 1992. The study also found that the North Slope Natives employed at Prudhoe Bay made up less than 1 percent of the 6,000 North Slope oil-industry workers (USDOI, MMS, 1993). This pattern is confirmed by data from 1998; it shows that 10 North Slope Borough Inupiat residents were employed in the oil industry that year and that this employment pattern has continued (Table III-13).

One of the NSB's main goals has been to create employment for Alaska Native residents. It has been successful in hiring many Natives for the NSB's construction projects and operations. However, only a few who are NSB residents hold jobs at the Prudhoe Bay industrial enclaves. Native residents seem to prefer NSB employment to jobs that are potentially available in industry. The NSB pay scales are equal to or better than those in the oil and gas industry, and the working conditions and flexibility offered by the Borough are considered by Native employees to be superior to those in the oil and gas industry. The NSB employment has been high paying and very flexible compared with standards in other parts of Alaska; especially so for policies that permit employees to take time off (particularly for subsistence hunting).

The NSB has tried to facilitate employment of Alaska Natives in the oil industry at Prudhoe Bay. It is concerned that the oil industry has not done enough to train unskilled laborers or to allow them to participate in subsistence hunting. The NSB is also concerned that the oil industry recruits with methods common to western industry. The NSB would like the industry to make serious efforts to increase hiring of Borough residents (Nageak, 1998). For further information, see USDOI, MMS (1998:Section III.C.1). In response to this situation, BP Exploration (Alaska), Inc. (BPXA) has established the Itqanaiyagvik Program whose purpose is to increase BP's hire of Natives who are NSB residents. This joint venture between the ASRC and its oil-field subsidiaries is coordinated with the Borough and the NSB School District (BP Exploration [Alaska], Inc., 1998b).

The Nuiqsut Public Hearing for the NW NPR-A Draft IAP/EIS on March, 2003 provides additional insight to the oil-industry's employment of NSB-resident Alaska Natives. It was noted that ConocoPhillips has partnered with ASRC in offering training programs for North Slope residents interested in oil field maintenance and heavy equipment maintenance. Twenty North Slope residents spent their summer in 2002 working and training in these areas. ConocoPhillips has worked closely with Kuukpik Corporation, ASRC, and other companies to hire and train Alaska Natives. Conoco Phillips, in cooperation with Kuukpik Corporation, sponsors mentoring and training at the Alpine Field for North Slope residents (Mr. Wheathall, Nuiqsuit Public Hearing, 2003). Bernice Kaigelak has lived in Nuiqsut since it was resettled in 1973 and has seen changes since then. She feels that ConocoPhillips has broken promises for jobs at Alpine. She thinks that 3 or 4 percent of the 500 residents of Nuiqsut work at Alpine (Bernice Kaigelak, Nuiqsut Public Hearing, 2003). Eli Nakapigak agrees with Ms. Kaigelak's comments. He adds that 8 years ago Secretary of the Interior Bruce Babbitt and Alaska Governor Tony Knowles held a pubic hearing in Nuiqsut before opening the Northeast NPR-A. They stated they would open that area and promised the village jobs. At that time Nuiqsut had 14 percent unemployment and still has 15 percent unemployment. He questions when promises to Nuiqsut will be kept (Eli Nakapigak, Nuiqsut Public Hearing, 2003).

(5) Non-Oil Employment in Northwest NPR-A

Other than oil exploration, the Northwest NPR-A has offered very little cash employment. The most likely possible employment of other types would be associated with recreation, government activities, and scientific research. For recreation, 30 one-week float trip parties per year have generated employment in recent years (Delaney, 2002, pers. comm.). This is equivalent to one person working for 8 months per year. Employment with government activities and scientific research is assumed to be so small that it is effectively zero. This non-oil employment is in the Northwest NPR-A only and does not include employment in Barrow or other communities of the NSB; they are not within the boundaries of the Northwest NPR-A.

(6) Federal Employment

The Nation employed 137 million people in 1999 (www.bea.doc.gov/bea/regional/).

(7) Personal Incomes

Aggregate. Aggregate personal income in 1999 was: North Slope Borough--$200 million; South Central Alaska (Municipality of Anchorage, Matanuska-Susitna Borough, and Kenai Peninsula Borough) and Fairbanks Northstar Borough--$13.2 billion; U.S.--$7,739.4 billion (www.bea.doc.gov/bea/regional).

Per Capita. Per capita personal income in 1999 was: North Slope Borough--$20,540; Matanuska-Susitna Borough--$13,400; Municipality of Anchorage--$25,287; Kenai Peninsula Borough--$20,949; Fairbanks Northstar Borough--$21,553 (www.dced.state.ak.us).

Median Family. Median familly income in 1999 was: North Slope Borough--$63,810; Matanuska-Susitna Borough--$56,939; Municipality of Anchorage--$63,682; Kenai Peninsula Borough--$54,106; Fairbanks Northstar Borough--$56,478 (www.dced.state.ak.us).

c. Subsistence and the North Slope Borough Economy

The Inupiat residents of the NSB have traditionally practiced and relied on subsistence activities. Although subsistence is not fully part of the cash economy, households do need to expend cash to purchase equipment used in the subsistence harvest, such as boats, rifles, all-terrain vehicles, and snowmobiles. The Inupiat are the predominant ethnic group in the NSB. Also, the Inupiat are the prevailing ethnic group expending income for subsistence-harvest equipment. The 1998 annual household subsistence expenditures by ethnicity are shown in Table III-16. It is apparent that subsistence hunting is important to the NSB's whole economy and even more important to the culture as described in Sec. III.C.3, Subsistence-Harvest Patterns, and Sec. III.C.4, Sociocultural Systems.

2. Cultural Resources

The history of the culture of northern Alaska defines the Northwest NPR-A Planning Area. For this IAP/EIS, northern Alaska is that portion of Alaska north of the Continental Divide or that area north of 68° N. latitude. The cultural history of northern Alaska differs significantly from the cultural history of other regions of North America since its earliest human residents appear to be the first people in the Western Hemisphere. The physical remains of roughly 12,000 years of human occupation are within northern Alaska, and it is the only place where the prehistoric cultural history of the Western Hemisphere can be traced from its origin to today. However, since much of ancient Beringia now makes up the floor of the Beaufort and Chukchi Seas, the initial chapter of the region's cultural history is speculative.

The term Beringia describes an ecological region that existed during the glacial episodes of the Pleistocene, when world-wide sea level was as much as 300 ft lower than today, creating a dry-land connection between Siberia (Asia) and Alaska (North America). Beringia included most of northeastern Siberia, that part of Alaska to the Alaska Peninsula, and the land bridge connecting them. This area was a vast, mostly unglaciated landmass of nearly 2 million mi² with an extreme continental climate (Hopkins et al., 1982).

Most archaeologists agree that northern Alaska was initially occupied by immigrants from Northeast Asia who crossed the land bridge from Siberia to Alaska around 15,000 years Before Present (BP). Some time before 11,500 BP descendants of these immigrants moved south, populating the rest of the Western Hemisphere. However, that is probably as far as consensus would go. Although these Asian immigrants produced some bifacial stone tools such as projectile points, the basis of their stone tool industry was a core and blade technology producing unifacial tools such as burins, scrapers, and drills on blades. The latter is a common trait among the late Pleistocene Siberian cultures (Dikov, 1977, 1979, 1996, 1997).

There is little doubt that the various cultural groups involved in the earliest migrations into the North American Arctic were deterred from moving south because of the glacial ice mass that isolated Alaska from the rest of the North American continent (Kunz, 1996). While contained within this unglaciated but ice-bound region, some of these immigrant groups may have coalesced and developed a stone tool technology specific to procuring the large mammals of the region such as bison, muskoxen, and caribou. Although it did produce some blades, this evolving stone tool industry was based on bifacial technology, which produced tools such as lanceolate projectile points and knives, as well as distinctive unifacial tools such as spurred scrapers and gravers made on flakes rather than blades. If so, these people would have been the first Paleoindians, as defined by technology and culture.

Although northern Alaska may well have been the location of the Paleoindian culture and it may have been where the stone tool industry first evolved, it was not where Paleoindians were first recognized. Paleoindians were first noted in an archaeological site more than 3,000 mi south of Alaska at Folsom, New Mexico in 1926. It was not until the late 1970's that Paleoindian sites were discovered in northern Alaska, a discovery that caused archaeologists to reexamine theories of emerging populations in the New World. Since the middle of the last century, Paleoindians have been considered by most scholars to represent the first indigenous, geographically widespread North American cultural tradition (Kunz and Reanier, 1995). As the climate and vegetation began to change at the end of the Pleistocene with the large Ice Age mammals disappearing and the ecosystems reorganizing, the Paleoindians vanished from northern Alaska's archaeological record. From approximately 9,700 years BP until 7,800 years BP, there is no solid evidence of human occupation in northern Alaska (Kunz, 2000). This abruptly ends the first chapter of northern Alaska's cultural history.

The loosely defined, Siberian-affiliated, Paleo-Arctic tradition, which appears to be as ancient as the Paleoindian tradition, is adjacent to the Northwest NPR-A Planning Area on the south side of the Continental Divide (Anderson, 1970). Although some researchers (Anderson, 1970; Bowers, 1982; Gal, 1982) have suggested that a few sites derived from the Paleo-Arctic tradition may lie north of the Continental Divide, this is uncertain because the tradition lacks diagnostic artifacts and has no radiocarbon evidence. However, since the boundary separating northern Alaska from the area to the south is little more than a line drawn on a map, the Paleo-Arctic tradition may well be part of northern Alaska's cultural history. Because of its ephemeral nature, various researchers define and describe the Paleo-Arctic tradition differently (Anderson, 1970; Dumond, 1987; West, 1981), making it difficult to determine an end date for this techno/cultural group. However, the consensus among experts is that the end came sometime after 8,000 years BP.

The Northern Archaic tradition (Anderson, 1968) followed the transitional Ice Age cultures group. Northern

Archaic tradition groups inhabited northern Alaska sometime after 8,000 years BP until 3,000 to 2,000 years BP. The hallmarks of the tradition's stone tool assemblages are large, bifacial side/corner notched and stemmed projectile points, bifacial knives, and large scraoral. Although the mammoth, bison, and horse of the Ice Age had disappeared, these people inhabited the region and exploited its resources (large terrestrial mammals such as caribou, muskoxen, and moose) in much the same way as their ancient predecessors.

Roughly 5,000 years BP, a new cultural entity appeared in northern Alaska--the Eskimo. While Eskimos were not among the first residents of northern Alaska, their varied and sophisticated technology allowed them to exploit the resources of the region more than their Northern Archaic predecessors/neighbors. Soon they dominated the area and grew more numerous than any previous groups who had inhabited the region. Their technological sophistication enabled them to exploit the coastal and inland ecosystems and to expand eastward into Canada and Greenland. There is an unbroken record of their use of northern Alaska since they first appeared in the region (Reanier, 1997; Sheehan, 1997). The technological signatures of the Eskimo cultures are a chipped stone industry of small, often delicate, well-made bifacial projectile points, ground stone implements, a variety of well-made, often decorated bone, ivory, and antler tools and items of personal adornment, as well as a proliferation of composite tools (Irving, 1964; Dumond, 1987).

The succession of the Eskimo Continuum cultures began with the Denbigh Flint Complex people, followed by the Choris, Norton and Ipiutak cultures (Giddings, 1964; Dumond, 1987). These closely related cultural groups compose what archaeologists generally refer to as the Arctic Small Tool tradition (Irving, 1964). These early Eskimos spent as much or more time living in and exploiting the subsistence resources of the foothills and mountains of the Brooks Range as they did the Arctic coast.

About 1,600 years ago, there seems to have been a switch to coastal activities. The Birnirk people, who developed technology that allowed them to successfully exploit maritime resources (particularly whales) more than the earlier Eskimo cultures, initiated this change (Stanford, 1976). This trend continued with the Thule people into the historic period. At the same time, related but less numerous populations, referred to generically as Late Prehistoric Eskimos, continued to exploit the resources of the interior. They subsisted primarily on caribou and other large terrestrial mammals while wintering on the margins of lakes with plentiful fish (Gerlach and Hall, 1988). These people may have been the antecedents of the modern Nunamiut or Inland Eskimo who seem to appear in the archaeological record between 400 and 300 years BP (Kunz and Phippen, 1988).

Some of the earliest history of northern Alaska played out in this region with contact between the Euro-American arctic whaling fleet and Alaska Natives beginning in the middle of the 19th Century. More than 50 years of continuous contact followed, drastically altering a traditional culture and Alaska Native lifestyle (Brower, 1942; Foote, 1964; Bockstoce, 1978). In just a few generations, the indigenous people of northern Alaska moved from the Stone Age to the Atomic Age.

It is noteworthy that it is rare for a single cultural group to dominate a region as large as northern Alaska for such an extended period. The modern indigenous peoples of northern Alaska are as successful today as their ancestors of 5,000 years BP were, subsisting in one of the harshest environments on earth. The evidence supporting this history resides in thousands of prehistoric and historic sites throughout the region. These sites are the physical manifestation of the cultural history of northern Alaska--a nonrenewable resource. This resource must be protected and managed wisely for its scientific and cultural value.

To date, about 400 cultural resource sites have been identified within the Northwest NPR-A Planning Area. Most of these sites are prehistoric and they are the result of inventory conducted as part of the 105c studies undertaken during the late 1970's (Davis et al., 1981; Hall and Gal, 1988). The 105c archaeological surveys inventoried less than 3 percent of the land area within the Northwest NPR-A Planning Area, with most sites clustered in just a few locales. This distribution does not reflect the density of prehistoric people based on the locational preference. Rather, it suggests that only a few portions of the Planning Area have been examined through organized reconnaissance of cultural sites: e.g., wellsite locales, portions of the coast, and a few of the major drainages. The absence of recorded cultural sites across most of the Planning Area is simply the result of limited work there (Davis et al., 1981; NSB, 1978; Hall and Gal, 1988; Kassam and Wainwright Traditional Council, 2000). Where inventories and surveys have been conducted, cultural sites have usually been found. This suggests that there are a tremendous number of undiscovered cultural resource locales in the region and that examination of the unsurveyed portions of the Planning Area would dramatically increase the number of known sites. Known sites include evidence of irregularly used prehistoric camps and historic trading locales, fishing and hunting camps, and village sites. The sites recorded in the Traditional Land Use Inventory (North Slope Borough, 1978) display the greatest density on the major rivers and associated drainages and along portions of the coast (Kassam and Wainwright Traditional Council, 2000).

The NSB's Traditional Land Use Inventory and the Wainwright Traditional Council's Human Ecology Mapping Project compile subsistence resource/use locations, landmarks, travel routes, and special significance locales in the living memory of the Inupiat people. The Planning Area contains extensive locales. This graphically demonstrates that the communal cultural memory of the Inupiat people is a large and extremely valuable resource essential to the NPR-A planning process and will be equally important for guiding future identification of mitigation sites, if development occurs.

Most of the cultural sites in the Planning Area are, by virtue of their isolation and remoteness, protected from most types of impacts other than those caused by nature. The majority of the prehistoric sites however, are partially exposed or shallowly buried and therefore, vulnerable to impacts from human activity. Almost without exception, historic sites lie on the surface and are extremely vulnerable. Although most surface-disturbing activities occur during the winter when snow covers the deeply frozen ground, damage to or destruction of cultural sites can occur. For this reason, foreknowledge of planned surface-disturbing activities, whether planned for the winter or summer, is essential if these resources are to be protected, as directed by law and policy.

3. Subsistence-Harvest Patterns

This section describes the subsistence-harvest patterns of the Inupiat communities in and adjacent to the Northwest NPR-A Planning Area: Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. This community-by-community description provides general information on subsistence-harvest patterns, harvest information by resource and community, timing of the subsistence-harvest cycles, and harvest-area concentrations by resource and by community.

Further information regarding the harvest areas, species harvested, and quantities harvested can be found in the final EIS for Beaufort Sea Sales 144 and 170 (USDOI, MMS, 1996a, 1998). The following summary is augmented by information from current studies including: Alaska Department of Fish and Game (ADF&G) (1995a); S.R. Braund and Associates and UAA, ISER (1993); S.R. Braund and Associates (1996); Alaska Consultants, Inc. (ACI), Courtnage, and Braund (1984); ACI and Braund (1984); Kruse et al. (1983); Alaska Natives Commission (1994); City of Nuiqsut (1995); USDOI, MMS (1996b, 1996c, 1997); Hoffman, Libbey, and Spearman (1988); North Slope Borough Contract Staff (1979); Impact Assessment (1990a,b); Hall (1983); Fuller and George (1997); and Impact Assessment (1989). Other sources include USDOI, BLM NPR-A 105(c) and other pertinent documents: USDOI, BLM (1978a,b,c; 1979a,b,c,d; 1981; 1982a,b,c; 1983a,b,c; 1990; 1991; and 1997); the *National Petroleum Reserve-Alaska Final IAP/ EIS* (USDOI, BLM and MMS, 1998) and the *Liberty Development and Production Plan Final EIS* (USDOI, MMS, Alaska OCS Region, 2002b).

a. Subsistence Defined

Generally, subsistence is considered to be hunting, fishing, and gathering for the primary purpose of acquiring food. The Alaska National Interest Land Conservation Act (ANILCA) defines subsistence as:

> the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade (16 U.S.C. § 3113).

The North Slope Borough Municipal Code defines subsistence as:

> an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities (North Slope Borough Municipal Code 19.20.020 (67)).

As a lifestyle for Alaska Natives, subsistence is more than the harvesting, processing, sharing, and trading of marine and land mammals, fish, and plants. Subsistence should be understood to embody cultural, social, and spiritual values that are the essence of Alaska Native cultures (Bryner, 1995; Alaska Department of Natural Resources, 1997).

The community residents adjacent to the Beaufort Sea multiple-sale area participate in a subsistence way of life. While new elements have been added to the way people live, this way of life is a continuation of centuries-old Inupiat traditional patterns. Until January 1990, Alaska statutes defined "subsistence uses" as,

> the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption (AS § l6.05.940),

and subsistence uses were given priority over other uses. In January 1990, as a result of McDowell vs. State of Alaska, the Alaska Supreme Court declared this law unconstitutional. However, Federal law (Title VIII of ANILCA) continues to provide for subsistence and grants it priority over other uses on the public lands.

The 1989 ruling means Alaska cannot legally (according to State law) establish rural preference for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State had until then to devise a solution to the issues raised in the McDowell decision. The Alaska Legislature was and has not been able to pass any subsistence legislation, despite special sessions called for that purpose and other efforts initiated more recently by Governor Tony Knowles. On Federal lands and navigable waters in Alaska, Federal laws grant subsistence priority over other uses, and Federal Agencies are now managing these subsistence hunts. These agencies will continue to do so until State legislation can be enacted (USDOI, FWS, 1992). Spurred by a number of recent court decisions and the State of Alaska's inability to enact a subsistence plan that guarantees some type of rural preference, the Department of the Interior manages subsistence fisheries on Federal lands (Whiney, 1996; Hulen, 1996a,b; Kizzia, 1996).

b. The Cultural Importance of Subsistence

Subsistence activities are assigned the highest cultural values by the Inupiat and provide a sense of identity in addition to being an important economic pursuit. Many species are important for the role they play in the annual cycle of subsistence-resource harvests, yet effects on subsistence can be serious, even if the net quantity of available food does not decline. Subsistence resources provide more than dietary benefits. They also provide materials for personal and family use and the sharing of resources helps maintain traditional Inupiat family organization. Subsistence resources also provide special foods for religious and social occasions; the most important ceremony, Nalukataq, celebrates the bowhead whale harvest. The sharing, trading, and bartering of subsistence foods structures relationships among communities, while at the same time the giving of these foods helps maintain ties with family members elsewhere in Alaska.

Subsistence activities on the North Slope occur within a matrix of a mixed cash and subsistence-harvest economy. As one North Slope hunter observed: "The best mix is half and half. If it was all subsistence, then we would have no money for snowmachines and ammunition. If it was all work, we would have no Native foods. Both work well together." (ACI, Courtnage, and Braund, 1984).

c. Community Subsistence-Harvest Patterns

Two major subsistence-resource categories occur on the North Slope: the coastal/marine and the terrestrial/aquatic. In the coastal/marine group, the food resources harvested are whales, seals, walruses, waterfowl, and fish. In the terrestrial/aquatic group, the resources sought are caribou, freshwater fishes, moose, Dall sheep, edible roots and berries, and furbearing animals. Generally, communities harvest resources most available to them. Harvests tend to be concentrated near communities, along rivers and coastlines, and at particularly productive sites. The distribution, migration, and seasonal and more extended cyclical variation of animal populations make decisions on what, where, and when to harvest a subsistence resource very complex. Many areas might be used infrequently, but they can be quite important harvest areas when they are used (USDOI, BLM, 1978d). Under certain conditions, harvest activities may occur anywhere in the Planning Area.

How a village uses any particular species can vary greatly over time and data from short-term harvest surveys can often lead to a misinterpretation of use/harvest trends. For example, if a particular village did not harvest any bowhead whales in one year, whale use would go down; consequently, consumption and use of caribou and other species would likely go up, in absolute and percent terms. If caribou were not available one winter, other terrestrial species could be hunted with greater intensity. The harvest of faunal (animal) resources, such as marine and terrestrial mammals and fish, is heavily emphasized, so the subsistence harvest of vegetation by communities adjacent to the Planning Area is limited. When compared with southerly regions, the total spectrum of available resources in the arctic region is limited.

While subsistence-resource harvests differ from community to community, the resource combination of caribou, bowhead whales, and fish has been identified as the primary grouping of resources harvested. Caribou is the most important overall subsistence resource in terms of hunting effort, quantity of meat harvested, and quantity of meat consumed. The bowhead whale is the preferred meat and the subsistence resource of primary importance because it provides a unique and powerful cultural basis for sharing and community cooperation (Stoker, 1984, as cited by ACI, Courtnage, and Braund, 1984). In fact, the bowhead could be said to be the foundation of the sociocultural system. Depending on the community, fish is the second or third most important resource after caribou and bowhead whales (Table III-17). Bearded seals and various types of birds are also considered primary subsistence species. Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. Outside the North Slope, black brant that molt in the NPR-A have a substantial value to subsistence users in the Yukon-Kuskokwim Delta, while subsistence hunters in Alaska's Interior use Canada geese extensively. In the late 1970's when bowhead whale quotas were low and the Western Arctic herd (WAH) of caribou crashed (and the Alaska Board of Game placed bag limits on them), hunters turned to bearded seals (ugruk), ducks, geese, and fish to supplement the subsistence diet (Atqasuk could only turn to the last three resources) (Schneider, Pedersen, and Libbey, 1980). Seal oil from hair seals and bearded seals is an important staple and a necessary complement to other subsistence foods.

The subsistence pursuit of bowhead whales has major importance to the communities of Wainwright, Barrow, and Nuiqsut (some Point Lay men whale with crews from Wainwright and some Atqasuk men whale with Barrow crews). The sharing of whale muktuk, or fat, and whale meat is important to the inland community of Atqasuk and continues to be the most valued activity in the subsistence economy of these communities. This is true, even in light of harvest constraints imposed by quotas from the International Whaling Commission; relatively plentiful supplies of other resources such as caribou, fish, other subsistence foods; and the availability of retail grocery foods.

Whaling traditions include kinship-based crews, use of skin boats (only in Barrow for their spring whale-hunting season), distribution of the meat, and total community participation and sharing. In spite of the rising cash income, these traditions remain as central values and activities for all Inupiat on the North Slope. Bowhead whale hunting strengthens family and community ties and the sense of a common Inupiat heritage, culture, and way of life. Thus, whale-hunting activities provide strength, purpose, and unity in the face of rapid change. In terms of the whale harvest, Barrow is the only community within the Planning Area that harvests whales in the spring and fall. Subsistence whaling for the community of Nuiqsut occurs only during the fall season, although some Nuiqsut hunters travel to Barrow to join Barrow whaling crews during the spring whaling season (North Slope Borough, 1998).

An important shift in subsistence-harvest patterns occurred in the late 1960's, when the substitution of snow machines for dogsleds decreased the importance of ringed seals and walruses as key sources of dog food and increased the relative importance of waterfowl. This shift illustrates how technological or social change can lead to the modification of subsistence practices. Because of technological and harvest-pattern changes, the dietary importance of waterfowl also may continue to increase. However, these changes would not affect the central and specialized dietary roles that bowhead whales, caribou, and fish--the three most important subsistence-food resources to North Slope communities--play in the subsistence harvests of Alaska's Inupiat, and for which there are no practical substitutes.

The subsistence resources used by these communities are listed by common species name, Inupiaq name, and scientific name in Table III-18. For a comparison of the proportion of Inupiat household foods obtained from subsistence in 1977, 1988, 1993, and 1998, see Table III-19 (see also the *Beaufort Sea Sale 144 Final EIS*, Sec. III.C.3 [USDOI, MMS, 1996a]). The percentage of households in Barrow and Nuiqsut who participate in successful harvests of subsistence resources is shown in Table III-20 and the percentages of the total subsistence harvest by individual species for each community are shown in Table III-17. Relative household consumption of subsistence resources, changes in subsistence activity, and expenditures on subsistence for Wainwright, as determined from a North Slope Borough economic profile and census conducted in 1998-1999 (NSB, 1999) are displayed in Figure III-12, Figure III-13, and Figure III-14 (respectively).

Many species are important for the role they play in the annual cycle of subsistence-resource harvests, yet effects on subsistence can be serious even if the net quantity of available food does not decline. The consumption of harvestable subsistence resources provides more than dietary benefits; it also provides materials for personal and family use and the sharing of resources helps maintain traditional Inupiat family organization. Additionally, subsistence provides a link to the cash economy: many households earn cash from the crafting of whale baleen or walrus ivory and from the tanning of furs.

Full-time wage employment has had a positive effect on the subsistence hunt by providing cash for snow machines, boats, motors, and fuel--important tools for the hunt. However, full-time employment also limits the time a subsistence hunter can spend hunting to after-work hours. During midwinter, this window of time is further limited by waning daylight. In summer, extensive hunting and fishing can be pursued after work and without any limitations.

Subsistence harvest patterns are potentially impacted by oil and gas activities. Inupiat concerns regarding oil development in the NPR-A identified during scoping, and those identified in public outreach for recent OCS actions and the Northstar project, fall into eight categories.

1. Disrupting migrating subsistence species (particularly caribou).
2. Damaging subsistence resources and habitats.
3. Interrupting or preventing access to subsistence areas.
4. Destroying Native food.
5. Degrading traditional Inupiat places.
6. Impacting communities from the cumulative effects of oil development (especially in the community of Nuiqsut).
7. Failing to sufficiently recognize Inupiat indigenous knowledge concerning subsistence resources, subsistence-harvest areas, and subsistence practices.
8. Damaging Inupiat culture.

One analysis of Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. Most concerns confirmed those raised in scoping, centering on the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, or interruption of subsistence-species migration. These four concerns represent 83 percent of all concerns heard in the testimony from the North Slope for this period (S.R. Braund and Assocs., In prep.; Kruse et al., 1983:table 35; USDOI, MMS, 1994; Human Relations Area Files, Inc., 1992).

d. Annual Cycle of Harvest Activities

The primary subsistence-harvest areas for Point Lay and Wainwright are displayed on Map 65. The primary subsistence-harvest areas for Barrow, Atqasuk, and Nuiqsut are displayed on Map 89. Very few Inupiat live outside the traditional communities, but the seasonal movement to hunting sites and camps for subsistence activities involves travel over and use of extensive areas around these settlements. The aggregate community subsistence-harvest areas for the primary subsistence resources of marine mammals (whales, seals, walruses, polar bears), caribou, fish, birds (and eggs), furbearers (for hunting and trapping), moose, Dall sheep, grizzly bears, small mammals, and invertebrates, as well as berries, edible roots, and fuel and structural material are shown on Map 66. Specific species' harvest areas for Point Lay are shown on Map 67 and Map 68; for Wainwright, see Map 69, Map 70, and Map 71;for Barrow, see Map 72, Map 73, Map 74, and Map 75; for Atqasuk, see Map 76; and for Nuiqsut, see Map 77and Map 78. Annual subsistence cycles for Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut are described below and depicted in Figure III-03, Figure III-04, Figure III-05, Figure III-06, and Figure III-07, respectively. The subsistence areas and activities of these five communities in or near the Northwest NPR-A Planning Area could be affected by the activities evaluated in this IAP/EIS. Portions of the terrestrial subsistence-harvest areas of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut lie within or near the Planning Area.

(1) Point Lay

With a population of 139 in 1990 and 247 in 2000 (USDOC, Bureau of the Census, 1991 and 2001), Point Lay has the smallest population of any of the communities in the North Slope Borough (NSB). About 90 mi southwest of Wainwright, the village sits on the edge of Kasegaluk Lagoon near the confluence of the Kokolik River with Kasegaluk Lagoon. As with other communities in and adjacent to the Northwest NPR-A Planning Area, Point Lay residents enjoy a diverse resource base that includes both marine and terrestrial animals. But, Point Lay is unique among the communities; its dependence is relatively balanced between marine and terrestrial resources and, unlike the other communities discussed here, local hunters do not pursue the bowhead whale. Beluga whale is the village's preferred and pivotal marine mammal resource. Barrier island shores, and the protected and productive lagoons they form, provide prime habitat for other sea mammals and birds--both important resources in the Point Lay subsistence round (USDOI, BLM, 1978d; Fuller and George, 1997).

Point Lay marine subsistence activities take place in the sea-ice and coastal zones extending from the Punnuk Creek area in the south northward to Icy Cape. In the past, Point Lay residents were the Kukparungmiut (people of the Kukpowruk River) and the Utukamiut (people of the Utokok River). These origins continue in the persistence of an important traditional use practice that takes subsistence hunters inland, up the Kukpowruk and Utukok Rivers, and into the De Long Mountains for trapping and for hunting caribou. Beluga hunting and seasonal occupation of fish camps are important family and community activities reflecting the communal effort needed for a successful harvest and the overall importance of these resources (USDOI, BLM, 1978d). Point Lay's subsistence-harvest area is shown on Map 65. Subsistence resources used by Point Lay are listed by common species name, Inupiaq name, and scientific name in Table III-18. Point Lay's specific subsistence-harvest areas for major subsistence resources are depicted on Maps 67and 68. The Point Lay seasonal subsistence round is shown in Figure III-03.

In 1992, the NSB surveyed its eight communities on subsistence harvests, but obtained insufficient data on species taken at Point Lay, so current harvest levels could not be estimated. Enough data was gathered to develop a picture of household participation in various subsistence activities though. These results are displayed in Table III-21 (Fuller and George, 1997).

Gregg Tagarook, hunter and elder from Wainwright, had this to say about weather and hunting conditions in Kasegaluk Lagoon:

> I grew up on Barter Island for a long while. I was at Wainwright and lived in Pt. Hope for 14 years. I know a little bit about how things travel, and I've been taught by different community elders, and one elder has said something I never forgot. I'm grateful that I understand a place called Kasegaluk. Our older generation has observed Kasegaluk and said the north wind would blow hard and the current would be strong but this would never change. I understand the hard times and the older generations would take their families out there for camping. When there is nothing dangerous there, I want to say in hunting in fall and mid-winter there would be some shallow spots and the upper part of it would be good. Around there it is dangerous. When the wind is coming from the west, the shore ice would come off from the shore. That is west of Wainwright. A place called Mikigealiak. When it was a west wind, we dared not be out there hunting because it is dangerous. We were saying that the oil industry should know about these conditions that occur when the west wind is blowing in that area because the ice is very strong. North northwest wind. That's that wind 90 miles west of here. (Alaska Traditional Knowledge and Native Foods Database, Northwest Arctic Regional Meeting, Sept. 1998 [UAA, ISER, No date]).

(a) Bowhead Whales

Unlike the communities of Wainwright, Barrow, and Nuiqsut, bowhead whaling is not practiced in Point Lay, primarily because spring ice leads are too far offshore of the barrier island/lagoon environment of the community. The unique environmental challenges presented by the physical setting at Point Lay have kept bowhead whaling from appearing in the more modern seasonal subsistence round. Bowhead whales were taken traditionally, but there has not been a bowhead taken in the village since it was resettled in 1972. In fact, no bowheads have been taken in the area since 1941 (S.R. Braund and Assocs., 1988; Impact Assessment, Inc., 1989). More recently, a few Point Lay men participated in the bowhead whale hunt by traveling to Point Hope, Barrow, and primarily Wainwright, to whale with local bowhead whaling crews (Impact Assessment, Inc., 1989).

Dorcas Neakok, interviewed in 1988 and 1989, recounted early whaling at Point Lay:

> People don't hunt whales at Point Lay. But Tony Joule put a whaling crew out when I was a teenager here [1930's]. Amos Agnasagga's uncle Alvy was adopted to Shaglook, so his name is Alvy Shaglook. He lives in Kotzebue now. Well, this uncle had two skin boats here. Tony Joule got a crew together for each of those boats.
>
> The open lead was way out, so they had to travel far. I don't know how many miles out they had to go. You couldn't see land from out there - only the mountains way to the south. Maybe twenty-five miles? They each got a whale, but it was tough work.
>
> They cut the whales in pieces in the water because there were not enough people here to pull them out. There were over a hundred people but that wasn't enough for those big whales. Everybody went out to help except a few women taking care of the babies back at the village. We had to cut fast so the whales wouldn't get smelly. They didn't have to cut little thing. Just what they could take home.
>
> All the students helped too. We did the cooking for the whalers and whatever had to be done. That was part of our schooling....All the dog teams were working hard. Every family had their own dog team because that was their only transportation. That's how I got tired out--hauling meat back and forth. Some of us took turns. The dogs would get so tired, they couldn't move anymore. We would stop and let them sleep. Then we'd start again. There must have been ten to twenty teams.
>
> That was the first time I saw much of a whale... (Impact Assessment, Inc., 1989).

(b) Beluga Whales

Point Lay's most important subsistence marine resource is the beluga whale and the community depends on this species more than any other Native community in Alaska. Beluga whale makes up more than 60 percent of the community's total annual subsistence harvest. A major community activity is a single cooperative hunt in the summer, principally in the first two weeks of July, on the outer coast of the barrier islands. Hunting is done in a few key passes between these islands where schools of belugas migrating north are known to feed, and within Kasegaluk Lagoon. Most hunting is concentrated south of the village in Kukpowruk and Naokok passes. Normally, when a pod is sighted, all available hunters herd the whales into the shallows of Kasegaluk Lagoon, near the old village, where they can be more easily shot and beached. They are swiftly butchered and shared equally by all participating hunters and throughout the community. Beluga is shared with other communities and may be exchanged for other subsistence foods hard to come by in Point Lay, such as bowhead whale. In 1983, the beluga harvest was reported to range from 3 to 30 whales annually, with a mean annual harvest of 13 (Davis and Thompson, 1984). In 1982, Point Lay harvested 28 belugas (Braund and Burnham, 1984) and in 1992 the estimated harvest was revised upward to 40 whales annually from 1983 to 1992 (Fuller and George, 1997). The relative contribution of beluga whale to the Point Lay subsistence harvest is shown in Figure III-08; for harvest seasons, see Figure III-03; for use area/habitat, see Map 67; for annual beluga harvest since 1982, see Table III-23; and for Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24 (USDOI, BLM, 1978d; ADF&G, 1996; Braund and Burnham, 1984).

According to hunters in Point Lay, belugas move slowly along the coast from Omalik Lagoon to Icy Cape while they feed. They move up the coast in two or three pulses and enter the passes in Kasegaluk Lagoon when the tide and current are going out. When they enter the lagoon, they stay in the deep channels near the inlets and do not go out a different inlet unless they are herded. Big, white adults lead the group and adults and young travel together. If belugas encounter ice, they retreat to the inlets until the ice is gone. If spooked, they will return when the disturbance has stopped. This beluga behavior is usually observed from late June to early July. Hunters say that the migration path taken by the belugas is determined by the first group to pass by. If the first group is disturbed, succeeding groups of whales may not come within hunting range. Hunters believe that this first pulse of belugas should not be interfered with. It must be left alone to establish the migration path which succeeding pulses of whales will follow, regardless of hunting activity (Huntington and Mymrin, 1996).

Beluga meat is dried and stored in the oil. The oil is aged and said to have medicinal properties. It is supposed to help sores heal quickly and is good for earaches (Huntington and Mymrin, 1996).

Dorcas Neakok had this to say about techniques for the beluga hunt at Point Lay:

> ...People still do that together--herd them up and hunt. We butcher them across the lagoon on the hill where it's not sandy. The mayor is in charge of dividing the beluga up for everyone in the village. We make a pile for each house and have to haul them up to the ice cellars because they spoil quick. I remember around 1980 we got lots of beluga. Those were happy days but lots of work. We were lucky. A few years we didn't get any beluga.
>
> People don't get beluga other places because they travel in the open lead with whales and sink easy in that deep water after shooting. We herd them to a shallow place in the lagoon so they can't sink. That's why lots of people want beluga. When we have enough, we send lots of bags and boxes to Barrow, Wainwright, and Kotzebue. But not this year; fourteen was not enough for the village. We could only send a little part (Impact Assessment, Inc., 1989).

(c) Walrus

Walrus are hunted from Icy Cape to the southern end of Kasegaluk Lagoon and as much as 20 mi offshore. In years with favorable ice conditions, walrus are harvested from the end of June until the end of July on ice floes 15 mi offshore moving northward with the prevailing coastal currents. If hunting is unsuccessful near the village, hunters will travel to Icy Cape and continue the hunt into August. In recent years, the traditional importance of walrus as food for dog teams has declined and walrus are now primarily hunted for human consumption. In years with good ice conditions, the harvest averages 10 to 15 animals. A 1987 subsistence survey recorded a harvest of 6 walrus by 25 households (out of 43 total households). From 1988 to 1997, 10 walrus were harvested, from a low of zero for the years 1988 to 1992, to a high of 4 in 1995 and 1996. For Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24; for annual walrus harvest numbers, see Table III-25; and for harvest seasons, see Figure III-03 (USDOI, BLM, 1978d; Braund and Burnham, 1984; ADF&G, 1996; Stephensen, Cramer, and Burn, 1994; Cramer, 1996, pers. comm.).

(d) Seals

Bearded seals (ugruk) and ringed seals are taken in the spring when they can be found sunning on the northward-moving ice. Point Lay hunters begin the spring sea mammal hunt south of the community because the first broken ice holding sea mammals appears there, usually in April. Seals can be killed and dressed out while the prevailing currents carry the hunters and their kills back (north) to Point Lay. In some seasons, if this process is unsuccessful, hunters will travel to Icy Cape where the sea ice grounds on shoals and concentrates the game.

Later in the season, hunters looking for bearded seals and walrus take ringed seals closer to the community. Bearded seal hunting occurs in June after spring sealing is over. Hunters search the broken ice for ugruk as far as 6 mi out, and they sometimes go farther if they are also looking for walrus. Spotted seals feed in Kasegaluk Lagoon in the summer and are harvested on the shores adjacent to the passes into the lagoon. They have valuable skins and do not sink when shot. They are available in the fall and all winter but are seldom taken during this season. The seal harvest area ranges from Cape Beaufort in the south to Icy Cape in the north. The annual harvest of bearded seals was estimated to range from 2 to 10 in 1984. A State of Alaska subsistence survey in 1987 recorded 13 taken. In the same 1987 survey, 25 households harvested 49 ringed seals and 53 spotted seals. For Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24; for harvest seasons, see Figure III-03 (USDOI, BLM, 1978d; ADF&G, 1996; Braund and Burnham, 1984).

With the introduction of the snow machine in the early 1980's and the decline in the use of dog teams, seal meat was no longer needed as dog food. In addition, because aluminum and wood boats replaced skin boats, ugruk skins were no longer in high demand. Further, as caribou from the WAH became more plentiful, the hunting preference shifted away from seals (Braund and Burnham, 1984).

Waldo Bodfish, interviewed in 1985, related this about past seal hunting at Icy Cape:

> There's a place they call Atigutitugvik. At the mouth of that little stream they put a net out here in early fall before freezeup and caught a lot of seals. There's a big bar right here about 200 feet long, right from here it's sticking out, and spotted seals always lay on that big bar right there by that point and also someplace in here. It's still there. And Taiugniqtuq, that means 'salty ocean.' And Avuk mound. The bar is right there. There's no (drinking) water there so you have to carry enough water to last you a few days. I always did that when I went hunting there, go across the lagoon and camp right on the spit, when I used to hunt spotted seals years ago.
>
> That's a good place for seining seals too, with a net. They always go there from every direction, sometimes more than 500 gathered there this time of the year, August. But when you shoot you have to hit one every time. If you miss they move some other place. These spotted seals are really spooky, they won't stay any place where there are people around, you know. They'll go away someplace.
>
> When the spotted seals are gathered somewhere along the coast they gradually move along to the south on those entrances all the way to below Point Lay, move along gradually and then go in and stay for a while and then go out and move along to another entrance. They do that every fall before freezeup. I've never told that to people who want to know about the coast, but I did this time so you'll know. As soon as the lagoon freezes up, they lay on top of the ice right back of the entrance, have a great time, and when the lagoon ice starts to get thick, they go out and move to another place farther south. The ones that want to stay just spend the whole winter under the ice, but they make breathing holes here and there and keep them open (Neakok et al., 1985).

(e) Fish

Fish is a valued resource in the subsistence economy. Fishing and time spent at fish camps is an important community activity for Point Lay residents. The most intense marine fishing with set gill nets starts in July and peaks in August. Chum, pink, and king salmon (rarely) are caught, as well as herring, smelt, flounder, Arctic char, grayling, and broad whitefish. In the fall, people move up the Kukpowruk and Utukok Rivers in family groups to fish camps where they net fish. When the ice hardens in the fall, they turn to jigging. Marine fishing takes place on the sea and lagoon shores of the barrier islands and along the mainland coast from Icy Cape to the south end of Kasegaluk Lagoon. Intensive use areas are found at Naokok Pass, near the old village, and on the shores near the present village site. For Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24; for harvest seasons, see Figure III-03 (USDOI, BLM, 1978d; Braund and Burnham, 1984; ADF&G, 1996).

Dorcas Neakok recounted this about subsistence fishing:

> We had lots of fun fishing when the village started again. Our house at fish camp was too small, so whoever wanted to follow brought their own gear and used tents. Fall is the only fishing time, October and part of November. There's grayling, dolly varden, silver fish, and dog salmon. You just have to get your hook out. It's freezing then so as you take the fish out they freeze (Impact Assessment, Inc., 1989).

(f) Polar Bears

In the short days of winter when the sea ice is solid, polar bears are sometimes taken, although they are hunted less actively than in the past when it was still legal to sell their skins. In 1983, local hunters saw few bears, but they had seen many in years past. In 1987, a State subsistence survey reported one polar bear taken by 25 households (out of a total of 50 households). The community harvest figures for polar bear from 1983 to 2001 are shown in Table III-26. For Point Lay's 1987 Subsistence-Harvest Summary, see also Table III-24; for harvest seasons, see Figure III-03 (USDOI, BLM, 1978d; Braund and Burnham, 1984; ADF&G, 1996).

Dorcas Neakok related these details of the trapping era:

> Most of our living was off the land from Warren's [her husband] trapping. Fur prices weren't much in those days. Fox were fifteen to thirty buck depending on how clean they were. Polar bear was pretty good, five to ten dollars a square foot. There was quite a bit of polar bear but not as many as right now. Sometimes they travel eight in a bunch now. It looks like the whole family with young ones and old ones (Impact Assessment, Inc., 1989).

Kate Petersen said this about polar bear hunting:

> We moved to Point Lay because there was no work. My husband Dan Susook hunted polar bear. He always killed those. They used to sell the skins for good money. Now people can't sell polar bear (Impact Assessment, Inc., 1989).

(g) Caribou

In the early 1970's, when resettlement occurred, caribou was Point Lay's single most important subsistence food source; but in the intervening years, beluga whale has supplied the greater amount of food. After beluga hunting, caribou hunting had the next highest participation percentage (for Point Lay's household participation in various subsistence activities, see Table III-21). Hunters prefer hunting in late summer and fall, during the months of August, September, and October, when the animals are fat and the males have yet to rut. Caribou are available in winter and are sometimes taken then. When caribou populations plummeted in the 1970's and strict harvest regulations were imposed, the community had difficulty making dietary adjustments; it could not rely on bowhead whales because of limited accessibility, or on the area's limited fish resources (streams and rivers in the area are small and only marginally important in terms of area fish production [Craig, 1984]). For Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24 ; for harvest seasons see Figure III-03 (USDOI, BLM, 1978d; ADF&G, 1996; Fuller and George, 1997).

(h) Waterfowl

Migratory birds (and their eggs) are an important food source for Point Lay residents, supplying them with their first source of fresh meat when ducks and geese migrate north in the spring. Eider ducks and geese migrate coastally while other types of geese follow major river drainages. Hunting is usually done from the edge of the spring ice leads during May when hunters are looking for seals. In late August and early September, geese are again hunted as they fly south. Eider and oldsquaw are the most hunted ducks, while brant and Canada geese are the primary geese species. Ptarmigan can be taken all year and, like caribou, are available during the winter months. For Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24; for harvest seasons, see Figure III-03 (USDOI, BLM, 1978d; Braund and Burnham, 1984; ADF&G, 1996).

Dorcas Neakok remembers:

> I would walk across from Kali [Old Village] to this area where the village is now for ptarmigan. This was way before DEW-line came in. I used a shotgun or .22 and put lots of winter ptarmigan in a sack in the ice cellar. We'd eat those in the springtime because they don't store away long like ducks. Summer and falltime we'd hunt fresh new ptarmigan (Impact Assessment, Inc., 1989).

(i) Other Resources

In spring, ground squirrel and wolverine come out of hibernation and they are actively hunted; grizzly bear are sometimes taken in spring as well. Late summer is the best time for berry picking; mussels, clams, and other invertebrates are also gathered at this time. With the onset of winter, trapping and hunting for fox, wolverine, and wolf begin (for Point Lay's 1987 Subsistence-Harvest Summary, see Table III-24; for harvest seasons, see Figure III-03; USDOI, BLM, 1978d). Data for Point Lay's household consumption of subsistence resources, changes in subsistence activities, and expenditures on subsistence for 1998-1999 (as derived from a NSB economic profile and census conducted in 1998-1999; NSB, 1999) are displayed in Figure III-09, Figure III-10, and Figure III-11, respectively.

Dorcas Neakok had this to say about medicinal plants when interviewed in 1988 and 1989:

> What else did the old people do? They used plants, the leaves and little flowers. They put it in water and drank the plants for colds or sore throats. I never really got to see that kind. The first time I tried any of those plants was yesterday. Somebody gave me a certain kind of leaf [artemesia, stinkweed] for my swollen knee. It's been hurting, and I couldn't even bend it.

> Last night I wrapped those leaves on top and went to sleep. Now, today, I can bend it. It sure helped. I don't feel my knee hurting. It's like those leaves sucked it out. They told me I can even pick the leaves in the wintertime when they're dried up. I never believed much in those myself-'till I tried it now. I'm going to start collecting them... (Impact Assessment, Inc., 1989).

(2) Wainwright

The community of Wainwright, with a population of 492 in 1990 and 546 in 2000 (USDOC, Bureau of the Census, 1991 and 2001), enjoys a diverse resource base that includes both terrestrial and marine resources. The city sits on the Chukchi Sea coast about 100 mi southwest of Barrow. Marine subsistence activities focus on the coastal waters from Icy Cape in the south to Point Franklin and Peard Bay in the north. The Kuk River lagoon system--a major marine estuary--is an important marine and wildlife habitat used by local hunters. Wainwright is situated near the northeastern end of a long bight that affects sea-ice conditions as well as marine-resource concentrations. Wainwright's terrestrial subsistence-harvest area is within the boundaries of the Northwest NPR-A Planning Area and any Chukchi Sea coastal landfall developed for exploration would be adjacent to marine subsistence harvest areas.

Lydia Agnasagga gave this testimony at a local public hearing in 1987 for MMS' Chukchi Sea Lease Sale 109:

> We live on subsistence, and everybody knows that...especially on the Arctic Coast. We live mainly on the animals from the sea and from the land, as well, and we can't very well live without those...our food because we didn't grow up with beef or anything like that, and I can say that everything costs so much nowadays. It's hard to try to live just by buying...store-bought food, and that's the reason why I'm concerned about this [lease sale] (USDOI, MMS, 1987c).

At the same hearing, Jim Allen Aveoganna related:

> I was raised [by] hunting only. My dad had never been working, just hunting for a living. And I raised my family half the time just by hunting, which I can say. That's how we live. Us older people here...we have lived just for [the] hunt. We were raised just by hunting only. No money, nothing. My dad never had been employed; only time he start employ[ment] was the time he was [an] old age citizen. So, that's how we lived (USDOI, MMS, 1987c).

(a) Bowhead Whales

Bowhead whales are Wainwright's most important marine resource; they are available in the Wainwright area beginning in late April (Figure III-04). Wainwright is not as ideally situated for bowhead whaling as Point Hope and Barrow. Ice leads often break far from shore and they are often wider than those near Barrow or Point Hope; multiple leads are common. Skin boats are used early in the season, when the leads are narrower (ACI/Courtnage/Braund, 1984). Because of the wider leads occurring later in the season, Wainwright whalers are likely to use aluminum boats to pursue bowheads farther offshore. There are approximately eight whaling camps along the edge of the landfast ice (ACI/Braund, 1984). In some years, these camps are 10 to 15 mi offshore. The bowhead whale harvest area delineated in Map 70 and Map 71 (Braund and Burnham, 1984; Kassam, 2001) indicates the harvest concentration areas over the past few years. Bowhead harvest areas vary from year to year, depending on where the open leads form; the distance of the leads from shore also varies from year to year (ACI/Courtnage/Braund, 1984).

From 1962 to 1982, the bowhead harvest accounted for 8.2 percent of the total annual subsistence harvest (an average of 1.5 whales taken each year) (Stoker, 1983). The annual bowhead harvest has not varied as much as the harvest of other subsistence resources. However, over the past 20 years, the number of whales taken has varied from 0 to 6, and the relative bowhead contribution to the total annual subsistence harvest has increased (see Table III-27). In a subsistence study conducted in Wainwright from 1988 to 1989 (S.R. Braund and Assocs., 1989a), bowhead whales (4 whales harvested) accounted for 42.3 percent of total edible pounds harvested while marine mammals made up 70 percent of the total edible pounds harvested. Two whales were harvested during the 1989 to 1990 season. They composed 29 percent of the total edible pounds harvested (ADF&G, 2002). No bowheads were taken in 1992 and the marine mammal harvest was made up primarily of walrus, beluga whale, and ugruk (Fuller and George, 1997).

In local interviews with hunters, conducted by the Wainwright Traditional Council and University of Calgary researchers for the Mapping Human Ecology Project in Wainwright, one hunter said: "It makes you more like a human being when you catch a whale--makes you real proud. Nobody understands what that feels like" (Kassam and Wainwright Traditional Council, 2001).

A hunter interviewed for the same project stated that hunters generally prefer small whales because they are easier to work with and the maktak (skin and blubber) is softer. The whalers determine whale size by the size of their "noses": "If we see he's got a big high nose, then we know it's a big one. If you see one with a small nose and it disappears right away, we know that's a small one" (Kassam and Wainwright Traditional Council, 2001).

(b) Beluga Whales

Beluga whales are available to Wainwright hunters during the spring bowhead-whaling season (late April to early June); however, pursuing belugas during this time jeopardizes the bowhead whale so the beluga hunt occurs only if no bowheads are in the area. Belugas also are available later in the summer (July through late August) in the lagoon systems along the coast (Map 69 and Map 71). The reluctance of Wainwright residents to harvest belugas during the bowhead-whaling season means the community must rely on the unpredictable summer harvest for the major volume of the beluga whale harvest resource. Consequently, the relative importance of the beluga whale varies from year to year (Nelson, 1981; ACI/Courtnage/Braund, 1984). The annual average harvest of belugas (over 20 years from 1962-1982) is estimated at 11, or 2.7 percent of the total annual subsistence harvest (Stoker, 1983). In Braund's studies (1989a) and with UAA, ISER (1993), 2 whales were harvested, making up 1.1 percent of Wainwright's harvest in 1989. In 1990, no whales were harvested. Since 1990, the beluga harvest has ranged from 0 to 38 animals in 1998, while in 2001 23 whales were taken (Fuller and George, 1997) (see Table III-23).

In local hunter interviews conducted for the Mapping Human Ecology Project in Wainwright, one hunter stated:

> There were these two guys out there. They were watching the killer whales chasing the belugas, and the killer whale got one. And he talked to it in Eskimo and kind of high and mighty, and he said, 'Give me a piece of that beluga.' And the [killer] whales bit off a piece of it, bit off a chunk of it, went over, got near the edge of the ice, held out that piece of beluga in his mouth. His buddy seen that, and that guy who was asking for some was too scared, and pretty soon that killer whale just left.

Belugas are considered an unpredictable subsistence resource and some community members believe that marine boat traffic is pushing the belugas farther south. There are two pulses of beluga whales that go by Wainwright, one in early May and another in late June. Because people are focusing on the bowhead whale harvest in May, they only hunt belugas from the late June migration. Whales are communally hunted as in Point Lay. A group of boats will herd the whales into Kuk Lagoon where they are harvested in the shallow water (Kassam and Wainwright Traditional Council, 2001).

(c) Pacific Walrus

Walruses are present seasonally in Wainwright, with the exception of a few that overwinter in the area. The peak hunting period occurs from July to August (Figure III-04) as the southern edge of the pack ice retreats. In late August and early September, Wainwright hunters occasionally harvest walrus that are hauled out on beaches. The focal area for hunting walruses is from Milliktagvik north to Point Franklin. However, hunters prefer to harvest walruses south of their communities (Map 65, Map 69, and Map 71) so northward-moving pack ice can carry the hunters toward home while they butcher their catch on the ice. This northward-moving current also helps the hunters return home in their heavily loaded boats (Nelson, 1981). The annual average harvest (over 20 years from 1962-1982) is estimated at 86 walruses, or 18.5 percent of the total annual subsistence harvest (Stoker, 1983). In Braund's 1989a study, walrus composed 17.6 percent of the total harvest and in 1989 they accounted for 33.7 percent of the total harvest (1989a) (for the number harvested, see Table III-22). Since 1989, the annual walrus harvest has ranged from 0 to 153 animals (see Table III-25). In 1992, 82 walrus were harvested, composing 25 percent of the total subsistence harvest (Fuller and George, 1997).

In hunter interviews conducted for the Mapping Human Ecology Project in Wainwright, a hunter related:

> Long ago, the walrus was hunted 15 to 20 miles out. It was a long way to haul a heavy walrus back. We had to fill the canoes with walrus, the hides--no bones. The only bones you carried on those canoes were the tusks. You take all the meat off and sink the carcass for the rest of the animals. When they got through butchering the walrus, they would say: 'I hope we have calm weather for the trip home.' That's what they would say to animals, 'hope it is calm all the way home.' And they would usually come in on a calm day.

Many people still eat walrus kauk (the breast portion), meat, and blubber, and fewer consume the heart, kidneys, intestine, and liver (Kassam and Wainwright Traditional Council, 2001).

(d) Seals

Wainwright residents hunt four seal species--ringed, spotted, ribbon (all hair seals), and bearded seals. Ringed seals (the most common species) are generally available throughout the ice-locked months. Bearded seals are available during the same period, but they are not as plentiful. Although they are harvested less frequently, spotted seals are common in the coastal lagoons during the summer; most are taken in Kuk Lagoon. Ribbon seals occasionally are available during the spring and summer months. Ringed and bearded seals are harvested most intensely from May through July (ACI/ Courtnage/Braund, 1984). Most ringed seals are harvested along the coast from Milliktagvik to Point Franklin, with concentration areas along the shore from Kuk Inlet southward to Milliktagvik and from Nunagiaq to Point Franklin. Migrating seals are most concentrated at Qipuqlaich, just south of Kuk Inlet (Map 69 and Map 71) (Nelson, 1981).

The bearded-seal harvest is an important subsistence activity in Wainwright because it is a preferred food and the skins are used as covers for the whaling boats (ACI/Courtnage/Braund, 1984). The best harvest areas for bearded seals are on the flat ice south of Wainwright, off Qilamittagvik and Milliktagvik and beyond, towards Icy Cape (Nelson, 1981). Although no annual harvest data was available for bearded seals in the 1962-1982 twenty-year-average computation, the annual average subsistence harvest (over 20 years from 1962-1982) is estimated at 250 seals, or about 12.3 percent of the total annual subsistence harvest (Stoker, 1983). In 1988, Braund (1989a) documented that 97 bearded seals were harvested, accounting for 6.6 percent of the marine-mammal harvest that year. One hair seal harvest during the past 20 years is estimated at between 250 and 1,600 seals. In recent years, approximately 250 hair seals have been harvested each year. In 1989, Braund recorded 98 hair seals (ringed and spotted), composing 1.1 percent of the total marine-mammal harvest (1989a). For 1989 harvest numbers, see Table III-22.

Traditionally, ringed and bearded seals were widely harvested. Today ugruk (bearded seal) is the most sought after species and ringed seal is not considered as important. The ugruk is considered a mainstay subsistence resource and is prized for its fat and meat. It is harvested from spring through fall. Smaller ugruk are preferred for their meat and the larger ones are considered best for rendering oil. Recently, some elders have commented that there is a change in the taste and texture of ugruk meat and oil. The meat has a stronger taste when boiled and the oil rendered from the blubber is not white (Kassam and Wainwright Traditional Council, 2001).

(e) Fish

Wainwright residents harvest a variety of fishes in most marine and freshwater habitats along the coast and in lagoons, estuaries, and rivers. The most important local fish harvest occurs from September through November (Figure III-04) in the freshwater areas of the Kuk, Kugrua, Utukok, and other river drainages (Craig, 1987; see Map 69). Ice fishing for smelt and tomcod (saffron cod) occurs near the community, primarily during January, February, and March. In the summer months, Wainwright residents harvest Arctic char, chum, and pink salmon, Bering cisco (whitefish), and sculpin along the coast and the lower portions of Kuk Lagoon (Nelson, 1981; ACI/Courtnage/Braund, 1984). The most common species harvested in the Kuk River system are Bering cisco and least cisco, grayling, lingcod, burbot, and rainbow smelt. Other species that are harvested less frequently along the coast (in some cases in estuaries or freshwater) include rainbow smelt, flounder, cisco, saffron cod, arctic cod, trout, capelin, and grayling (Nelson, 1981; Craig, 1987). Marine fishing is conducted from Peard Bay to Icy Cape and in Kuk Lagoon.

During the period 1969 to 1973, the annual fish harvest was about 3,800 lbs The annual per capita fish catch was 9 lbs. (The ADF&G cautions that this data was not systematically collected or verified [Craig, 1987].) Stoker (1983, as cited by ACI/Braund, 1984) uses this data and lists fish as a minor resource in the total harvest of Wainwright subsistence resources (approximately 0.8% of the annual harvest averaged over 20 years). Fish were the third-largest source of subsistence foods and the third-most-important species harvested in Wainwright in 1981. In Braund's study, fish made up 3.9 percent of the total harvest in 1989, with whitefish and least cisco the most important. In 1990, fish accounted for 4.9 percent of the total harvest, with least cisco and rainbow smelt again the most important species (S.R. Braund and Assocs., 1989a; S.R. Braund and Assocs. and UAA, ISER, 1993). For the 1989 harvest numbers, see Table III-22.

This increase in the importance of fish resources can be attributed to: 1) the increase in the importance of fish as a subsistence resource because snow machines and motorized skiffs have made distant fish camps more accessible; and 2) a value change that has stimulated the residents' interest in fishing and camping away from the community (Nelson, 1981). The fish harvest plays an important role in strengthening kinship ties in the community (Nelson, 1981; ACI/Courtnage/Braund, 1984). In addition, fish are a crucial resource when other resources are less abundant or unavailable and, over time, fish are a more reliable and stable resource (Nelson, 1981). Fuller and George (1992) estimated that fish resources made up 8.8 percent of the total subsistence harvest in 1992.

In interviews conducted in Wainwright for the Mapping Human Ecology Project, community members said that fish taste best in the fall, during caribou hunting season. Fish harvested during this season are whitefish, lingcod, salmon, and grayling. "Winter fishing takes place before the ice is too thick to cut through." The community noted that recently there seems to be more salmon in local rivers. Historically, chum salmon was the only variety caught, but recently people have reported catching king, chum, Coho, and sockeye (Kassam and Wainwright Traditional Council, 2001).

(f) Polar Bears

Polar bears are generally harvested along the coastal area in the Wainwright region, around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island (Nelson, 1981; Map 71). Wainwright residents hunt polar bears primarily in the fall and winter, less frequently in the spring, and rarely in the summer (Figure III-04). Polar bears account for a small portion of the Wainwright subsistence harvest, with an annual average (over 20 years) of 7 harvested, or 1 percent of the annual subsistence harvest (Stoker, 1983). Braund found that polar bears made up 1.4 percent of the total harvest in 1989 and 1.7 percent in 1990 (S.R. Braund and Assocs., 1989; S.R. Braund and Assocs., and UAA, ISER, 1993). For the 1989 number harvested, see Table III-22. Since 1972, the prohibition of the commercial sale of polar bear hides has diminished the intensity of the harvest. Even so, the pursuit of polar bears continues to be an important manifestation of Inupiat traditional skills and an expression of manhood in a society that places an extremely high value on hunting as a way of life (Nelson, 1981). The annual numbers of polar bears harvested in Wainwright from 1983 to 2001 are shown in Table III-26.

Since the sale of polar bear hides was banned in the late 1970's, the local harvest of polar bear has declined. Some local hunters believe that, "Inupiat were paying the price for the over harvesting of polar bears by non-Native hunters, who used Cessna aircraft." Most of the bears hunted since the ban are normally bears that have come too close to the community and appear to be threatening. Polar bears are no longer specifically harvested for subsistence reasons. Because of changing ice conditions (ice forms later in the season) bears are more commonly trapped on land and cannot reach the ice to hunt for seal. Community members believe that many bears are starving because of this change in ice conditions (Kassam and Wainwright Traditional Council, 2001).

(g) Caribou

Caribou is the primary source of meat for Wainwright residents. Before freezeup, caribou hunting is conducted along the inland waterways, particularly along the Kuk River system. During the winter, most of the herd moves inland to the Brooks Range and then south of the North Slope, but some caribou remain near the coast. During the spring, the herd returns and concentrates near the Utukok and Colville River headwaters. In June, the herd follows major stream and river drainages toward the coast (Nelson, 1981). Wainwright's caribou harvest area is displayed on Map 65 and Map 69. An annual average (over 20 years from 1962-1982) of 1,200 caribou was harvested (Stoker, 1983), accounting for 51.6 percent of the total annual subsistence harvest. Caribou are available throughout the year, with a peak harvest period from August to October (Figure III-04). In Braund's 1989 study in Wainwright, caribou made up 23.1 percent of the total harvest, and in 1990 they composed 23.7 percent of the total harvest. In 1992, 748 caribou were harvested, representing 34.3 percent of the annual subsistence harvest (1989a, 1993; Fuller and George, 1997). For 1989 harvest numbers, see Table III-22.

In interviews conducted in Wainwright for the Mapping Human Ecology Project, one hunter stated that, "He and his brother were hunting one time, and they happened to shoot the first caribou on the wrong side of the river. The rest of the migrating caribou stopped on that very spot and stayed there for a few days. He believed that they had no tracks to follow, and they were not sure which way to go. He and his brother decided that they would never shoot those first caribou again. These first caribou are the lead caribou and mark the route for the rest of the migrating herd." A caribou killed in winter is covered with snow and left for a few days. It is propped up in a sitting position because the meat is said to "taste like dung if the animal is not sitting on its haunches." Some older hunters do not skin or gut a caribou killed at this time, believing that leaving it intact "sweetens the meat." The heat produced by leaving the carcass intact is said to partially cook the meat and innards. After a couple of days, the animal is skinned, cleaned, and taken back to the community and eaten as quaq (frozen meat). Over the last 50 years, hunters contend that caribou have become tamer and many do not migrate but instead spend the entire year in the Wainwright area (Kassam and Wainwright Traditional Council, 2001).

(h) Waterfowl

The migration of ducks, murres, geese, and cranes begins in May and continues through June. The waterfowl harvest is initiated in May at whaling camps and continues through June (Figure III-04). Hunting decreases as the bird populations disperse to their summer ranges. During the fall migration south, the range is scattered over a wide area (Map 65 and Map 69) and, with the exception of Icy Cape, hunting success is limited (ACI/Courtnage/Braund, 1984). Wainwright residents annually harvest an estimated 1,200 lbs of birds (averaged over 20 years from 1962-1982), or about 0.3 percent of the total annual subsistence harvest (Stoker, 1983). In 1989, Braund reported that birds were 2.4 percent of the total harvest and geese were 2.0 percent of the total bird harvest; in 1990, birds were 2.1 percent of the harvest (S.R. Braund and Assocs., 1989a; S.R. Braund and Assocs. and UAA, ISER, 1993). For 1989 harvest numbers, see Table III-22. Although the volume of waterfowl meat is a relatively small portion of the total subsistence harvest, waterfowl hunting is a key element in Wainwright's subsistence routine. Like fishing, bird hunting is highly valued in social and cultural terms. Waterfowl dishes are an essential part of community feasts prepared for holidays such as Thanksgiving and Christmas (Nelson, 1981). Fuller and George (1992) estimated that birds made up 4.5 percent of the total subsistence harvest in 1992.

Because the bowhead harvest and spring bird hunting periods overlap, hunters sometimes have to choose between the two activities. At whaling festivals following a successful bowhead harvest, geese are traditionally served as well. It is often the friends and relatives of a whaling captain who take care of providing geese for the feast. When harvesting eider ducks, residents try to avoid killing spectacled and Steller's eiders because they are aware that they are threatened and endangered species; nevertheless, they admit that some are killed when they happen to be flying in a flock of common or king eiders. With brant, hunters prefer the taste of spring birds because they have not yet begun to eat sea grasses and seaweed. Many hunters do not the like new Federal regulations requiring the use of steel shot, claiming that it does not bring down geese as well as lead shot (Kassam and Wainwright Traditional Council, 2001).

(3) Barrow

As with other communities adjacent to the Planning Area, Barrow residents (population 3,469 in 1990, 3,908 in 1993, 4,641 in 1998, and 4,581 in 2000 [USDOC, Bureau of the Census, 1991 and 2001; NSB, 1995, 1999]) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location is unique among the communities in the Northwest NPR-A Planning Area; the community is a few miles southwest of Point Barrow, the demarcation point between the Chukchi and Beaufort seas. This location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes. Barrow's subsistence-harvest area is depicted on Map 72 and Map 73. Subsistence resources used by Barrow are listed by common species name, Inupiaq name, and scientific name in Table III-18. Specific subsistence-harvest areas for major subsistence resources for Barrow are shown on Map 73. Barrow harvest sites recorded by Braund from 1987 through 1990 are shown on Map 72 (S.R. Braund and Assocs. and UAA, ISER, 1993), and known Barrow hunting and fishing camps are depicted on Map 74.

(a) Bowhead Whales

Barrow residents hunt the bowhead whale during spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season (Figure III-05). In 1977, the International Whaling Commission (IWC) established an overall quota for subsistence hunting of the bowhead whale by the Alaskan

Inupiat. The quota is regulated by the Alaska Eskimo Whaling Commission that annually decides how many bowheads each whaling community may take. At the May 2002 meeting of the IWC, Japan led a vote by member countries denying the Alaskan Inupiat bowhead quota. North Slope whalers pursued diplomatic measures through the State Department to conduct another vote on the bowhead quota and were successful in getting the quota restored (Kizzia, 2002; Kizzia and O'Harra, 2002; Dobbyn, 2002; Gay, 200). In the past, Barrow whalers continued their hunt in the fall to meet the quota and to seek strikes that have been transferred to the community from other villages from the previous spring hunts. During the spring hunt, there are approximately 30 whaling camps along the edge of the landfast ice. The locations of these camps depend on ice conditions and currents. Most whaling camps are located south of Barrow, some as far south as Walakpa Bay. Typically, Atqasuk whalers participate in the subsistence bowhead hunt by joining Barrow whaling crews.

Depending upon the season, the bowhead is hunted in two areas. In the spring (from early April until the first week of June), the bowheads are hunted from leads that open when pack-ice conditions deteriorate. At this time, bowhead whales are harvested along the coast from Point Barrow to the Skull Cliff area and the distance of the leads from shore varies from year to year. The leads are generally parallel and quite close to shore, but occasionally they break directly from Point Barrow to Point Franklin and force Barrow whalers to travel over the ice as many as 10 mi offshore seeking open leads. Typically, the lead is open from Point Barrow to the coast and hunters seek whales 1 to 3 mi from shore. A stricken whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats because the narrow leads prohibit the use of aluminum skiffs, which are more difficult to maneuver than the traditional skin boats (ACI, Courtnage, and Braund, 1984; S.R. Braund and Assocs. and UAA, ISER, 1993). Fall whaling occurs east of Point Barrow from the vicinity of Barrow to Cape Simpson. Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water as many as 30 mi offshore.

No other marine mammal is harvested with the intensity and concentration that is expended on the bowhead whale. Bowheads are very important in the subsistence economy. From 1962-1982 bowhead whales accounted for 21.3 percent of the annual subsistence harvest (ACI, Courtnage, and Braund, 1984), for an average of 10.1 whales/year. From 1987 through 1990, Braund (S.R. Braund and Assocs. and UAA, ISER, 1993) conducted a 3-year subsistence study in Barrow. The number of subsistence species harvested by year and the 3-year average reported in the study are shown in Table III-28. During the last year of the study, harvest data indicated that 58.2 percent of the total harvest was marine mammals and 43.3 percent of the total harvest was bowhead whales (ADF&G, 1995b). For the number harvested, see Table III-29. As with all species, the harvest of bowheads varies from year to year; over the past 40 years, the number taken each year has fluctuated from 0 to 30 (see Map 75, Figure III-05, and Table III-27). In the memory of community residents, 1982 is the only year in four decades when a bowhead whale was not harvested (ACI, Courtnage, and Braund, 1984; S.R. Braund and Assocs. and UAA, ISER, 1993; Fuller and George, 1997; Braund, 2002, pers. comm.).

(b) Beluga Whales

Beluga whales are available from the beginning of the spring whaling season through June and occasionally in July and August in ice-free waters (Figure III-05). Barrow hunters do not like to hunt beluga whales during the bowhead hunt, preferring to harvest them after the spring bowhead season ends, which depends on when the bowhead quota is met. Belugas are harvested in the leads between Point Barrow and Skull Cliff. Later in summer, belugas are occasionally harvested on both sides of the barrier islands of Elson Lagoon. The annual average beluga harvest from 1962-1982 was estimated at 5 whales, or 5 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In Braund's 1993 study, there were no harvests of beluga whales in the three-year period of data collection (S.R. Braund and Assocs. and UAA, ISER, 1993; ADF&G, 1995b; see Table III-28). During the period 1982-1996, belugas were taken very rarely at Barrow, with an annual average of about one per year. Since 1987, the Alaska Beluga Whale Committee records 23 belugas taken by Barrow hunters, ranging from 0 in 1987, 1988, 1990, 1992, and 1995 to a high of 8 in 1997 (see Table III-23; ABWC, 2002; Fuller and George, 1997).

(c) Walrus

Walrus are harvested during the summer marine-mammal hunt west and southwest of Point Barrow to Peard Bay. Most hunters travel no more than 15 to 20 mi to hunt walrus. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August (Figure III-05). The annual average harvest from 1962-1982 was estimated at 55 walruses, or 4.6 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). Braund's 1987-1990 study (S.R. Braund and Assocs. and UAA, ISER, 1993; See Table III-28) indicates an increased walrus harvest, with an average annual harvest of 81 walrus, accounting for 9.0 percent of the total edible pounds of meat harvested during this period. Since 1990, the harvest has ranged from 7 to 206 animals (Table III-25) (Schliebe, 2002, pers. comm.; S.R. Braund and Assocs. and UAA, ISER, 1993; Fuller and George, 1997).

(d) Seals

Hair seals are available from October through June. However, because of the availability of bowheads, bearded seals, and caribou during various times of the year, seals are harvested primarily during the winter months, especially from February through March (see Figure III-05). Ringed seals are the most common hair seal species harvested, and spotted seals are harvested only in the ice-free summer months. Ringed seal hunting is concentrated in the Chukchi Sea, although some hunting occurs off Point Barrow and along the barrier islands that form Elson Lagoon. During the winter, leads in the area immediately adjacent to Barrow and north toward the Point make this area an advantageous spot for sealing. Spotted seals also are harvested occasionally off Point Barrow and the barrier islands of Elson Lagoon. Oarlock Island in Admiralty Bay is a favorite place for hunting spotted seals. From 1962-1982, the hair seal harvest ranged between 31 and 2,100 seals a year, with the average annual harvest estimated at 955 seals, or 4.3 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In the last year of Braund's 3-year Barrow subsistence study, ringed seals provided 2.1 percent of the total edible pounds harvested (S.R. Braund and Assocs. and UAA, ISER, 1993; ADF&G, 1995b). For the number harvested, see Table III-28.

The hunting of bearded seals (ugruk) is an important subsistence activity in Barrow because the bearded seal is a preferred food and because bearded sealskins are the preferred covering material for the skin boats used in spring whaling. About 6 to 9 skins are needed to cover a boat. For these reasons, bearded seals are harvested more than the smaller hair seals. Most bearded seals are harvested during the spring and summer and from open water during the pursuit of other marine mammals in the Chukchi and Beaufort seas (North Slope Borough, 1998). Occasionally, they are available in Dease Inlet and Admiralty Bay. No early harvest data was available for the number of bearded seals harvested annually; thus, the annual subsistence harvest averaged over 20 years from 1962-1982 was 150 seals, or about 2.9 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). Harvests from 1988-1989 were documented at 109 seals, providing 6.0 percent of the total edible pounds (S.R. Braund and Assocs. and UAA, ISER, 1993; Fuller and George, 1997). For the number harvested, see Table III-29.

(e) Fish

Barrow residents harvest marine and riverine fishes, but their dependence on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, trout, and whitefish are harvested (ACI, Courtnage, and Braund, 1984). Fishing occurs primarily in the summer and fall months and peaks in September and October (Figure III-05). Fishing also occurs concurrently with caribou hunting in the fall. Tomcod are harvested during the fall and early winter when there is still daylight (NSB, 1998). Primarily because Barrow residents supplement their camp food with fish whenever they are hunting, the subsistence-harvest area for fish is extensive.

Most fishing occurs at inland fish camps, particularly in lakes and rivers flowing into the southern end of Dease Inlet (Craig, 1987). Inland fish camps are found in the Inaru, Meade, Topagoruk, Chipp, Alaktak, and Ikpikpuk river drainages, and as far east as Teshekpuk Lake. At established fish camps, hunters place set nets for whitefish, char, and salmon. These camps provide good fishing opportunities as well as access to inland caribou and birds. When whitefish and grayling begin to migrate from the lakes into the major rivers in August, inland fishing intensifies. This also is the period of peak gathering of berries and greens (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984). From 1969-1973, the average annual harvest of fish was about 80,000 lbs (Craig, 1987); from 1962-1982, the estimated annual average was 60,000 lbs, which accounted for 6.6 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In a 1986 partial estimate of fish harvests for the Barrow fall fishery in the Inaru River, the catch composition was least cisco (45%), broad whitefish (36%), humpback whitefish (16%), arctic cisco (1%), fourhorn sculpin (1%), and burbot (0.5%) (Craig, 1987). In Braund's study (1993), 1989-1990 fish harvests provided 13.5 percent of the total edible subsistence harvest (S.R. Braund and Assocs. and UAA, ISER, 1993; Fuller and George, 1997). For the number harvested, see Table III-28.

(f) Polar Bears

Barrow residents hunt polar bears from October to June (Figure III-05). Polar bears make up a small portion of the Barrow subsistence harvest, with an annual average of 7.8 bears taken from 1962-1983, or 0.3 percent of the annual subsistence harvest (Schliebe, 1985; ACI, Courtnage, and Braund, 1984). From 1989-1990, 39 polar bears were harvested, providing 2.2 percent of the total edible pounds harvested (S.R. Braund and Assocs. and UAA, ISER, 1993; ADF&G, 1995b; see Table III-29). Barrow polar bear harvests from 1983-2001 are shown in Table III-26. Over this 18-year period, the average annual harvest was 21 animals (Fuller and George, 1997).

Data for household consumption of subsistence foods, changes in subsistence activity, and expenditures on subsistence activities in Barrow for 1998-1999 (derived from a NSB economic profile and census conducted in 1998-1999) (NSB, 1999) are displayed in Figure III-16, Figure III-17, and Figure III-18, respectively.

(g) Caribou

Caribou, the primary terrestrial meat for Barrow residents, are available throughout the year, with peak harvest periods from February through early April and from late June through late October (Figure III-05). The approximate boundary for Barrow's primary subsistence-harvest area for caribou, as reflected in research conducted in the late 1980's and early 1990's, extends southwest from Barrow along the Chukchi coast for roughly 35 mi, then runs south and eastward toward the drainage of the upper Meade River. It swings easterly, crossing the Usuktuk River and then trends north and east crossing the Topagoruk and Omalik rivers until it reaches Teshekpuk Lake. From here the boundary generally traces the coastline back to Barrow. (Note: The area described here is a boundary circumscribing reported harvest sites and does not represent a reported harvest area as such [S.R. Braund and Assocs. and UAA, ISER, 1993].) From 1962-1982, residents harvested an annual average of 3,500 caribou, accounting for 58.2 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). In the last year of Braund's 3-year Barrow subsistence study, caribou provided 22.2 percent of the total edible pounds harvested (S.R. Braund and Assocs. and UAA, ISER, 1993; ADF&G, 1995b; Fuller and George, 1997). For the number harvested, see Table III-28.

(h) Waterfowl

Migratory birds, particularly eider ducks and geese, provide an important food for Barrow residents. This is not because of the quantity of meat harvested or the time spent hunting them, but because of the dietary importance of birds as the first source of fresh meat in the spring. In May, geese are hunted and hunters travel great distances along major inland rivers and lakes to harvest them; most eider and other ducks are harvested along the coast (Schneider, Pedersen, and Libbey, 1980). Once harvested extensively, snowy owls are no longer taken regularly. Bird eggs are still gathered occasionally, especially on the offshore islands where foxes and other predators are less common. Waterfowl--hunted during the whaling season (beginning in late April or early May) when their flights follow the open leads--provide a source of fresh meat for whaling camps. Later in the spring, Barrow residents harvest many geese and ducks, with the harvest peaking in May and early June but continuing until the end of June (Figure III-05). Birds may be harvested throughout the summer, but only incidentally to other subsistence activities. In late August and early September, with peak movement in the first two weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eiders and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet. Concentrated hunting areas are also located along the shores of the major barrier islands of Elson Lagoon. During spring whaling, families not involved with whaling may go geese hunting; successful whaling crews also may be hunting geese while other crews are still whaling (NSB, 1998).

A favorite spot for hunting birds is the "shooting station" at the narrowest point of the barrier spit forming Point Barrow and separating the Chukchi Sea from Elson Lagoon. Barrow residents easily access this area, a highly successful hunting spot during spring and fall bird migrations. From 1962-1982, Barrow residents harvested an estimated annual average of 8,000 lbs of birds, which accounted for about 0.9 percent of the total annual subsistence harvest (ACI, Courtnage, and Braund, 1984). From 1989-1990, 29,215 lbs were harvested, accounting for 3.3 percent of the total edible pounds harvested (S.R. Braund and Assocs. and UAA, ISER, 1993; ADF&G, 1995b; Fuller and George, 1997). For the number of birds harvested, see Table III-28.

(4) Atqasuk

Atqasuk, population 216 in 1990 and 228 in 2000 (USDOC, Bureau of the Census, 1991, 2001), is an inland community within the Northwest NPR-A Planning Area. The marine-resource areas used by Atqasuk residents include those used by Barrow residents as explained in the Barrow discussion. Only a small portion of the marine resources used by Atqasuk residents is acquired on coastal hunting trips that are initiated in Atqasuk; most resources are acquired on coastal hunting trips initiated in Barrow or Wainwright with relatives or friends (ACI/Courtnage/Braund, 1984). The local connection with the coast and marine resources is important to the community. As one resident observed: "We use the ocean all the time, even up here; the fish come from the ocean; the whitefish as well as the salmon migrate up here" (ACI, Courtnage, and Braund, 1984).

Inland, there is less diversity of resources and subsistence opportunities are restricted to fewer species than those available on the coast and offshore. Atqasuk hunters harvest the community's key resources of caribou, fish, and migratory waterfowl, and some of the community's harvest areas overlap with those of Barrow. Areas used exclusively by the community and heavily used by local subsistence hunters are: the entire Meade River drainage, the Avalik River, the upper Okpiksak, the Topagoruk, and the Nigisaktuvik rivers (Schneider, Pedersen, and Libbey, 1980; S.R. Braund and Assocs. and UAA, ISER, 1993; NSB, 1998b). Atqasuk's subsistence-harvest area is displayed on Map 66. Subsistence resources used by Atqasuk are listed by common species name, Inupiaq name, and scientific name in Table III-18. Atqasuk's specific subsistence-harvest areas for major subsistence resources are depicted on Map 76. Levels of 1988 subsistence participation by Atqasuk households are shown in Table III-30.

(a) Fish

Fish is a preferred food in Atqasuk, although in an ACI, Courtnage, and Braund study (1984), respondents indicated that fish is the secondary resource in quantity harvested. Summer gillnetting, hook and line, late fall and winter jigging through ice, and winter gillnetting under the ice are the four common fishing techniques. The most productive season for gillnetting begins in June and runs to fall and early winter. Narvaqpak (southeast of Atqasuk) is a popular fishing area (NSB, 1998). Most fishing occurs along the Meade River a few miles from the village, but is also pursued in most rivers, streams, and deeper lakes of the region. Fish camps are also located on two nearby rivers, the Usuktuk and the Nigisaktuvik, and downstream on the Meade River near the Okpiksak River (Craig, 1987). The most prevalent subsistence-fishing activity is catching humpback whitefish and least cisco in gillnets. Also caught are broad whitefish, burbot, grayling, and chum salmon (only caught in some years), which are fished with gillnets and baited hooks, and by jigging (Craig, 1987). Fall and early winter are the preferred times for fishing, when water levels in the Meade River drop and the water becomes clearer. Nets are most commonly set close to the community. During the fall and winter, fishing continues under the ice in the Meade River and in nearby lakes (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984; S.R. Braund and Assocs. and UAA, ISER, 1993; NSB, 1998).

Humpback whitefish and least cisco accounted for 96 percent of the summer catch in 1983. The summer gillnet fishery in the Meade and Usuktuk rivers produced a harvest of approximately 8,450 lbs of fish. Adding catches with other gear (angling) and winter catches (1,100 lbs and 2,700 lbs, respectively), the total harvest was approximately 12,250 lbs. The annual per capita catch in 1983 was about 43 lbs for the 231 village residents (Craig, 1987). A subsistence-harvest survey conducted by the NSB Department of Wildlife Management (DWM) from July 1994 to June 1995 reported that fish harvests by Atqasuk hunters represented 37 percent of the total subsistence harvest in edible pounds (Opie, Brower, and Bates, 1997). For the number of fish harvested by month, see Table III-31.

(b) Caribou

Caribou is the most important resource harvested by Atqasuk residents. Although the late summer-early fall harvest is the most important, caribou are harvested every month of the year (Figure III-06). Caribou migration patterns and limited access prohibit hunting in the late spring and early summer. A subsistence-harvest survey conducted by the NSB DWM from July 1994 to June 1995 noted that 187 caribou were reported as having been harvested by Atqasuk hunters (approximately 57 percent of the total subsistence harvest in edible pounds) (Opie, Brower, and Bates, 1997). See Table III-31.

In recent years, the caribou population has been high, and Atqasuk residents have not had to travel far to hunt (distances are not available). Caribou are hunted by boat and snow machine and on foot from hunting camps along the Meade, Inaru, Topagoruk, and Chipp river drainages, which are used for fishing. Caribou hunting by snow machine involves considerable travel over a widespread area (Schneider, Pedersen, and Libbey, 1980; ACI, Courtnage, and Braund, 1984).

(c) Waterfowl

Atqasuk residents harvest migratory birds (especially white-fronted geese--the most common goose harvested by Atqasuk hunters) from late April through June when the geese begin to appear along rivers, lakes, and the tundra as they follow the snowline north (Figure III-06; NSB, 1998). This is also the time when ptarmigan are harvested and bears and moose appear, although moose are rare near Atqasuk (NSB, 1998). Waterfowl are hunted continually through June and July along the major rivers from late August through September on numerous lakes and ponds, as well as on the Meade River and its tributaries. Ptarmigan are also heavily hunted during the fall (NSB, 1998). Eggs are gathered in the immediate vicinity of the community for a short period in June (ACI, Courtnage, and Braund, 1984; S.R. Braund and Assocs. and UAA, ISER, 1993). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported that bird harvests by Atqasuk hunters represented 3 percent of the total subsistence harvest in edible pounds (Opie, Brower, and Bates, 1997). For the number harvested, see Table III-31.

Data for household consumption of subsistence resources, changes in subsistence activity, and expenditures on subsistence activities in Atqasuk for 1998-1999 (derived from an NSB economic profile and census conducted in 1998-1999) (NSB, 1999) are displayed in Figure III-19, Figure III-20, and Figure III-21, respectively.

(5) Nuiqsut

Specific harvest areas for wildfowl, caribou, moose, fish, whales, and seals for Nuiqsut are shown on Map 66, Map 77, and Map 78. The Inupiat community of Nuiqsut has subsistence-harvest areas in and adjacent to the Northwest NPR-A Planning Area. Nuiqsut's marine subsistence-harvest area is in the Beaufort Sea. Cross Island and vicinity is a crucially important region for Nuiqsut's subsistence bowhead whale hunting. Before oil development at Prudhoe Bay, the onshore area from the Colville River Delta in the west to Flaxman Island in the east and inland to the foothills of the Brooks Range (especially up the drainages of the Colville, Itkillik, and Kuparuk rivers) was historically important to Nuiqsut for the subsistence harvests of caribou, waterfowl, furbearers, fish, and polar bears.

Offshore, in addition to bowhead whale hunting, seals historically were hunted as far east as Flaxman Island. Also, commercial whaling near and within the barrier islands during the late 1800's has been documented (Thomas P. Brower, as cited in NSB, Commission on History and Culture, 1980). Bowheads also have been observed inshore of the barrier islands, and recent mention has been made of the area being used as a whale feeding area (V. Nauwigewauk, as cited in Shapiro, Metzner, and Toovak, 1979; Isaac Akootchook, as cited in USDOI, MMS, 1979a; Thomas P. Brower, as cited in NSB, Commission on History and Culture, 1980; Frank Long, Jr., as cited in Dames and Moore, 1996c; Burton Rexford, as cited in USDOI, MMS, 1996d; and Isaac Nukapigak, as cited in USDOI, MMS, Alaska OCS Region, 1998a).

Nuiqsut's population stood at 354 in 1990, 418 in 1993, 420 in 1998, and 433 in 2000 (USDOC, Bureau of the Census, 1991, 2001; NSB, 1995, 1999). Nuiqsut is located near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, important subsistence resources include bowhead whales, caribou, fish, waterfowl, ptarmigan and, to a lesser extent, seals, muskoxen, and Dall sheep. Polar bears, beluga whales, and walruses are seldom hunted but can be taken opportunistically while in pursuit of other subsistence species. A 1993 ADF&G subsistence study showed that nearly two-thirds of all Nuiqsut households received more than half their meat, fish, and birds from local subsistence activity (Pedersen et al., 1995, as cited in Fall and Utermohle, 1995). Nuiqsut's marine and terrestrial subsistence-harvest areas can be seen on Map 66 and Map 77. The preferred harvest periods for Nuiqsut are indicated in Figure III-07. A summary of subsistence resources in percentages of edible pounds harvested in the 1993 and 1994-1995 seasons can be seen in Table III-17.

Data for household consumption of subsistence resources, changes in subsistence activity, and expenditures on subsistence activities in Nuiqsut for 1998-1999 (derived from an NSB economic profile and census conducted in 1998-1999) (NSB, 1999) are displayed in Figure III-22, Figure III-23, and Figure III-24.

(a) Bowhead Whales

Even though Nuiqsut is not located on the coast but approximately 25 mi inland with river access to the Beaufort Sea, bowhead whales are a major subsistence resource. Bowhead whale hunting usually occurs between late August and early October, with the exact timing depending on ice and weather conditions. Ice conditions can extend the season up to two months, or condense it to less than two weeks. Unlike the Barrow spring whale hunt staged from the edge of ice leads using skin boats, Nuiqsut whalers use aluminum skiffs with outboard motors to hunt bowheads in open water. Generally, Nuiqsut residents harvest bowhead whales within 10 mi of Cross Island, but hunters may, at times, travel 20 mi or more from the island. Historically, the entire coastal area from Nuiqsut east to Flaxman Island and the Canning River Delta has been used, but whale hunting to the west of Cross Island has never been as productive. In addition, whale hunting too far to the east requires long tows of the whales to Cross Island for butchering, creating the potential for meat spoilage (Impact Assessment, Inc., 1990a).

In the past, Nuiqsut has not harvested many bowhead whales (20 whales from 1972-1995); however, the community's success has improved in the past few years. Unsuccessful harvests were more common in the 1980's, with no whales taken in 1984 and 1988. In the 1990's, the only unsuccessful year was 1994 (USDOI, MMS, 1996a; U.S. Army Corps of Engineers, 1998). For more information, see Map 78, Figure III-15, and Table III-27.

A 1993 ADF&G subsistence survey in Nuiqsut indicated that 31.8 percent of the total subsistence harvest consisted of marine mammals and 28.7 percent of the total harvest consisted of bowhead whales (ADF&G, 1995a; Fuller and George, 1997). For harvest numbers, see Table III-32 and Table III-33. The harvest of bowhead whales at Nuiqsut greatly affects the percentage of total harvest estimates because in years when whales are taken, other important subsistence species are underrepresented owing to the great mass of the total pounds of harvested whale.

Although in Nuiqsut bowheads are not the main subsistence resource in terms of edible pounds harvested per capita, they remain, as in other North Slope communities, the most culturally prominent to the Inupiat. The bowhead is shared extensively with other North Slope communities and often with Inupiat residents in communities as distant as Fairbanks and Anchorage. Nuiqsut Whaling Captains Association President, Frank Long, Jr., presented a history of Nuiqsut bowhead whaling and summarized major issues of concern in the *Proceedings of the 1995 Arctic Synthesis Meeting* (USDOI, MMS 1996d).

(b) Beluga Whales

Some sources have mentioned that beluga whales are taken incidentally during the bowhead harvest. However, Thomas Napageak, resident of Nuiqsut and Chairman of the Alaska Eskimo Whaling Commission, in recent testimony stressed that the village of Nuiqsut has never hunted beluga whales, "I don't recall a time when I went hunting for beluga whales. I've never seen a beluga whale here." (USDOI, BLM, 1998a).

(c) Walrus

The ADF&G subsistence-survey data indicates that two walruses were harvested in the 1985/1986 harvest season, but no new walrus data for the community has been gathered since then (ADF&G, 1993, 1995a). Walruses are probably incidentally taken during seal hunting.

(d) Seals

Seals are hunted year-round, but the bulk of the seal harvest takes place during the open-water season, with breakup usually occurring in June. In the spring, seals can be hunted once the landfast ice goes out. Present-day sealing is most commonly done at the mouth of the Colville River when it begins flooding in June. According to Thomas Napageak:

> ...when the river floods, it starts flowing out into the ocean in front of our village affecting the seals that include the bearded seals in the spring month of June....When the river floods, near the mouth of Nigliq River it becomes filled with a hole or thin spot in [the] sea ice that has melted as the river breaks up. When it reaches the sea, that is the time that they begin to hunt for seals, through the thin spot in the sea ice that has melted. They hunt for bearded seals and other types of seals (USDOI, BLM, 1998a).

Nuiqsut resident Ruth Nukapigak recounts past trips to this same sealing area:

> I love to follow my son Jonah every year just when the ice begins moving down there and it takes us one hour travel time to get there. That is where we go to hunt for seals (USDOI, BLM, 1998a).

Nuiqsut elder Samuel Kunaknana, interviewed in 1979, noted that when the ice is nearshore in the summer, it is considered to be good for seal hunting (S. Kunaknana, as cited in Shapiro, Metzner, and Toovak, 1979). While seal meat is eaten, the dietary importance of seals primarily comes from seal oil, served with almost every meal that includes subsistence foods. Seal oil is also used as a preservative for meats, greens, and berries. Also, sealskins are important in the manufacture of clothing and, because of their beauty, spotted seal skins often are preferred for making boots, slippers, mitts, and parka trim. In practice, however, ringed seal skins are used more often in the making of clothing, because the harvest of this species is more abundant.

A 1993 ADF&G subsistence survey in Nuiqsut indicates that 31.8 percent of the total subsistence harvest was marine mammals, and 3.1 percent of the total harvest was seals (ADF&G, 1995a). Fuller and George (1997) estimated 24 ringed seals, 6 spotted seals, and 16 bearded seals were harvested in 1992, and the overall marine mammal contribution (including bowhead whales) to the total subsistence harvest was estimated at 36 percent. A subsistence-harvest survey conducted by the NSB Division of Wildlife Management (DWM) covering the period from July 1994 to June 1995, reported a harvest of 23 ringed seals and a contribution of marine mammals of 2 percent to the total subsistence harvest, primarily because no bowhead whales were harvested that season (Brower and Opie, 1997; Brower and Hepa 1998).

(e) Fish

Fish provides the most edible pounds per capita of any subsistence resource harvested by Nuiqsut residents (see Table III-32 and Table III-33; ADF&G, 1993, 1995a). The harvests of most subsistence resources, such as caribou, can fluctuate widely from year to year because of variable migration patterns and because harvesting techniques depend on ice and weather conditions, much the same as the conditions surrounding the bowhead whale hunt. Even though fish-harvest rates (and total catch) vary from year to year, the harvest of fish is perhaps more consistent than the harvest of land animals. The harvesting of fish is not subject to seasonal limitations, a situation that adds to their importance in the community's subsistence round. Nuiqsut has had the largest documented subsistence fish harvest on the Beaufort Sea coast (Moulton, 1997; Moulton, Field, and Brotherton, 1986). Moreover, in October and November, fish may provide the only source of fresh subsistence foods.

Fishing is an important activity for Nuiqsut residents because of the community's location on the Nechelik Channel of the Colville River, which has large resident fish populations. The river supports 20 species of fish, and Nuiqsut residents take approximately half (George and Nageak, 1986). Local residents generally harvest fish during the summer and fall, but the fishing season runs from January through May and from late July through mid-December. The summer open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a greater area, is longer than the fall/winter harvest, and residents catch a greater number of species than at other times. Broad whitefish is the primary anadromous species harvested during the summer. Thomas Napageak relates that:

> ...in the summer when it is time to fish for large, round-nosed whitefish the place called Tirragruag is filled with them as well as the entrance to Itqiliq. Nigliq River gets filled with nets all the way to the point where it begins. We do not go to Kuukpiluk in the summer months. Then we enter Fish Creek...another place where they fish for whitefish is Nuiqsagruaq (USDOI, BLM, 1998a).

In July, lake trout, northern pike, broad whitefish, and humpback whitefish are harvested south of Nuiqsut. Traditionally, coastal areas were fished in June and July, when rotting ice created enough open water for seining. Nuiqsut elder Sarah Kunaknana, interviewed in 1979 said,

> ...in the little bays along the coast we start seining for fish (iqalukpik). After just seining one or two times, there would be so many fish we would have a hard time putting them all away (Shapiro, Metzner, and Toovak, 1979).

Salmon species have reportedly been caught in August but not in large numbers. Pink and chum salmon are the most commonly caught, although reports suggest there has not been a great interest in harvesting them (George and Nageak, 1986). Arctic char is found in the main channel of the Colville River but does not appear to be a major subsistence species because, although apparently liked, it is not abundantly caught (George and Nageak, 1986; George and Kovalsky, 1986; ADF&G, 1993, 1995a).

The fall/winter under-ice harvest of fish begins after freezeup, when the ice is safe for snow machine travel. Local families begin fishing approximately one month after freezeup. The Kuukpigruaq Channel is the most important fall fishing area in the Colville region and the primary species harvested are arctic and least cisco. Even after freezeup, people continue to fish for whitefish (Thomas Napageak [USDOI, BLM, 1998a]). Nuiqsut resident Ruth Nukapigak recounts a recent winter fishing trip in December 1997: "I, myself, took my net out in December right before Christmas Day. I was catching whitefish in my net." (USDOI, BLM, 1998a). Arctic and least cisco amounted to 88 percent and 99 percent of the harvest in 1984 and 1985, respectively; however, these percentages varied greatly depending on the net-mesh size. Humpback and broad whitefish, sculpin, and some large rainbow smelt also are harvested, but in low numbers (George and Kovalsky, 1986; George and Nageak, 1986). A fish identified as "spotted least cisco" has also been harvested. This fish is not identified by Morrow (1980) but could be a resident form of least cisco (George and Kovalsky, 1986). Additionally, weekend fishing for burbot and grayling occurs at Itkillikpaat, 6 mi from Nuiqsut (George and Nageak, 1986; ADF&G, 1995a).

A study conducted in 1985 estimated the summer catch for that season at about 19,000 lbs of mostly broad whitefish; in the fall, approximately 50,000 lbs of fish were caught, for an annual per capita catch of 244 lbs; some of this catch was shipped to Barrow (Craig, 1987). A 1985 ADF&G subsistence survey estimated a smaller per capita catch with the edible pounds of all fish harvested at 176.13 lbs per capita (44.1 percent of the total subsistence harvest; ADF&G, 1993). In 1986, there was a reduced fishing effort in Nuiqsut, and the fall harvest was 59 percent of that taken in 1985 (Craig, 1987). In 1992, 34 percent of the edible pounds of the subsistence harvest was fish and by 1993 the estimate for edible pounds of all fish harvested had risen to 250.62 lbs per capita (33.7 percent of the total subsistence harvest [George and Fuller, 1997; ADF&G, 1995a]). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported that subsistence fishing provided 30 percent of the total subsistence harvest (Fuller and George, 1997). For numbers harvested by month, see Table III-33; Brower and Opie, 1997; Brower and Hepa, 1998. A recent survey shows that 80 percent of all Nuiqsut households participate in some fishing activity (ADF&G, 1995a).

Fish are eaten fresh or frozen. Because of their important role as an abundant and stable food source and as a fresh-food source during the midwinter months, fish are shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Fish also appear in traditional sharing and bartering networks among North Slope communities. Because it often involves the entire family, fishing serves as a strong social function in the community and most Nuiqsut families (from a total 91 households in 1993) participate in some fishing activity (ADF&G, 1995b).

(f) Polar Bears

The harvest of polar bears by Nuiqsut hunters begins in mid-September and extends into late winter. Polar bear meat is sometimes eaten, although little harvest data is available. There is record of one bear harvested in the 1962-1982 period. For the period 1983-1995 Nuiqsut harvested 20 polar bears (Schliebe, 1995; ADF&G, 1993, 1995a; Brower and Opie, 1997; Brower and Hepa, 1998). According to whaling captain Thomas Napageak's statement at the Beaufort Sea Sale 144 Public Hearings in Nuiqsut, the taking of polar bear is not very important now because Federal regulations prevent the selling of the hide: "...as valuable as it is, [it] goes to waste when we kill a polar bear" (USDOI, MMS, 1995b). Polar bear harvests from 1983-2001 for Point Lay, Wainwright, Barrow, and Nuiqsut are shown in Table III-26.

(g) Caribou

Nuiqsut harvests several large land mammals, including caribou and moose. Of these, caribou is the most important subsistence resource. Caribou may be the most preferred mammal in Nuiqsut's diet and, during periods of high availability, provides a source of fresh meat throughout the year. Caribou-harvest statistics for 1976 show that 400 caribou provided approximately 47,000 lbs of meat for an estimated 90.2 percent of the total subsistence harvest (Stoker, 1983, as cited in ACI, Courtnage, and Braund, 1984; S.R. Braund and Assocs. and UAA, ISER, 1993). In 1985, an estimated 513 caribou were harvested, providing an estimated 60,000 edible lbs of meat (37.5 percent of the total subsistence harvest; ADF&G, 1993). Pedersen (unpublished data) in his unpublished report "Nuiqsut: Wild Resource Harvests and Uses in 1993" estimated a harvest of 270 caribou in 1985, as did Fuller and George (citing Pedersen) (1997). Fuller and George (1997) estimated that 278 caribou were harvested in 1992. An ADF&G subsistence study reported a harvest of 672 caribou for 1993, providing about 82,000 edible lbs of meat (30.6 percent of the total subsistence harvest). In 1993, 74 percent of Nuiqsut households harvested caribou, 98 percent used caribou, 79 percent shared caribou with other households, and 79 percent received caribou shares (ADF&G, 1995a). Harvests occurred at 16 locations with the highest harvest of 111 caribou at Fish Creek (Pedersen et al., 1995, as cited in Fall and Utermohle, 1995). Pedersen (unpublished data) estimated a harvest of 458 caribou in 1993, a number also cited in Fuller and George (1997). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported 249 caribou (258 if estimated for all households) harvested by Nuiqsut hunters, or 58 percent of the subsistence harvest in edible lbs. The report noted this as quite a low number of caribou when compared with estimated high harvest numbers for earlier years (Brower and Hepa, 1998). Fuller and George (1997) note that if the lower estmated harvest numbers are used the "...caribou harvest in 1992 was fairly typical for the village based on comparisons with past data" (Fuller and George, 1997:83; see Table III-33). Explanations for harvest fluctuations offered by local hunters were: 1) the need to travel longer distances to harvest caribou than in the past; 2) the increasing numbers of muskoxen (that hunters believe keep caribou away from traditional hunting areas); 3) restricted access to traditional subsistence-hunting areas because of oil exploration and development in these areas; and 4) disruption of caribou migration into traditional Nuiqsut harvest areas (Brower and Opie, 1997; Brower and Hepa, 1998; NSB, 2003).

Because of the unpredictable movements of the Central Arctic and Teshekpuk Lake caribou herds, and because of ice conditions and hunting techniques that depend on the weather, Nuiqsut's annual caribou harvest can fluctuate markedly. However, when herds are available and when weather permits, caribou are harvested year-round. Elders Samuel and Sarah Kunaknana related that caribou hunters in the past had to go inland to hunt caribou because they never came down to the coast as they do now (Shapiro, Metzner, and Toovak, 1979).

(h) Moose

Moose are normally harvested from August-October by boat on the Colville (upriver from Nuiqsut), Chandler, and Itkillik rivers; however, the timing for the harvest varies, depending on the current hunting regulations. Harvest data show that moose have been harvested during the winter months by snow machine (Brower and Opie, 1997). In 1985, hunters from 40 out of 76 surveyed households reported a harvest of 7 moose (ADF&G, 1993). In 1993, 62 of 91 households surveyed managed to harvest 9 moose (ADF&G, 1995a). A subsistence-harvest survey conducted by the NSB DWM covering the period from July 1994 to June 1995 reported 5 moose harvested, or 5 percent of the total edible pounds harvested that season (Brower and Opie, 1997; Brower and Hepa, 1998). In 1992, caribou and moose accounted for 27 percent of the total subsistence harvest (Fuller and George, 1997). In 1993, moose and caribou accounted for 33 percent (Pedersen, 1996) and in the period covered by the North Slope Borough subsistence survey (July 1994-June 1995), moose and caribou accounted for 63 percent of the edible lbs of subsistence resources harvested by Nuiqsut hunters (Brower and Opie, 1997; Brower and Hepa, 1998). This jump to a much higher percentage for terrestrial mammals is likely explained by an unsuccessful bowhead whale harvest during the study period (Suydam et al., 1994).

(i) Waterfowl

Waterfowl and coastal birds are a subsistence resource that has become increasingly important since the mid-1960's. Birds are harvested year-round, with peak harvests in May to June and September to October. The most important species for Nuiqsut hunters are the Canada and white-fronted goose and brant; eiders are harvested in low numbers. Ruth Nukapigak relates that,

> when the white-fronted goose come, they do hunt them. When the thin ice near the mouth of the river breaks up, that is when they start duck hunting. We, the residents of Nuiqsut, go there to hunt for ducks when they arrive (USDOI, BLM, 1998a).

The only upland bird hunted extensively is the ptarmigan (ADF&G, 1993, 1995a; Brower and Opie, 1997). Recent data indicates that the subsistence bird harvest has provided 5 percent of the total harvest (Brower and Opie, 1997; Brower and Hepa, 1998). Waterfowl hunting occurs mostly in the spring, beginning in May, and continues throughout the summer. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking fishnets.

(6) Other Subsistence Communities

Anaktuvuk Pass is an inland community south and east of the NPR-A. Subsistence-harvest areas for Anaktuvuk Pass are not within the Northwest NPR-A Planning Area. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the Planning Area; and movement by the TLH would bring it into the harvest area of Anaktuvuk Pass subsistence hunters (Map 66). Outside the North Slope, black brant that molt in the NPR-A have a substantial value to subsistence users in the Yukon-Kuskokwim (Y-K) Delta, and subsistence hunters in the Interior use Canada geese extensively.

Although subsistence users in many areas south of the Brooks Range utilize migratory waterfowl, by far the most important use is by Y-K Delta subsistence hunters. The Yup'ik Eskimo of the Y-K Delta sustain themselves by harvesting their subsistence mainstays of salmon, other fish, and seals. Waterfowl and other birds are important seasonal foods, particularly in the spring when they migrate to the delta. One of the most productive areas for geese worldwide, the Y-K Delta is home to all of the world's cackling Canada geese (65,000), nearly all of the emperor geese (59,000), about 80 percent of the world's Pacific black brant, and tens of thousands of white-fronted geese (107,000). In addition, almost 75 percent of Alaska's population of sandhill cranes breeds on the Delta (Wentworth and Andrews, 1988).

Large numbers of waterfowl breed, molt, and/or stage within or adjacent to the Northwest NPR-A Planning Area. Because most of these species migrate along the Pacific and Mid-Continent flyways and other major corridors to distant locations where they spend most of the year, subsistence hunters on the Y-K Delta are interested in their conservation and management.

Between 1985 and 1995, an estimated annual average of 97,000 birds was taken for subsistence use on the Y-K Delta. Six species of geese are hunted on the Y-K Delta for subsistence: Pacific white-fronted, lesser Canada, cackling Canada, emperor, black brant, and lesser snow goose. Tundra swans and sandhill cranes are the important species taken. The principal duck species are pintails, mallards, and scoters. Other duck species taken are scaup and oldsquaws, and king and spectacled eiders. Eighty-one percent of all birds harvested are taken before September 1 (Wentworth and Siem, 1996).

Of the total harvest, 26,000 (27%) were geese, 44,000 (46%) were ducks, 6,000 (6%) were swans, 3,000 (3%) were cranes, 16,000 (16%) were ptarmigan, and 2,000 (2%) were other birds (primarily loons, murres, shorebirds, and gulls). This represents an average of 33 harvested birds for every household on the Y-K Delta. Converted to usable weights, the subsistence harvest of birds provided an average of 280,000 lbs of food annually to Y-K Delta residents between 1985 and 1995, or about 95 lbs of food per Y-K Delta household (Wentworth and Siem, 1996).

(7) Subsistence Access Routes

In the often featureless plain characterizing much of the Planning Area during winter, topographic features such as river valleys, shorelines, large lakes, and the Beaufort and Chukchi Sea coastlines, as well as geological formations such as pingos, are crucial to the Inupiat in determining safe routes to subsistence-hunting sites. The Inupiat are skilled hunters with several millennia of experience with extreme terrain and weather conditions. During periods of severe weather, river valleys and shore banks offer some measure of protection to the traveler. If the weather is not too extreme and the river valley sufficiently well defined, a hunter can travel. During good weather, Inupiat hunters can steer off such features as meandering river bends that are familiar to them and transit between river drainages in the pursuit of game. Although fluvial features may define movement corridors, they should be considered as points from which general cross-country movement can and does occur.

In 1973, twenty-seven families from Barrow re-established the community of Nuiqsut. The Colville River valley and adjacent coastal lowlands compose a traditional Inupiat harvest zone that had been actively inhabited until the 1940's. The coastal Inupiat have historically used the Colville River as a link to the Interior. Beyond its function as an interregional link, the Colville River and its tributaries provide the people of Nuiqsut with an area rich in hunting, fishing, and trapping. Moose are hunted along the length of the river while summer fishing occurs in the delta (see Map 80, Historical Subsistence Access Routes on the North Slope).

Winter fishing occurs around the village and inland along Fish Creek. Caribou are taken throughout the range of Nuiqsut's coastal subsistence-harvest area and along the southern reaches of the Itkillik River well (Map 65 and Map 73). The principal watercourses west of the Colville used in the pursuit of subsistence resources are the Ublutuoch River and Judy and Fish creeks. Along the coastal plain, Nuiqsut hunters seem to favor the area between their community and Teshekpuk Lake. The lake is approximately 85 mi northwest of Nuiqsut, and subsistence hunters often circumnavigate it before returning home.

While hunting near Teshekpuk Lake, Nuiqsut hunters often encounter hunters from Barrow, which has the largest subsistence-hunting zone on the North Slope. It is believed that Barrow hunters use all of the depicted historical subsistence routes--and more--as shown on Map 80. Atqasuk is used as a base camp for Barrow hunters as they hunt toward and into the foothills of the Brooks Range. The Meade, Topagoruk, and Ikpikpuk rivers are used for navigation into the Interior. The Ikpikpuk River route is particularly important because it lies on the boundary of the Northwest NPR-A Planning Area. The Beaufort Sea shoreline guides Barrow hunters who use the smooth ice and the landfast-ice zone to reach Teshekpuk Lake. They often circumnavigate the lake and will often proceed to Nuiqsut to visit family members (Tremont, 1987; 1997, pers. comm.). Atqasuk subsistence hunters primarily use the Meade, Inaru, Topagoruk, and Chipp river drainages for caribou hunting and for fishing, but the extent of their subsistence-harvest area extends farther west toward the Chukchi coast and east toward the Omalik and Ikpikpuk rivers (USDOI, BLM, 1978c; Schneider, Pedersen, and Libbey, 1980). Wainwright hunters use the Kuk River as their route into the Interior. The Utukok and Kokolik river drainages are also important thoroughfares for Point Lay and Wainwright hunters in their pursuit of interior game and fish.

4. Sociocultural Systems

Sociocultural systems encompass the social organization and cultural values of a society. This section profiles the sociocultural systems characterizing the communities near and within the Planning Area that might be affected by activities discussed in this IAP/EIS. These communities are Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut. All of these communities are within the North Slope Borough (NSB).

The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Inupiat. Their populations and current socioeconomic conditions are discussed before the important variables in a sociocultural analysis--social organization, cultural values, institutional organization, and other ongoing issues--are considered.

Sociocultural systems of the North Inupiat are described and discussed in detail in the *Liberty Development and Production Plan Final EIS* (USDOI, MMS, Alaska OCS Region, 2002b), the *Beaufort Sea Sale 170 Final EIS* (USDOI, MMS, 1998), the *Northeast National Petroleum Reserve-Alaska Draft Integrated Activity Plan/EIS* (USDOI, BLM and MMS, 1998), the *Beaufort Sea Oil and Gas Development Project/ Northstar Final EIS* (U.S. Army Corps of Engineers, 1998), and the *Beaufort Sea Sale 144 Final EIS* (USDOI, MMS, 1996a). Sociocultural systems of the North Slope Inupiat also are described and discussed in the *Beaufort Sea Sale 97 Final EIS* (USDOI, MMS, 1987a), the *Chukchi Sea Sale 109 Final EIS* (USDOI, MMS, 1987b), and the *Beaufort Sea Sale 124 Final EIS* (USDOI, MMS, Alaska OCS Region, 1990). The following description is augmented by information from current studies, including Alaska Department of Fish and Game (ADF&G) (1996, 2002); Kassam (2001); USDOI, MMS (1996b,c); Fall and Utermohle (1995); City of Nuiqsut (1995); Alaska Natives Commission (1994); Human Relations Area Files (1994); S.R. Braund and Assocs. and UAA, ISER (1993); S.R. Braund and Assocs. (In prep.); Impact Assessment, 1989; Hoffman, Libbey, and Spearman (1988); Braund and Burnham (1984); Schneider, Pedersen, and Libbey (1980); and the USDOI, BLM's NPR-A 105(c) studies and other pertinent documents that accompanied the 105(c) analysis (USDOI, BLM, 1978a,b, and c; 1979b,c, and d; 1981; 1982a,b, and c; 1983a,b, and c; 1990; and 1991).

a. Characteristics of the Population

The North Slope has a homogeneous population of Inupiat; approximately 72.5 percent of the residents reported in 1990 that they were Alaska Native or American Indian, and 73.8 percent in 2000 reported they were all or part Alaska Native or American Indian. The Census did distinguish between Eskimo, Aleut, and Indian, although Inupiat, Yup'ik, Cup'ik, and Siberian Yup'ik were grouped together as "Eskimos"; "Indians" included numerous Athabascan tribes: Haida, Eyak, and Tsimsians. In 1990, 4,241 of the 5,979 residents of the NSB were Eskimo. The large majority was Inupiat. The percentage in 1990 ranged from 92.7 percent Inupiat in Nuiqsut to 61.8 percent Inupiat in Barrow (USDOC, Bureau of the Census, 1991). The percentages in 2000 ranged from 89.1 percent Inupiat in Nuiqsut to 64.0 percent Inupiat in Barrow (USDOC, Bureau of the Census, 2001). In 1990, the populations of each of the communities near the Planning Area were: 139 in Point Lay, 492 in Wainwright, 216 in Atqasuk, 3,469 in Barrow, and 354 in Nuiqsut (USDOC, Bureau of the Census, 1991). In 2000, 5,450 (73.8%) NSB residents reported they were all or part Alaska Native or American Indian. Although the Census did not differentiate between Eskimo, Aleut, and Indian, it asked a more specific question: the individual's "Alaska native or American Indian tribe(s)." Based on tribal data, at least 4,594 of the 7,385 NSB residents were Eskimo. The large majority remains Inupiat. In 2000, population counts were 247 for Point Lay, 546 for Wainwright, 228 for Atqasuk, 4,581 for Barrow, and 433 for Nuiqsut (USDOC, Bureau of the Census, 2001; State of Alaska, 2003).

North Slope society responded to early contacts with outsiders by successfully changing and adjusting to new demands and opportunities (Burch, 1975a,b; Worl, 1978; North Slope Borough Contract Staff, 1979). Since the 1960's, the North Slope has witnessed a period of "super change," a pace of change quickened by the area's oil developments (Lowenstein, 1981). In the Prudhoe Bay/Kuparuk industrial complex, oil-related work camps have altered the seascape and landscape, making some areas off limits to traditional subsistence hunting. In addition, large NSB Capital Improvement Projects (CIP's) have dramatically changed the physical appearance of the Borough communities.

Social services have increased dramatically since 1970, with larger Borough budgets and early grants acquired by the Inupiat Community of the Arctic Slope, and later grants acquired by the Arctic Slope Native Association and other Borough nonprofit organizations. In 1970 and 1977, residents of North Slope villages were asked about their state of well-being in a survey conducted by the University of Alaska Anchorage, Institute of Social and Economic Research (Kruse et al., 1983). The survey identified notable increases in complaints about alcohol and drug use in all villages between 1970 and 1977. Health and social services programs have attempted to address these problems with treatment programs and shelters for abused wives and families, as well as well as enhanced recreational programs and services. More recently, a lack of adequate financing for city governments within the NSB has hampered the development of these programs, and declining revenues from the State have seriously impaired the overall performance of these city governments. In the last decade, all communities in the NSB have struggled with banning the sale, use, and possession of alcohol. The issue of whether a community will become "dry" or stay "wet" is constantly brought before local voters.

The introduction of modern technology has increasingly tied the Inupiat subsistence economy to a cash economy (Kruse, 1982). Nevertheless, oil-supported revenues have supported a lifestyle still distinctly Inupiat, and outside pressures and opportunities have sparked what may be viewed as a cultural revival (Lantis, 1973). What exists in the communities of the North Slope is "a unique lifestyle in which a modern cash economy and traditional subsistence are interwoven and interdependent" (USDOI, BLM, 1979a). People continue to hunt and fish but aluminum boats, outboard motors, snow machines, and all-terrain vehicles now blend these pursuits with wage work. Inupiat whale hunting remains a proud tradition that involves ceremonies, dancing, singing, visiting, cooperation between communities and, most importantly, the sharing of foods.

North Slope residents exhibit an increasing commitment to area-wide political representation, local and regional tribal governments, and the cultural preservation of such institutions as whaling crews and dancing organizations, and the revival of traditional seasonal celebrations. The NSB has a Commission on Inupiat History, Language, and Culture--an important body for preserving Inupiat heritage, conducting elders' conferences and other cultural activities to preserve oral histories, and pursuing the repatriation of cultural artifacts and remains under the Native American Graves Protection and Repatriation Act. Effects from ongoing and potential oil exploration and development on subsistence and, thus, on the overall sociocultural system, have been and will continue to be a major concern for residents of North Slope communities (Kruse et al., 1983; ACI and S.R. Braund and Assocs., 1984; USDOI, MMS, 1994, 1995b, 1996a; S.R. Braund and Assocs., In prep.; USDOI, BLM, 1997a; USDOI, MMS, 1998).

b. Social Characteristics of the Communities

The following subsection describes the Alaskan North Slope communities that may be affected directly by oil and gas exploration and development in the Planning Area. These community-specific descriptions discuss factors relevant to the sociocultural analysis of each community in relation to industrial activities, population, and current socioeconomic conditions. Following these descriptions, the social organization, cultural values, and other issues common to all the communities are discussed.

(1) Socioeconomic Conditions in Point Lay

Point Lay has the smallest population of any community in the NSB, with a population of 139 in 1990 and 247 in 2000 (USDOC, Bureau of the Census, 1991 and 2001). In 1990, the Inupiat population represented 81.3 percent of the total, and in the 2000 Census, Point Lay's Inupiat population had increased to 88.3 percent of the total (USDOC, Bureau of the Census, 1991, 2001; Harcharek, 1992). About 90 mi southwest of Wainwright, the community sits on the Chukchi Sea coast at the edge of Kasegaluk Lagoon near the confluence of the Kokolik River and Kasegaluk Lagoon. Point Lay is 26 mi from the western boundary of the NPR-A, and, as with other communities in and near the Northwest NPR-A Planning Area, Point Lay residents enjoy a diverse resource base including marine and terrestrial animals. The community is unique because its wild food dependence is relatively balanced between marine and terrestrial resources and unlike the other communities discussed here, local hunters do not pursue the bowhead whale. It is also the only unincorporated community in the NSB.

The community was established in the 1920's and its number of residents increased until the 1930's when its population began a slow decline, largely because of the decline in reindeer herding. By 1960, it was not included in the national census. The village was reestablished on a barrier island spit opposite the Kokolik River in the 1970's (motivated by the terms of ANCSA). Residents of Barrow, Wainwright, Point Hope, Kotzebue, and other Inupiat with traditional ties to the area resettled here. The town then moved to its present mainland site south of the Kokolik Delta in 1981. In 1983, a NSB census recorded 126 residents in the community. Local employment during this period revolved around DEW Line and Borough Capital Improvement Program (CIP) projects. Smaller Borough, village-corporation, and State-funded construction projects continue to employ local workers on a temporary basis, and the NSB government remains the largest local full-time employer.

Limited oil exploration activity has occurred near Point Lay, with a well drilled 25 mi northeast of the community in 1981 on Arctic Slope Regional Corporation (ASRC) lands, and the Tunalik #1 test well drilled within NPR-A inland and southeast of Icy Cape in 1978 and 1979. Both wells were plugged and abandoned. Point Lay is similar to Atqasuk in avoiding the rapid social and economic changes experienced by Barrow and Nuiqsut from past oil development activities. However, future sociocultural change could accelerate as a result of oil exploration and development in the Northwest NPR-A Planning Area. A large portion of Point Lay's terrestrial subsistence-harvest area lies within the western part of the Northwest NPR-A Planning Area.

(2) Socioeconomic Conditions in Wainwright

Wainwright is located on the Chukchi Sea 100 mi southwest of Barrow on the western boundary of the Northwest NPR-A Planning Area. In 2000, Wainwright's population was 546 (USDOC, Bureau of the Census, 2001).

As in other North Slope communities, the changes in Wainwright from 1975 to 1985--stimulated by the NSB CIP boom--are not as dramatic as the changes in Barrow. Nonetheless, the CIP has led to retention of the population and the creation of new jobs, housing, and infrastructure. Although there has been an influx of non-Natives into Wainwright, most are transient workers and cannot be considered permanently settled or even long-term residents. In 1989, approximately 8.7 percent of all Wainwright residents were non-Native (NSB, Dept. of Planning and Community Services, 1989). This was a decrease from 30 percent non-Native in 1983 (Luton, 1985) and is most likely a direct result of the end of the NSB CIP boom. Of these approximately 43 residents, only a few would be in Wainwright six months to a year later. Even most of the eight Caucasian teaching couples in Wainwright in 1983 (Luton, 1985) had not been in Wainwright more than a year. The Caucasians in Wainwright tend to be nonpermanent, mobile residents who have relatively little interaction with the Native population; this has created a certain degree of racial tension in the community (Luton, 1985).

The Wainwright CIP has not only been central to the local economy, but it has also changed the face of the community and affected the quality of life. Residents now live in modern, centrally heated homes with running water, showers, and electricity. New buildings dominate the town and upgraded roads have encouraged more people to own vehicles. Between July 1982 and October 1983, the number of pickup trucks and automobiles in Wainwright more than tripled (Luton, 1985). In 1990, the total population of Wainwright was 492, with the Inupiat population representing 94.3 percent of the total. In the 2000 Census, Wainwright's total population stood at 546 with the Inupiat population decreasing slightly to 93 percent of the total (USDOC, Bureau of the Census, 1991, 2001; Harcharek, 1992). Some of Wainwright's subsistence marine resources are harvested in a portion of the Planning Area and all of the community's terrestrial subsistence use areas are within Northwest NPR-A.

(3) Socioeconomic Conditions in Barrow

Barrow is the largest community on the North Slope and its regional center. Barrow's population in 2000 was 4,581 (USDOC, Bureau of the Census, 2001). The city has already experienced dramatic population changes as a result of increased revenues from onshore oil development and production at Prudhoe Bay and in other smaller oil fields; these revenues stimulated the North Slope Borough CIP projects in the early years. In 1970, the Inupiat population of Barrow represented 91 percent of the total population (USDOC, Bureau of the Census, 1971). In 1985, non-Natives outnumbered Natives between the ages of 26 and 59 (North Slope Borough, Dept. of Planning and Community Services, 1989). By 1990, Inupiat representation had dropped to 63.9 percent, but in the 2000 Census, Barrow's Inupiat population remained undiminished at 64.0 percent of the total (USDOC, Bureau of the Census, 1991, 2001; Harcharek, 1992). Most of Barrow's terrestrial and marine subsistence-harvest area lies in or adjacent to the Beaufort Sea multiple-sale area.

From 1975 to 1985, Barrow experienced extensive social and economic transformations. The NSB CIP projects stimulated a boom in the Barrow economy and an influx of non-Natives to the community; between 1980 and 1985, Barrow's population grew by 35.6 percent (Kevin Waring Assocs., 1989). Inupiat women entered the labor force in the largest numbers ever known and they achieved positions of political leadership in newly formed institutions. The proportion of Inupiat women raising families without husbands also increased during this period, a noticeable alteration in a culture where the extended family, operating through interrelated households, is salient in community social organization (Worl and Smythe, 1986). During this same period, the social organization of the community became increasingly diversified with the proliferation of formal institutions and the large increase in the number of different ethnic groups, although socioeconomic differentiation was not new in Barrow. During the periods of commercial whaling and reindeer herding, there were influxes of outsiders and significant shifts in the economy. Other fluctuations have occurred during different economic cycles: fur trapping, U.S. Navy and arctic contractors' employment, the capital improvement projects boom, and periods of downturn (Worl and Smythe, 1986). As a consequence of the changes it has already sustained, Barrow may be more capable of absorbing additional change resulting from oil exploration and development than would smaller, homogenous Inupiat communities such as Point Lay, Wainwright, Atqasuk, or Nuiqsut.

(4) Socioeconomic Conditions in Atqasuk

Atqasuk is a small, predominantly Inupiat community on the Meade River, about 60 mi south of Barrow. The total 1990 community population was 216 (92% Inupiat). In 2000, there were 228 residents, 94.3 percent of whom were Inupiat (USDOC, Bureau of the Census, 1991, 2001). The community was established in mid-1970 under the 1971 Alaska Native Claims Settlement Act (ANCSA) by Barrow residents who had traditional ties to the area. People lived in tents until NSB-sponsored housing arrived in 1977. The 1980 Census tallied 107 residents; two years later, a Borough census recorded 210 residents. By July 1983, the population had risen to 231, a 166-percent increase since the first census in 1980. Atqasuk is an inland village and its subsistence preferences follow, with caribou and fish being the primary subsistence resources. Social ties between Barrow and Atqasuk remain strong, and men from Atqasuk go to Barrow to join bowhead-whaling crews.

To a large degree, Atqasuk has avoided the rapid social and economic changes experienced by Barrow and Nuiqsut brought on by oil development activities, but future change could accelerate as a result of oil exploration and development in the Northwest NPR-A Planning Area. Possible new pipeline routes could cross Atqasuk's terrestrial subsistence-harvest areas, as most of its traditional subsistence-use area is within the Northwest NPR-A Planning Area.

(5) Socioeconomic Conditions in Nuiqsut

Nuiqsut sits on the west bank of the Nechelik Channel of the Colville River Delta, about 25 mi inland from the Arctic Ocean and approximately 150 mi southeast of Barrow. The population was 354 (92.7 percent Inupiat) in 1990 and 433 (89.1 percent Inupiat) in 2000 (USDOC, Bureau of the Census, 1991, 2001). In 1973, 27 families from Barrow resettled Nuiqsut, one of three abandoned Inupiat villages in the North Slope region identified in ANCSA. Today, Nuiqsut is experiencing rapid social and economic change, with a new hotel, the influx of non-Inupiat oil workers from the Alpine facility adjacent to the community, and the potential development of oil in the NPR-A.

Most of Nuiqsut's terrestrial subsistence-harvest area is adjacent to the eastern boundary of the Northwest NPR-A Planning Area.

c. Social Organization

The social organization of Inupiat communities is strongly based on kinship. Kinship forms "the axis on which the whole social world turn[s]" (Burch, 1975a,b). Historically, households were composed of large, extended families, and communities were kinship units. Today, there is a trend away from the extended-family household because of increased mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Inupiat society continue to be important and remain a central focus of social organization.

The social organization of North Slope Inupiat encompasses not only households and families but also wider networks of kinfolk and friends. These types of networks are related through overlapping memberships and they are embedded in those groups responsible for hunting, distributing, and consuming subsistence resources (Burch, 1970). An Inupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. The interdependencies among Inupiat households differ markedly from those found in the United States as a whole. In the larger non-Inupiat society, the demands of wage work emphasize a mobile and prompt workforce. While modern transportation and communication technologies allow for contact between parents, children, brothers, sisters, and other extended-family members, more often than not, independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) form independent "production" units that do not depend on extended-family members for the day-to-day support of food, labor, or income. A key contrast between non-Native and Inupiat cultures occurs in their differing expectations of families--the Inupiat expect and need support from extended-family members on a day-to-day basis.

Associated with these differences, the Inupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units, and giving--especially by successful hunters--is regarded as an end in itself, although community status and esteem accrue to the generous. The sharing and exchanging of subsistence resources strengthen kinship ties (Nelson, 1969; Burch, 1971; Worl, 1979; ACI, Courtnage, and Braund, 1984; Luton, 1985; Chance, 1990).

d. Cultural Values

Traditionally, Inupiat values focused on the Inupiat's close relationship with natural resources, specifically game animals. The Inupiat also had a close relationship to the supernatural with specific beliefs in animal souls and beings controlling the movements of animals. Other values included an emphasis on the community, its needs, and its support of other individuals. The Inupiat respect people who are generous, cooperative, hospitable, humorous, patient, modest, and industrious (Lantis, 1959; Milan, 1964; Chance, 1966, 1990). Although there have been substantial social, economic, and technological changes in Inupiat lifestyle, subsistence continues to be the central organizing value of Inupiat sociocultural systems. The Inupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1969). North Slope residents voice this refrain repeatedly (Kruse et al., 1983; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a,b; USDOI, MMS, 1994). Task groups are still organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an integral part of Inupiat life, and a major component of significant kin ties is the identity of those with whom one cooperates (Heinrich, 1963). Large amounts of subsistence foods are shared within the community, and the people one gives to and receives from are major components of what makes up significant kin ties (Heinrich, 1963; ACI, Courtnage, and Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system. The hunt, the sharing of the products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men, and good hunters are often respected leaders. Good health comes from a diet derived from the subsistence hunt. Young hunters still give their first game to the community elders and generosity brings future success.

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities occurring in Inupiat society. However, cultural value is also apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations (some families will dominate one type of government administration or one organization, for example--the village corporation), employment, sports activities, and membership in voluntary organizations (Mother's Club, Search and Rescue, etc.) (ACI, Courtnage, and Braund, 1984).

Bowhead whale hunting remains the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess (see Bockstoce et al., 1979; ACI, Courtnage, and Braund, 1984). Barrow resident Beverly Hugo, testifying at public hearings for MMS' Beaufort Sea Sale 124, summed up Inupiat cultural values this way:

> ...these are values that are real important to us, to me; this is what makes me who I am....the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others...and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility to our tribe, humility...these are some of the values...that we have...that make us who we are, and these values have coexisted for thousands of years, and they are good values...(USDOI, MMS, 1990a).

The importance of the whale hunt is more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and define community leadership patterns. The structured sharing of the whale helps determine social relations within and between communities (Worl, 1979; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a). Structured sharing also holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to elders does more than feed old people, bonding giver and receiver, joining them to a living tradition, and drawing the community together.

Today, this close relationship between the spirit of a people, their social organization, and the cultural value of subsistence hunting may be unparalleled when compared with other areas in America where energy-development is taking place. The Inupiat's continuing strong dependence on subsistence foods, particularly marine mammals and caribou, creates a unique set of potential effects from onshore and offshore oil exploration and development on the social and cultural system. Barrow resident Daniel Leavitt articulated these concerns during a 1990 public hearing for Beaufort Sea Sale 124:

> ...as I have lived in my Inupiat way of livelihood, that's the only...thing that drives me on is to get something for my family to fill up their stomachs from what I catch (USDOI, MMS, 1990a).

One analysis of Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. Most concerns centered on the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, or interruption of subsistence-species migration. These four concerns were expressed in 83 percent of all the testimony taken on the North Slope (Kruse et al., 1983:tbl 35; USDOI, MMS, 1994; Human Relations Area Files, Inc., 1992). Public Scoping Meetings were held in Wainwright, Barrow, Atqasuk, and Nuiqsut in December 2001 and in Point Lay and Anaktuvuk Pass in February 2002. Major concerns expressed at these meetings are summarized in the following section on Environmental Justice (Section III.C.5).

Only a viable monitoring regime can assess the impacts of development on the North Slope on these issues. One suggestion that was repeatedly made at the April 16 to 18, 1997, NPR-A Symposium (USDOI, BLM and MMS, 1997a) was the need for an ongoing subsistence-oversight panel of Federal, State, Alaska Native, and oil-industry interests to address these concerns as well as the issue of instituting an ongoing subsistence-monitoring program (USDOI, BLM and MMS, 1997a). In response to this need, and as part of its mitigation strategy for exploration and development in the Northeast NPR-A, the BLM established a subsistence advisory panel in l988. This panel is composed of representatives from Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright and BLM decision-makers who address subsistence issues and concerns. The panel has met ten times in Barrow, Nuiqsut, and Wainwright and has developed an ongoing dialogue on these issues. This dialogue will guide the BLM in its decisions for future exploration and development activities in the Northwest NPR-A Planning Area.

A substantial concern among NSB Inupiat communities is the lack of traditional knowledge and testimony in government documents, particularly MMS's lease sale EIS's. Mayor George N. Ahmaogak, Sr., of the NSB said in a 1990 letter to MMS:

> The elders who spoke particularly deserve a response to their concerns. You should respect the fact that no one knows this environment better than Inupiat residents (Ahmaogak, 1990, pers. comm.)

In public testimony in 1993 concerning a Letter of Authorization for bowhead whale monitoring at the Kuvlum Prospect, the late Burton Rexford, then Chairman of the Alaska Eskimo Whaling Commission, stated that the most important environmental information would come from whaling captains, crew members, and whaling captains' wives.

> We know our environment--our land and resources--at a deep level (National Marine Fisheries Service, 1993).

These same concerns were echoed unanimously by those testifying for Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut in hearings and scoping meetings for Beaufort Sea Sales 144 and 170, for the Northeast NPR-A IAP/EIS, for the Northstar and Liberty projects, and for the Beaufort Sea multiple sales (Public Hearing Transcripts, Beaufort Sea Sale 144 [USDOI, MMS, 1995a,b, and c], Beaufort Sea Sale 170 [USDOI, MMS, 1997b], NPR-A IAP/EIS [USDOI, BLM and MMS, 1997b], Beaufort Sea Oil and Gas Development Project/Northstar [U.S. Army Corps of Engineers, 1996], and the Liberty Project [USDOI, MMS, Alaska OCS Region, 1999]).

e. Institutional Organization of the Communities

The NSB provides most government services to the communities of Point Lay, Wainwright, Barrow, Atqasuk, and Nuiqsut and other communities. These services include public safety, public utilities, fire protection, and some public-health services. Athough NSB revenues have remained healthy and the Borough's permanent fund account continues to grow--as does its role as primary employer in the region--future fiscal and institutional growth is expected to slow because of economic constraints on direct Inupiat participation in oil-industry employment, growing constraints on the statewide budget, and the Alaska Legislature's threat to limit the NSB's bonding authority (Kruse et al., 1983; Harcharek, 1992, 1995). The ASRC, formed under ANCSA, runs several subsidiary corporations. Most of the communities also have a village corporation, a Traditional Village or Indian Reorganization Act (IRA) Council, and a city government. The IRA and village governments have not provided much in the way of services, but village corporations have made many service contributions. The Inupiat Community of the Arctic Slope, the regional tribal government, has recently taken on a more active and visible role in regional governance.

f. Other Ongoing Issues

Other issues important to an analysis of sociocultural systems are those that will affect or already are affecting Inupiat society (i.e., cumulative impacts). The environmental impact statements for MMS Sales 97, 124, 144, 170; the Northstar and Liberty projects; and the National Petroleum Reserve-Alaska detail issues about changes in employment, increases in income, decreases in fluency in Inupiaq, rising crime rates, and substance abuse (USDOI, MMS, 1987a, 1990b, 1996a, 1998; USDOI, MMS, Alaska OCS Region, 2002b; USDOI, BLM and MMS, 1998; U.S. Army Corps of Engineers, 1996). These documents also discuss the fiscal and institutional growth of the NSB. These discussions are incorporated by reference and summarized below. In addition, Smythe and Worl (1985) and Impact Assessment, Inc. (1990a) detail the growth and responsibilities of local governments.

Recent statistics on homicides, rapes, and wife and child abuse present a sobering picture of some aspects of life in NSB communities. Violent deaths account for more than one-third of all deaths on the North Slope. The Alaska Native Health Board notes the "overwhelming involvement of alcohol (and drug) abuse in domestic violence, suicide, child abuse, birth defects, accidents, sexual assaults, homicide and mental illness" (Alaska Native Health Board, 1985). The lack of comparable data makes it impossible to compare levels of abuse and violence between aboriginal (before contact with Caucasians), traditional (from the time of commercial whaling through the fur trade), and modern (since World War II) Inupiat populations. Nonetheless, it is apparent from reading earlier accounts of Inupiat society that there has been a drastic increase in these social problems, although a study conducted in the early 1980's on the North Slope indicates that no direct relationship was found between energy development and "accelerated social disorganization" (Kruse, Kleinfeld, and Travis, 1982, cited in Impact

Assessment, Inc., 1990b). Studies in Barrow (Worl and Smythe, 1986) detail the important changes in Inupiat society occurring in the last decade as a response to these problems. Services from outside institutions and programs have recently begun to assume a greater responsibility for functions formerly provided by extended families. Today, there is an array of social services available in Barrow that is more extensive for a community of this size than anywhere in the U.S. (Worl and Smythe, 1986).

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasing scrutiny, regulation, and incremental alteration. Increased stresses on social well-being and on cultural integrity and cohesion come at a time of relative economic well-being. The expected challenges to the culture by the decline in CIP funding from the State have not been as significant as once expected. The buffer effect has come mostly through the dramatic growth of the Borough's own permanent fund, the NSB taking on more of the burden of its own capital improvement, and its emergence as the largest employer of local residents. However, Borough revenues from oil development at Prudhoe Bay are on the decline, and funding challenges (and subsequent challenges to the culture) continue as the State Legislature alters accepted formulas for Borough bonding and funding for rural school districts.

5. Environmental Justice

The Inupiat, a recognized Alaska Native minority, are the predominant residents of the North Slope Borough (NSB), the region potentially most affected by leasing in the Northwest NPR-A Planning Area. The Inupiat rely heavily on subsistence foods. Oil and gas exploration and development could affect the subsistence resources and harvest practices they depend upon.

Environmental Justice is an initiative that culminated with President Clinton's February 11, 1994, Executive Order (E.O.) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," and an accompanying Presidential memorandum. The E.O. requires that each Federal Agency consider environmental justice to be part of its mission. Its intent is to promote fair treatment of people of all races, so no person or group of people bears a disproportionate share of the negative environmental effects from the country's domestic and foreign programs. While the E.O. focuses on minority and low-income populations, the EPA defines environmental justice as the "equal treatment of all individuals, groups or communities regardless of race, ethnicity, or economic status from environmental hazards" (U.S. Department of Energy, 1997; Envirosense, 1997). Specific to the EIS process, the E.O. requires that proposed projects be evaluated for "disproportionately high adverse human health and environmental effects on minority populations and low income populations."

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," requires the BLM to consult with Inupiat tribal governments of the North Slope on Federal matters that significantly or uniquely affect their communities. The EPA's Environmental Justice guidance of July 1999 stresses the importance of government-to-government consultation. As one way to foster tribal participation and mitigate exploration and development impacts in the Northeast NPR-A, BLM created the Subsistence Advisory Panel (SAP) in 1998. Representatives from the communities of Anaktuvuk Pass, Atqasuk, Barrow, Nuiqsut, and Wainwright, as well as BLM decision-makers, and a representative from the North Slope Borough compose the SAP. Since its inception, the SAP has met ten times in North Slope Borough communities, resulting in an ongoing dialogue that will guide the BLM in making decisions on future exploration and development activities in the NPR-A.

Scoping meetings were held during development of the Northwest NPR-A draft EIS. Inupiat translators were provided at these meetings to facilitate participation of non-English speakers. Environmental Justice considerations for this EIS included: 1) initial scoping, 2) local radio broadcasts and notices in the North Slope newspaper, and 3) follow-up meetings that included discussions specific to Environmental Justice concerns. The scoping meetings were held in the North Slope Borough communities as follows: Wainwright on December 5, 2001; Atqasuk on December 6, 2001; Barrow on December 10, 2001; Nuiqsut on December 11, 2001; Anaktuvuk

Pass on February 8, 2002; and Point Lay on February 7 and 8, 2002. During this scoping process, BLM received feedback on specific Environmental Justice concerns, documented additional concerns of the Inupiat residents, and conducted a special subsistence workshop with the SAP to discuss community issues and identify possible mitigation measures. Through the SAP, the BLM maintains an open dialogue on Environmental Justice issues with the communities of the North Slope.

Major concerns expressed at these meetings included:

- Protecting Native Allotments, hunting and fishing camps, and cultural sites (all 6 communities)
- Identifying and protecting important subsistence areas (all 6 communities)
- Protecting caribou migration routes (all 6 communities)
- Cleaning up contaminated sites (5 communities)
- Restricting access to subsistence areas and resources (5 communities)
- Studying and maintaining the health of wildlife (3 communities)
- Providing natural gas to local communities (3 communities)
- Studying caribou and fish (3 communities)
- Mitigating seismic disturbance of caribou, fish, and whales (3 communities)
- Making better use of Traditional Knowledge (3 communities);
- Regulating and monitoring guides and outfitters (3 communities)
- Preventing fish contamination from contaminated sites (3 communities);
- Providing more local hire (3 communities)
- Updating outdated resource data (2 communities)
- Involving local people in scientific studies of resources (2 communities)
- Clarifying BLM's government-to-government policy (2 communities)
- Providing river setbacks or buffers to protect historic fishing sites (2 communities)
- Including local people in the planning process (2 communities)
- Improving oversight and enforcement of mitigation measures (2 communities)
- Minimizing disturbance from staging areas, roads, docking facilities, and pipeline access (2 communities)

The Environmental Justice concerns listed above were incorporated into environmental studies and into the mitigating measures/stipulations in this IAP/EIS. The measures/stipulations include:

- revising/clarifying consultation procedures concerning oil and gas and related activities and potential impacts of those activities on subsistence users and practices (specifically with regard to subsistence cabins and campsites);
- strengthening the requirements of annual subsistence plans submitted by industry so they improve communication and avert subsistence conflicts with oil and gas and related activities;
- conducting in-depth subsistence harvest studies of Nuiqsut, Atqasuk and Barrow to assess the impact of oil and gas development on subsistence activities in and around these communities;
- conducting research on caribou movement, impacts of winter exploration on tundra vegetation, and studying baseline soil contamination and hydrology; and
- notifying all known NPR-A aircraft users to apprise them of subsistence conflicts with local residents created by aircraft use.

6. Land Uses and Coastal Management

a. Land Ownership and Uses

(1) Land Ownership

Most land within the Planning Area is under Federal jurisdiction. The non-Federal lands are limited primarily to Native entities and are located near Barrow, Atqasuk, and Wainwright (Map 02). The NSB owns approximately 229 acres of surface estate in the Cape Simpson area and 190,370 acres of the subsurface estate (natural gas) in the Barrow area.

(a) Federal Jurisdiction

Executive Order 3797-A, signed by President Warren G. Harding on February 27, 1923, reserved 23.7 million acres of Federal land and established the Naval Petroleum Reserve Number 4 (PET-4). This area was reserved for oil and gas development for Naval defense. The Naval Petroleum Reserves Production Act of 1976 (P.L. 94-258) (NPRPA) transferred jurisdiction of PET-4 from the Navy to the Secretary of the Interior (Secretary) and renamed it the National Petroleum Reserve-Alaska (NPR-A).

The boundary of the Northwest NPR-A Planning Area encompasses approximately 9.4 million acres, approximately 8.8 million acres of which are under Federal jurisdiction. At present, the total area of privately owned surface estate within the Planning Area is approximately 530,886 acres, leaving approximately 8,848,113 acres under Federal jurisdiction. The portion of the subsurface estate in the Planning Area under Federal jurisdiction consists of approximately 9,065,602 acres of subsurface oil estate and 9,066,692 acres of subsurface gas estate. The Planning Area boundary extends to the northern boundary of the NPR-A, generally following the shoreline, but extending offshore to encompass certain bays and lagoons. Under authority of the Federal Submerged Lands Act, the State of Alaska owns the lands beyond this northern boundary, extending from mean low tide to 3 mi offshore. Decisions regarding the use of these State lands--including decisions on oil and gas leasing--are made by the Alaska Department of Natural Resources (ADNR).

The ownership of the land in tidally influenced bays and lagoons within the NPR-A boundary has been disputed by the State and Federal Governments. In the United States v. State of Alaska (Orig. 84), or "Dinkum Sands" case, the U.S. Supreme Court ruled in June of 1997 that these lands are federally owned because the U.S. Congress retained them at the time Alaska achieved statehood (1959). These offshore lands within the Northwest NPR-A Planning Area could be available to oil and gas leasing, along with onshore Federal lands.

(b) Native Allotments

The Native Allotment Act of 1906, as amended, allowed an Alaska Native to receive up to 160 acres of vacant and unappropriated land. There are approximately 226 allotments encompassing approximately 24,616 acres within the Northwest NPR-A Planning Area. Certificates of Allotment on lands valued for oil and gas set aside those resources for the Federal Government. It is presumed that all certificates for allotments in the Planning Area will contain this stipulation.

(c) Village Corporation Lands

The ANCSA allowed the four village corporations of Atqasuk, Barrow, Nuiqsut, and Wainwright to select surface lands under Sections 12(a) and 12(b). The NPRPA reaffirmed the availability of the surface of lands for selection and conveyance to village corporations under ANCSA. Section 12 of the Technical Corrections Act of 1992 allowed the villages to reconvey lands under a valid Native Allotment application in exchange for an equal number of acres of additional selections. The acreage received and the remainder of the entitlements for Atqasuk, Barrow, and Wainwright (current as of October of 2001) are shown in Table III-34.

(d) Regional Corporation Lands

The Arctic Slope Regional Corporation (ASRC) owns 68,053 acres of surface lands in the Barrow area that are within the Planning Area; it also owns the subsurface oil estate of 56,997 acres. The NSB has received the natural gas from these lands and the village corporation has received the sand and gravel in the Barrow area. The ASRC also owns 143,862 acres of subsurface estate (oil and gas) underlying surface lands conveyed to the village of Wainwright.

The ANCSA did not allow the ASRC to select the subsurface estate within the NPR-A. However, Section 12(a)(1) did allow the ASRC to select the subsurface estate from lands outside the NPR-A withdrawal in acreage equal to its entitlement. Public Land Order 5183, dated March 9, 1972 clarified this selection when it withdrew NPR-A lands from subsurface selection by the regional corporation. The NPRPA restated the arrangement in 1976, recognizing the village corporation's selections of surface estate as provided by ANCSA without providing for other land claims.

It would be five years before regional corporations would be allowed to select land in the NPR-A. The Appropriations Act of 1981 (P.L. 96-514) authorized the Secretary to lease lands within the NPR-A for oil and gas exploration and development. The passage of this act allowed the implementation of Section 1431(o) of ANILCA by providing specific legislative authority for the exchange of NPR-A lands--contingent upon legislative direction to open the NPR-A to commercial development. This specific provision allowed the regional corporation (ASRC) to select the subsurface of village-selected lands if lands within 75 mi of the village lands were made available for commercial development. The ASRC later selected the subsurface estate under all lands selected by Nuiqsut and a portion of the subsurface estate under lands conveyed to the village of Wainwright.

(e) North Slope Borough

The NSB owns 229 surface acres in the Cape Simpson area and rights to approximately 178,446 acres of natural gas and 112,539 acres of subsurface oil estate, both in the Barrow area.

(2) Land Uses

(a) Authorized Use

The poor soil conditions in the Planning Area limit the BLM's approval of most land use proposals for summer operations. Permafrost underlies the entire NPR-A, and floodplains/wetlands cover the majority of the area, reducing even further BLM's ability to allow surface activity. The BLM authorizes temporary use of the lands within the Northwest NPR-A under minimum impact permits. Current management policy for the Planning Area allows only those activities that, with stipulations, would have a negligible impact on the environment. Because of the fragile nature of thawed tundra during the summer, permit sites are restricted to durable areas such as gravel bars, beaches, or existing gravel pads. During the winter, when the freeze has stabilized the mineral soils and the snow protects the vegetation, it is possible to traverse the tundra with Rolligon-type vehicles (low-impact vehicles operating on the tundra with minimal disturbance).

A number of annual overland supply moves are carried out between the North Slope communities using track--or Rolligon-equipped vehicles. Active and inactive DEW-Line installations (active-Barrow; inactive--Wainwright) are located within the Planning Area. Minimum Impact Permits (3-year duration) as provided by the Federal Land Policy and Management Act (FLPMA), might include, but are not limited to, activities such as: use of subsistence cabin sites, support activities related to environmental clean up, and scientific research of all types. The BLM-authorized areas within Barrow include a right-of-way for the BUECI power plant, the National Weather Service weather station site, and a Recreation and Public Purposes (R&PP) area to be used for a recreation field. These sites may become available for other uses later. BLM manages several withdrawals within the Planning Area including a National Oceanic and Atmospheric Administration (NOAA) research site used as a climate monitoring and diagnostics laboratory, and a research site assigned to the United States Geological Service (USGS) for a geomagnetic observatory. The BLM-sponsored research includes revegetation at wellsites and climatic studies. Finally, a variety of communication/navigation-related authorizations to Federal Agencies (such as Vortec sites, RACON sites, and communication towers) support all who work on the North Slope.

There are currently about 15 authorizations for the above-listed activities within the Northwest NPR-A Planning Area. Most authorizations allow land use for 3 to 5 years, with nothing but the withdrawals exceeding 20 years.

(b) Access

There are no roads linking the Planning Area to communities within or outside the NPR-A. However, trails provide access to the communities of Barrow, Atqasuk, and Wainwright and link the NPR-A to lands outside the boundaries of the NPR-A. Most trails are usable only during the winter. The winter trails follow--but are not part of--existing ANCSA Section 17(b) easements that eventually meet with existing roads within communities and State, public, and private roads outside the NPR-A. The coastal trail from Kotzebue to Barrow is extremely important for inter-village travel from Point Lay to Atqasuk, Wainwright, and Barrow. Another access route runs from Nuiqsut to Atqasuk and Barrow along the northern coast of the NPR-A. Various Section 17(b) easements across interim-conveyed and patented lands controlled by Native corporations access the southeast corner of the NPR-A from Anaktuvuk Pass. Inter-village trails inland from the coast that connect Point Lay, Wainwright, Atqasuk and Barrow are extremely important to local communities and the general public for transporting people and goods. These trail locations may move from year to year depending upon snow and ice conditions.

There are no officially designated corridors for transportation and such things as pipelines, power lines, and communication sites within the Planning Area at this time. The BLM reviewed the need for designation of such corridors. For a discussion of why this management action was eliminated from further consideration in IAP/EIS see Section II.G.

The Planning Area has at least two locations with staging/storage capacity. One is the former Peard Bay DEW-Line site, 45 nautical miles (nmi) from Barrow. This site is just north of the Peard Bay lagoon and consists of a 1,660-ft gravel airstrip on a 1,460-acre withdrawal, most of which is underplayed with gravel. As Peard Bay is a Formerly Used Defense Site (FUDS), the U.S. Army Corps of Engineers (COE) cleaned up the area in the mid-1990's. There is a road to the beach from this site reserved under a 44 LD 513.

The second location with staging/storage capacity is the Wainwright DEW-Line site. This site is 80 nautical miles (nmi) from Barrow and, like the Peard Bay site, it is on the Chukchi Sea. It consists of 1,518 acres with a gravel airstrip approximately 3,600 ft long. There is no road access from this site to the beach and village lands owned by the Olgoonik Corporation surround it. The FUDS cleanup for Wainwright is scheduled for 2005 when the site will be partially deactivated. A short-range radar facility would remain active and use of the pad/airstrip would require non-objection from the Air Force.

Cape Simpson, an additional site for staging and storage, is owned by the NSB and the Borough would require approval for its use in staging and storage. Its FUDS cleanup having been carried out years ago, this old DEW-Line site consists of 229 acres, including a large work pad and 2,568-ft airstrip.

(c) Structures

Numerous structures (primarily cabins) located on Federal public lands lack BLM authorization. Before accurate numbers of structures can be determined, Native Allotments must be surveyed and conveyed, and an inventory establishing the location and ownership of these structures must be compiled. When these actions have been carried out, the level of unauthorized use can be determined. Fish camps must also be inventoried. Although fish camps do not usually entail permanent structures, waste materials such as garbage and fuel are commonly left on site.

b. Coastal Zone Management

The Federal Coastal Zone Management Act (CZMA) (16 U.S.C. 1456), enacted in 1972 and last amended in 1996, and the 1977 Alaska Coastal Management Act (ACMA) (AS 46.40), last amended in 1994, guide development and land use in coastal areas, seeking a balance between use of coastal areas and protection of valuable coastal resources.

(1) Alaska Coastal Management Program

In 1979, the Alaska Coastal Management Program (ACMP) was approved in accordance with the Federal CZMA. The ACMP includes statewide standards and coastal district enforceable policies that address development and use of lands and natural resources of the coastal zone. The coastal zone and coastal district boundaries are mapped in Coastal Zone Boundaries of Alaska, an atlas prepared by the Alaska Department of Fish and Game, Division of Habitat and Restoration.

The Northwest National Petroleum Reserve-Alaska Planning Area lies entirely within the boundaries of the North Slope Borough; the vast majority of the land within the Planning Area is under Federal jurisdiction. The remaining lands are limited primarily to Native entities. The CZMA excludes from the coastal zone ". . . lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal Government, its officers, or agents" (16 U.S.C. Sec. 1453). Although these lands are excluded from the coastal zone, all Federal activities, such as an oil and gas lease sale, having reasonably foreseeable effects on any coastal use or resource must be consistent to the maximum extent practicable with the standards of the ACMP and the enforceable policies of the North Slope Borough's Coastal Management Program (NSB CMP). A consistency determination prepared by the Bureau of Land Management initiates the State's review for oil and gas lease sales.

Federally permitted activities in the coastal area of National Petroleum Reserve-Alaska must undergo an ACMP review if they require a listed Federal authorization (15 CFR 930.53(a)(1)). Federally permitted activities outside the coastal area that have reasonably foreseeable effects to coastal resources or uses must also undergo a State consistency review. Applicants for these federally permitted activities must certify that their activities are consistent with the ACMP. The State consistency review for federally permitted activities begins when the State receives a consistency certification and necessary data and information from the party submitting the application to the Federal Agency. Federally permitted activities subject to ACMP review will not be authorized if they are not consistent with the statewide standards of the ACMP and the coastal district enforceable policies.

The standard of review for Federal activities such as oil and gas lease sales is that a project must be consistent with the ACMP "to the maximum extent practicable." The consistent "to the maximum extent practicable" standard does not apply to federally permitted activities. The standard of review for applicable federally permitted activities requires that these activities must be consistent with the ACMP standards and enforceable policies.

(2) Statewide Standards

Title 6 of the Alaska Administrative Code (AAC), Chapter 80 contains the statewide standards of the ACMP for the management of land and water uses of Alaska's coastal zone. The standards are listed under two sections in these State regulations: Uses and Activities and Resources and Habitats.

Article 2 of Title 6, Chapter 80 lists nine standards under Uses and Activities.

6 AAC 80.040 COASTAL DEVELOPMENT STANDARD

(a) In planning for and approving development in coastal areas, districts and state agencies shall give in the following order, priority to:

(1) water-dependent uses and activities;
(2) water-related uses and activities; and
(3) uses and activities which are neither water-dependent nor water-related for which there is no feasible and prudent inland alternative to meet the public need for the use or activity.

(b) The placement of structures and the discharge of dredged or fill material into coastal water must, at a minimum, comply with the standards contained in Parts 320-323, Title 33, Code of Federal Regulations.

This standard gives priority to uses and activities in coastal areas that are water-dependent. The intent of this policy is to ensure that onshore development and activities that can be placed inland do not displace activities dependent upon shoreline locations, including marine, lake, and river waterfronts. Activities and uses that are neither water dependent nor water related will be given priority if there is no feasible or prudent alternative to meet the public need.

6 AAC 80.050 GEOPHYSICAL HAZARD AREAS

(a) Districts and state agencies shall identify known geophysical hazard areas and areas of high development potential in which there is a substantial possibility that geophysical hazards may occur.

(b) Development in areas identified under (a) of this section may not be approved by the appropriate state or local authority until siting, design, and construction measures for minimizing property damage and protecting against loss of life have been provided.

Geophysical hazard areas are defined in the standards as areas which present a threat to life or property from geophysical or geological conditions, including flooding, tsunamis, storm surges, landslide, snow slides, faults, ice hazards, and littoral beach processes.

This statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

6 AAC 80.060 RECREATION

(a) Districts shall designate areas for recreational use. Criteria for designation of areas of recreational use are:

(1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or
(2) the area has potential for high quality recreational use because of physical, biological, or cultural features.

(b) Districts and state agencies shall give high priority to maintaining and, where appropriate, increasing public access to coastal water.

The North Slope Borough has not designated any part of the Planning Area for recreation.

6 AAC 80.070 ENERGY FACILITIES

(a) Sites suitable for the development of major energy facilities must be identified by districts and the state in cooperation with districts.

(b) The siting and approval of major energy facilities by districts and state agencies must be based, to the extent feasible and prudent, on the following standards:

(1) site facilities so as to minimize adverse environmental and social effects while satisfying industrial requirements;
(2) site facilities so as to be compatible with existing and subsequent adjacent uses and projected community needs;
(3) consolidate facilities;
(4) consider the concurrent use of facilities for public or economic reasons;
(5) cooperate with landowners, developers, and federal agencies in the development of facilities;
(6) select sites with sufficient acreage to allow for reasonable expansion of facilities;
(7) site facilities where existing infrastructure, including roads, docks, and airstrips, is capable of satisfying industrial requirements;
(8) select harbors and shipping routes with least exposure to reefs, shoals, drift ice, and other obstructions;
(9) encourage the use of vessel traffic control and collision avoidance systems;
(10) select sites where development will require minimal site clearing, dredging, and construction in productive habitats;
(11) site facilities so as to minimize the probability, along shipping routes, of spills or other forms of contamination which would affect fishing grounds, spawning grounds, and other biologically productive or vulnerable habitats, including marine mammal rookeries and hauling out grounds and waterfowl nesting areas;

(12) site facilities so that design and construction of those facilities and support infrastructures in coastal areas of Alaska will allow for the free passage and movement of fish and wildlife with due consideration for historic migratory patterns and so that areas of particular scenic, recreational, environmental, or cultural value will be protected;
(13) site facilities in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained;
(14) site facilities where winds and air currents disperse airborne emissions which cannot be captured before escape into the atmosphere;
(15) select sites in areas which are designated for industrial purposes and where industrial traffic is minimized through population centers; and
(16) select sites where vessel movements will not result in overcrowded harbors or interfere with fishing operations and equipment.

(c) Districts shall consider that the uses authorized by the issuance of state and federal leases for mineral and petroleum resource extraction are uses of state concern.

The first part of this standard requires identification of suitable sites for development of major energy facilities. Part (b) requires siting of energy facilities according to 16 criteria to the extent feasible and prudent. "Feasible and prudent" is defined in 6 AAC 80.900(2) to mean "consistent with sound engineering practice and not causing environmental, social, or economic problems that outweigh the public benefit . . ." The last part of this standard requires that districts recognize that oil and gas development are uses of State concern.

6 AAC 80.080 TRANSPORTATION AND UTILITIES

(a) Transportation and utility routes and facilities in the coastal area must be sited, designed, and constructed so as to be compatible with district programs.

(b) Transportation and utility routes and facilities must be sited inland from beaches and shorelines unless the route or facility is water-dependent or no feasible and prudent inland alternative exists to meet the public need for the route or facility.

This standard requires the siting and construction of transportation and utility routes to be compatible with district programs. The siting of routes must be inland from beaches and shoreline unless the route or facility is water dependent or no feasible and prudent inland alternative exists.

6 AAC 80.090 FISH AND SEAFOOD PROCESSING

Districts shall identify and may designate areas of the coast suitable for the location or development of facilities related to commercial fishing and seafood processing.

There are no fish and seafood processing facilities in the Planning Area. This policy does not apply.

6 AAC 80.100 TIMBER HARVEST AND PROCESSING

AS 41.17, Forest Resources and Practices, and the regulations and procedures adopted under that chapter with respect to the harvest and processing of timber, are incorporated into the Alaska coastal management program and constitute the components of the coastal management program with respect to those purposes.

The Planning Area is located above the northern limit for forests. This policy does not apply.

6 AAC 80.110 MINING AND MINERAL PROCESSING

(a) Mining and mineral processing in the coastal area must be regulated, designed, and conducted so as to be compatible with the standards contained in this chapter, adjacent uses and activities, statewide and national needs, and district programs.

(b) Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits, when there is no feasible and prudent alternative to coastal extraction which will meet the public need for the sand or gravel.

This standard requires that mining and mineral processing in the coastal zone be compatible with the other standards; adjacent uses and activities; State and national needs and district programs. When there is no feasible or prudent alternative that will meet the public need, sand and gravel may be extracted.

6 AAC 80.120 SUBSISTENCE

(a) Districts and state agencies shall recognize and assure opportunities for subsistence usage of coastal areas and resources.

(b) Districts shall identify areas in which subsistence is the dominant use of coastal resources.

(c) Districts may, after consultation with appropriate state agencies, Native corporations, and any other persons or groups, designate areas identified under (b) of this section as subsistence zones in which subsistence uses and activities have priority over all nonsubsistence uses and activities.

(d) Before a potentially conflicting use or activity may be authorized within areas designated under (c) of this section, a study of the possible adverse impacts of the proposed potentially conflicting use or activity upon subsistence usage must be conducted and appropriate safeguards to assure subsistence usage must be provided.

(e) Districts sharing migratory fish and game resources must submit compatible plans for habitat management. (Eff. 7/18/78 , Register 67)

The statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the North Slope Borough. Parts (b)(c) and (d) address identification of areas in which subsistence is the dominant use of coastal resources, requiring a study of possible adverse impacts of potentially conflicting activities. No area within the Northwest National Petroleum Reserve–Alaska Planning Area has been designated by the North Slope Borough for this purpose.

Article 3 of Title 6, Chapter 80 contains 3 standards that address Resources and Habitats:

6 AAC 80.130 HABITATS

(a) Habitats in the coastal area which are subject to the Alaska coastal management program include:

(1) offshore areas;
(2) estuaries;
(3) wetlands and tideflats;
(4) rocky islands and seacliffs;
(5) barrier islands and lagoons;
(6) exposed high energy coasts;
(7) rivers, streams, and lakes; and
(8) important upland habitat.

(b) The habitats contained in (a) of this section must be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources,

(c) In addition to the standard contained in (b) of this section, the following standards apply to the management of the following habitats:

(1) offshore areas must be managed as a fisheries conservation zone so as to maintain or enhance the state's sport, commercial, and subsistence fishery;
(2) estuaries must be managed so as to assure adequate water flow, natural circulation patterns, nutrients, and oxygen levels, and avoid the discharge of toxic wastes, silt, and destruction of productive habitat;
(3) wetlands and tideflats must be managed so as to assure adequate water flow, nutrients, and oxygen levels and avoid adverse effects on natural drainage patterns, the destruction of important habitat, and the discharge of toxic substances;
(4) rocky islands and seacliffs must be managed so as to avoid the harassment of wildlife, destruction of important habitat, and the introduction of competing or destructive species and predators;
(5) barrier islands and lagoons must be managed so as to maintain adequate flows of sediments, detritus, and water, avoid the alteration or redirection of wave energy which would lead to the filling in of lagoons or the erosion of barrier islands, and discourage activities which would decrease the use of barrier islands by coastal species, including polar bears and nesting birds;
(6) high energy coasts must be managed by assuring the adequate mix and transport of sediments and nutrients and avoiding redirection of transport processes and wave energy; and
(7) rivers, streams, and lakes must be managed to protect natural vegetation, water quality, important fish or wildlife habitat and natural water flow.

(d) Uses and activities in the coastal area which will not conform to the standards contained in (b) and (c) of this section may be allowed by the district or appropriate state agency if the following are established:

(1) there is a significant public need for the proposed use or activity;
(2) there is no feasible prudent alternative to meet the public need for the proposed use or activity which would conform to the standards contained in (b) and (c) of this section; and
(3) all feasible and prudent steps to maximize conformance with the standards contained in (b) and (c) of this section will be taken.

(e) In applying this section, districts and state agencies may use appropriate expertise, including regional programs referred to in 6 AAC 80.030(b).

This statewide standard contains an overall standard policy plus policies specific to eight habitat areas. Activities and uses that do not conform to the standards may be permitted if there is significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance. The standard requires that habitats in the coastal zone be managed to maintain or enhance biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources.

6 AAC 80.140 AIR, LAND, AND WATER QUALITY

Notwithstanding any other provision of this chapter, the statutes pertaining to and the regulations and procedures of the Alaska Department of Environmental Conservation with respect to the protection of air, land, and water quality, in effect on August 18, 1992, are incorporated into the Alaska Coastal Management Program and, as administered by that agency, constitute the components of the coastal management program with respect to those purposes.

This standard incorporates all the statutes pertaining to air, land and water quality, and the regulations and procedures of the Alaska Department of Environmental Conservation.

6 AAC 80.150 HISTORIC, PREHISTORIC, AND ARCHAEOLOGICAL RESOURCES

Districts and appropriate state agencies shall identify areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory.

This standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of nation, State, or local history or prehistory.

(3) North Slope Borough Coastal Management Program (NSB-CMP)

The Borough adopted the NSB-CMP in 1984. Following several revisions, the NSB-CMP was approved--first by the Alaska Coastal Policy Council in April 1985 and then by the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management in May 1988. The coastal management boundary adopted for the NSB-CMP varies slightly from the interim boundary of the ACMP. In the mid-Beaufort sector, the boundary was extended inland on several waterways to include anadromous fish spawning and overwintering habitats. The NSB-CMP applies inland to approximately 25 mi and along the full length of all major river corridors.

Preservation of the Inupiat subsistence lifestyle is of highest priority to the NSB. To this end, the Borough's CMP seeks to balance the exploration, development, and extraction of nonliving natural resources involved in economic development with maintenance of and access to the living resources upon which the Inupiat base their traditional cultural values and way of life. Accordingly, land use on the North Slope is divided between traditional subsistence uses and the development of oil and gas resources. The NSB-CMP contains four categories of policies: 1) standards for development, 2) required features for development, 3) best-effort policies that cover allowable development and applicable required features, and 4) minimization of negative impacts. These policies are outlined under their applicable category.

(a) Standards for Development

NSB-CMP Policy 2.4.3(a)

When extensive adverse impacts to a subsistence resource are likely and cannot be avoided or mitigated, development shall not deplete subsistence resources below the subsistence needs of local residents of the borough.

Intent: The impacts addressed in this policy may result from a single project or from a series of projects. To implement this policy, the North Slope Borough would need to establish:

1. Documentation of subsistence needs.

2. A preponderance of the evidence indicating that the project will deplete a subsistence resource below the level necessary to meet those needs.

NSB-CMP Policy 2.4.3(b)

Offshore drilling and other development within the area of bowhead whale migration during the migration seasons shall not significantly interfere with subsistence activities nor jeopardize the continued availability of whales for subsistence purposes.

Intent: The area of the bowhead whale migration will be determined annually on the basis of best scientific information available, including that provided by the North Slope Borough and National Marine Fisheries Service monitoring programs. With respect to seismic exploration, the policy will be implemented by prohibiting seismic exploration in the vicinity of migrating whales when the exploration is likely to significantly interfere with subsistence activities or to jeopardize the continued availability of whales for subsistence purposes.

NSB-CMP Policy 2.4.3(c)

Development on barrier islands and in the marine and estuarine waters within 3 miles of the passes of Kasegaluk Lagoon intensively used by beluga whales shall not significantly interfere with subsistence use of beluga whales; shall not cause the whales to be displaced from these passes; and shall not jeopardize the continued use of these passes and lagoon system by beluga whales. The passes intensively utilized by beluga whales are Kukpowruk Pass , Akunik Pass , Utukok Pass , Icy Cape Pass , and Alokiakatat Pass (see Map 11 of the NSB Resource Atlas).

NSB-CMP Policy 2.4.3(d)

Development shall not preclude reasonable subsistence user access to a subsistence resource.

Intent: The intent of this policy is to ensure that development will not preclude reasonable subsistence user access *to a subsistence resource on which they depend. "Reasonable access" is access using means generally available to subsistence users. Reasonable opportunities for access to customary subsistence resources must not be precluded. "Precluding access" addresses not only means of access, but access to areas where resources are present and can be used by subsistence users.*

Policy 2.4.3.(e) [sic] should be distinguished from Policy 2.4.5.1(b). Policy 2.4.3.(e) [sic] requires that access to a subsistence resource not be precluded. Policy 2.4.5.1(b) applies when access is diminished or restricted. Policy 2.4.5.1(b) provides that access to subsistence resources be restricted only when there are no feasible and prudent alternatives. This is intended to discourage restrictions on subsistence, but it does not absolutely prohibit such restrictions.

NSB-CMP Policy 2.4.3(e)

Development which is likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall 1) be required to avoid the sites; or 2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance. (Descriptions of sites identified to date are contained in Appendix C of the North Slope Borough Coastal Management Program Background Report and referenced on Map 2 of the NSB Resource Atlas.)

NSB-CMP Policy 2.4.3(f)

Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the coastal management program.

NSB-CMP Policy 2.4.3(g)

Development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation.

NSB-CMP Policy 2.4.3(h)

Development shall comply with state or federal land, air and water quality standards or regulations.

(b) Required Features for Applicable Development

NSB-CMP Policy 2.4.4(a)

Vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated. Concentrations may be seasonal or year-round and may be due to behavior (e.g., flocks or herds) or limited habitat (e.g., polar bear denning, seal haul-outs). Horizontal and vertical buffers will be required where appropriate. Concern for human safety will be given special consideration when applying this policy.

NSB-CMP Policy 2.4.4(b)

Offshore structures must be able to withstand geophysical hazards and forces which may occur while at the drill site. Design criteria must be based on actual measurements or conservative estimates of geophysical forces. In addition, structures must have monitoring programs and safety systems capable of securing wells in case unexpected geophysical hazards or forces are encountered.

NSB-CMP Policy 2.4.4(c)

Development resulting in water or airborne emissions must comply with all state and federal regulations.

NSB-CMP Policy 2.4.4(d)

Industrial and commercial development must be served by solid waste disposal facilities which meet state and federal regulations.

NSB-CMP Policy 2.4.4(e)

Development not on a central sewage system is required to impound and process effluent to state and federal quality standards.

NSB-CMP Policy 2.4.4(f)

Plans for offshore drilling activities are required to include a relief well drilling plan and an emergency countermeasure plan. The relief well drilling plan must identify suitable alternative drilling rigs and their location; identify alternative relief well drilling sites; identify support equipment and supplies including muds; casing, and gravel supplies which could be used in an emergency; and specify the estimated time required to commence drilling and complete a relief well. The emergency countermeasures plan must identify the steps which will be taken to protect human life and minimize environmental damage in the event of 1) loss of a drilling rig; 2) ice override; or 3) loss or disablement of support craft or other transportation systems.

NSB-CMP Policy 2.4.4(g)

Offshore drilling operations and offshore petroleum storage and transportation facilities are required to have an oil spill control and clean-up plan. The plan must contain a risk analysis indicating where oil spills are likely to flow under various sets of local meteorological or oceanographic conditions. Impact areas must be identified and strategies fully developed to protect environmentally sensitive areas; the spill control and clean-up equipment which is available to the operator and the response time required to deploy this equipment under the various scenarios must be contained in the risk analysis.

Intent: Policies 2.4.4.(f) and 2.4.4.(g) are not intended to establish new regulations for offshore facilities. They restate and highlight requirements of existing regulations. Industry will not be required to go to considerable additional effort as a result of these policies.

NSB-CMP Policy 2.4.4(h)

Offshore oil transport systems (e.g., pipelines) must be specially designed to withstand geophysical hazards, specifically sea ice.

NSB-CMP Policy 2.4.4(i)

All causeways are required to be sited and designed to allow free passage of fish, marine mammals, and molting birds with due consideration for migration patterns; to prevent changes in water circulation patterns that would have significant adverse impacts on fish and wildlife; and to ensure adequate sediment transport.

NSB-CMP Policy 2.4.4(j)

Residential development associated with industrial and resource extraction development must be removed and the area rehabilitated to standards consistent with the coastal management program when the industrial or extractive use is completed, unless removal is more environmentally harmful than nonremoval.

NSB-CMP Policy 2.4.4(k)

Impermeable lining and diking is required for fuel storage facilities with a capacity greater than 660 gallons.

(c) Best Effort Policies

NSB-CMP Policy 2.4.5

All development must comply with each of the policies set out in sections 2.4.5.1 and 2.4.5.2 unless 1) the following criteria have been established; or 2) the policy is not applicable to the development.

(1) There is a significant public need for the proposed use and activity; and

(2) The development has rigorously explored and objectively evaluated all feasible and prudent alternatives to the proposed use or activity and cannot comply with the policy. When alternatives are eliminated from consideration, the reasons for their elimination shall be briefly documented by the developer.

NSB-CMP Policy 2.4.5.1

Development of the following categories or types will be allowed only if the development has met the criteria under 2.4.5 above, and the developer has taken all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent.

(a) Development that will likely result in significantly decreased productivity of subsistence resources of their ecosystems.

(b) Development which restricts subsistence user access to a subsistence resource.

(c) Development activities from June 15 to July 31 that will likely displace beluga whales from Kasegaluk Lagoon. These development activities may include, but are not limited to, extensive barge or boat traffic; low altitude or frequent plane and helicopter traffic; and other activities resulting in excessive noise or other forms of disturbance.

(d) Development on or near a shoreline that has the potential of adversely impacting water quality (e.g., landfills, or hazardous material storage areas, dumps, etc.). (Near, as used in the phrase "near the shoreline," is defined as that area within a 1,500 foot setback from the mean high water mark along the coast, lakeshore, or river).

(e) Public highway development, except for village roads and streets and highways indicated in the state and/or local capital improvements program.

(f) Transportation development, including pipelines, which significantly obstructs wildlife migration.

(g) Development to accommodate large scale movement of crude oil or natural gas via marine tankers.

Intent: The intent of this policy is to limit development to accommodate large scale movement of crude oil or natural gas via marine tankers to instances where no feasible and prudent alternatives exist, recognizing that development of marine tanker facilities is a use of state concern.

(h) Duplicative transportation corridors from resource extraction sites.

(i) Mining of beaches, barrier islands or offshore shoals. In those circumstances where no feasible and prudent alternatives exist, substantial alteration of shoreline dynamics is prohibited.

(j) Placement of structures in floodplains subject to a 50 year recurrence level and in geologic hazard areas as identified on the following coastal management maps in the NSB Resource Atlas: Map 6 - Areas of moderate and severe ridging and historic ice override. Maps 7 and 22 - Areas of moderate and severe ice ridging.

NSB-CMP Policy 2.4.5.2

The following are required of applicable development except where the development has met the criteria of 2.4.5 above, and the developer has taken all feasible and prudent steps to maximize conformance with the policy.

NSB-CMP Policy 2.4.5.2(a)

Mining (including sand and gravel extraction) in the coastal area shall be evaluated with respect to type of extraction operation, location, possible mitigation measures, and season so as to lessen, to the maximum extent *practicable, environmental degradation of coastal lands and waters (e.g., siltation of anadromous rivers and streams).*

NSB-CMP Policy 2.4.5.2(b)

Development is required to be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes.

NSB-CMP Policy 2.4.5.2(c)

Resource extraction support facilities, including administration offices, operations, residences, and other uses not absolutely required in the field, must be located in a designated service base which is sited, designed, constructed, and maintained to be as compact as possible and to share facilities to the maximum extent possible.

NSB-CMP Policy 2.4.5.2(d)

Gravel extraction activities within floodplains shall maintain buffers between active channels and the work area, avoid instream work, permanent channel shifts and ponding of water, clearing of riparian vegetation, and disturbance to natural banks.

NSB-CMP Policy 2.4.5.2(e)

New subdivisions or other residential development must provide state-approved water and sewer service to prevent damage to fish and wildlife and their habitat.

NSB-CMP Policy 2.4.5.2(f)

Transportation facilities and utilities must be consolidated to the maximum extent possible.

NSB-CMP Policy 2.4.5.2(g)

Development within the Alaska Coastal Management Program-defined coastal habitats must be conducted in accordance with ACMP Standard 6 AAC 80.130(b), (c), and (d), and applicable policies of the North Slope Borough Coastal Management Program. These habitats include the following:

1. *Offshore areas;*
2. *estuaries;*
3. *wetlands and tideflats;*
4. *rocky islands and seacliffs;*
5. *barrier islands and lagoons;*
6. *exposed high-energy coasts;*
7. *rivers, streams and lakes; and*
8. *important upland habitat.*

NSB-CMP Policy 2.4.5.2(h)

Development is required to be located, designed, and maintained in a manner that does not interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence use areas.

(d) Minimization of Negative Impacts

NSB-CMP Policy 2.4.6

Applicable development is required to minimize its impact as follows:

NSB-CMP Policy 2.4.6(a)

Development associated with purely recreational uses of land and wildlife habitat (i.e., commercial hunting and fishing camps and recreational second-home subdivisions) shall minimize adverse impacts on subsistence activities.

NSB-CMP Policy 2.4.6(b)

Siting, design, construction, and maintenance of transportation and utility facilities (including the ice roads) are required to minimize alteration of shorelines, water courses, wetlands, tidal marshes, and significant disturbance to important habitat and to avoid critical fish migration periods.

NSB-CMP Policy 2.4.6(c)

Development is required to maintain the natural permafrost insulation quality of existing soils and vegetation.

NSB-CMP Policy 2.4.6(d)

Airports and helicopter pads are required to be sited, designed, constructed, and operated in a manner that minimizes their impact upon wildlife.

NSB-CMP Policy 2.4.6(e)

A means of providing for unimpeded wildlife crossing shall be included in the design and construction of structures such as roads and pipelines that are located in areas used by wildlife. Pipeline design shall be based on the best available information and include adequate pipeline elevation, ramping, or burial to minimize disruptions of migratory patterns and other major movements of wildlife. Aboveground pipelines shall be elevated a minimum of 5 feet from the ground to the bottom of the pipe, except at those points where the pipeline intersects *a road, pad, or caribou ramp, or is constructed within 100 feet of an existing pipeline that is elevated less than 5 feet. Temporary pipelines (not to exceed 6 months) are exempt from this policy.*

Intent: In areas used by wildlife, this policy establishes a five-foot minimum pipeline elevation where elevation is the preferred means of providing for unimpeded wildlife crossings. Best available information will be evaluated during project review to determine if pipeline burial, ramping, elevation, or a combination thereof, will be employed.

NSB-CMP Policy 2.4.6(f)

Development in floodplains, shoreline areas, and offshore areas is required to be sited, designed, and constructed to minimize loss of life or property due to riverine flooding, icings, streambank erosion, oceanic storms, sea waves, ice gouging and override, and shore erosion.

NSB-CMP Policy 2.4.6(g)

Seismic exploration must be conducted in a manner that minimizes its impact on fish and wildlife.

(4) North Slope Borough Land Management Regulations

The NSB Comprehensive Plan and Land Management Regulations (LMR's) were adopted in December 1982 and revised in April 1990. The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan--to preserve and protect the land and water habitat essential to the subsistence character of Inupiat life.

The new LMR's have five zoning districts: Village, Barrow, Conservation, Resource Development, and Transportation Corridor. All areas within the Borough are in the Conservation District unless specifically designated as within the limited boundaries of the villages or Barrow; as a unitized oil field within the Resource Development District; or along the Trans-Alaska Pipeline System corridor.

The LMR's categorize uses as 1) those that can be administratively approved without public review, 2) those that require a development permit and must have public review before they can be administratively approved, and 3) those considered to be conditional development that must be approved by the Planning Commission.

Policy revisions in LMR's have incorporated the policies of the NSB-CMP and supplemented these with additional policy categories: Village Policies, Economic Development Policies, Offshore Development Policies, and Transportation Corridor Policies. All policies address oil and gas leasing activities, onshore and offshore. The enforceable policies of the NSB-CMP have been incorporated within the zoning ordinance in Section 19.70.050.

It is BLM's policy to consider local zoning to the extent practical in any decision regarding the use of Federal lands. Rezoning would not be required before a Federal lessee or permittee could proceed with activities in the National Petroleum Reserve-Alaska as long as the activities have been authorized by BLM. Oil companies may choose (but are not required) to comply with the NSB's comprehensive plan in the National Petroleum Reserve-Alaska.

7. Recreation Resources

The BLM describes recreation resources in terms of the Recreation Opportunity Spectrum (ROS). The ROS classes are:

P = Primitive,
SPNM = Semi-Primitive Nonmotorized,
SPM = Semi-Primitive Motorized,
RN = Roaded Natural,
RM = Roaded Modified,
R = Rural,
MU = Modern Urban.

All lands are placed in a particular ROS class and managed based on the setting, activity and experience opportunities. Most of the lands in the Northwest NPR-A Planning Area fall within the SPM management class (approximately 8.8 million acres). The remainder, corresponding to private lands within the Planning Area, falls within the RM class (approximately 557,000 acres).

a. Setting

The Northwest NPR-A Planning Area is a vast arctic region with outstanding primitive recreation opportunities. Certain portions of the area are well suited for outdoor recreational activities such as backpacking, float boating, camping, fishing, hunting, and winter sports. Hunting and fishing activities of area residents are not extensively addressed here because those activities are too deeply ingrained in the subsistence lifestyle to be considered recreational. Discussion of those activities can be found in the subsistence section of this document (Sec. III.C.3).

The area's small resident population, costly access, lack of facilities, and few visitors contribute to its recreational under-use, and for this reason, the Northwest NPR-A Planning Area could support additional recreation activities. Despite its immense size (over 9 million acres), recreational use of the Planning Area probably represents less than 1 percent of statewide recreation.

Because of the lack of roads to (and within) the Planning Area, summer access is almost exclusively by charter aircraft. Aircraft are available for hire at various locations, including Barrow (located on the north side of the Brooks Range) and Bettles (located on the south side of the Brooks Range). Guide services are an additional cost and vary with the type of guided activity.

Among the more attractive opportunities in the Planning Area are those associated with the pristine quality of the region, such as backpacking, float boating, and wildlife viewing. The untouched environment and the remoteness of the area offer a wilderness experience comparable to any other available in the U.S. Even in Alaska, there are few areas such as the NPR-A where an individual can be 100 mi or more from the closest village or site of human activity. The area's principal outdoor recreational activities are described in the following discussion.

b. Activities

(1) Backpacking and Hiking

Very little backpacking (overnight trip) or hiking (day trip) unrelated to subsistence activities presently takes place within the Planning Area. It is likely that fewer than 3 recreational backpacking parties (4 persons per party) enter the area each year, with most of this use probably limited to areas near Barrow. Backpacking and hiking occur in the major river valleys in conjunction with float boating activities. The backpacking/hiking season is rather short, generally from late June to early September. There are no developed hiking trails. Aircraft that use the larger lakes and gravel bars as landing sites provide access to the area for backpackers.

Opportunities for cross-country hiking or backpacking in the majority of the Planning Area are very poor. The vast areas of tussocks and/or wet, boggy terrain throughout the coastal plain are all but impassable in the summer. Most of the consistently good terrain for walking is in a narrow corridor of the Colville River riparian area (generally outside the Planning Area boundary). The scenery is more varied in the Colville corridor than elsewhere in the Planning Area, and good camping sites are available. The bluffs of the Colville River and the foothills and mountain terrain in the southern part of the Planning Area provide excellent vantage points for viewing the landscape.

(2) Boating

Very little recreational use (i.e., not related to subsistence) is made of the rivers in the Planning Area. Fewer than 5 multi-day recreational float trips (4 persons per trip) are estimated to occur within the Planning Area each year. Most of the boating is done with rubber rafts or folding kayaks to facilitate access by aircraft, which land on gravel bars or beaches, river pools, or lakes.

Opportunities for floating the rivers in the Planning Area are not outstanding in comparison to opportunities elsewhere in Alaska. Because most of the rivers have an insufficient flow of water during much of the summer, none of the rivers in the area offers whitewater boating. The snow melts rapidly in spring, and the thin vegetative mat overlying the permafrost provides little runoff once the snow is gone. Most of the runoff is discharged in a few days but can take several weeks. During the short-use season however, certain rivers do offer outstanding float-trip opportunities. Some of the better boating rivers in the area are the Colville (outside the Planning Area) and the Ikpikpuk rivers; the Colville's watershed is larger and its flow is correspondingly greater and more sustained.

The recreational value of rivers such as the Colville and the Ikpikpuk is augmented by their function as corridors for arctic wilderness travel--including boating and hiking--since cross-country movement for long distances is usually not possible except in the winter. The riverine areas also provide some of the best places in the Planning Area for viewing wildlife.

Recreational boating and sailing on the many lakes and ponds in the Planning Area are not practical. Many of the lakes are very shallow and the usually persistent winds, swampy shorelines, and difficult portage discourage boating. The shallow depths of the lakes also limit access by plane.

(3) Sightseeing

According to Alaska's Outdoor Recreation Plan, sightseeing is one of the most popular recreational activities of Alaska's residents and the most popular recreational activity of visitors to Alaska (ADNR, Division of Parks, 1976:111-6,7). Although very little sightseeing occurs in the Planning Area, the potential for viewing wildlife in its natural habitat is perhaps the most exciting recreational opportunity in the region. Millions of waterfowl and other birds seasonally migrate to and through the area. Many animals, including grizzly bear, arctic fox, wolf, wolverine, caribou, moose, various raptors, and other animals, inhabit the area. Some species tend to gather in the river valleys at certain times of the year, while other animals are found in large numbers near the coast (USDOI, BLM, 1978c). Several wildlife-viewing areas within the Planning Area offer a variety of opportunities.

- During the summer, the area along the northern coastal plain of the NPR-A, including Teshekpuk Lake, contains the highest concentration of geese, swans, dabbler and diving ducks, gulls, terns, jaegers, and loons in the NPR-A. Snowy owls may also be observed along the coast during the summer months.
- The area located approximately north of 70° N. latitude, south of Teshekpuk Lake and between the Colville and Ikpikpuk rivers, has moderate to high concentrations of geese, swans, diving and dabbler ducks, jaegers, terns, and loons during the summer.
- The area along the middle segment of the Colville River (along the southern boundary of the Planning Area) provides habitat for a subspecies of peregrine falcon (*Falco peregrinus tundrius*) and other raptors during the summer. The area also provides an opportunity for observing grizzly bears from June through September.
- The area located on the upper Ikpikpuk River affords opportunities to observe moose during the summer. Grizzly bears and ptarmigan also may be seen here from June through September (USDOI, BLM, 1978d).

The prime viewing conditions are related to the open, treeless, arctic tundra, the tendency of some animals to concentrate in the riverine areas, the long hours of daylight during the summer, and the lack of extensive contact with humans. Wildlife is easily seen at comfortable distances on the tundra; surprise encounters, which may startle the animals and cause them to move away, are less likely. If visitors are quiet and unhurried, they may watch and photograph the animals as they go about their daily routines of subsisting in the arctic environment. Caribou and bird migrations, tundra vegetation, and the profusion of animal and plant life during the summer provide an opportunity for sightseers to observe animal and plant relationships in the Arctic.

Guided or packaged sightseeing tours may account for a sizable increase in the number of visitors to the region in the future. However, most of this use is expected to be limited to villages and village corporation lands and would not affect public lands. At present, tourist activity is focused almost exclusively on Barrow, at the northern tip of the Planning Area.

(4) Sport Hunting

Big game animals are the primary targets of most sport hunting in the Northwest NPR-A Planning Area. Few trophy animals are found however, and game populations are abundant only in scattered locations within the Planning Area. The Alaska Department of Fish and Game (ADF&G) harvest data generally represent non-subsistence harvest figures, with estimates of subsistence harvests.

Caribou of the Teshekpuk Lake herd are the most numerous big game animals in the Planning Area. Subsistence hunting by North Slope residents accounts for most of the caribou harvest within this herd.

Most moose are taken within the Colville River drainage, and generally outside the Northwest NPR-A Planning Area. According to ADF&G's most recent data (1976a), approximately 30 percent of the hunters are not Alaska residents, 20 percent reside within the Arctic Slope, and the rest are Alaskans from other areas of the state. Moose populations on the North Slope, especially on the Colville River, have declined substantially in recent years, and moose hunting in the area has been severely curtailed by the ADF&G. When moose populations come back to ADF&G-approved levels, guided trips and subsistence hunting are expected to increase.

Grizzly bears are the only bears hunted in the Planning Area. Black bears do not inhabit the area. Grizzlies are taken during the fall and spring. Bears are hunted in the foothills and protected river valleys of the southern portion of the Planning Area. The highest population of bears in the NPR-A is found in the southwestern portion, generally outside the Planning Area (USDOI, BLM, 1978d). Recreational hunters harvest few animals other than those discussed in this section.

(5) Sport Fishing

Sportfishing on the Arctic Slope is more of an add-on to other activities--such as big game hunting, float boating, and construction or government projects--than it is a primary activity. Most fishing occurs during the ice-free summer months (ADF&G, 1976b), although the fishing season is open all year. Fish are likely to be caught in the deeper (> 6 ft) coastal lakes, and the middle and lower Colville River outside the Planning Area.

The overall, long-term potential for the sport harvest of fish is low when compared with opportunities in other areas of Alaska. Fish in the Planning Area are vulnerable to over-fishing. However, because of the lack of present fishing pressure in these remote waters, good fishing can be experienced in some localities, and limited trophy fishing may be available. Fish are most abundant in lakes with inlets or outlets, suitable spawning substrate, and deeper than 6 ft (USDOI, BLM, 1978d).

In some places, sportfishing opportunities in streams deteriorate as summer progresses and low-water conditions occur. Locations in the Planning Area likely to experience these conditions are tundra streams on the coastal plain and Colville River tributaries.

(6) Winter Activities

Very little winter recreation occurs in the Planning Area beyond the immediate area of Nuiqsut. Although extensive travel is usually linked to subsistence hunting and fishing and to visiting other villages, some travel is recreational. The gentle terrain and wind-packed snow throughout much of the Planning Area create favorable conditions for snow machining, dog sledding, and cross-country skiing. The best skiing is found in the river and creek drainages, where snow is deeper, and the hard-packed surface is more level than elsewhere. The arctic wind can be a serious deterrent to any recreational activity, particularly when it blows loose snow, creating visibility problems and a severe wind-chill hazard. The possibility of getting lost on the vast, relatively flat coastal plain is another obstacle to winter recreational use by visitors and residents. Because of these conditions, the potential for winter recreational use is probably limited to the vicinity of the villages, major river drainages, parts of the mountains, the Beaufort Sea coastline, and well-established winter trails. The most favorable months for winter recreation are April and May, when temperatures are usually higher and periods of daylight longer.

(7) Tourism

Tourism could account for the greatest increase in the number of visits to the region in the future. Currently, few visitors leave the immediate vicinity of the villages or Native corporation lands.

(8) Off-Highway Vehicles

The BLM is required by Executive Order (E.O.) 11644 and 43 CFR 8340 to designate all public lands as "open," "limited," or "closed" to off-road vehicle (ORV) use. In Presidential E.O.'s and BLM regulations, the term "off-road vehicle" or "ORV" has a legally established definition. For this discussion however, the term "off-highway vehicle" or "OHV" will be used. This is a designation treated by the public, industry, and land management agencies as interchangeable with the term "off-road vehicle" to describe the broad use of motorized vehicles in the Planning Area.

Recreational (nonsubsistence) use of OHV's is considered very low in the Northwest NPR-A Planning Area. The Planning Area has vast stretches of wet, boggy terrain covered with tussocks, making OHV use difficult during the summer months. While some summer OHV use does occur adjacent to village lands and subsistence camps, access to the Planning Area is primarily via aircraft or motorboat along waterways.

Winter use of snow machines is more common, although mostly associated with subsistence activities. Inter-village winter travel occurs along several travel routes that can migrate with changing snow and ice conditions, making a trail route difficult to establish and winter travel dangerous for the average recreational user. There is a potential for development of guided tour operations between villages, although this activity would need to be authorized through a Special Recreation Permit under 43 CFR 8370 regulations and would include use stipulations.

c. Experience

For the most part, the recreational experience provided by the Planning Area is primitive. The area is an unmodified natural environment with a very low concentration of users and low evidence of human use. There are abundant opportunities for visitors to feel a part of the natural environment and to be isolated from the sights and sounds of other humans. This primitive experience may, however, be tempered by the allowed use of snow machines and motorized boats in the Planning Area.

d. Existing Recreation Developments

The BLM has no maintained or authorized recreational developments or structures on public lands within the Planning Area. There is no developed road system into or through the area. Recreational access is almost entirely by aircraft. Typically, natural features such as lakes, rivers, gravel bars, and ridges serve as airstrips. Umiat--outside but within reach of the Northwest NPR-A Planning Area--has a State-maintained airstrip, fuel, and limited lodging. Established as an oil and gas exploration camp in the 1950's, Umiat is used by area guides and outfitters as a base camp and jump-off point to adjacent public lands, including lands within the Northwest NPR-A Planning Area. Atqasuk, Wainwright, and Barrow maintain landing strips that can be used by the public although, with the exception of Barrow, their use by nonresident recreationists is not vigorously promoted. Emergency landings are possible at DEW-Line sites along the coast.

8. Wilderness

For an area to be considered for Wilderness designation it must be roadless and possess the characteristics required by Section 2(c) of the Wilderness act of 1964. These characteristics are:

1. naturalness--lands that are natural and primarily affected by the forces of nature;
2. roadless and having at least 5,000 acres of contiguous public lands; and
3. outstanding opportunities for solitude or a primitive and unconfined types of recreation.

In addition, areas may contain:

4. supplemental values--consisting of ecological, geological or other features of scientific, educational, scenic or historical importance (*BLM Wilderness Inventory and Study Procedures Handbook* H-6310-1, 2001).

The Northwest NPR-A Planning Area was evaluated for the above characteristics during the Section 105(c) studies. Practically all of NRP-A remains as it was during that study, that is, in a state of de facto wilderness. Residents of the area do occupy seasonal dwellings or fish camps, which if not entirely compatible with naturalness and solitude are, nonetheless, allowed in designated wilderness areas in Alaska. While the population does travel extensively by motorized vehicle (primarily snow machines) over parts of the Planning Area (certainly areas in the vicinity of communities), there are no roads outside those communities. In spite of the NPR-A having been subjected intermittently to oil and gas exploration since the 1920's, the overall character of the Planning Area (excluding private lands) is that of a natural, undisturbed area, with very few obvious signs of modern human influence or presence. A visitor to the area or an inhabitant of one of the few settlements in or near the NPR-A can easily find opportunities for solitude (USDOI, BLM, 1978d). Some areas within the Planning Area contain excellent ecological, geological, scientific, educational, scenic, and historical values.

During the initial inventory conducted in 2001, the BLM identified wilderness units within the Planning Area. These units were identified using hydrologic borders. This inventory identified the entire Planning Area as possessing wilderness characteristics. Each study unit was assigned a name and letter designation (Map 88 and Table III-35). Although most of the Northwest NPR-A Planning Area meets the criteria for wilderness, there are distinct differences in the characteristics, attributes, and uses within the Planning Area.

a. Characteristics of Wilderness

(1) Naturalness

Because of the sheer size of the Planning Area, most of the lands have probably never had human intrusion. A large portion of the northern half of the Planning Area, however--especially those lands near Barrow, Atqasuk, and Wainwright--is used and has been used for many years by the people who live in those communities. Use consists of subsistence hunting with OHV's, motorboats, etc. Trails have been established (some heavily used) from village to village and from villages to camps along river corridors. Many trails have no specific direction and were made in pursuit of subsistence resources. Use of OHV's and other means of access are allowed in wilderness areas (see ANILCA, Section 1110) for traditional and subsistence purposes.

Village to village utility proposals such as power lines, natural gas lines, and other facilities oriented to village and/or city living, are being looked at for future accommodations. Cabins, generally used for subsistence, are numerous along the northern rivers and some lakes. Native Allotments either are or will become private lands. These allotments tend to be located throughout the northern half of the Planning Area, especially along the coast and rivers.

Other facilities in place throughout the Planning Area (camps, airstrips, wellheads, etc.) remain from past oil and gas exploration. Most of these facilities are in various stages of reclamation. Some of the old methods of seismic surveys and transportation of personnel and equipment did leave lasting impacts on the soils and vegetation of the area. Scars of this past activity are still noticeable in some parts of the Planning Area today.

(2) Roadless

Most of the Northwest NPR-A Planning Area is roadless as defined by the *BLM Wilderness Inventory and Study Procedures Handbook* (2001): "The word 'roadless' refers to the absence of roads which have been improved and maintained by mechanical means to insure relatively regular and continuous use. A way maintained solely by the passage of vehicles does not constitute a road." In addition, with over 8.8 million acres of public lands, meeting the size requirements of at least 5,000 acres is obviously not a factor in considering whether the Northwest NPR-A Planning Area meets the roadless and sufficient size criteria.

(3) Outstanding Opportunities for Primitive and Unconfined Recreation

Outstanding opportunities for a primitive and unconfined recreation experience do exist in the Planning Area. These opportunities are largely attributed to the extreme remoteness of the area. Even in Alaska, there is a limited number of locations where an individual can be more than 100 mi in any direction from the nearest population center. This isolation provides opportunities for a wilderness experience.

The mountain unit (2,051,394 acres) and foothills (737,526 acres) unit on the southern boundary of the Planning Area provide summertime opportunities for backpacking, exploring, photographing nature, viewing wildlife, camping, fishing, and hunting. The mountainous areas also offer varied scenery. When they contain sufficient flow, major rivers such as the Meade, Awuna, Kigalik, and Italuk, are suitable for floating--an activity that also allows for wildlife viewing, hiking, camping, and hunting.

Outstanding primitive recreation opportunities are also available along the Chukchi Sea coastline, particularly between Wainwright Inlet and Icy Cape. With the prevailing wind at their backs, travelers can paddle small boats or kayaks from Wainwright, traversing the Kasegaluk Lagoon to Icy Cape. The barrier islands, running parallel to the shore, offer some protection from the wind and ocean currents. During summer, visitors may be rewarded with unusual views of marine mammals, multitudes of waterfowl, or drifting ice packs close to shore.

Depending on the skills, initiative, experience, and equipment of the participant, parts of the Northwest NPR-A are attractive for winter recreational activities. The most favorable time of the year for these activities is late winter or early spring when temperatures are usually higher and days are longer than mid-winter. Although actual winter recreational use is currently minimal, the gentle terrain and wind-packed snow throughout much of the Planning Area create favorable conditions for dog sledding, snow machining, and cross-country skiing. The wind however, can deter or seriously curtail any activity in the Arctic. In mountainous areas, gale force winds can make travel nearly impossible. Wind combined with low temperatures produces chill factors that require travelers to take extreme caution. Orientation can be difficult on the flat expanse of the coastal plain. Most winter recreational use and potential are limited to the area around villages, major river drainages, portions of the mountain and foothills area, the Chukchi Sea coastline, and established winter trails.

(4) Supplemental Values

In addition to the mandatory characteristics of naturalness, size, solitude and/or primitive and unconfined recreation, an area may also contain supplemental values. The Northwest NPR-A Planning Area contains several wilderness supplemental values. Principal among these is the varied wildlife in the area and the associated opportunities for scientific study.

There are thousands of lakes in the area; many of these lakes are shallow and do not support fish. Game animals, primarily caribou, are abundant in some areas, but very few of these animals are trophy size. In summer, the tussocks and boggy terrain make cross-country hiking impossible over the northern half of the Planning Area. Many rivers in the area do not contain sufficient water for floating for more than a couple of weeks in the summer. North Slope weather conditions, including frequent winds, low fog, and extreme weather, affect the recreational opportunities in the region.

b. Wildlife

Wildlife is an important characteristic that affects the quality of the wilderness experience in three ways. First, it enhances the experience by its very presence, particularly those species that commonly cause people to visualize wild country. In the Arctic, these species may include grizzly bear, polar bear, wolf, wolverine, caribou, moose, loons, gyrfalcon, peregrine falcon, golden eagle, and ptarmigan. Wildlife-viewing opportunities in the Planning Area are very good because some forms of wildlife are locally abundant and easily viewed at comfortable distances across relatively flat, treeless terrain. Wilderness-associated species are those often associated in the public's mind with (although not always biologically dependent on) a wilderness-like environment. Second, because of their intolerance of humans or their need for large areas of untrammeled land, some species can survive best in wilderness settings. Parts of Northwest NPR-A Planning Area provide habitat for caribou, grizzly bear, wolf, wolverine, geese, and swans, all of which require wilderness conditions. Third, wilderness may provide habitat for rare and endangered species, which visitors would otherwise never have an opportunity to view. These species may not inherently need a wilderness habitat, but because they are close to extinction, wilderness is a sanctuary.

Most of the large animals such as caribou, grizzly bear, and wolf, tend to concentrate in the mountains and foothills to the south and outside the Planning Area (in the Utukok river uplands, Colville river valley, etc.). Water birds, however, are widely distributed throughout the Planning Area from May through September. The coastal plain within the Planning Area contains the largest populations. Within the coastal plain, there are two areas of heavy concentration. The first is the northernmost part of the coastal plain, generally north of an imaginary line connecting Skull Cliff on the Chukchi Sea and the Colville River delta. This area provides nesting, molting, and staging habitats for geese, dabbler and diving ducks, shorebirds, jaegers, terns, loons, and swans. Its importance as waterfowl habitat was recognized when approximately 1.7 million acres of the area around Teshekpuk Lake was established as a Special Area. The second waterfowl concentration is along the Chukchi Sea coastline near Icy Cape (USDOI, BLM, 1978a).

In the spring, as sea ice breaks up and moves away from shore, marine mammals may be observed migrating northward, following the ice leads. The points of land extending into the water are places where the migrating mammals tend to pass near the shore and where they may be viewed easily from land. The sites include Barrow, Cape Franklin, and Icy Cape. Marine mammals that might be observed here include beluga whale, gray whale, spotted seal, and walrus.

c. Environment and Challenge

To many people, wilderness evokes images of an area where one can experience solitude or serenity and that requires self-reliance. Recreational users of wilderness also expect outstanding opportunities for unusual adventure, excitement, and challenge.

Nearly all of the NPR-A offers a wilderness environment in which visitors can experience feelings of solitude, adventure, and serenity. The bleakness of the Far North also contributes to the impression of solitude. Even at a short distance from the few settlements, one is challenged with having to "fend for oneself." Because of remoteness, lack of convenient public access, and "unknown" quality of the area, recreation-oriented visits are now extremely limited. Thus, the visitor who does make the effort to get into the area is rewarded with a unique wilderness environment.

d. Opportunities for Scientific Study

The presence of features for scientific, educational, scenic, or historical value is an important consideration in identifying areas for possible designation as wilderness. The opportunity for nature study or informal outdoor education as well as formal scientific study is an important attribute of wilderness, if study can be done in a manner compatible with the essence of wilderness. Wilderness areas offer an ideal place for observing plant and animal relationships that have developed without human manipulation. Wilderness also serves as a control for comparison with areas where resources have been altered by man's activities. The Northwest NPR-A Planning Area has unique value for scientific study for a number of reasons. It represents a broad transect with many features typical of the environmental gradient between the Arctic Coast and the Brooks Range. The coastal marine environment gradually changes from the wet sedge meadows to the upland tussock tundra and then to the alpine tundra, with several less distinct gradations between each of these divisions. The coastal-plain ecosystems of the Northwest NPR-A occupy larger areas and are more distinct than those of the eastern portion of the North Slope. The Planning Area's coastal plain also includes a large area of wet sedge meadows, with their associated ponds and oriented lakes not as well represented in the eastern portion of the Arctic. Research opportunities in the Northwest NPR-A Planning Area have been and are still excellent.

Inventories from other programs assist in identifying areas within the NPR-A containing ecological, geological, or other features of scientific, educational, scenic, or historical value. The Joint Federal /State Land Use Planning Commission for Alaska is promoting an ecological reserve system for Alaska and a number of sites have been proposed (Underwood, 1977). Ecological reserves are field sites uniquely conducive to natural science research and education. There were several ecological reserve sites proposed in the late 1970's within the NPR-A. However, one prominent site in the Northwest NPR-A Planning Area is Icy Cape, or Kasegaluk Lagoon area.

National Natural Landmarks are areas that possess exceptional value in illustrating the natural heritage of the Nation. Under sponsorship of the National Park Service, a number of sites in the NPR-A having unique or noteworthy ecological, biological, or geological aspects have been examined and proposed for Natural Landmark status in two studies (Detterman, 1978: Koranda and Evans, 1975). Many of these proposed Natural Landmarks possess attributes similar to those considered in evaluating wilderness values. The proposed landmarks include land areas that represent the ecological, biological, and geological characteristics of large portions of the arctic lowland.

e. Summary of Wilderness Characteristics and Attributes in the Planning Area

(1) Mountain Wilderness Unit and Foothills Wilderness Unit

The Mountain Wilderness Unit (2,051,394 acres) and Foothills Wilderness Unit (737,526 acres) (Units F and G) are generally roadless and natural with few noticeable human impacts and many opportunities for backpacking. In addition, the Foothills Unit offers good opportunities for cross-country skiing. Both units provide excellent scenic variety, better than any other within the Planning Area. The area is the natural habitat for caribou, wolf, wolverine, and grizzly bear, which prefer large areas with minimal disturbance.

(2) Kasegaluk Lagoon (321,000 acres) Wilderness Unit

The Kasegaluk Lagoon Wilderness Unit is also roadless and natural, with some impacts from human presence along the lagoon shoreline; it offers outstanding opportunities for primitive recreation endeavors.

The coastal area of the Chukchi Sea between Wainwright Inlet and Icy Cape includes offshore islands, lagoons, small estuaries, and numerous lakes and ponds. The area contains one of the Arctic's best examples of a barrier island/lagoon environment. The proposal for two separate National Landmarks, one emphasizing ecological values and the other emphasizing geological values, points up the significance of the area (Detterman, 1978; Koranda and Evans, 1975).

Kasegaluk Lagoon provides unusual primitive recreation opportunities, including recreational boating and sightseeing. In the spring and fall, marine mammals may be seen migrating fairly close to shore. In the late summer, large numbers of shorebirds and waterfowl, including eiders and black brant, may be seen in the area. The area offers outstanding opportunities for scientific study and education.

In a site evaluation report by Steven B. Young (1979) for the Center for the Northern Studies in Wolcott Vermont, the author states:

> The proposal area (Kasegaluk Lagoon) contains the largest lagoon and barrier beach system in the North American Arctic and this complex system displays essentially all of the features and processes associated with this landform, as well as a broad spectrum of the variation inherent in these processes. While no single geological feature can be said to be totally unique to the area, there is probably no place where they are all better displayed.

The area is ecologically significant in that it provides an exceptional situation for migrating and breeding waterfowl and other birds. Additional studies of the marine and estuarine animals and plants may well disclose additional important features. In addition, the heavy utilization of the area by marine mammals is important. In the final analysis, the value of the area probably depends most on the combination of features, some of which are unique and some of which are generally characteristic of the arctic lowland and coastal environments.

9. Visual Resources

An in-depth inventory of visual resources within the Planning Area was conducted as part of the NPR-A 105(c) studies in 1979. The section in those studies, Scenic Quality Evaluation, remains the best available information on the subject.

A scenic quality evaluation describes the characteristic landscape and determines scenic quality ratings for the visual resources of an area. Visual resources are defined as the land, water, vegetation, animals, structures, and other features that are visible on the land. The evaluation represents the overall impression a viewer has of the visual resources and does not present the view from any specific location, perspective (such as aerial) or particular season.

For the NPR-A 105(c) studies, the NPR-A was divided into 16 scenic quality rating units (SQRU's) using the basic elements of landform, vegetation, water, color, distinctiveness, and cultural modification. Landform, vegetation, water, and color are self-explanatory. Distinctiveness refers to the degree to which a scenic resource is very rare or unique within a region or--if it is somewhat more common--because of its distinguishing characteristics is usually memorable. Cultural modifications are defined as any human-caused change to the landform, waterform, or vegetation, or the addition of a structure that creates a visual contrast to the basic elements (form, line, color, texture) of the natural landscape.

Each SQRU was evaluated to determine its scenic quality. The Planning Area has 10 SQRU units as displayed in Table III-36. The following is a brief description of each SQRU using the key elements of landform, vegetation, water, color, distinctiveness, and the overall effect that cultural modification has had on the scenic quality of the SQRU.

- *Coastline.* This landscape is broad, with far horizons and big skies. The area is characterized by islands, lagoons, spits, and open sea. Cliffs are also present in some areas. During the winter, pressure ridges of ice may form along the coast.
- *Wet Plains.* This landscape comprises flat, vast plains with many thousands of small lakes and ponds, as well as a few larger lakes, bays, and inlets. The area includes two large bodies of water and polygonal ground patterns.
- *Plains.* This landscape is large and visually expansive coastal plain. It is similar to Wet Plains, except it has fewer lakes and ponds.
- *Ridges.* This landscape displays a marked variation in topographic relief, with flatlands and rolling hills. The water bodies and river corridors are commonly confined, and they add diversity.
- *Colville River Valley.* This area cuts across several other scenic quality rating units. High, steep, rugged bluffs are in the middle portion. The bluffs are deeply eroded and they contrast notably with the flat tablelands that extend to the edges of the bluffs.

Based on information from scoping meetings and the Land Use Emphasis Area Workshop, new sensitivity levels were developed as displayed in Table III-37. Also based on information from scoping meetings and the Land Use Emphasis Area Workshop, a new Distance Zones Map was developed.

Visual resource management class boundaries for the Northwest NPR-A Planning Area were delineated using the process in the BLM publication, *Visual Resource Inventory Handbook* (H-8410-1).

- Class II: the Colville River area
- Class III: rivers, transportation corridors and coastal areas
- Class IV: the majority of the Planning Area.

Class II Objective. The objective of this class is to retain the existing character of the landscape. The allowed level of change to the landscape should be low. Management activities may be seen, but they should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Class III Objective. The objective of this class is to partially retain the existing character of the landscape. The level of allowed change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Class IV Objective. The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic elements.

Visual resource management classes do not apply to community or private land.

10. Potential Additions to the National Wild and Scenic Rivers System

a. Statutory Background

Congress has directed the Federal Government to consider potential additions to the National Wild and Scenic Rivers (WSR) System during land use planning as described below.

(1) Policy Protecting Certain Rivers

Section 1(b) of the Wild and Scenic Rivers Act, 16 U.S.C. § 1271 et seq. (2001) states:

> It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.

(2) Direction to Evaluate Rivers While Planning

Section 5(d)(1) of the WSRA requires that:

> In all planning for the use and development of water and related land resources, consideration shall be given by all federal agencies involved to potential national wild, scenic and recreational river areas, and all river basin and project plan reports submitted to the Congress shall consider and discuss any such potential. The Secretary of the Interior and the Secretary of Agriculture shall make specific studies and investigations to determine which additional wild, scenic and recreational river areas within the United States shall be evaluated in planning reports by all federal agencies as potential alternative uses of the water and related land resources involved.

b. Definitions of Wild and Scenic River Planning Terms

Recommending the suitability of rivers for addition to the National Wild and Scenic Rivers System requires agreement on the meaning of several terms. The BLM has made every effort to consistently apply terms with the following definitions.

(1) Eligibility

Eligibility is mentioned only once in the WSRA (Sec. 5(d)(1)) and it is not defined. Nevertheless, the term has come to refer to the initial screening of a potential river during the wild and scenic river study process (Diedrich and Thomas, 1999). To be eligible for designation as a component of the National WSR System, a river must be free flowing and possess one or more outstandingly remarkable values (see paragraph (3) below). Should a river meet the eligibility requirements, it then requires further scrutiny to determine its suitability as a worthy addition to the national system. Eligibility is, in legal terms, a fact-based determination and not a planning decision. (See the definition of suitability in paragraph (4) below.)

(2) Free Flowing

Section 16(b) of the WSRA defines "free flowing" as:

> ...existing or flowing in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway.

The existence however, of low dams, diversion works, and other minor structures at the time a river is proposed for inclusion in the national WSR system would not automatically bar inclusion provided that the existence of such impediments to free flow:

> ... shall not be construed to authorize, intend, or encourage future construction of such structures within components of the national WRS system.

At this writing, all rivers in the Planning Area are free flowing.

(3) Outstandingly Remarkable Values

An outstandingly remarkable value must be a unique, rare, or exemplary feature that is significant on a regionally or nationally comparative scale. An outstandingly remarkable value is an attribute conspicuous among a number of uncommon or extraordinary values. Only one outstandingly remarkable value is needed for eligibility. The BLM used a regional scale (the NPR-A) along with the national scale to determine outstandingly remarkable values for the Northwest NPR-A Planning Area.

While the spectrum of attributes that may be considered is broad, outstandingly remarkable values are directly river-related. These features should:

1. be located in the river or on its immediate shore lands (generally within 1/4 mi on either side of the river),
2. contribute substantially to the functioning of the river ecosystem, and/or
3. owe their location or existence to the presence of the river.

(4) Suitability

Based on this IAP/EIS, determinations will be made on the suitability/nonsuitability of the rivers within the Planning Area as additions to the National WSR System. Congress may then choose to recommend the suitable rivers for designation. In contrast to eligibility, which is based on a factual description of the existing situation, suitability is based on the weighing of various elements through the planning process. The process used to make suitability determinations is described below.

(a) Key Elements of Suitability Determinations

A suitability determination is made in response to the following four questions:

- Should the river's free-flowing character, water quality, and outstandingly remarkable value(s) be protected, or are one or more other uses important enough to warrant not protecting them?
- Would the river's free-flowing character, water quality, and outstandingly remarkable value(s) be protected through designation?
- Would designation be the best method for protecting the river corridor? The benefits and impacts of WSR designation must be evaluated, and alternative protection methods considered.
- Is there a demonstrated commitment to protect the river by any non-federal entities that may be partially responsible for implementing protective management?

(b) Factors to Be Considered in Suitability Determinations

The WSRA lists a number of factors that must be addressed in reports on suitability/non-suitability:

- status of land ownership and use in the area (discussed in Sec.III.C.6 Land Use and Ownership);
- reasonably foreseeable potential uses of the land and water that would be enhanced, foreclosed, or curtailed if the area were included in the National WSR System (discussed in Sec.IV. Environmental Consequences);
- Federal, State, local, tribal, public, or other interests in designation or non-designation (discussed below in this sub-subsection; in Sec. IV. Environmental Consequences; and in Sec. VI. Consultation and Coordination);
- the Federal Agency that would manage the river, if it were designated (assumed to be the BLM for any designated rivers resulting from planning for the Northwest NPR-A);
- the extent to which the costs of river management would be shared by state and local agencies, if any were to be designated (assumed the federal government would bear the costs of managing any designated rivers within the Planning Area);
- the ability of the BLM to manage and/or protect the river as a WSR area (discussed in Sec. IV. Environmental Consequences);
- historical or existing rights that could be adversely affected by designation (discussed in Sec. II.

Alternatives; Sec.III. Description of the Affected Environment; and Sec. IV. Environmental Consequences); and
- the estimated cost to the U.S., if a river were to be designated (discussed in Sec. II. Alternatives; and Sec.IV. Environmental Consequences).

c. Previous Studies of the Colville and Ikpikpuk Rivers

A review of previous study efforts reveals that the Planning Area has twice been broadly examined for potential additions to the national WSR system (Bureau of Outdoor Recreation,1972; NPR-A 105(c) Study). Report 2 of the NPRA 105(c) Study examined the Colville, the Awuna, the Kuk-Ketik, the Ikpikpuk, and the Meade rivers in detail. The Awuna is outside the Planning Area and is not considered here, however the remaining rivers are considered in this plan.

The 105(c) study found the Colville River, which is outside but adjoining the Planning Area, suitable for addition to the WSR System. The remaining rivers were classified as non-suitable "due to insufficient flow of water and the lack of outstanding attributes."

The Alaska National Interest Lands Conservation Act (ANILCA) amended the WSRA § 5(a) to place the Colville in protective status while giving Congress time to consider the 105(c) recommendations. The Colville River suitability finding was sent to Congress as ANILCA § 604 instructs, but Congress did not add the Colville to the National WSR System. Because Congress chose not to act, the protective status for the Colville River as a WSRA § 5(a) study river expired three years after submission of the 105(c) study to Congress.

In addition to these studies, the Colville and Ikpikpuk rivers were reviewed for eligibility and suitability by the BLM in the *Northeast NPR-A Final IAP/EIS*. The plan reported that the Ikpikpuk River lacked outstandingly remarkable values (USDOI, BLM and MMS,1998:III-C-52), rendering it ineligible for inclusion in the National WRS System. That plan also reported the Colville River, adjacent to the Planning Area, "eligible but non-suitable," because of lack of support from local interests and state government, noting:

> Without the support and assistance of local interests and other land owners/managers, the Colville River is unmanageable and, therefore, unsuitable as a component of the WSR system (USDOI, BLM and MMS, 1998:IIIc-54).

The Ikpikpuk River was thoroughly evaluated as a potential addition to the national WSR system in the *Northeast NPR-A IAP/EIS* and that analysis is incorporated here by reference. The Ikpikpuk River was found unsuitable for WSR designation. Because the Northeast NPR-A IAP/EIS did not determine suitability on the portion of the Colville adjoining the Northwest NPR-A Planning Area, this *Northwest NPR-A IAP/EIS* considers suitability that portion of the Colville River that adjoins the Planning Area (Section II.C.4).

d. Eligible Rivers in the Planning Area

Since all the rivers in the Planning Area are free flowing, identifying eligible rivers according to the WSRA rests on the existence of outstandingly remarkable values. Throughout the scoping process, in public meetings, and planning team workshops, the planning team identified the presence of outstandingly remarkable values. Previous planning and inventory efforts were reviewed. In the Northwest NPR-A planning Area, 22 eligible rivers were identified. These rivers are listed in Table III-38 along with their associated outstandingly remarkable values. The BLM has identified the appropriate classification as "scenic" because of the level of development (mainly subsistence cabins and camps), although this does not mean that scenery is an ORV. In fact, none of the eligible rivers in the Planning Area has scenery as an ORV.

e. Response of Entities Affected by River Designation Status

During the scoping process, the State of Alaska and local and tribal governments opposed the designation of wild and scenic rivers in the Planning Area. Tribal governments and village residents strongly believe that WSR designation could eventually restrict subsistence use and access by area residents--a possibility that is not acceptable to these governments, groups, and individuals.

There was specific support for designation of the Colville River from some individuals at scoping meetings in Fairbanks. There were also individuals at the Fairbanks meetings who expressed blanket opposition to WSR designations in the Planning Area. There was no indication of either support or opposition to designation at scoping meetings held in Anchorage. No Federal Agencies involved in the scoping process have expressed interest in designation or non-designation.

11. Transportation

Transportation systems developed for the Prudhoe Bay and the Kuparuk oil reservoirs would support activities in the Northwest NPR-A Planning Area. The Prudhoe Bay/Kuparuk wells are mature producers relying on an extensive network of access roads and crude-oil gathering lines. This network is constantly expanding as new and satellite crude-oil production sites are identified. A new production site, the Alpine project, has brought the expanding North Slope infrastructure to the edge of the NPR-A. Pertinent land routes (Dalton Highway, North Slope oil roads, associated trails, and rights-of-way), airports and airstrips, and cargo-docking facilities are discussed in this section.

Within the NPR-A there are few roads, identified rights-of-way, or airstrips, and no marine facilities. The Dalton Highway and the Deadhorse airstrip adequately support the development of the Northeast NPR-A. Any future oil and gas industry expansion into the NPR-A would extend from the existing North Slope infrastructure. Thus, this transportation discussion concentrates on existing Prudhoe Bay/Kuparuk facilities east of the NPR-A and those facilities within the NPR-A.

a. Road Systems

The Dalton Highway (also known as the Haul Road) is a north-south, 415-mi-long, all-weather, gravel road connecting Livengood with the Deadhorse airstrip at Prudhoe Bay. North of Fairbanks, the community of Livengood is connected to Fairbanks by a 75-mi section of the Elliot Highway. The Dalton Highway is the sole overland route connecting Prudhoe Bay to Alaska's other major highway systems. The Dalton Highway is 28 ft wide, with an average of 3 to 6 ft of gravel surfacing. Historically, only the portion of the highway from Livengood to the Yukon River Bridge (and later Disaster Creek) was open to the public. In 1995 however, the highway was opened to public access as far as the security gate at Deadhorse. Beyond the security gate, the oil roads are privately owned and maintained.

The majority of vehicles traveling the Dalton Highway are commercial-freight vehicles associated with oil-field activities, though privately owned vehicles and commercial tour operators also use the highway. Summer traffic levels for the Dalton (June-August) are substantially higher than traffic levels for the rest of the year. During the summer of 2000, each month's average daily traffic count at milepost 134 (the Yukon River Bridge) averaged 450 vehicles, however, the annual average daily traffic (AADT) count at the same checkpoint for the year was 245. Farther north on the Dalton Highway, AADT levels fell somewhat. In 2000 the Atigun River checkpoint AADT level was 230 (State of Alaska, DOTPF, 2001).

Annual Dalton Highway truck traffic (loaded and unloaded combined) in 1996 was 45,236 trucks, with a monthly average of 3,770. While numbers of trucks increased substantially between FY1990 and FY 1996, by 2,000, monthly truck volume had fallen to approximately 2,500 (State of Alaska, DOTPF, 2001).

The main road within the Prudhoe Bay/Kuparuk operations area is called the Spine Road. This road provides access from Deadhorse west to the Kuparuk Base Camp and east to the Endicott oilfield. Milne Point, the Oliktok field, and other satellite fields and facilities within the Prudhoe Bay/Kuparuk Operating Area are connected to the Spine Road. The newly discovered Alpine field in the Colville River delta will be connected to the Spine Road by an ice road rather than the standard gravel road. Exploratory drilling of the Alpine prospect was also assisted by ice-road connections to the Prudhoe/Kuparuk complex, with no gravel roads emplaced. The gravel roads are typically 35 ft wide and embanked approximately 5 ft above the ground.

Within Prudhoe Bay's Eastern and Western Operating Areas are approximately 200 mi of interconnected gravel roads. There are approximately 94 mi of other interconnected roads within the Kuparuk River Unit. There are also 8 mi of causeways providing access to facilities and drilling sites, including the 5-mi causeway to the satellite production and main production islands at the Endicott field. Traffic data is not available on the roads within the Prudhoe Bay/Kuparuk Operating Area.

Nuiqsut and other North Slope communities have gravel roads accessing the airstrip, housing, and community facilities. During winter, the roads are covered with ice and transportation is by cars, trucks, snow machines, and other all-terrain vehicles. During the summer, cars, trucks, and all-terrain vehicles use the roads. Data is not available for traffic volume on Nuiqsut's road system.

West of the Colville River and outside the villages described above, surface transportation routes take the form of ice roads or Rolligon trails. The winter transport routes utilized by Phillips and BPX vary, using nearby lakes as water sources for ice-road construction. The BPX route north to the Trailblazer exploratory well was built largely offshore. The Phillips ice roads were constructed north and west of Nuiqsut. The residents of Nuiqsut apparently have also utilized these ice roads.

b. Aviation Systems

There are three major airstrips in the Prudhoe Bay/Kuparuk area--the State-owned and operated Deadhorse airport and the privately owned and operated Prudhoe Bay and Kuparuk airstrips. The Deadhorse airport is served by a variety of aircraft and can accommodate Boeing 737 jet aircraft. This airport has an asphalt airstrip approximately 6,500 ft long by 150 ft wide. The airport has a small passenger terminal, hangars, storage warehouses, and equipment for freight handling. The annual number of passengers on scheduled flights (Alaska Airlines) into Deadhorse is estimated to be 140,000. Total annual oil and support company personnel passenger counts ranged between 205,000 and 220,000 persons from 1992 to 1996 (Ahern, 1997, pers. comm.). Aviation Shared Services transports only oil and gas industry employees, contractors, and cargo. Commercial cargo service is also provided into Deadhorse and to satellite oil field strips. Annual freight tonnage shipped by air into the Prudhoe\Kuparuk complex is difficult to estimate. A range of 250 to 500 tons is probable, as most cargo tonnage is carried over the Dalton Highway.

The Prudhoe Bay and Kuparuk airstrips are owned and operated by Aviation Shared Services. The two airstrips at Prudhoe Bay and Kuparuk are approximately 6,500 ft long and 150 ft wide. They are used primarily by Aviation Shared Services for scheduled flights several times a week (Morrison, 1997, pers. comm.) Leased commercial aircraft transporting industry personnel (Phillips and BP Exploration employees and contractors) also use these airstrips.

Barrow has a state-owned airport with an asphalt runway approximately 6,500 ft long and 150 ft wide. This community is the transportation hub for villages on the North Slope. Alaska Airlines provides regularly scheduled jet passenger flights into Barrow from Anchorage and Fairbanks and other air carriers offer shuttle service from Barrow to various North Slope communities. The Barrow airstrip is accessible year round with use constraints involving severe weather, an occasionally obstructed runway, and migratory waterfowl that may be in the area during spring and fall. Available airport services include minor airframe and power-plant repairs (USDOC, NOAA, 1997). Airport facilities include two large hangars, storage warehouses, and equipment for freight handling.

Nuiqsut is serviced by a 4,500-ft long gravel airstrip located adjacent to the community. The airport is equipped with a rotating beacon, approach lights, high-intensity runway lights, and visual-approach slope-indicator systems. The runway is unattended and unmonitored (USDOC, NOAA, 1997). The community is served by twice-daily flights carrying passengers, cargo, and mail. These commercial flights connect it with Barrow and Deadhorse. Chartered aircraft also use the airport on a regular basis.

Unattended gravel runways serve the communities of Wainwright and Atqasuk. The Wainwright airstrip is 4,500 ft long and 90 ft wide while the Atqasuk airstrip is 4,370 ft long and 110 ft wide (USDOC, NOAA, 1997). Each airport is also equipped with a rotating beacon, approach lights, high-intensity runway lights, and visual-approach systems.

c. Marine Transportation Systems

Marine transportation on the North Slope is generally freight oriented, with the exception of relatively small inboard- and outboard-engine watercraft used by villagers and less frequently by scientific research personnel. Marine transportation provides an economical means of transporting heavy machinery and other cargo with a low value-to-weight ratio. Marine shipments to the North Slope are limited to a seasonal window between late July and early September, when the arctic coast is ice free. Port facilities on the North Slope range from shallow-draft docks with causeway/road connections to Prudhoe Bay to beach-landing areas in North Slope communities. Because there is no deep water port, cargo ships and oceangoing barges are typically offloaded to shallow-draft or medium-draft ships for lightering to shore. Occasionally, smaller craft are used to transport cargo upriver.

Prudhoe Bay has three dockheads for unloading barges--one at East Dock and two at West Dock. A 1,100-ft long causeway connects East Dock to a no-longer-used 100- by 270-ft long wharf constructed from grounded barges (U.S. Army Corps of Engineers and ERT, 1984). West Dock, a 13,100-ft-long by 40-ft-wide, solid-fill, gravel causeway runs along the northwestern shore of Prudhoe Bay east of Point McIntyre. There are two unloading facilities off the gravel causeway at West Dock. One facility is 4,500 ft from shore and has a draft of 4 to 6 ft. The second facility is about 8,000 ft from shore and has a draft of 8 to 10 ft. Water depths around the causeway average 8 to 10 ft (U.S. Army Corps of Engineers and ERT, 1984).

Oliktok Point has another dock extending 750 ft from the original shoreline. At the dockface, water depths reach 10 ft, while the dock's boat ramp has a draft of at least 5 ft. The Oliktok facility also doubles as a seawater treatment plant (Rookus, 1997, pers. comm.).

Marine sealifts bring oil-field supplies and equipment to the Prudhoe Bay/Deadhorse area as expanding or new facilities require. Arrival and off-loading are affected by sea ice. The ice-free window occurs generally from late July through early September.

There are no port facilities in Barrow. Supplies and cargo are brought into the area by barges and larger cargoships and taken to shore by smaller vessels. Supplies are either off-loaded directly onto the beach or offloaded by crane. The primary area used for off-loading supplies is north of the community. Nuiqsut is roughly 18 mi upriver from the sea on a channel of the Colville River. Supplies and cargo are brought to the shoreline of the Beaufort Sea by barges and larger cargo ships and then taken upriver by smaller vessels.

d. Pipeline Systems

As with all North Slope oil production, all potential NPR-A oil production will be transported to the Trans-Alaska Pipeline System (TAPS) Pump Station No.1 for delivery to Valdez Terminal. There are several major trunk pipeline systems carrying crude oil to the TAPS--Prudhoe Bay East, Prudhoe Bay West, Milne Point, Endicott, Lisburne, Kuparuk, Badami, and Alpine. These systems combined are approximately 415 mi long and of various types of crude-oil carriers. All of these pipelines are above ground, elevated on vertical support members. Serving these major TAPS gathering lines are numerous production-pad feeder lines. Often pipelines are "bundled" with different crude and non-crude lines occupying the same right-of-way. Access roads run along each of the pipelines (except Badami and Alpine) to provide for operations, maintenance, and repair.

Crude oil produced within the Planning Area would be transported to Pump Station No. 1 through the 22-mi Kuparuk Pipeline. Oil flow in the Kuparuk line was 343,000 bbl/day in 1992; after a decline, it is expected to soon reach 335,000 bbl/day. Production from the newly discovered Alpine prospect--as well as additional discoveries in the NPR-A--could create a product flow in excess of the Kuparuk line's carrying capacity.

From Pump Station No. 1, the TAPS heads south for more than 800 mi to an oil trans-shipment terminal at Valdez. The oil pipeline has a 48-inch diameter with a 30-ft-wide work pad adjacent to it. Approximately 376 mi of the pipeline are buried to a depth of 3 to 12 ft; the other 420 mi of the pipeline run above ground, mounted on vertical support members.

The TAPS throughput maximum capacity is approximately 2.1 to 2.2 million bbl (MMbbl) per day, its daily throughput averaging 1.0 to 1.4 MMbbl. Declining throughput has reduced the number of pumping stations from an historic high of 11 to 6. The TAPS southern terminus is the Valdez Marine Terminal. The terminal has 18 crude-oil storage tanks for a total storage capacity of 9.18 million bbl. In 1996, there were 619 loaded oil tanker departures from the Valdez terminal (Bogart, 1997, pers. comm.).

e. NPR-A Facilities

There are few transportation facilities within the NPR-A. Apart from Nuiqsut, the only facilities warranting special attention are those at Lonely, Umiat, and Inigok. Lonely is the site of a remotely controlled DEW-Line station that also doubled as an oilfield support base for Husky Oil during the 1974 to 1982 NPR-A exploration period. During that time, Lonely contained a well-maintained gravel runway 5,200 ft long by 150 ft wide, runway lighting and beacons, as well as navigational aids, fuel supplies, and warehouses. At the end of the Husky Oil exploration period, Husky surplussed its logistics facility at Lonely via public bid and it was purchased by Cook Inlet Region, Inc. Currently, Lonely's airport is closed and its condition is unknown. The Lonely DEW-Line station does have a short pipeline for offshore oil deliveries from tanker barges and a gravel barge-landing site (Meares, 1997, pers. comm.).

The Umiat facility is a public airstrip operated by the State of Alaska. During summer months, a private contractor maintains the airstrip; there is no winter maintenance. The field measures 5,400 ft by 74 ft, has some navigational aids and runway lights, and can accommodate Hercules-class cargo aircraft (Meares, 1997, pers. comm.). Privately owned facilities are next to the airstrip.

Inigok, the third major airstrip, is at a former Husky Oil drilling site. The airstrip, estimated at 7,000 ft by 100 ft, was constructed in 1977 and experienced its first loaded cargo aircraft (C-130) landing in June 1978. The Inigok facility is an insulated gravel airstrip. Approximately 1 ft below the gravel surface, polystyrene foamboard underlies the runway. Below the foamboard, to a depth of 6 ft from the runway top, is a layer of permanently frozen sand fill (Kachadoorian and Crory, 1988). Because of the nature of its construction, the Inigok strip remains useable 18 years after its abandonment and is routinely used by the BLM during the summer (Meares, 1997, pers. comm.).

f. Ice Roads

Historically, the Inupiat have navigated from Barrow to the Nuiqsut region along a cluster of coastal and landfast ice routes, with weather and ice conditions often dictating the route used. The Inupiat travel to Teshekpuk Lake, the Colville River Delta, and Nuiqsut along these routes today. Since 1983, ice bridges have been constructed across the Colville River. The first bridge was built to facilitate drilling on a lease held by the Arctic Slope Regional Corporation. The second bridge, built by the people of Nuiqsut in 1984, helped the village respond to a fuel crisis(Smith, Copeland, and Grundy, 1985, as cited in Tremont, 1987). Since then, villagers have annually constructed an ice road from Nuiqsut to Oliktok--or to the nearest oil-exploration ice road--whichever is closer. Once sufficient thickness has been reached, the road is created by blading the snow off the river's ice cover. The road is used for the overland transport of fuel and other material; it also gives residents access to the Dalton Highway (Sec. V, NSB, Comment 1669-028 in the *Northeast NPR-A Final IAP/EIS,* [USDOI, BLM and MMS, 1998]).