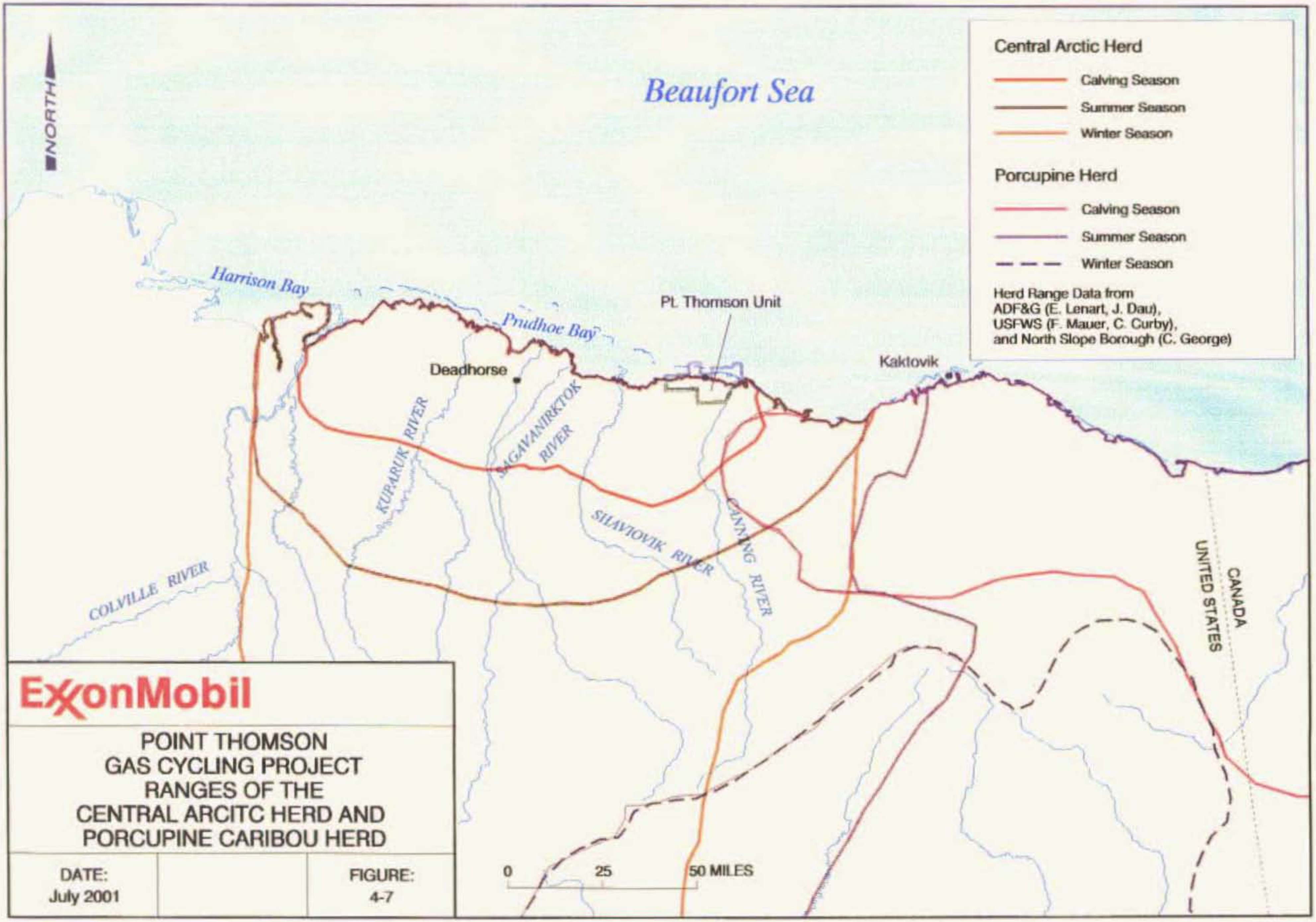
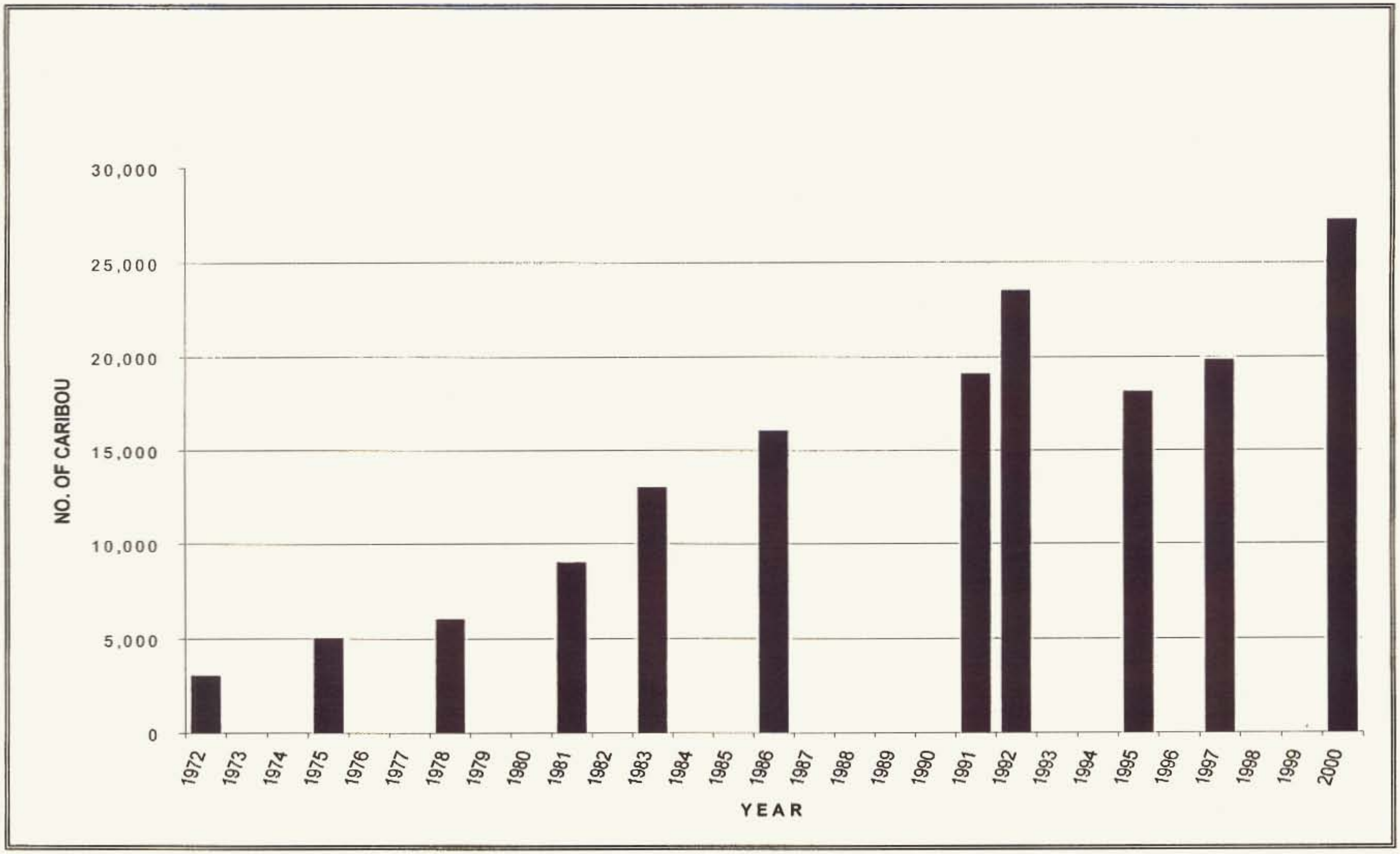

NORTH
Beaufort Sea
Central Arctic Herd
Calving Season
Summer Season
Winter Season
Porcupine Herd
Calving Season
Summer Season
Winter Season
Herd Range Data from
ADF&G (E. Lenart, J. Dau),
USFWS (F. Mauer, C. Curby),
and North Slope Borough (C. George)
Harrison Bay
Prudhoe Bay
Pt. Thomson Unit
Kaktovik
Deadhorse
KUPARUK RIVER
SAGAVANIRKTOK RIVER
SHAVIOVIK RIVER
CANNING RIVER
COLVILLE RIVER
UNITED STATES
CANADA
ExxonMobil
POINT THOMSON
GAS CYCLING PROJECT
RANGES OF THE
CENTRAL ARCITC HERD AND
PORCUPINE CARIBOU HERD
DATE:
July 2001
FIGURE:
4-7
0
25
50 MILES

fig4_7.dgn

Figure 4-8 Central Arctic Caribou Herd Size



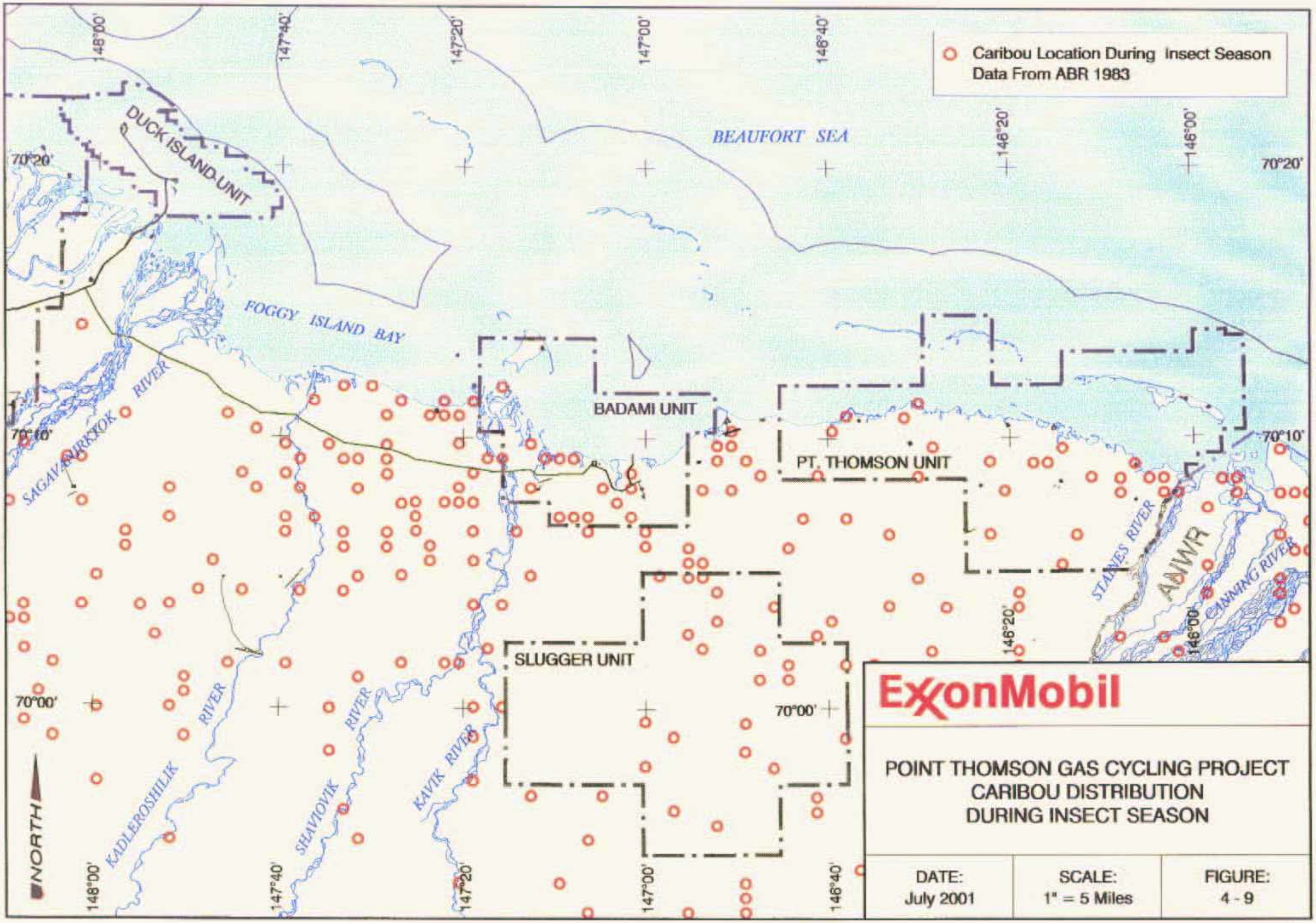

Caribou Location During Insect Season
Data From ABR 1983
BEAUFORT SEA
FOGGY ISLAND BAY
DUCK ISLAND UNIT
BADAMI UNIT
PT. THOMSON UNIT
SLUGGER UNIT
SAGAVANIRKTOK RIVER
KADLEROSHILIK RIVER
SHAVIOVIK RIVER
KAVIK RIVER
STAINES RIVER
CANNING RIVER
ANWR
NORTH
148°00'
147°40'
147°20'
147°00'
146°40'
146°20'
146°00'
70°20'
70°10'
70°00'
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
CARIBOU DISTRIBUTION
DURING INSECT SEASON
DATE:
July 2001
SCALE:
1" = 5 Miles
FIGURE:
4 - 9

fig4_9.dgn

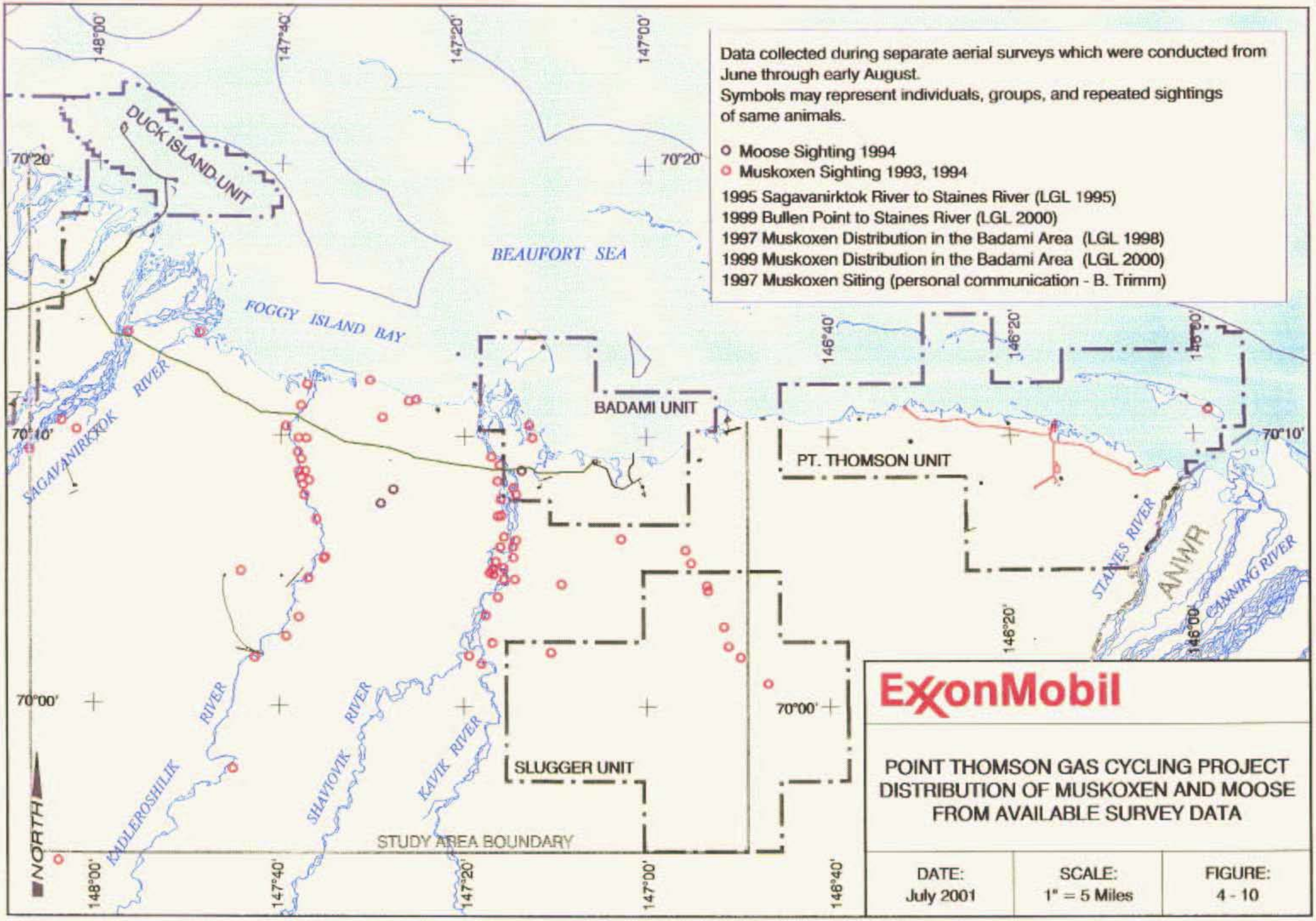

Data collected during separate aerial surveys which were conducted from June through early August.
Symbols may represent individuals, groups, and repeated sightings of same animals.
Moose Sighting 1994
Muskoxen Sighting 1993, 1994
1995 Sagavanirktok River to Staines River (LGL 1995)
1999 Bullen Point to Staines River (LGL 2000)
1997 Muskoxen Distribution in the Badami Area (LGL 1998)
1999 Muskoxen Distribution in the Badami Area (LGL 2000)
1997 Muskoxen Siting (personal communication - B. Trimm)
BEAUFORT SEA
FOGGY ISLAND BAY
DUCK ISLAND UNIT
BADAMI UNIT
PT. THOMSON UNIT
SLUGGER UNIT
STUDY AREA BOUNDARY
SAGAVANIRKTOK RIVER
KADLEROSHILIK RIVER
SHAVIOVIK RIVER
KAVIK RIVER
STAINES RIVER
CANNING RIVER
ANWR
NORTH
70°20'
70°10'
70°00'
148°00'
147°40'
147°20'
147°00'
146°40'
146°20'
146°00'
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
DISTRIBUTION OF MUSKOXEN AND MOOSE FROM AVAILABLE SURVEY DATA
DATE: July 2001
SCALE: 1" = 5 Miles
FIGURE: 4 - 10

fig4_10.dgn

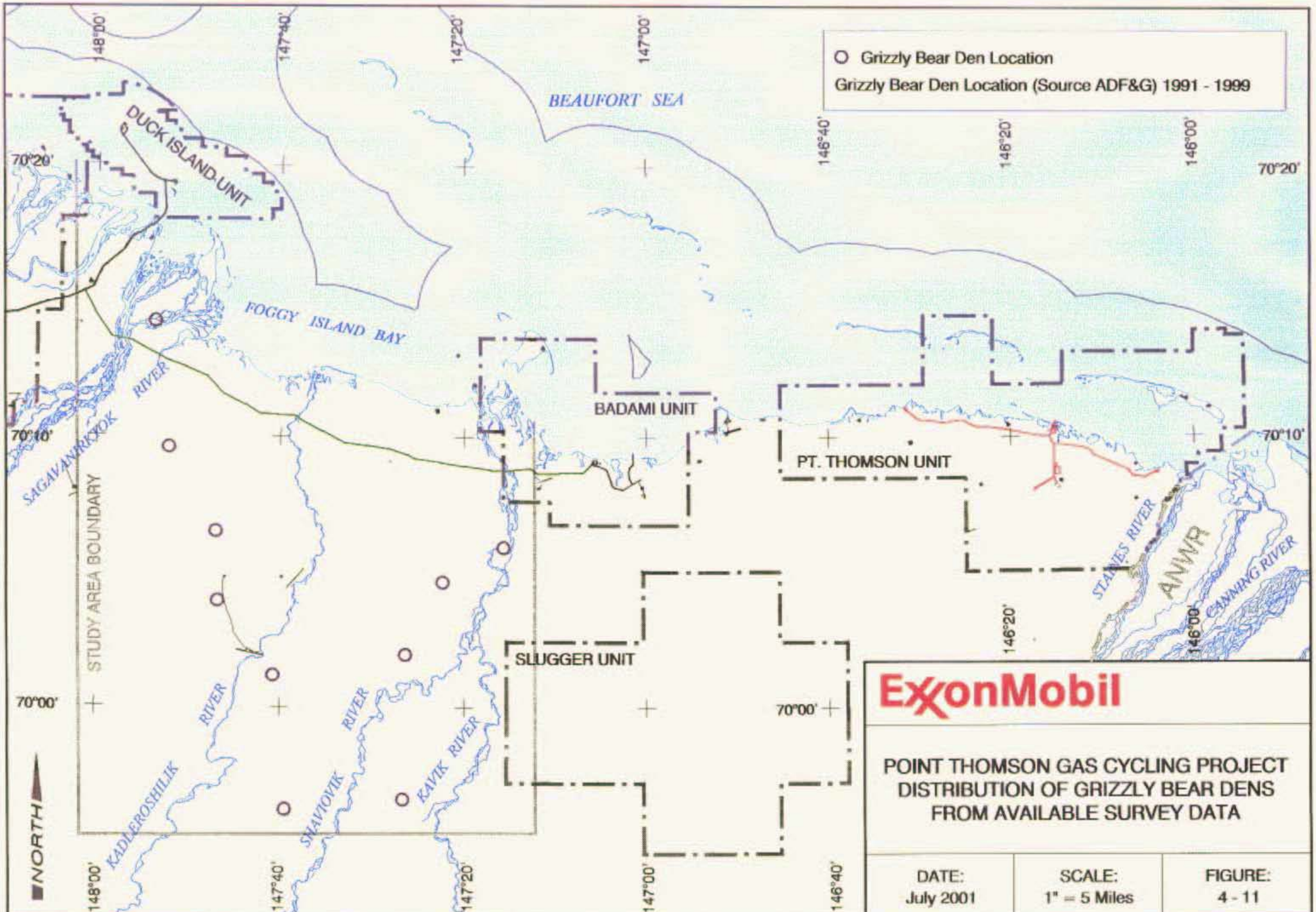

O Grizzly Bear Den Location
Grizzly Bear Den Location (Source ADF&G) 1991 - 1999
BEAUFORT SEA
FOGGY ISLAND BAY
DUCK ISLAND UNIT
BADAMI UNIT
PT. THOMSON UNIT
SLUGGER UNIT
STUDY AREA BOUNDARY
SAGAVANIRKTOK RIVER
KADLEROSHILIK RIVER
SHAVIOVIK RIVER
KAVIK RIVER
STAINES RIVER
CANNING RIVER
ANWR
NORTH
148°00'
147°40'
147°20'
147°00'
146°40'
146°20'
146°00'
70°20'
70°10'
70°00'
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
DISTRIBUTION OF GRIZZLY BEAR DENS
FROM AVAILABLE SURVEY DATA
DATE:
July 2001
SCALE:
1" = 5 Miles
FIGURE:
4 - 11

fig4_11.dgn

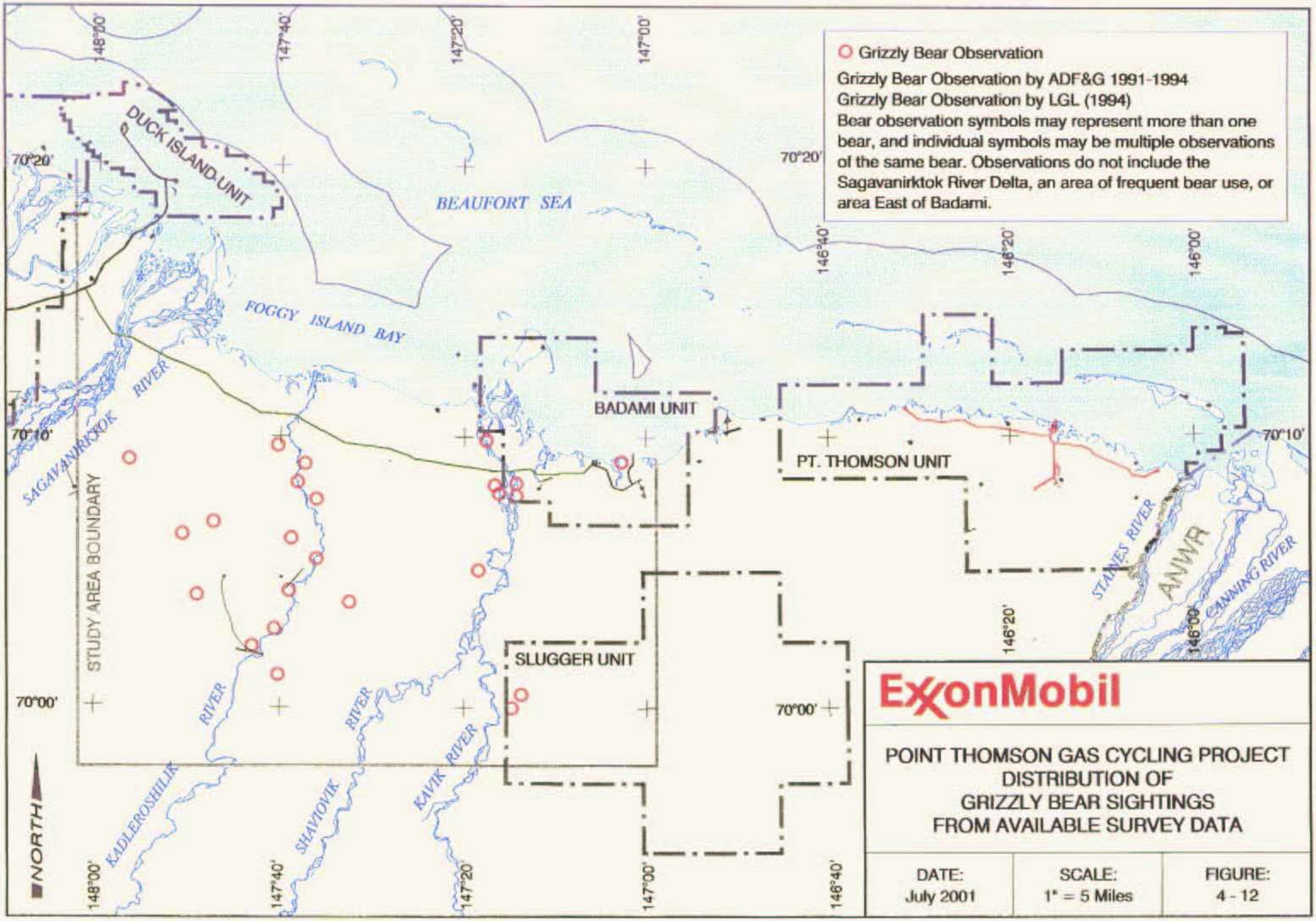

Grizzly Bear Observation
Grizzly Bear Observation by ADF&G 1991-1994
Grizzly Bear Observation by LGL (1994)
Bear observation symbols may represent more than one bear, and individual symbols may be multiple observations of the same bear. Observations do not include the Sagavanirktok River Delta, an area of frequent bear use, or area East of Badami.
148°00'
147°40'
147°20'
147°00'
146°40'
146°20'
146°00'
70°20'
70°10'
70°00'
DUCK ISLAND UNIT
BEAUFORT SEA
FOGGY ISLAND BAY
SAGAVANIRKTOK RIVER
STUDY AREA BOUNDARY
BADAMI UNIT
PT. THOMSON UNIT
SLUGGER UNIT
STAINES RIVER
ANWR
CANNING RIVER
RIVER
RIVER
KAVIK RIVER
KADLEROSHILIK
SHAVIOVIK
NORTH
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
DISTRIBUTION OF
GRIZZLY BEAR SIGHTINGS
FROM AVAILABLE SURVEY DATA
DATE:
July 2001
SCALE:
1" = 5 Miles
FIGURE:
4 - 12

fig4_12.dgn

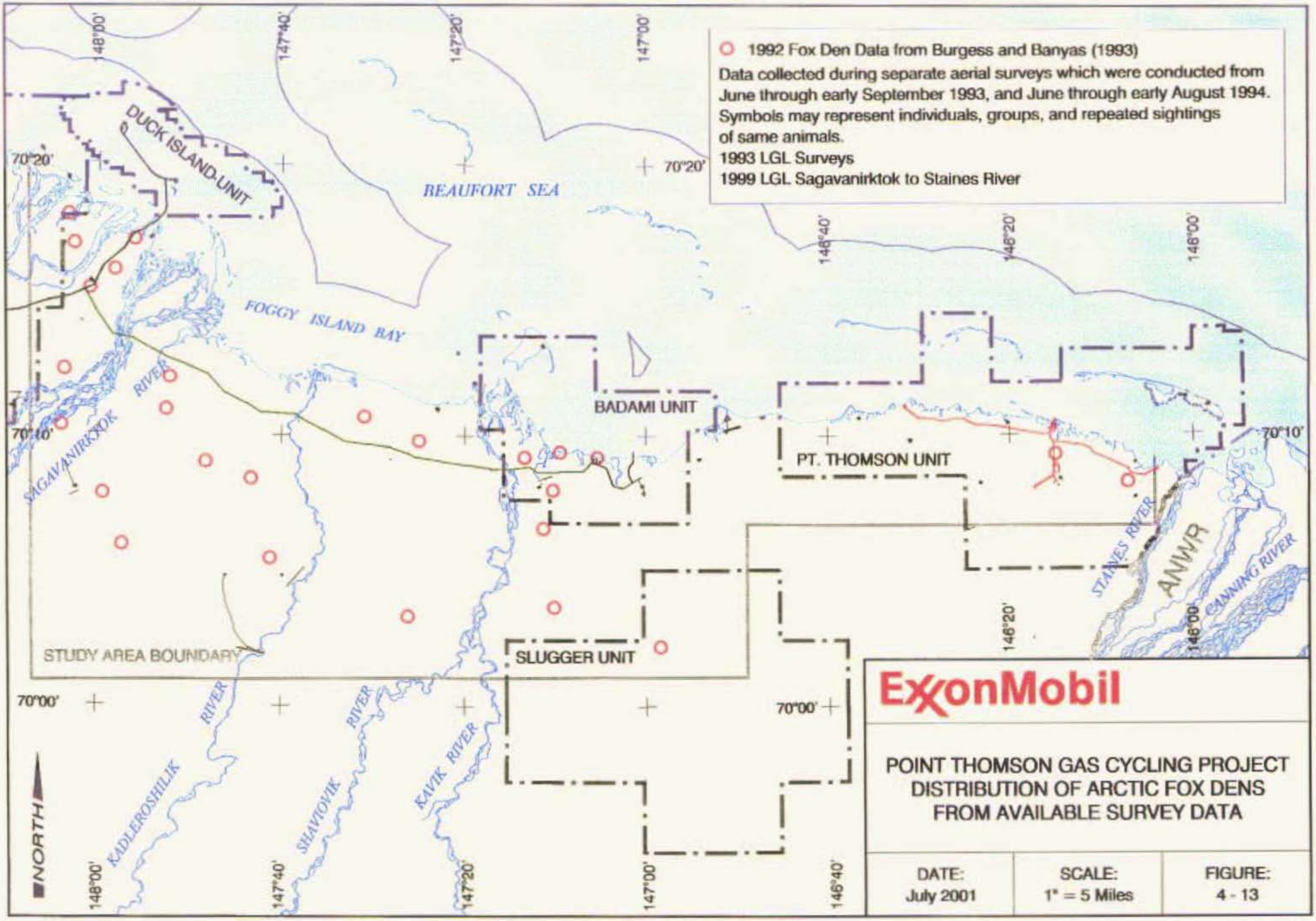

1992 Fox Den Data from Burgess and Banyas (1993)
Data collected during separate aerial surveys which were conducted from June through early September 1993, and June through early August 1994.
Symbols may represent individuals, groups, and repeated sightings of same animals.
1993 LGL Surveys
1999 LGL Sagavanirktok to Staines River
BEAUFORT SEA
FOGGY ISLAND BAY
DUCK ISLAND UNIT
BADAMI UNIT
PT. THOMSON UNIT
SLUGGER UNIT
STUDY AREA BOUNDARY
SAGAVANIRKTOK RIVER
KADLEROSHILIK RIVER
SHAVIOVIK RIVER
KAVIK RIVER
STAINES RIVER
CANNING RIVER
ANWR
NORTH
70°20'
70°10'
70°00'
148°00'
147°40'
147°20'
147°00'
146°40'
146°20'
146°00'
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
DISTRIBUTION OF ARCTIC FOX DENS
FROM AVAILABLE SURVEY DATA
DATE:
July 2001
SCALE:
1" = 5 Miles
FIGURE:
4 - 13

fig4_13.dgn

4.11 THREATENED AND ENDANGERED SPECIES

The Point Thomson project area is seasonally occupied by the spectacled eider, which has been identified as threatened under the Endangered Species Act (ESA). Steller's eiders, which also have been listed as threatened could occur in the project area, but have not been sighted during recent surveys. In addition, the listed bowhead whale migrates offshore of the barrier islands that separate Lions Lagoon from the Beaufort Sea.

4.11.1 Bowhead Whale

The bowhead whale is listed as endangered under the ESA and is designated as depleted under the MMPA. The western Arctic population of bowhead whales was estimated to be 8,200 (6,900 to 9,200 confidence interval) animals in 1993 (NMFS, MMC 2000). The population appears to be increasing at a rate of 3.2% per year despite subsistence harvests of 14 to 74 bowheads per year from 1973 to 1993. Western Arctic bowhead whales winter in the central and western Bering Sea, and spend the summer in the Canadian Beaufort Sea. Migration through the western Beaufort Sea occurs in spring and autumn. For more information of the bowhead whale see Section 4.9.1.1.

4.11.2 Spectacled Eider

The spectacled eider, a threatened bird species, has declined by more than 96 % from historical levels (50,000 pairs) on the Yukon–Kuskokwim Delta in western Alaska (Stehn et al. 1993). Historical records of spectacled eider abundance on the ACP are unavailable, but the USFWS has estimated the current population to be at least 5,000 to 7,000 breeding birds (Larned et al. 2001). Recent estimates suggest that the ACP now supports the main breeding population of spectacled eiders in Alaska (USFWS 1994 and Larned et al. 1999). Spectacled eiders also nest on the Yukon–Kuskokwim Delta, possibly on the Seward Peninsula, and in arctic Russia. Data for the nesting population in the Prudhoe Bay area suggest that it may have declined by as much as 80% between 1981 and 1992 (Warnock and Troy 1992 and TERA 1993). However, recent estimates for the breeding population across the entire ACP, based on aerial survey counts since 1992, suggest that the spectacled eider population is relatively stable (Larned et al. 2001).

Aerial surveys for spectacled eiders were conducted in the Point Thomson region in 1994 (Byrne et al. 1994) and during 1998–2000 (TERA 1999, TERA 2000, and D. Troy, TERA pers. comm.), and this area has been encompassed by surveys conducted across the entire ACP by USFWS since 1992 (Larned et al. 1999 and 2001). Surveys of breeding pairs of spectacled eiders in the Point Thomson region have not been conducted for a sufficient time period to identify discernable trends, but densities in the region are lower than those found in other areas in and adjacent to the oil fields (Table 4-10). Most of the spectacled eiders seen during the aerial surveys were in the vicinity of the Kadleroshilik and Shaviovik rivers and few eiders were seen east of the Shaviovik River (Figure 4-14). No nests of spectacled eiders have been found in the Point Thomson area, although breeding in the area was confirmed by the observation of one brood (female with 4 young) south of Point Sweeny in July 1998 (LGL et al. 1999). Day et al. (1995) observed one pair of spectacled eiders and one male flying west along the coast at the Bullen Point Dewline site during a ground survey of that site in 1994. They also found one badly decomposed carcass of a female-plumaged spectacled eider. No spectacled eiders were seen at the Bullen Point Dewline site during an aerial survey there in June 2000 (Day and Rose 2000). In general, Point Thomson is thought to be located at the eastern range of this species.

Table 4-10 Abundance and Density (birds/mi²) of Eiders in the Point Thomson Study Area, 1993, 1998–2000.

SPECIES / YEAR	BREEDING PAIRS[A] NUMBER PAIRS	BREEDING PAIRS[A] DENSITY PAIRS/MI²	SURVEY AREA (MI²)	SOURCE
Spectacled Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	50	0.37	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	4	0.07	56.5	Byrne et al. (1994)
1998	2	0.03	76.7	TERA (1999)
1999	3	0.04	76.7	TERA (2000)
2000	0	0	76.7	D. Troy (pers. comm.)
King Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	81	0.59	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	32	0.57	56.5	Byrne et al. (1994)
1998	133	1.73	76.7	TERA (2000)
1999	127	1.66	76.7	TERA (2000)
2000			76.7	
Common Eider				
1993				
(Sagavanirktok to Mikkelsen Bay)	1	0.01	136.6	Byrne et al. (1994)
(Mikkelsen Bay to Staines River)	1	0.02	56.5	Byrne et al. (1994)
1998 (inland)[b]	5	0.25	76.7	TERA (1999)
1998 (including coast)	14	0.18	76.7	TERA (1999)
1999 (inland)	18	0.23	76.7	TERA (2000)
1999 (including coast)	75	0.98	76.7	TERA (2000)
2000 (inland)			76.7	
2000 (including coast)			76.7	

[a] Breeding pairs equals numbers of males seen on the surveys.

[b] Common Eiders seen inland from the coast.

Critical habitat had been proposed for spectacled eiders on the North Slope by USFWS (65 FR 6114), but final rulings on this designation (66 FR 9146) did not delineate specific areas for critical habitat protection in the region. Critical habitat was not designated for the North Slope since habitat, and in particular nesting habitat, is not limiting. However, the proposal did identify elements of critical habitat that that may warrant more scrutiny during oilfield planning. These elements included five specific habitats for the North Slope: all deep water bodies; all water bodies that are part of basin wetland complexes; all permanently flooded wetlands and water bodies containing either *Carex aquatilis*, *Arctophila fulva* (pendant grass), or both; all habitat immediately adjacent to these habitat types; and all marine waters out to 25 mi (40 km) from shore, its associated aquatic flora and fauna in the water column, and the underlying benthic community. Many of these habitats are found in the Point Thomson area.

Spectacled eiders arrive on the ACP of northern Alaska in late May (Warnock and Troy 1992, Anderson and Cooper 1994, Johnson 1995, and Johnson et al. 1996 and 1997). Observations during the pre-nesting period suggest that habitats containing open water early in the season are important to spectacled eiders (Anderson and Cooper 1994 and Johnson et al. 1999). Nesting begins in mid-June and eggs start hatching in mid-July; males disperse from the area by late June (Warnock and Troy 1992 and Anderson and Cooper 1994). In recent studies on the Colville River delta, spectacled eiders nested in a variety of habitats, including salt-killed tundra, aquatic sedge with deep polygons, brackish water, and non-patterned wet meadow (Johnson et al. 2000a). Spectacled eiders in the Kuparuk Oilfield nested primarily in non-patterned wet meadows within wetland complexes containing emergent grasses (*Arctophila fulva*) and sedges (*Carex* spp.) (Anderson and Cooper 1994, and Anderson et al. 2000). Spectacled eiders in the Prudhoe Bay Oilfield nested principally in non-patterned wet meadows (Warnock and Troy 1992).

During brood-rearing, from mid-July to when the young fledge in early September (TERA 1995), spectacled eiders use a variety of aquatic habitats on the coastal plain. For example, broods on the Colville River delta were observed in nine different habitats, but most broods were seen in two habitats, salt-killed tundra and deep open water with islands or polygonized margins (Johnson et al. 2000a). Brood-rearing in the Kuparuk, Milne Point, and Prudhoe Bay oilfields primarily occurs in water bodies with margins of emergent grasses and sedges, basin wetland complexes, and occasionally deep open lakes (Warnock and Troy 1992, Troy 1994, Anderson and Cooper 1994, and TERA 1995). These results demonstrate that brood-rearing (and nesting) habitat is strongly associated with aquatic habitats, particularly coastal habitats when available. When young are capable of flight, spectacled eiders depart the ACP usually by mid-September, when freeze-up begins.

4.11.3 Steller's Eider

The Steller's eider was listed as a threatened species on 11 June 1997 (62 FR 31748). Historically, Steller's eiders nested throughout much of western and northern coastal Alaska and in arctic Russia (Kertell 1991 and Quakenbush and Cochrane 1993) but currently they nest only on the Yukon–Kuskokwim Delta (a few pairs since 1994), the ACP, and arctic Russia (Kertell 1991, Quakenbush and Cochrane 1993, and Flint and Herzog 1999).

Critical habitat was proposed for Steller's eiders on the North Slope by USFWS west of the Colville River delta (65 FR 13262); no critical habitats were proposed in the Point Thomson area. The final ruling did not designate any areas on the North Slope as critical habitat (66 FR 8850). The primary constituent elements identified in the original proposal were "… small ponds and shallow water habitats (particularly those with emergent vegetation), moist tundra within 326 ft (100m) of permanent surface waters including lakes, ponds, and pools, the associated aquatic invertebrate fauna, and adjacent nesting habitats" (65 FR 13267).

Nesting densities on the ACP are highest near Barrow, but the current breeding range on the ACP probably extends from near Point Lay in the west to the vicinity of the Colville River delta in the east (Day et al. 1995 and Quakenbush et al. 1995). Nonbreeders and post-breeding birds use the nearshore zone of the northeastern Chukchi Sea and large lakes around Barrow for molting and summering, and a few occasionally occur as far east as the Canadian border. Steller's eiders have not been recorded in the Point Thomson region, but have been seen periodically in the Prudhoe Bay area (Quakenbush et al., in review). The preferred habitats of Steller's eiders near Barrow are waterbodies with *Arctophila fulva* (pendant grass). The Point Thomson area is probably not used at all by Steller's Eiders.

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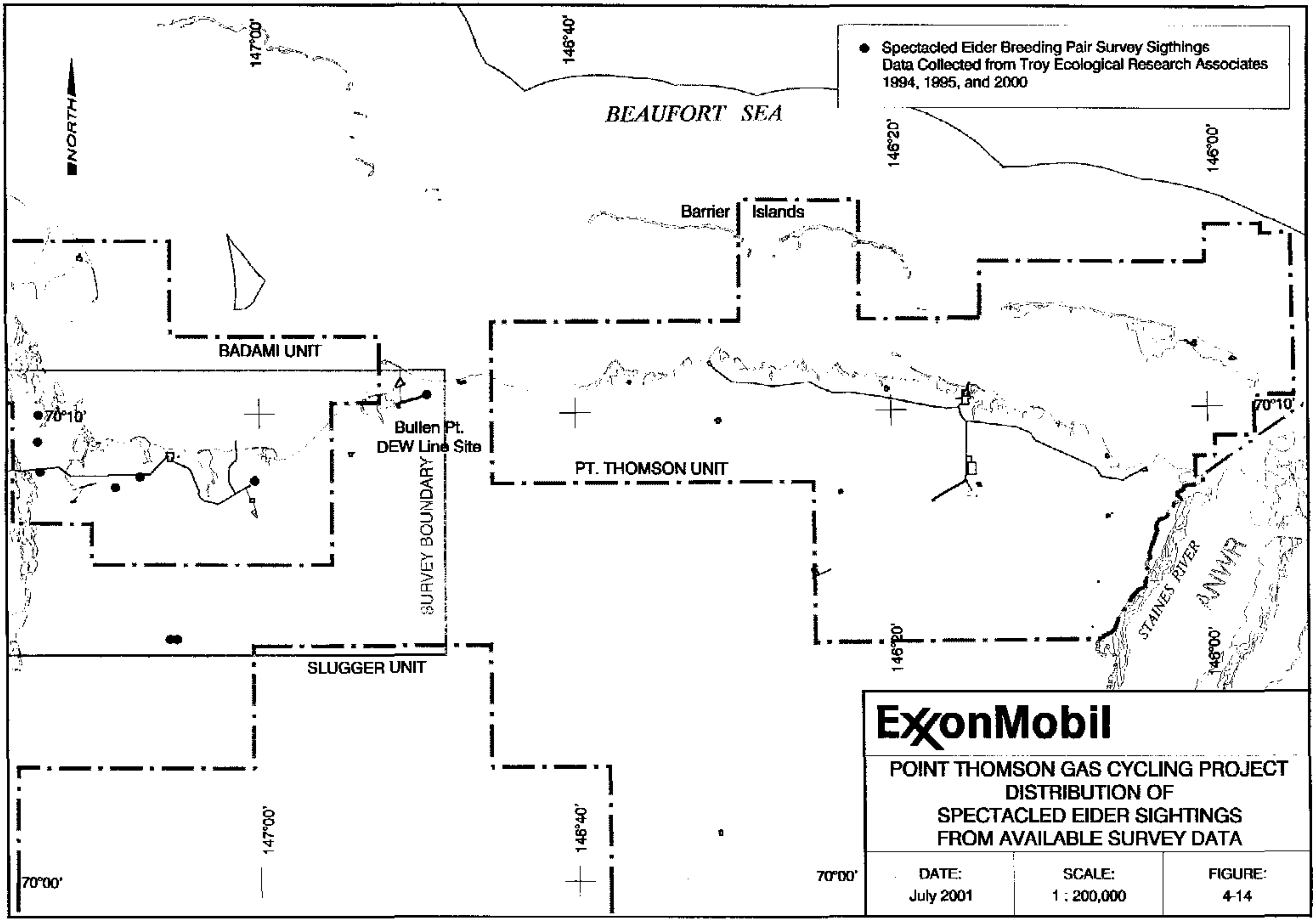
● Spectacled Eider Breeding Pair Survey Sigthings
Data Collected from Troy Ecological Research Associates
1994, 1995, and 2000
NORTH
147°00'
146°40'
146°20'
146°00'
BEAUFORT SEA
Barrier Islands
BADAMI UNIT
70°10'
Bullen Pt.
DEW Line Site
PT. THOMSON UNIT
SURVEY BOUNDARY
SLUGGER UNIT
STAINES RIVER
ANWR
70°00'
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
DISTRIBUTION OF
SPECTACLED EIDER SIGHTINGS
FROM AVAILABLE SURVEY DATA
DATE:
July 2001
SCALE:
1 : 200,000
FIGURE:
4-14

fig4 14.dgn

4.12 CULTURAL RESOURCES

Cultural resource sites on Alaska's North Slope contain non-renewable data about human history prior to European contact (prehistoric) and after contact (historic). On the North Slope, the contact era began in the 1800s, although indirect influences (especially from Siberia) through established trade networks occurred much earlier. Historic and prehistoric cultural resources include sites, features, structures, buildings, and objects that can provide information on human prehistory or history. These resources can be located in uplands, the intertidal zone, and/or underwater.

4.12.1 Regulatory and Compliance Background

Prehistoric or historic sites (also termed "historic properties" in the National Historic Preservation Act of 1966) are those listed in or eligible for the National Register of Historic Places (36 CFR 800). A site must be over 50 years old to be considered "historic" unless it has exceptional national, state, or local significance. Certain Alaskan Native sacred sites may also be significant (Executive Order 13007 1996), and certain traditional cultural properties also may be eligible for the National Register (36 CFR 60.4). The State of Alaska Historic Preservation Act and the North Slope Borough (NSB) also stipulate protection of area cultural resources.

The Alaska Office of History and Archaeology (OHA) and the NSB Inupiat History, Language, and Culture Commission (IHLC) are the primary repositories of archaeological and historic land use data for the North Slope. The OHA maintains the Alaska Heritage Resource Survey (AHRS), a statewide listing of archaeological site data. The NSB's Traditional Land Use Inventory (TLUI) database contains place-names and site data primarily related to important historic (post-contact) subsistence use areas, although some of these sites may also have prehistoric components. TLUI sites include a variety of site types including villages, camps, graves, hunting and fishing sites, graves, quarries, trails, and landmarks. The Geographical Information System (GIS) version of the database contains both Inupiaq and English descriptions and visual information (ESRI 1999).

Past and present local subsistence, Western exploration, trade, and commercial resource extraction has involved small boats, ships and barges. Although this project is not likely to involve submerged cultural resources, historic shipwrecks-particularly those associated with commercial whaling-are a component of the area's archaeological and historical record. Small boat wrecks and boat parts can also found on area shorelines. Department of the Interior Minerals Management Service (MMS) maintains a historic shipwreck database including over 50 wrecks in the Beaufort Sea management unit (Tornfelt and Burwell 1992). The MMS Handbook for Archaeological Resource Protection 620.1-H and Notice to Lessee 00-A03 describes current management schemes for shipwrecks.

4.12.2 North Alaska Prehistory

Tools left behind by ancient Paleoindians in the Arctic may be as old as 11,800 years and as recent as 8,800 years ago (Figure 4-15). The Mesa Site is the oldest and best-dated (Kunz and Reanier 1994), followed by the Putu (Alexander 1987) and Bedwell sites (Alexander 1974 and Reanier 1995) where ancient lanceolate projectile points were found.

Paleoarctic sites from northern Alaska include the Gallagher Flint Station (Dixon 1972, Bowers 1983, and Ferguson 1995), a site that also yielded Northern Archaic and Arctic Small Tool Tradition materials; and the Lisburne Site (Bowers 1982 and 1999). The early chapters in Alaska prehistory are still being written. New discoveries are affecting New World cultural migration and habitation scenarios. While each new site helps illuminate the ancient past, Lobdell et al. (2000) noted, "There is much of the peopling of the Americas, including the Arctic, which is not yet understood."

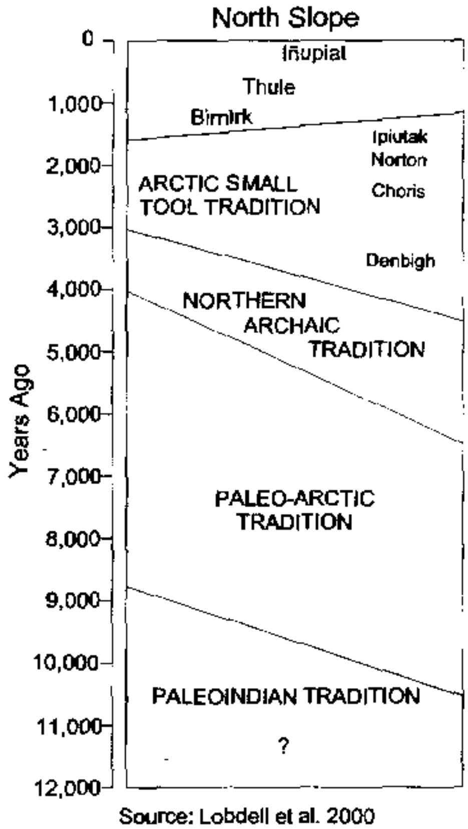

Figure 4-15 North Alaska Prehistory

Northern Archaic side-notched projectile points start appearing throughout Northern Alaska 6,500 to 6,000 years ago (Anderson 1968), possibly indicating an expanding boreal forest tradition (Anderson 1984). On the North Slope, the Kuparuk Pingo (Lobdell 1986) and the Putuligayuk River (Lobdell 1981) contain these diagnostic projectile points.

The Arctic Small Tool Tradition (ASTT) sites are known by their well made, minutely flaked, tools that may mark an emerging bow and arrow technology. Various Choris, Norton, and Ipiutak expressions of the Arctic Small Tool tradition are now recognized. The North Slope ASTT sites include Putuligayuk River Delta Overlook (Lobdell 1981) and the Central Creek Pingo (Lobdell 1992d).

Expanded marine mammal hunting in the first millennium, combined with caribou hunting and fishing, set the scene for a Thule cultural explosion that flourished in Arctic Alaska, Canada, and southern Greenland. Modern Inupiat life evolved out of a cultural milieu focused on whaling and featuring intensive exploitation, trade, and exchange of a wide variety of coastal and interior resources. The cooperative nature of the subsistence lifestyle that once enabled the Thule culture to flourish on the North Slope of Alaska continues into the present and has been a key to modern Inupiat cultural survival. In the Historic Era, Inupiat people adapted to rapid and extensive culture change brought by disease epidemics, commercial whaling, fox skin trading, and reindeer herding. Inupiat culture has absorbed the impact of Western military, educational, medical and religious institutions, and the effects of oil development. Cooperative resource harvesting and sharing persist in the third millennium among the Inupiat and continue to bind people to their homeland on the North Slope.

4.12.3 Point Thomson Cultural Resources

Scores of commercial whalers passed by the Point Thomson area in the late 1800s as they followed the bowhead migration past ancient Inupiat villages and into the Beaufort Sea. Historic Period archeological sites with traditional land use associations dating to the commercial whaling and fox trapping eras are the principal cultural resource sites in the project area (LGL et al. 1998). Libbey (1981) recorded Inupiat elders' oral histories and traditional accounts of some project areas from Josephine Itta, Mary Akootchook, Sarah Kukaknana, Joe Koganaluk, and others. Leffingwell (1919), Dawson (1916) and others record coastal trade activities on Flaxman Island, at Brownlow Point, and in the eastern Beaufort Sea. Jenness (1957) and Steffanson (1913) recorded aspects of area Inupiat life during their explorations and scientific investigations.

Summer trade fairs had brought Inupiat people together from villages all along the Arctic coast and throughout the interior until the practice ended in the early 1900s (Hoffman et al. 1977). Shortly after the trade fairs ended, commercial enterprises run by former commercial whalers-turned-entrepreneurs, Tom Brower, Tom Gordon, Bill Allen and others, sprang up along the Arctic coast. Photos of Gordon's and others' trading posts from this era are present in historic photograph collections at the NSB IHLC and elsewhere.

Inupiat people adjusted to new social conditions after commercial whaling ceased in 1908, as inland caribou populations crashed around the same time. In addition, flu epidemics caused devastation and the survivors coalesced into new social units through migration, amalgamation and altered land and resource use strategies. A portion of the Inupiat population living along the Beaufort Sea coast in the early to mid twentieth century were members of inland bands who had moved to the coast because of depopulation and the caribou decline. Sod house and trading post ruins, ice cellar and food rack/cache remains, skin-processing features and implements, hunting tools, domestic refuse including metal, boat and sled parts, and other transportation-related artifacts are associated with sites from the early to mid 1900s.

The commercial fur-trapping era along the Beaufort Sea coast was an important social period, sandwiched in between the 1919 and 1945 epidemics on the North Slope. It was a readjustment phase as trading posts and related historic ruins in the project area attest. Local furs provided a source of cash for the mixed subsistence/cash economy after commercial whaling ceased. The Panningonas ran their trapline from Flaxman Island as far as Point Gordon (NSB 1980:84) and also hunted caribou in this area. (ibid:146). Located at Point Thomson were three interconnected sod houses belonging to Pausanna, Utuayuk, and Kuniochiak. Sara Kunaknana's family wintered in the same area during the 1920s (ibid).

Evidence of Inupiat heritage in the proposed project area was apparent in testimony concerning the original Point Thomson lease sale in 1978 (ADNR 1978). A hearing transcript documented that several elders living in Barrow, including Johnny Tookak, Lora Oyaga, Olive Ahkivgak, Josephine Itta, Nellie Ahnupkana, Thomas Panningona, and Henry Nashanik, had local knowledge of the area:

> *These people have, through personal experience, knowledge of wildlife, hunting and fishing locations, land use patterns, and historic sites in the area proposed for the Point Thomson lease sale...*

Inupiat ties to the Point Thomson area, although difficult to document archaeologically because of the extensive recent coastal erosion in certain localized areas such as Flaxman Island, remain an important heritage issue. Numerous site-specific and general archaeological surveys focused on identifying eligible cultural resources in the Point Thomson project area beginning with Campbell (n.d.) in 1974. Surveys conducted for oil and gas exploration and development (Bacon 1982a, 1982b, 1983, and 1985; Dames & Moore and Lobdell 1986; Lobdell 1980, 1992a, 1992b, 1992c, 1997a, 1997b, 1998, and 2000) have documented seventeen AHRS and TLUI sites in the project area, two of which are on Flaxman Island (Table 4-11). The nature of the project area's landscape, specifically Point Thomson area shorelines and the expansive areas of low-lying wet tundra, reduces the archaeological sensitivity of the proposed project area.

The fact that the only site in this area listed on the National Register of Historic Places is the geological exploration ruins at the Leffingwell Camp (XFI-00002) continues to be a source of local concern (Jana Harcharek, personal communication 1999). Local residents consider traditional Inupiat land use sites to be equally important. Other cultural resource sites in the project area include DEW (Distant Early Warning) line facilities at Bullen Point. Two of the sites at Bullen Point, SRRS Road System (XFI-00027) and SRRS Airfield (XFI-00028) were determined eligible for the National Register in 1999.

Shoreline erosion continues to alter and remove archaeological sites in certain areas along the Beaufort Sea, such as the recent loss of the gravesite XFI-007 on Flaxman Island (Lobdell 1997a). Although coastal erosion has likely erased ancient shoreline sites that may once have been located along the Beaufort Sea coast, the surviving historic sites and features attest to Inupiat heritage ties to the land. Even though ancient sites are unlikely to be preserved along project area shorelines, and although extensive prior reconnaissance surveys have not produced many archaeological sites, undiscovered sites or site remnants may still exist in the project area. Previously undiscovered, buried, and prehistoric sites could be located on elevated landforms or along stream channels away from the shoreline within the project area.

Table 4-11 TLUI and AHRS Sites in Project Area

AHRS #	TLUI#	Site Name, notes
XFI-00001	TLUIXFI002	POW-3 Bullen, Savaguik, Flaxman Island DEW Line Station
XFI-00002		Leffingwell Camp
XFI-00004	TLUIXFI003	Point Gordon
XFI-00005	TLUIXFI004	Point Hopson
XFI-00006	TLUIXFI006	Point Thomson
XFI-00007	TLUIXFI007	Flaxman Island (*)
XFI-00008	TLUIXFI018	East Flaxman Island
	TLUIXFI005	Point Sweeney
XFI-00021	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00022	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00023	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00024	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00025	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00026	TLUIXFI002	BULLEN POINT LRRS (POW-3) DEW LINE FACILITIES
XFI-00027	TLUIXFI002	BULLEN POINT SRRS ROAD SYSTEM [WACS, AC&W]
XFI-00028	TLUIXFI002	BULLEN POINT SRRS AIRFIELD [WACS, AC&W]
XFI-00029	TLUIXFI002	BULLEN POINT SRRS GRAVEL PAD SYSTEM [WACS, AC&W]
XBP-28	TLUIXFI001	Mikkelson Bay Village

* site destroyed

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4.13 SOCIOECONOMIC CHARACTERISTICS

The socioeconomic geographic scope for the Point Thomson Gas Cycling Project is defined as the area from Nuiqsut east to Kaktovik and seaward of the barrier islands south to the Brooks Range. This section discusses the socioeconomic characteristics of the proposed project area, and to a lesser extent the State of Alaska, including population, employment, income, and taxation. These characteristics are discussed separately from subsistence, making a distinction between socioeconomic issues and subsistence issues. This should not obscure the reality that wage employment, revenue from taxation, and subsistence are all vital components of the North Slope socioeconomic system (LGL et al. 1998).

The North Slope Borough (NSB) encompasses the entire northern coast of Alaska and is composed of about 88,281 mi^2 (14,000 km^2) (15 % of Alaska). The borough was organized in 1972 and adopted a home rule charter in 1974. The predominantly Inupiat residents of the borough have historically relied on subsistence activities. A major motivation for the formation of the borough was to maintain local control of regional economic development, and to provide a taxing mechanism through which NSB residents could benefit from the developing regional petroleum industry (at that time confined for the most part to Prudhoe Bay). The courts and the Alaska State Legislature ultimately defined the taxing authority of the NSB.

The Point Thomson Unit lies within the NSB, approximately 100 mi (161 km) east of the community of Nuiqsut and 60 mi (97 km) west of the community of Kaktovik. The North Slope oil field support center of Deadhorse is located 40 mi (64.4 km) west of the Point Thomson Unit.

4.13.1 Population, Employment and Income

The population, employment, and income characteristics of the State of Alaska and communities on the North Slope are affected by resource development projects such as proposed Point Thomson Gas Cycling Project. In addition to the potential effects of direct project employment, indirect effects occur through sales of services and materials to the petroleum industry, and from North Slope services and capital projects funded by revenues derived from oil and gas development projects.

4.13.1.1 Population

State Of Alaska

The Alaska population from 2000 census information is approximately 627,000. This is about 5,000 more than the 1998-1999 estimates prepared by the Alaska Department of Labor (ADOL). Over the past decade, ADOL estimates of annual population growth have ranged from 0.2 to 3%. Figure 4-16 presents population data for the State of Alaska since 1950.

North Slope Borough

The North Slope population from 2000 census information is 7,385; approximately 74% of the population are Alaskan Natives. The 2000 estimate is roughly the same as the estimated 1998 population of 7,413 prepared by the ADOL. Over the past decade, ADOL estimates of annual NSB population growth have ranged from 2 to 5%.

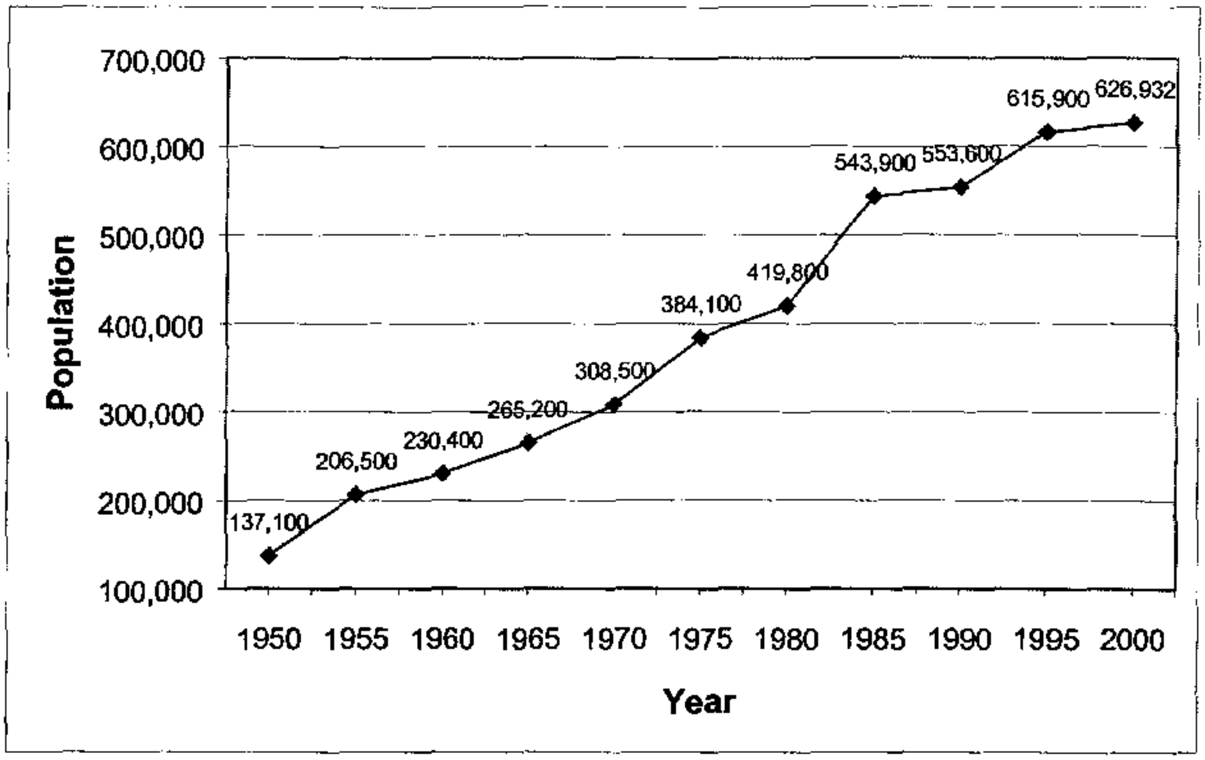

Figure 4-16 Population of the State of Alaska, 1950-2000

Nuiqsut

Nuiqsut's population grew from a total of 175 when it was re-established in 1973 to about 340 in 1985 (Pederson 1995). The Nuiqsut population from 2000 census information is 433; approximately 88 % of the population are Alaskan Natives. The 2000 estimate is slightly less than the estimated 1998 population of 486 prepared by the Alaska Department of Labor. Over the past decade, ADOL estimates of annual Nuiqsut population growth have ranged from 2 to 5%. Figure 4-17 presents current and historic population data for Nuiqsut.

Kaktovik

The Kaktovik population from 2000 census information is 293; approximately 75% of the population are Alaskan Natives. The 2000 estimate is slightly higher than the estimated 1998 population of 259 prepared by the Alaska Department of Labor. Over the past decade, ADOL estimates of annual Kaktovik population growth have ranged from 1 to 3 %. Figure 4-17 presents current and historic population data for Kaktovik.

4.13.1.2 Employment and Income

North Slope Borough

Total employment of resident and non-resident workers within the NSB region in 1994 was estimated at about 7,000, from a peak of over 10,300 in 1983. Oil industry jobs comprised 5,000 of the 1994 jobs and 7,800 of the 1983 jobs (LGL et al. 1998). Most, if not all, oil industry jobs are held by people residing outside of the NSB in other parts of Alaska or outside of Alaska.

Relatively few NSB residents are directly employed by the oil industry. However, most NSB employment is indirectly dependent on oil industry activity (through taxation revenue). NSB residents are also employed indirectly in support and service functions contracted to Alaska Native Claims Settlement Act (ANCSA) corporations by the oil industry.

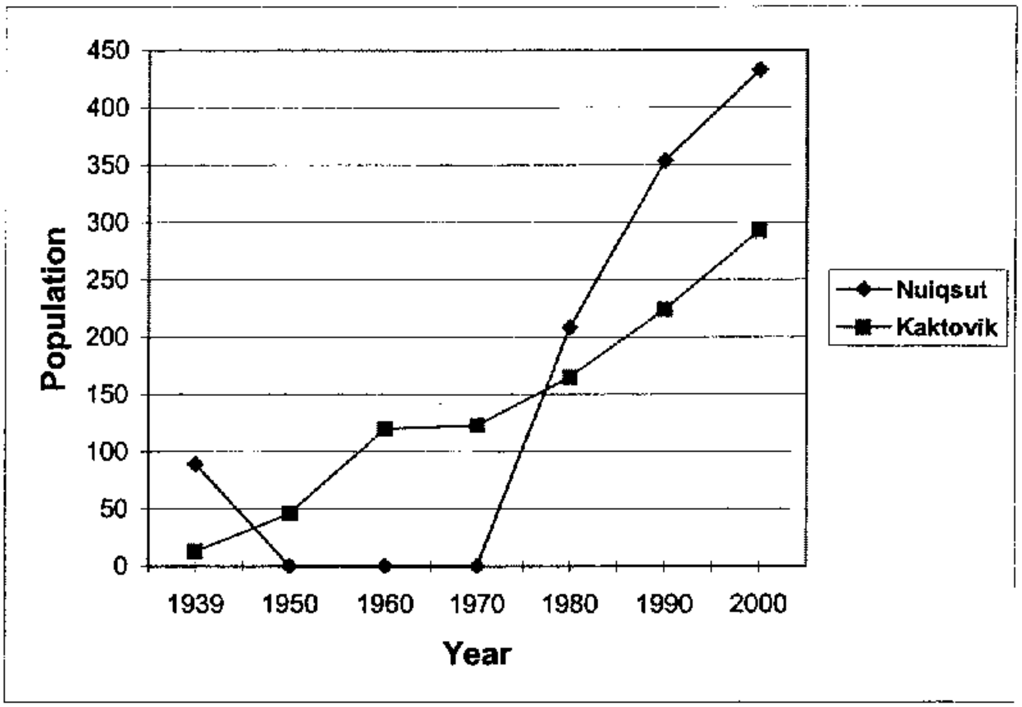

Figure 4-17 Population of Nuiqsut and Kaktovik, 1939-2000

The NSB is the most important employer other than the oil industry. The NSB, including the school district, employed 62 % of all working NSB residents in 1994. Most of the other residential workforce was employed by the regional or ANCSA corporations (or subsidiaries and joint ventures), or local community governments. Construction workers for all NSB Capital Improvements Program (CIP) projects from 1989 to 1994 consisted of 64 % NSB residents (LGL et al. 1998).

Unemployment is a difficult concept to discuss in terms of the NSB workforce. Official statistics are not always meaningful, since an unemployed person must be actively seeking work to be counted. Discouraged workers who are not actively seeking work are thus not counted; and seasonal workers, who do not desire full-time work, may also not be counted. The 1993/94 NSB survey computed an unemployment rate borough-wide of 11 %, with 22 % of the workforce reporting that they worked less than 40 weeks in the previous year, not including school district employees (LGL et al. 1998).

Declines in oil industry employment have resulted from consolidation and increased efficiency of operations, as well as the decline in production from the Prudhoe Bay, Endicott, and Kuparuk oil fields. Exploration and production from new fields could partially or totally offset these declines, but will not require the same labor force as has been historically employed. Since relatively few NSB residents are directly employed by the oil industry, this decline will not greatly affect them. However, North Slope regional and village ANCSA corporations provide oil field services, and employment could be affected by declines in oil field activities.

NSB revenues and expenditures are projected to decline over time, as decreased oil production yields lower taxation revenues. This will reduce employment opportunities for NSB residents. The NSB has historically funded an ambitious CIP, employing a large number of residents, through selling bonds. As these projects are completed and the bonds retired, more of the NSB's budget will be shifted to operations. CIP related employment is projected to decline significantly.

Nuiqsut

Information presented in this section is drawn from the NSB's survey of 1993/94, which itself is based on responses from 90 of 105 households (about 86 % of all households). In 1993/94, Nuiqsut had a labor force of 193 out of a total population of 403. Ninety-six survey respondents reported being employed. Unemployment was officially at 5.2 %, with underemployment being perceived as a locally important issue. Thirty percent of employed respondents identified themselves as underemployed, with 40% reporting less than 40 weeks of work in the preceding year. Members of the workforce identified unemployment and underemployment as persistent and serious problems (LGL et al. 1998).

Many jobs are seasonal, primarily those in construction (NSB for the most part) or with oilfield service companies (ice road building and maintenance). In 1993/94, approximately 63 % of regularly employed Nuiqsut residents worked for the NSB. The village corporation, Kuukpik Corporation, employed approximately 20 % of the workforce. The city had three employees, the state none, and the federal government one (the postmaster). All other employers accounted for approximately 13.5 % of total employment (LGL et al. 1998)

Over the period from 1973 to 1985, the average Nuiqsut household income increased from $32,125 to $56,743 (not adjusted for inflation). Average non-Inupiat household income in was $49,999 per year ($33,333 per capita) in 1993/94, while average Inupiat household income was $37,999 per year ($8,745 per capita). Approximately 36 % (32 of 90) of surveyed Nuiqsut households qualified as very low income households under federal regulations, 18 % (16 of 90) had low to moderate incomes, 46 % (42 of 90) had moderate or higher incomes (LGL et al. 1998).

Non-Inupiat households in Nuiqsut are generally smaller than Inupiat households, consisting primarily of salaried schoolteachers with typically one or two adults and no children. Inupiat households are generally comprised of more members and fewer wage earners. As a result of the NSB's building plan, many multigenerational households have been split up into smaller family units (Galginaitis et al. 1984). Housing has been improved through time on a number of measurable indices, for example, space per household member, heating systems, water systems, waste disposal, and construction and insulation quality (LGL et al. 1998).

Living expenses in Nuiqsut are quite high compared to both State of Alaska and national averages. Various federal and NSB subsidy programs tend to equalize some major categories of expenditure, such as rent and mortgage payments, but other costs (e.g., heat, utilities, transportation, and cost of imported goods) are often twice those of state averages (LGL et al. 1998).

Subsistence resources are an important component of Nuiqsut household economies, but cannot be easily quantified, either in terms of contribution to diet or cost of production (harvest). While subsistence production contributes significantly to household economies, cash expenditures for subsistence activities are also quite high. Of the 56 Nuiqsut households responding to this area of the 1993/94 NSB survey, 31 spent between $500 to $4,000 each year on subsistence activities, while 25 spent more than $4,000 each year. Seven of these 25 households spent more than $10,000 each year, probably in connection with whaling (LGL et al. 1998).

Kaktovik

Information presented in this section is drawn from the NSB's survey of 1993/94, which itself is based on responses from 66 of 71 households (about 93 % of all households). In 1993/94, Kaktovik had a labor force of 128 out of a total population of 230. Sixty-four survey respondents reported being employed. Unemployment was officially at 9.5 %, with underemployment being perceived as a locally important issue. Twenty-three percent of employed respondents identified themselves as underemployed, with 29 % reporting less than 40 weeks of work in the preceding year. Members of the workforce identified unemployment and underemployment as persistent and serious problems (LGL et al. 1998).

Many jobs are seasonal, primarily those in construction (NSB for the most part) or with oilfield service companies (ice road building and maintenance). Approximately 67 % of regularly employed Kaktovik residents worked for the NSB in 1993/94. The village corporation, Kaktovik Inupiat Corporation, employed approximately 16 % of the workforce. The city had two employees, the state none, and the federal government one (the postmaster). All other employers accounted for approximately 14 % of total employment (LGL et al. 1998).

Average non-Inupiat household income in Kaktovik was $71,874 ($43,230 per capita) in 1993/94, while average Inupiat household income is $30,984 ($9,832 per capita). Approximately 30 % (20 of 66) of surveyed Kaktovik households qualified as very low income households under federal regulations, 6 % (4 of 66) had low to moderate incomes, and 64 % (42 of 66) had moderate or higher incomes (LGL et al. 1998).

Non-Inupiat households in Kaktovik are generally smaller than Inupiat households, consisting primarily of salaried schoolteachers with typically one or two adults and no children. Inupiat households are generally comprised of more members and fewer wage earners. Anecdotal information indicates that new housing is being constructed in Kaktovik, attracting families from Canada related to Kaktovik residents to immigrate to the village. The village plans for upgrading the power and water plants and construction of a water and sewer system could attract more immigrants and provide more local employment (LGL et al. 1998).

As in Nuiqsut, living expenses in Kaktovik are quite high compared to both State of Alaska and national averages. Various federal and NSB subsidy programs tend to equalize some major categories of expenditure, such as rent and mortgage payments, but other costs (e.g., heat, utilities, transportation, and cost of imported goods) are often twice those of state averages (LGL et al. 1998).

Subsistence resources are an important component of Kaktovik household economies, but cannot be easily quantified, either in terms of contribution to diet or cost of production (harvest). While subsistence production contributes significantly to household economies, cash expenditures for subsistence activities are also quite high. Of the 41 Kaktovik households responding to this area of the 1993/94 NSB survey, 29 spent between $500 to $4,000 each year on subsistence activities, while 12 spent more than $4,000 each year. Four of these 12 households spent more than $10,000 each year, probably in connection with whaling (LGL et al. 1998).

4.13.2 Public Revenues and Expenditures

The NSB relies primarily upon property tax receipts to fund its operations and pay interest and principal on its bonds. While the establishment of an NSB permanent fund has diminished the reliance on the property tax in recent years, the NSB collected 71 % or $230 million of its revenue from property tax during fiscal year 1995. Nearly all property tax (approximately 98%) comes from assessments on the oil industry, with State and Federal revenue-sharing programs provide most of the rest of the NSB budget (ADNR 2001). About half of the NSB budget is for operations, and half is for debt service, primarily on bonds sold to fund the CIP (LGL et al 1998).

NSB revenues peaked in 1987 at $249 million, and declined in 1991 to $221 million. Revenues for 1992 through 1995 were roughly stable, ranging from $224 million to $235 million (DOI 1998). These figures are projected to decline somewhat, barring substantial new investment by the oil industry, due to depreciation of the existing tax base.

The main problem facing the NSB is one of operational expense. The NSB is actively seeking to reduce its operating budget, and has become more conservative in the amount of bonds that are sold to finance capital improvements. The years 1981 through 1985 were the years with the greatest CIP budgets, peaking at $302 million in 1983 (LGL et al. 1998). Anything that the borough builds must be maintained under the legal operational tax cap of 4.78 mills (DOI 1998 and LGL et al. 1998). Thus, although short-term revenue constraints do not drive current expenditures, when capital improvements are included in the overall budget, there are clear constraints on NSB operational expenditures due to a stagnant or declining property tax base.

Property values fluctuate, depending on world-energy prices. However, property value is not considered to be the constraining factor for future NSB revenues. Rather, such constraining factors include existing and potential State-imposed limits on NSB taxing authority, NSB residents' willingness to assume higher property-tax burdens, and State and Federal revenue-sharing policies.

4.13.3 Subsistence and Traditional Land Use Patterns

In general, communities harvest the subsistence resources most available to them, concentrating their efforts along rivers and coastlines and at particularly productive sites (Figures 4-18 to 4-22). Determining when and where a subsistence resource will be harvested is a complex activity due to variations in seasonal distribution, migration, and extended cyclical variation in animal populations. Areas that are infrequently used can be important harvest areas at times (DOI 1998). Figure 4-18 shows known historic and current subsistence harvest areas.

Two broad subsistence-resource niches occur on the North Slope:

- Coastal/marine: harvesting of whales, seals, waterfowl, fish, and other marine species
- Terrestrial/aquatic: harvesting of caribou, fish, moose, grizzly bears, other terrestrial animals, and edible roots and berries

Regardless of which subsistence-resource niche or combination of niche resources communities harvest, bowhead whales, caribou, and fish are the primary resources harvested. The bowhead whale harvest is important because it provides a unique and powerful cultural basis for sharing and community cooperation. Bowhead whaling strengthens family and community ties and provides a sense of common heritage and culture in Inupiat society (DOI 1998). Sharing and community cooperation were essential in the past. Cooperative harvesting and sharing of food was the best insurance against starvation, maximizing everyone's chances of survival during times of shortage (ADNR 2001).

Non-edible parts of subsistence resources are used to make many functional and/or artistic items. Hides and pelts are used to make bedding, clothing, slippers, mukluks, hats, dolls and other toys, drums, and masks. Ivory, bone, and antler are carved for knife handles, needle cases, and figurines. Jewelry and decoration for clothing and other item is made from many items, including ivory, antler, and feathers (ADNR 2001).

The relationship between engaging in subsistence activities and earning cash wages differs for each individual. The availability of jobs, community goods and services, and subsistence resources also affects the cash-subsistence relationship. The social costs of not participating in traditional subsistence activities of the village economy may be greater that the cash benefits derived from participation in the labor force. NSB residents earning cash wages participate in subsistence activities during weekends and vacations, and employers are encouraged to allow such employees time off during key seasonal events such as whaling (ADNR 1998).

The Point Thomson area encompasses lands traditionally and presently used for subsistence harvest by residents of Nuiqsut and Kaktovik. Traditional subsistence land use of the Point Thomson area included harvesting of fish, marine mammals, terrestrial mammals, birds, fur-bearing mammals, and plants. In addition, many of the marine mammal, fish, and terrestrial mammal species harvested by Nuiqsut and Kaktovik residents in areas other than Point Thomson migrate through the Point Thomson area. The following sections discuss the subsistence activities of Nuiqsut and Kaktovik in relation to the Point Thomson area.

4.13.3.1 Nuiqsut

In 1985, Nuiqsut was still a very young community, being resettled in 1973, and while some residents were intimately familiar with local subsistence resources from their experience of living on the land prior to 1973, many were not. The residents had a strong identification and historical relationship with the local area, but many did not have great personal knowledge of the marine subsistence areas. Per capita subsistence harvest doubled from 1985 to 1993 in Nuiqsut, indicating continued sharing of traditional knowledge (LGL et al. 1998).

Pedersen (1995) states that the average Nuiqsut household reportedly spent close to $800 a month for food, while at the same time 63 % of Nuiqsut households obtain over half of their food from subsistence resources. Only one person surveyed did not consume wild foods. Roughly 67% mentioned that one reason they ate wild foods was the high cost of store-bought food, and 93 % considered wild foods to be healthier than store-bought food (ADNR 1997 and LGL et al. 1998).

Marine mammals, fish, and terrestrial mammals each comprise about a third of the community's subsistence harvest. Birds and eggs provide a small percentage of the subsistence harvest, and plants yet a smaller amount (LGL et al. 1998 and ADNR 1999). Although Nuiqsut is located approximately 100 mi (161 km) west of the Point Thomson area, its residents may occasionally use the area to meet part of their subsistence needs.

Whales are the primary marine mammal resource harvested. In years when a whale is not harvested, fish and terrestrial mammals are more important to the subsistence harvest. Muktuk and whale meat from other communities is shipped into Nuiqsut during such years, although not in the quantities that would be consumed in the community if they had harvested their own whale meat (LGL et al. 1998).

Nuiqsut has a relatively high per capita harvest of subsistence resources. In years of a successful bowhead whale hunt, the per capita harvest average is higher than in years when a bowhead is not harvested. There are clear indications that Nuiqsut residents are investing more resources (both time and money) in these activities than they did in 1985. The proposed project is located onshore in the broad area described by Nuiqsut whalers as most important to them. Nuiqsut's self-described whaling use area extends from the Midway Islands eastward to Brownlow Point, and includes the Flaxman Island area. Whaling further west has not proven to be productive and moving further to the east requires too long a tow to a location where a whale could be butchered. All recorded strikes by Nuiqsut whaling crews have, in fact, occurred in a more limited area seaward of the barrier islands in the vicinity of Cross Island. Current Nuiqsut whalers typically hunt for whales no further east than Point Gordon. Most Nuiqsut whales are harvested near a base camp on Cross Island or on the seaward side of the barrier islands (LGL et al. 1998). Figure 4-19 shows the maximum range of subsistence harvest areas for Bowhead Whales.

Nuiqsut seal harvest activity is not well documented. Seals are typically hunted close to the community near the mouth of the Colville River (DOI 1998). Nuiqsut seal hunters state that they have used the proposed project area as well as Flaxman Island in the past, but current usage is thought to be low (LGL et al. 1998).

Nuiqsut residents harvest caribou mainly from the CAH. Subsistence use of the Point Thomson area for caribou is infrequent due to the distance from Nuiqsut. However, caribou harvested in the Point Thomson area could be from either the CAH or the PCH (LGL et al. 1998). Figure 4-21 depicts the maximum range of subsistene harvest areas for caribou. Depending on annual herd movements and weather, caribou are harvested year-round by Nuiqsut hunters (DOI 1998). In September, the CAH typically moves down the Ublutuoch River and east across the Colville River before heading south to their overwintering grounds in the Brooks Range. Late August is considered a prime time for harvesting caribou for two reasons: they are fat from grazing all summer and their hides are in good condition for making clothing (ADNR 1999).

Fishing is an important subsistence activity for Nuiqsut residents. Harvesting of fish is not seasonally limited and the community is located on the Nechelik Channel of the Colville River, which has large resident fish populations (DOI 1998). Subsistence fish harvested from July 1994 to June 1995 consisted primarily of Arctic cisco and broad whitefish (DOI 1998).

4.13.3.2 Kaktovik

Ninty-six percent of households surveyed in Kaktovik used locally harvested wild resources. Additionally, 89% of the surveyed households attempted to harvest wild resources, 89% were successful harvesters, 92% received shares of wild resources from other households, and 83% gave wild resources away to other community households (Pedersen 1995 and LGL et al. 1998).

Kaktovik's present subsistence area covers the northern part of ANWR and south into the Brooks Range to the headwaters of the Hulahula River. The coastal area west of ANWR may also be used during the summer, often to Flaxman Island and Bullen Point and occasionally west to the Shaviovik River and Foggy Island (LGL et al. 1998). Approximately 30% of the onshore subsistence areas used by Kaktovik residents are located on state land (Clough et al. 1987). Although the mid-Beaufort Sea area west of ANWR is no longer a primary area used for subsistence, it is where some present day Kaktovik residents were born or grew up, so strong associations remain.

The largest community resource use area is that used for caribou hunting. It covers 6,852 mi^2 (17,747 km^2) of terrestrial and coastal lagoon/barrier island area, extending 180 mi (290 km) along the coast and up to 70 mi (112.7 km) inland. Figures 4-21 and 4-22 depict the maximum subsistence harvest areas range and Kaktovik's caribou harvest areas in 1990, respectively. Caribou hunting takes Kaktovik hunters into a variety of habitats where they encounter a wide variety of resources. Nearly all of terrestrial subsistence resource categories are contained within the caribou use area, notable exceptions being Dall sheep and small mammal resource categories. The usual Kaktovik summer subsistence harvest area is from the Canadian border to Tigvariak Island (west of Mikkelsen Bay), and encompasses the Point Thomson area. To the east, the area beyond Griffin Point/Pokok Lagoon is usually avoided because of the lack of safe anchorage. Kaktovik residents frequent a summer caribou hunting and camping area to the east of Bullen Point, on the coast. This area is located approximately 10 mi (16.1 km) west of the proposed project area. This relatively small and localized area was the only site west of the Staines/Canning River discussed by the Kaktovik residents but is probably an example of the general use pattern (LGL et al. 1998).

Caribou are the staple and preferred terrestrial mammals in Kaktovik's subsistence diet (LGL et al. 1998). Kaktovik residents harvest caribou from the PCH and CAH. Caribou are hunted on the coast by boat in the summer, and are harvested where they are found, typically close to the community. Caribou are expected to be so common in summer that few hunters anticipate long trips for harvesting. The only exceptions are areas frequented by caribou where coastal water is too shallow for boat access. The limited information available indicates that over half of the caribou harvested by Kaktovik residents are taken during the period from June through September, at or near coastal sites (Pederson and Coffing 1984, Coffing and Pedersen 1985, Pedersen 1990, Wentworth 1979, and LGL et al. 1998). Caribou harvest also occurs inland during the winter when snow machine travel is possible (LGL et al. 1998).

Bowhead whales migrate past Barter Island to and from the eastern Beaufort Sea, and the village currently has a fall whale hunt. Kaktovik's primary whaling area is to the east of the Canning River (Figure 4-20). Other marine mammal hunting (e.g., bearded and hair seals) is also generally confined to that area, although a hunter from Kaktovik may occasionally travel farther for other reasons and take a seal on an opportunistic basis (LGL et al. 1998).

Presently there are more whaling crews from Kaktovik, and more effort is devoted to whaling in Kaktovik than at any time in the past (ADNR 2001). There is more investment in boats and equipment than previously reported (as in Nuiqsut). The community bowhead whale quota has increased, and the local hunt has become very well organized and coordinated; consequently the rate of success has increased (LGL et al. 1998).

4.13.4 Land Ownership, Use and Management

There are three important aspects of land use that affect development of the Point Thomson area: the general land ownership and jurisdiction in the project area, existing land and water uses of the area, and land use regulations and management plans that apply to activities in the area.

4.13.4.1 Land Ownership

State Lands

Most of the Point Thomson Gas Cycling Project area is patented to the State of Alaska. The Alaska Department of Natural Resources has jurisdiction over the state lands (including tidelands, submerged lands within 3 mi (4.8 km) of the coast, and barrier islands) and state waters (including offshore waters within 3 mi (4.8 km) of the coast, freshwater lakes, rivers, and streams). The state owns both the surface and subsurface (mineral) estates and has issued a number of oil and gas leases in the area. Under the terms of state oil and gas leases, the mineral lessee has a right to use as much of the surface as is reasonably necessary to develop and produce the minerals. The surface estate is reserved by the state, and such reservation allows for the issuance of road and pipeline rights-of-way to the extent that such rights-of-way do not interfere with the rights of the underlying mineral owner.

Federal Lands

Federal lands are located to the east and adjacent to the Point Thomson Unit. These lands are part of ANWR, and are under the jurisdiction of USFWS.

Native Allotments

A Native allotment is a parcel of land, containing 160 acres or less which can be conveyed to a Native based on that individual's use and occupancy of the land under the authority of the Native Allotment Act, May 17, 1906 (43 U.S.C. 270-1), as amended August 1956, and repealed by the Alaska Native Claims Settlement Act of December 18, 1971 (43 U.S.C. 1617). Within ANWR, the Federal government has begun to process conveyances of 25 applications, involving 34 parcels for Native allotments. These applications cover approximately 2,315 acres (DOI 1987). There is a Native Allotment application on Flaxman Island (*Bureau of Land Management, Fairbanks District File (F) 18780:* located within T10N, R17E, UM on Flaxman Island). No determination has been made in this case to date. The claim is in the immediate area of the Leffingwell camp, which is on the National Register of Historic Sites.

4.13.4.2 Land and Water Use

Historic and current land and water use of the Point Thomson area includes oil and gas exploration, traditional and subsistence use by Native Alaskans, scientific research and surveys, and occasional summer recreation uses that are primarily along the Canning River in ANWR. The area was originally leased for oil and gas exploration in 1970's. Activities associated with exploration for oil and gas have occurred intermittently in the area since that time. The Point Thomson Unit currently includes 32 individual oil and gas leases encompassing 83,825 acres.

Occasional summer recreation use occurs in the nearshore waters behind the barrier islands and along the Canning River on the western edge of ANWR. A very small number of sea kayakers and other classes of boats traverse the coast off the Point Thomson Unit. The Canning River is floated each year by a limited number of rafts, kayaks, and canoes (see section 4.13.6 for further detail).

4.13.4.3 Land Management and Regulations

The Point Thomson area has been unitized, and is subject to specific agreements and state regulations governing activities within unitized areas. An application is pending to change the unit boundaries by adding 16 leases and 58,376 acres (24,000 ha). The area between the Point Thomson Unit and the Badami Unit is not subject to a unit agreement.

The Point Thomson Unit is located within the boundaries of the North Slope Borough, and all project facilities are located within the boundary of the North Slope Borough coastal zone. Uses and activities within the Point Thomson Unit are subject to the provisions of the North Slope Borough Title 19 Land Management Regulations (LMR's), and the North Slope Borough and Alaska Coastal Management Programs. The LMR's establish zoning districts and performance-based land management policies. An overall intent of the Borough Comprehensive Plan and LMR's is to maintain and protect subsistence resources. As an existing oil and gas unit, Point Thomson is zoned for resource development and is subject to an existing Master Development Plan. However, the area between the Point Thomson Unit and the Badami Unit has not been unitized and is zoned as a Conservation District. Construction of pipeline from Point Thomson would require rezoning to resource development and preparation of a Master Development Plan for the area.

The NSB and Alaska Coastal Management Programs (ACMP) also establish performance-based land and water management policies. Uses and activities on lands and waters within the coastal boundaries must be consistent with Borough coastal management policies and the standards of the ACMP. The western boundary of ANWR is co-located with the eastern boundary of the Point Thomson Unit.

4.13.5 Transportation

Construction, operation and maintenance of the Point Thomson project will require movement of personnel, equipment, materials, and supplies by marine, highway/road, and air modes of transportation. Within the North Slope, the primary modes of transportation between communities and to access subsistence harvest areas are by airplane, snowmachines in the winter and boats during the ice-free months.

4.13.5.1 Marine Transportation

The major Alaska ports for transportation of supplies to the North Slope are Anchorage, Seward, Whittier, and Valdez. Marine transportation of supplies to the North Slope, known as sealift, occurs during a limited seasonal window when the North Slope coast is ice-free. The primary dock and barge landing facilities are located at Prudhoe Bay, although some of the satellite facilities, such as Endicott and Badami, have their own dock facilities.

4.13.5.2 Highway/Road Transportation

The James Dalton Highway is the only ground transportation route connecting Prudhoe Bay to Alaska's other major highway systems. The highway was opened for public access in 1996 as far as Deadhorse. Trucks transporting freight in support of oil field activities at Prudhoe Bay dominate traffic along the highway; however, privately owned and commercial tour vehicles also use the highway.

Within the Prudhoe Bay complex, there is an extensive gravel road system for accessing facilities and transporting supplies. Temporary ice roads are used extensively in the winter for access to remote facility and exploration sites off the gravel road system.

4.13.5.3 Air Transportation

The Barrow and Deadhorse Airports and Kuparuk airstrip provide air transportation service for North Slope oil facilities. Alaska Airlines serves these airstrips through public and charter service. Gravel airstrips at outlying facilities (e.g., Badami) and villages accommodate air service from Prudhoe Bay.

4.13.6 Recreation

Recreational activities on the North Slope take place mostly in ANWR, the National Petroleum Reserve, Alaska (NPRA), and along the Dalton Highway. The U.S. Bureau of Land Management and the Alaska Department of Transportation and Public Facilities conducted a survey and concluded that the most important reasons visitors travel the Dalton Highway is to view scenery and wildlife (Robbe 1996). Visitors on the Dalton Highway typically take a day trip from Fairbanks to Deadhorse and back to experience crossing the Arctic Circle (Robbe 1996).

Tourists can drive or fly to Deadhorse, but can only access the Prudhoe Bay Unit and adjacent unitized operating areas with approved tour operators. Public access is allowed on state lands that are not in unitized operating areas; however there are no public facilities in these areas.

Recreational opportunities available while floating the Canning River and other rivers in ANWR and the NPRA or camping in ANWR include scenic viewing, camping, sport fishing, hiking, hunting, rafting, recreational gold mining, and photography. Visitors travel to ANWR to view wildlife such as moose, wolf, bear, caribou, Dall Sheep, Arctic fox, red fox, wolverine, muskox, various small mammals, waterfowl, shorebirds, passerines, falcons, and golden eagles (Jensen 1994).

Recreation and tourism occur in limited parts of the proposed project area. Typically there are few participants and minimal revenues derived from these activities. Tourism to the North Slope and ANWR in particular tends to spike when Congress is considering legislation that could affect the status of ANWR. In addition to floating the Canning River just east of the project area, a very small number of sea kayakers and other classes of boats traverse the coast off the Point Thomson Unit (Clough et al. 1987, USFWS 1993, and BPXA 1995).

Point Thomson workers will not be allowed to hunt or hike over tundra during summer. Fishing is allowed with a valid ADF&G fishing license.

4.13.7 Aesthetic Characteristics

The Arctic coastal plain is a treeless, low relief landscape dominated by numerous lakes and ponds and low lying vegetation. The terrain is frozen and covered by ice and snow during the Arctic winter, which typically lasts more than 9 months with 56 days of darkness. The brief summer of continuous daylight lasts from June through August (Strahler and Strahler 1987). Cone shaped mounds that reach elevations of more than 100 ft (31m), are the only land forms on the coastal plain with significant height. Steep stream and riverbanks, coastal sand dune deposits, and steep coastal bluffs also create contrast in landscape elevation. Large rivers typically are braided and have broad floodplains and drainages. Smaller rivers and streams consist of thaw pools that are interconnected by narrow channels.

Oil field facilities are characterized by gravel pads, small and large buildings, gravel roads, pipelines with galvanized metal jackets, snow fences, heavy equipment, drilling rigs, flares, and lights. The Inupiat have expressed concern about the visual impacts of oil and gas development in the Prudhoe Bay area. Unnatural colors and lights are considered intrusive to the natural landscape and some colors and bright lights are thought to disturb or displace marine mammals that are important to the Native subsistence lifestyle. Light from Prudhoe Bay oil field activities is sometimes visible as a distant glow in the community of Nuiqsut, serving as a constant reminder of oil and gas activity in the region. Oil and gas development is an obvious visual change in the homogenous tundra environment and is considered to change the traditional subsistence way of life.

Public testimony received during scoping and other meetings held in North Slope communities indicates that people are concerned about industrialization and associated degradation of visual qualities of the area. The range of comments included visual impacts of dock facilities, degradation of rivers, and the creation of burning pits within the North Slope region. Additional concern has been raised about oil and gas development becoming widespread throughout the region, resulting in a further reduction in aesthetic value of the area (USACE 1998).

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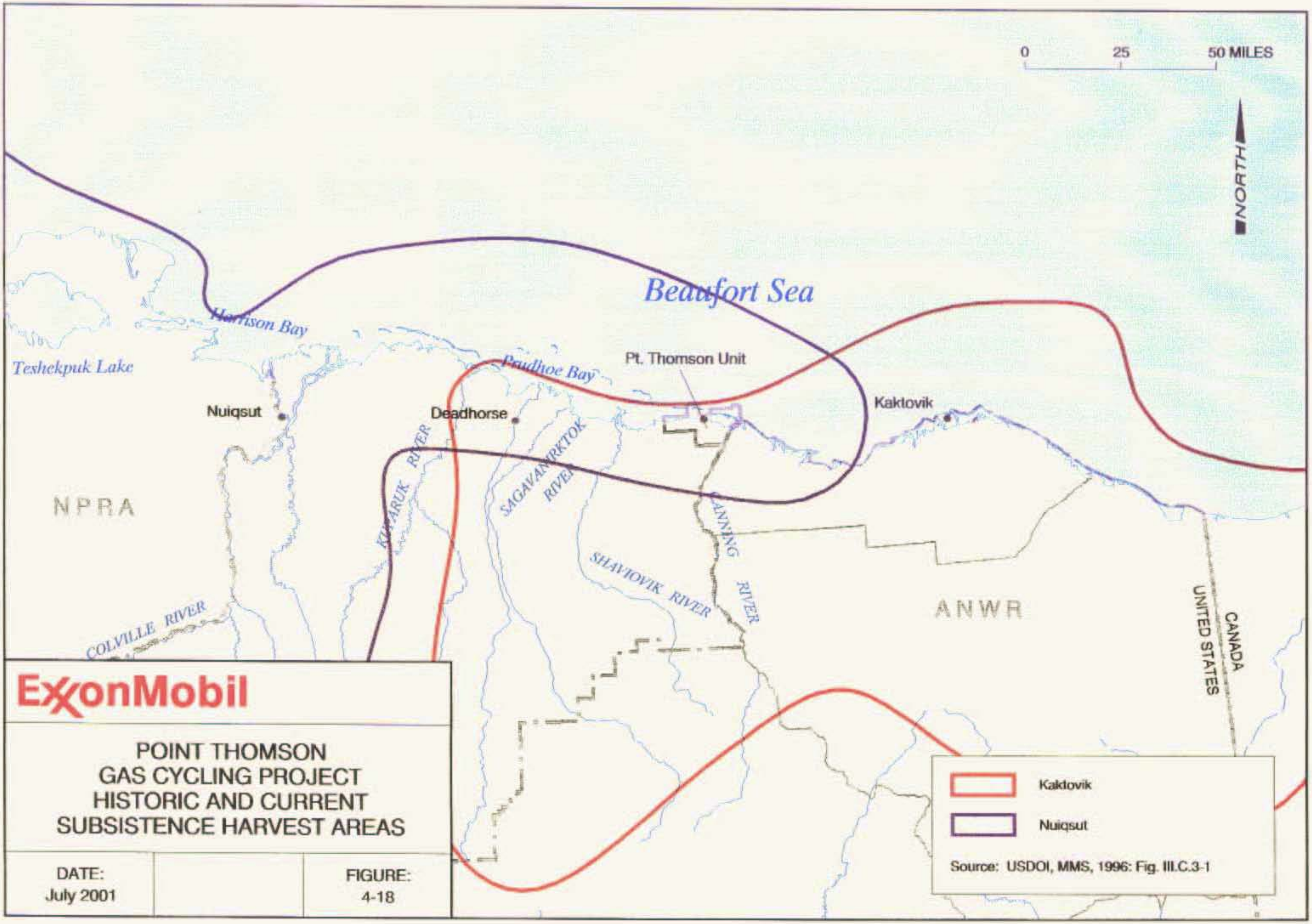
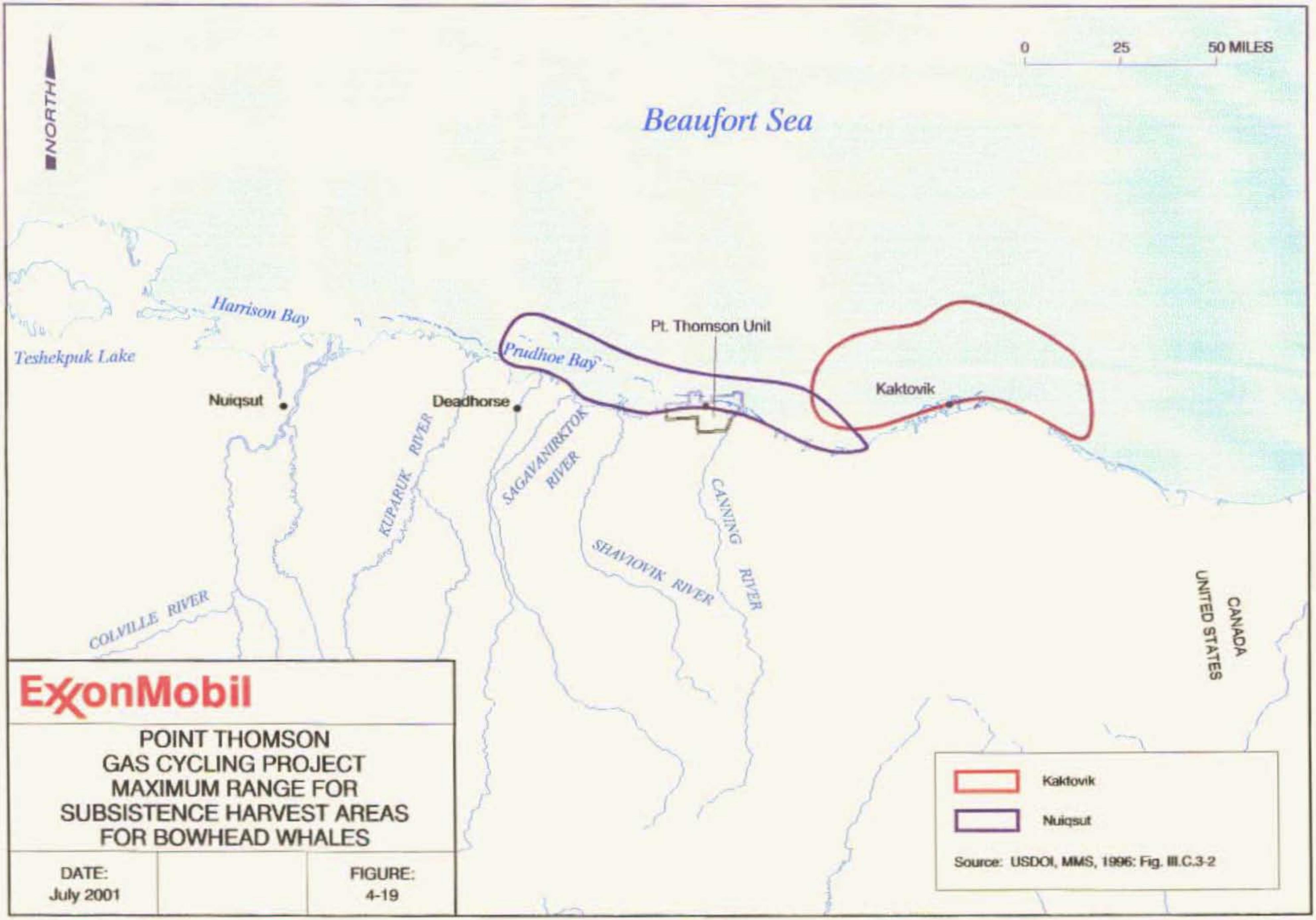


ExxonMobil

POINT THOMSON
GAS CYCLING PROJECT
HISTORIC AND CURRENT
SUBSISTENCE HARVEST AREAS

DATE: July 2001		FIGURE: 4-18

fig4_18.dgn



ExxonMobil

POINT THOMSON
GAS CYCLING PROJECT
MAXIMUM RANGE FOR
SUBSISTENCE HARVEST AREAS
FOR BOWHEAD WHALES

DATE: July 2001		FIGURE: 4-19

fig4_19.dgn

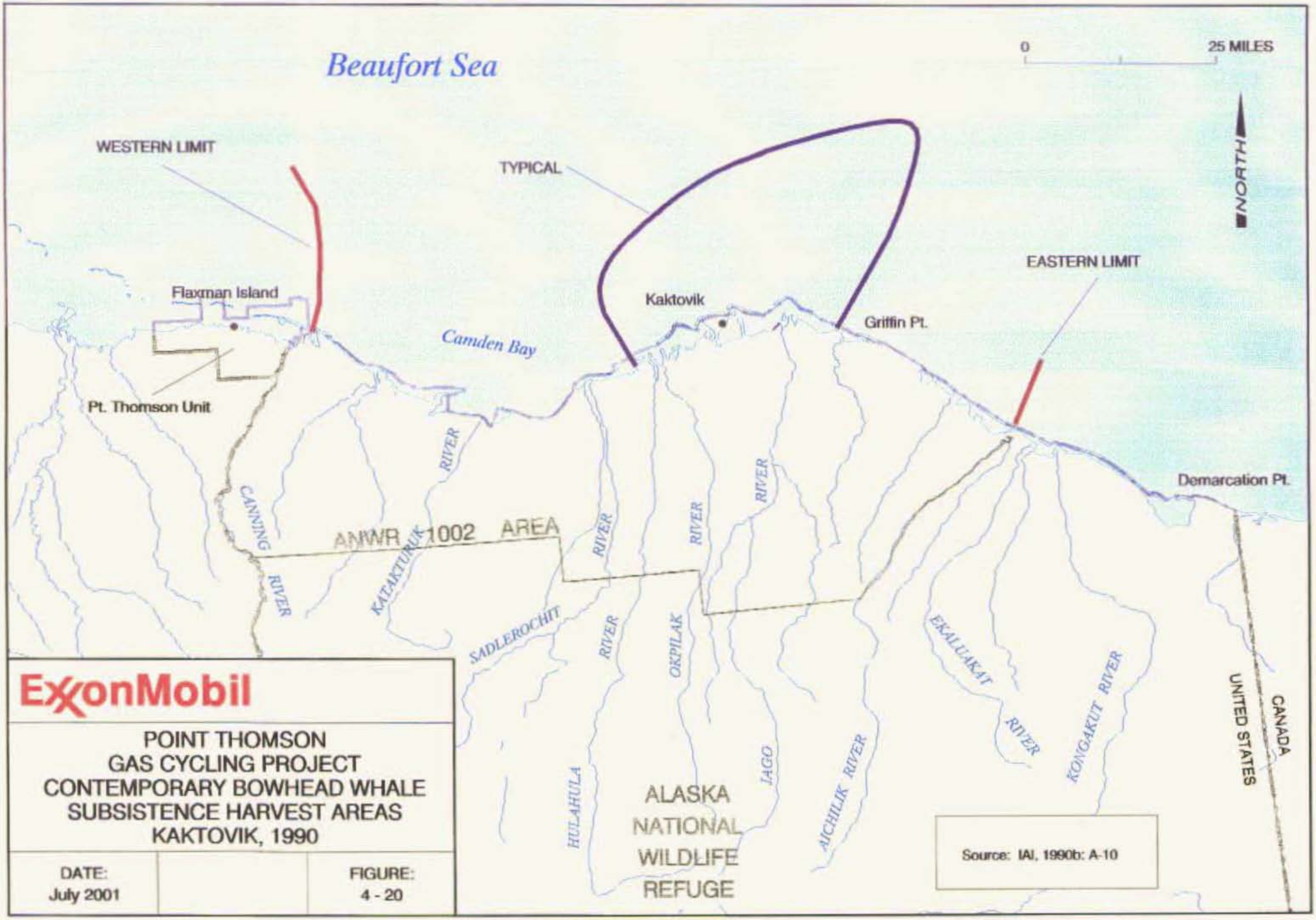
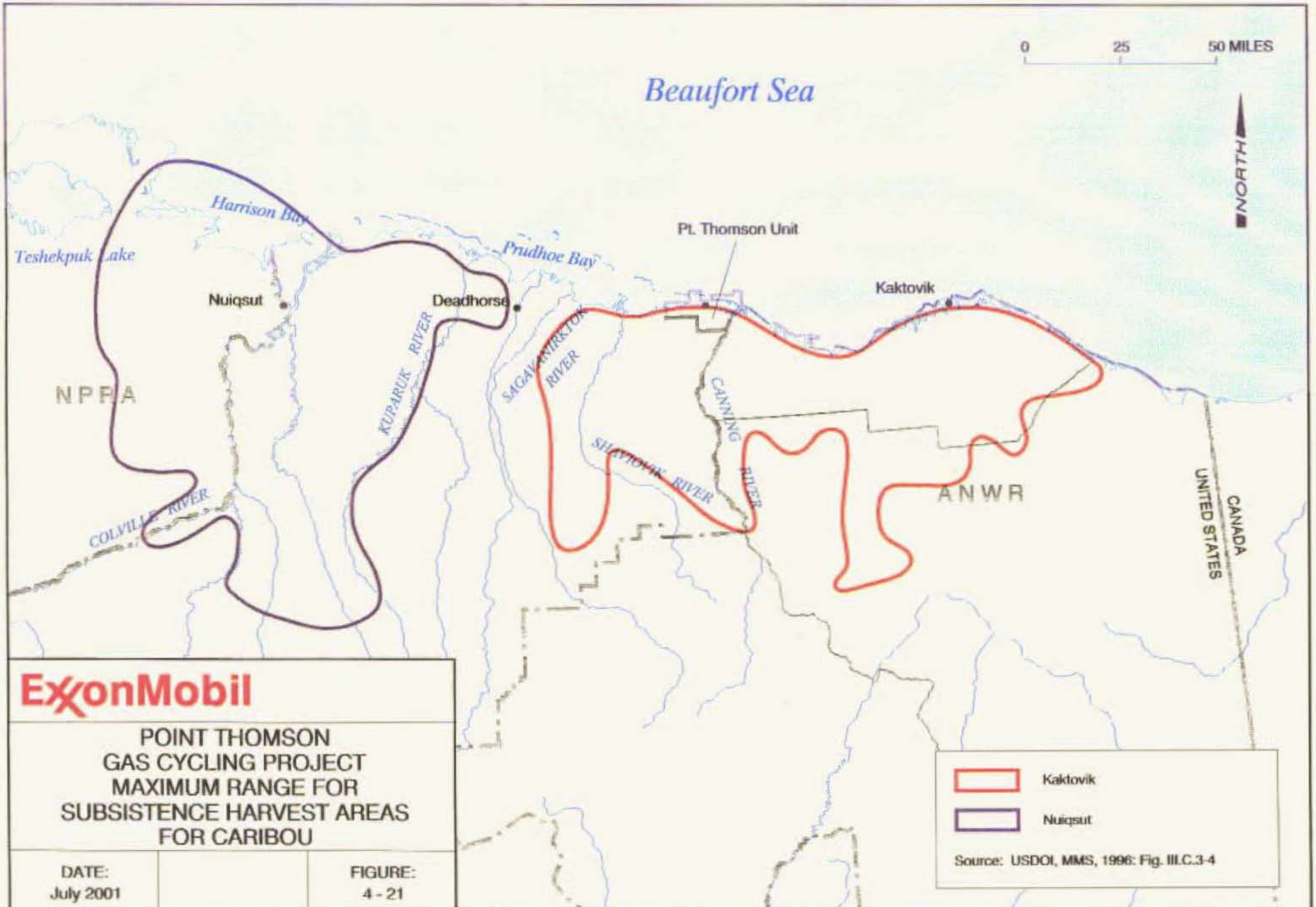

Beaufort Sea
0
25 MILES
NORTH
WESTERN LIMIT
TYPICAL
EASTERN LIMIT
Flaxman Island
Kaktovik
Griffin Pt.
Camden Bay
Pt. Thomson Unit
Demarcation Pt.
CANNING RIVER
KATAKTURUK RIVER
ANWR 1002 AREA
SADLEROCHIT RIVER
HULAHULA RIVER
OKPILAK RIVER
JAGO RIVER
AICHILIK RIVER
EKALUAKAT RIVER
KONGAKUT RIVER
UNITED STATES
CANADA
ALASKA NATIONAL WILDLIFE REFUGE
Source: IAI, 1990b: A-10
ExxonMobil
POINT THOMSON
GAS CYCLING PROJECT
CONTEMPORARY BOWHEAD WHALE
SUBSISTENCE HARVEST AREAS
KAKTOVIK, 1990
DATE:
July 2001
FIGURE:
4 - 20

fig4_20.dgn


Beaufort Sea
0
25
50 MILES
NORTH
Harrison Bay
Teshekpuk Lake
Prudhoe Bay
Pt. Thomson Unit
Kaktovik
Nuiqsut
Deadhorse
NPRA
KUPARUK RIVER
RIVER
CANNING RIVER
ANWR
UNITED STATES
CANADA
ExxonMobil
POINT THOMSON
GAS CYCLING PROJECT
MAXIMUM RANGE FOR
SUBSISTENCE HARVEST AREAS
FOR CARIBOU
DATE:
July 2001
FIGURE:
4 - 21
Kaktovik
Nuiqsut
Source: USDOI, MMS, 1996: Fig. III.C.3-4

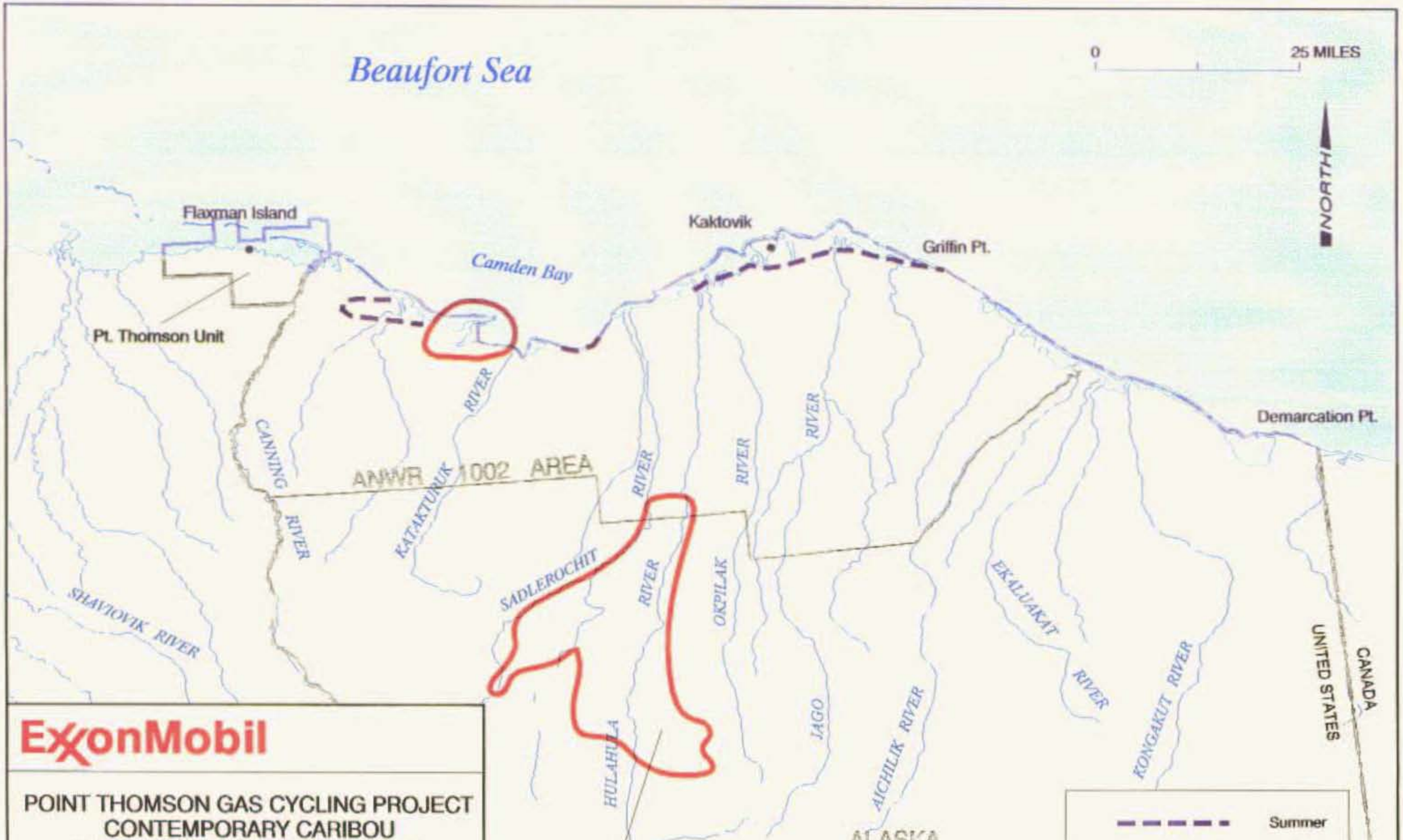

Beaufort Sea
0
25 MILES
NORTH
Flaxman Island
Pt. Thomson Unit
Camden Bay
Kaktovik
Griffin Pt.
Demarcation Pt.
CANNING RIVER
KATAKTURUK RIVER
ANWR 1002 AREA
SADLEROCHIT RIVER
HULAHULA RIVER
OKPILAK RIVER
JAGO RIVER
AICHILIK RIVER
EKALUAKAT RIVER
KONGAKUT RIVER
SHAVIOVIK RIVER
UNITED STATES
CANADA
MAIN CARIBOU
HARVEST AREA
FOR KAKTOVIK HUNTERS
ALASKA
NATIONAL
WILDLIFE
REFUGE
Summer
Winter
Source: IAI, 1990b: A-2
ExxonMobil
POINT THOMSON GAS CYCLING PROJECT
CONTEMPORARY CARIBOU
SUBSISTENCE HARVEST AREAS
KAKTOVIK, 1990
DATE:
July 2001
FIGURE:
4 - 22

fig4_22.dgn

5.0 ENVIRONMENTAL CONSEQUENCES

Environmental consequences of the proposed action at Point Thomson have the potential to impact the physical, biological and social/cultural resources of the area. The following sections discuss the potential effects, their anticipated severity, and ways that they may be mitigated.

5.1 PHYSICAL/CHEMICAL RESOURCES

Physical and chemical resources of the Point Thomson area include air, freshwater, and marine water quality, surface hydrology, and permafrost and soils. Project actions such as the placement and/or removal of gravel, emissions, discharges, and spills of materials to the environment, the removal of water from area ponds, lakes, and streams and offshore dredging operations have the potential to locally impact these resources. Project actions and the effects they produce are likely to differ among winter or summer construction periods and operations. Therefore, the potential effects on the resources due to project actions during different project phases are considered separately. Table 5-1 indicates the potential effects of the project on the physical and chemical resources of the area, and during which project phase the effects are anticipated.

The following paragraphs describe the project actions or mechanisms that have the potential to create an effect on the physical and chemical resources, and the methods used for assessing the potential effect.

Placement of Gravel

Placement of gravel to create the roads, pads, airstrip, and dock will directly effect the tundra through burial. These effects on vegetation are described in Section 5.2.2. In addition, gravel placement has the potential to effect soil conditions. One effect to the nearshore zone of Lions Lagoon is a temporary increase in suspended sediment in the vicinity of the dock. Gravel placement also has the potential to cause indirect impacts on air quality due to the generation of dust.

Obstruction of Flow/Circulation

Placement of gravel on the tundra to create roads, pads, and the airstrip could divert, impede, or otherwise block flow into stream channels or braided wetlands. The placement could also affect sheet flow over the tundra creating dry areas on one side of the structure and pools or wetter areas on the other side. Placement of a gravel-filled dock in Lions Lagoon could also locally impact the nearshore circulation patterns.

Emissions/Discharge/Spills

Emissions and discharges are defined as liquid or gaseous materials that are released during construction and operations activities at the Point Thomson facility. These releases will be regulated under water and air permits, and will be required to meet the discharge requirements of the permits. Spills are considered to be out-of-control events and can range from small to large quantities. Effects due to small-scale spills during construction and operations activities will be considered in this section. Impacts from large spills are considered in detail in Section 5.4.

Table 5-1 Potential Physical and Chemical Consequences

Physical/Chemical Resources	PROJECT ACTIONS				
	Placement of Gravel	**Obstruction of Flow/ Circulation**	**Emissions/ Discharges or Spills**	**Water Removal**	**Gravel Removal**
Air Quality	Y (W)[1]	N/A	Y (W,S,O)	N/A	Y (W)[1]
Surface Hydrology	N/A[2]	Y (W,S,O)[3]	N/A	Y (W,S,O)[3]	Y (W)
Freshwater Quality	Y(W,S)[4]	Y(W,S,O)	Y(W,S,O)	Y (W,S,O)[3]	Y (W)
Marine Water Quality	Y(W)[4]	Y (W,S,O)	Y(W,S,O)	N/A	N/A
Marine Currents	N/A[2]	Y (W,S,O)	N/A	N/A	N/A
Permafrost and Soils	Y (W,S,O)	N/A	N/A	N/A	Y (W)

[1]generation of dust
[2]impacts considered under obstruction of flow/circulation
[3]mitigated through project design and controls
[4]temporary increase in turbidity during construction; longer-term impacts considered under obstruction of flow/circulation

Notes:
N/A = not applicable
O = operations
S = summer construction
W = winter construction
Y = potential consequence

Gravel Removal/Mining

A gravel mine has been identified for the project in Section 3.0. This section discusses the effects of vegetative cover removal and excavation of the gravel for use in dock, pad, road, and airstrip construction. It discusses the effects of dust generated during gravel mining, with potential impacts to water quality.

Freshwater Removal

It will be necessary to remove quantities of freshwater to cap the sea ice road and to build infield onshore roads during the two proposed construction seasons. In addition, water will be needed for dust control on gravel surfaces and for camp support needs during construction and operations. An effect of water removal could include exacerbation of already low oxygen levels under the ice in tundra lakes. This effect and others are discussed in more detail in this section.

Offshore Dredging

The preferred alternative for providing a dock with capability for landing modules weighing up to 6,000 tons requires a one-season summer dredging operation offshore of the dock to provide sufficient water depth. Impacts of the dredging activity and subsequent spoils disposal include localized disturbance to marine mammals, fish, and birds from the generation of one or more turbidity plumes.

5.1.1 Air Quality

Effects on local air quality will occur during project construction and operations due to emissions from vehicles, vessels, aircraft, machinery, generators, and compressors. Air quality impacts may also include effects of dust from gravel mining and placement during construction of the dock and facility pads and roads, and from dust generated by vehicles during both construction and operations.

5.1.1.1 Emissions

The Point Thomson Gas Cycling Project activities have the potential to produce the following regulated air pollutants: nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter, and volatile organic compounds (VOCs). The type and amounts of air pollutants expected from this project will differ under construction and operations phases.

Winter and Summer Construction

Sources of emissions possible during both winter and summer construction phases include:

- Heavy construction equipment including gravel-hauling dump trucks
- Construction support equipment including cranes, pumps, generators, compressors, pile drivers, welders, and heaters
- Vehicles, vessels (in summer), helicopters, and airplanes used to transport equipment, materials, and personnel to and from Point Thomson

The main emission from these sources will be NOx, with lesser amounts of CO, SO_2, and particulates. Vehicle, vessel, and airplane emissions are expected to consist mainly of CO with small amounts of VOCs from aviation and other fuels.

Construction emissions will be temporary and will not contribute to long-term air quality issues. Emissions will be quickly dispersed by the frequent winds common to the area. Anticipated emissions from construction equipment, vehicles, and vessels will be identified in the Air Quality Permit to Construct submitted to the Alaska Department of Environmental Conservation (ADEC). It is anticipated that there will be no significant, long-term, adverse effects from the construction emissions.

Drilling and Operations

Sources of emissions possible during the drilling and operations phases include:

- Diesel generators to provide power for drilling initial wells, switching to gas turbines once fuel gas is available
- Drilling rig support equipment such as generators, boilers and heaters
- Gas turbine driven compressors and process heaters used for condensate production and gas re-injection
- Venting and flaring (intermittent source, with the exception of the pilot and purge volumes)
- Vehicles, vessels (in summer), helicopters, and airplanes used to transport equipment, materials, and personnel from to the site

The main source of emissions during drilling and operations would likely be the gas turbines for power generation and gas compression. The emissions from these turbines will consist mainly of NOx, and CO, with lesser amounts of SO_2 and particulates. Diesel generators and support equipment will produce NOx, with lesser amounts of SO_2, CO, and particulates. Flaring will burn up any emissions of VOCs, but will produce amounts of NOx, with lesser amounts of SO_2, CO, and particulates. Vehicle vessel and airplane emissions are expected to consist mainly of CO with small amounts of VOCs from aviation and other fuels..

Air emissions during drilling and operations at Point Thomson will be regulated under the facility's Title V Air Permit to Operate that will be issued by the ADEC. Lease operators at Point Thomson will be required to comply with the requirements of Title I, Part C, of the Clean Air Act (Prevention of Significant Deterioration of Air Quality). Therefore, air emissions for the drilling and production activities at Point Thomson will be evaluated to determine if they exceed Prevention of Significance Deterioration levels. An assessment of air quality effects will be conducted using the dispersion model approved by the United States Environmental Protection Agency. Air quality-related values, such as visibility, local vegetation, threatened and endangered species, and population growth, also will be reviewed; and a Best Available Control Technology assessment will be conducted on emissions sources. New Source Performance Standards will also be met as required. Significant effects from air emissions at the Point Thomson facility are not expected.

5.1.1.2 Dust

Removal of gravel from the mine and subsequent placement of gravel fill material for pads, roads, dock, and, airstrip are not likely to generate large concentrations of airborne dust. Because these construction activities are expected to occur during the winter months, minimal dust will be generated from the frozen materials. All gravel needed for facility maintenance over an estimated 20 year period will be mined during the first winter of construction and stockpiled.

It will be necessary to regrade and compact the pads, roads, dock, and airstrip during the first summer construction period. These activities will likely result in increased airborne dust particles, and a temporary reduction in air quality in the immediate vicinity of the activity. To mitigate the dusty conditions, water will be used to wet the areas prior to regrading. Long-term effects from the initial regrading and compaction activities are not anticipated.

Occasionally during the operations phase, it will be necessary to repair and re-grade the roads, airstrip, and possibly the dock. As described above, these activities will likely result in a temporary increase in airborne dust. Operations-related vehicle and aircraft traffic is another source of airborne dust. The airborne dust can be kept under control through mitigation measures such as watering of gravel surfaces and enforcing speed limits. Potential water sources for dust mitigation are provided in Figure 3-19. Long-term effects on air quality are not anticipated due to dust generated during operations.

5.1.2 Surface Hydrology and Fresh Water Quality

Impacts to drainage patterns and surface hydrology can occur when placement of gravel for roads, pads, or an airstrip diverts, impedes, or obstructs flow in stream channels or wetlands. Water quality impacts to freshwater lakes and streams can occur due to obstruction of flow, discharges and spills, water removal, and gravel removal (see Table 5-1). Effects can be in the form of temporary or long-term blockages to the drainage patterns, or degradation of freshwater quality.

5.1.2.1 Placement of Gravel and Obstruction of Flow

Impacts due to obstruction of flow and placement of gravel are combined when discussing surface hydrology and fresh water quality because these actions are intrinsically related. The proposed roads may cross small streams or drainages at several locations. During construction, temporary or log-term disruption of natural drainage patterns could occur when gravel is placed on the tundra. The potential effects of construction and the subsequent presence of the roads, pads, and airstrip on surface hydrology and freshwater quality could be:

- Blockage of natural drainage patterns and overland sheet flow by airstrip, road, and pad embankments resulting in seasonal or long-term impoundments on the upstream side and drying downstream of the embankment. Proper location of culverts and/or berm breaks can mitigate these effects.
- Diversion of stream-flow due to gravel placed adjacent to or within stream-beds can result in increased bank or shoreline erosion or sedimentation. Effects can be minimized with the proper siting of roads, pads, and the airstrip.
- Sedimentation and eventual blockage of culverts can sometimes occur. A program to inspect and clear blocked culverts would minimize effects.
- Ice buildup in culverts could block water flow for a short period during spring breakup. Mitigation measures including manually checking and removing the blockages would help minimize these effects.
- Concentration of flow by culverts and berm breaks and subsequent erosion (scour) of disturbed ground. Soils within the study area tend to be ice-rich sands and silts that easily erode. Scour holes are typically created by concentrated water flow immediately downstream from culvert outlets. Proper siting and design of culverts can help mitigate these effects.
- Obstructions or diversions in the sheet or stream flow can impact freshwater quality. If the water exchange among ponds is disrupted due to flow obstructions, estuaries of streams or creeks may no longer provide favorable habitat for fish or vegetation.
- Increased turbidity in streams and ponds at or adjacent to road crossings could occur during placement of gravel at these sites, but effects would be short-term. Effects would be mitigated by constructing road crossings during winter when the soil and smaller drainages are frozen.
- Potential increases in turbidity associated with construction activities during the first summer (i.e., re-grading and ongoing road and airstrip maintenance) will be short term and may be within the magnitude of typical sedimentation events associated with spring breakup conditions.

Impacts on local drainage patterns can also occur due to the presence of ice roads. The presence of an ice road can result in delayed snowmelt and tundra compaction. The effects of delayed snowmelt are confined primarily to the first summer season following use of an ice road, where as effects of tundra compaction may persist. A delay in snowmelt can cause water flow obstructions during spring break up. This effect will be mitigated by breaching the ice road at the drainage locations as needed during breakup to allow flow. After each of the first and second construction seasons, ice roads will be abandoned and allowed to melt. While some ponding might occur during a rapid onset of snowmelt, melt-water channels can cut through naturally occurring river aufeis (overflow icing) and rapidly drain the impounded water (Sloan et al. 1975). Should onshore ice roads be used in the future, they could be offset somewhat from year to year, minimizing any effects of these short-term impoundments.

The pipeline will be suspended above the drainages or water bodies on VSMs. Large lakes and ponds will be avoided as much as possible. By having the pipeline suspended over the drainages, effects due to blockage of flow will be minimized.

5.1.2.2 Discharges

Impacts to fresh water quality can occur due to discharges that can occur during construction and operations activities. During construction, permitted discharges will include domestic wastewater, stormwater discharge, and may include pipeline hydrotest water. During operations, only the occasional, permitted, discharge of domestic wastewater will be required should the underground injection well be inoperable.

Accidental discharges due to small spills could occur during both construction and operations. These small spills typically consist of diesel fuel and other fluids necessary for vehicle operations and other chemicals stored onsite that are used in the process modules and other facilities. Impacts from large spills are considered in detail in Section 5.4.

Winter and Summer Construction

Permitted Discharges

Camp facility domestic and sanitary wastes will typically be treated on site and discharged to the tundra under the requirements of a National Pollution Discharge Elimination System (NPDES) General Permit for tundra disposal. During peak camp use approximately 30,000 gallons per day (gpd) (114,000 liters/day) of wastewater could be generated. Once the disposal well is operational during the second year of construction, domestic wastewater will be routinely disposed of by underground injection. Since the discharge of domestic wastewater will be short-term and will meet the specific NPDES effluent requirements, it is unlikely to have significant long-term effect on water quality.

Stormwater runoff from construction areas is also regulated by the EPA under the NPDES stormwater program. Runoff that is generated during summer construction activities at the Point Thomson facility will be regulated under the General NPDES permit for construction activity on the North Slope. Under the permit requirements, Best Management Practices will be developed and implemented to minimize any potential impacts of this discharge on water quality. Pipeline hydrotesting will occur during the second summer of construction. Hydrotest source water will be fresh, and is not likely to contain contaminants. However, the discharge location(s), amount(s), and characteristics will be regulated under an NPDES permit. Hydrotest discharges will meet the NPDES requirements; therefore, adverse effects to freshwater quality are not expected.

Spills and Leaks

Construction equipment, vehicles, and vessels are typically powered by diesel fuel. In addition, diesel generators will provide power until the gas fired turbine generators are brought on line. All storage of fuels and refilling of equipment and machinery will be conducted following the fuel transfer guidelines and liner use procedures outlined in Section 7 of the North Slope Environmental Field Handbook (BPXA and Phillips Alaska Inc.) and the refueling guidelines provided in Section 17 of the ExxonMobil Production Company Safety Manual. All employees will be trained in the proper methods and authorized locations for refueling. By limiting the locations of fueling and instituting controls for fueling methods, small spills and leaks can be prevented. Stored fuels have the potential to spill or leak and can cause temporary or long-term damage to fresh water quality. Fuels for construction equipment will be properly stored in approved containers in lined, bermed areas.

Ice roads can contain trapped contaminants from vehicle exhaust, antifreeze, oil, and other vehicle-related fluids. These contaminants could enter into the water system(s) each spring as the ice roads melt. The discharge is not anticipated to be significant since ice roads are only planned for the first two winter construction periods, and would potentially produce only short-term effects. Mitigation to include regular inspection for and clean up of road spills, scraping of the affected road surface and proper disposal of the scraped materials prior to breakup will further minimize effects.

The majority of wastes generated during drilling consist of drill cuttings and spent muds. All drilling fluids will be disposed of through onsite injection into a permitted disposal well. The materials will be temporarily stored on site in a lined and bermed area, during circumstances when the Grind and Inject facility is not functioning. Therefore, it is anticipated that drilling-associated wastes will not be spilled onto the tundra and effects to freshwater quality from these materials are not expected.

<u>Operations and Maintenance</u>

Permitted Discharges

As described above for the construction camp, domestic wastewater from the permanent operations camp will be treated and injected into the disposal well. During periods of full staffing about 7,500 gpd (28,400 liters/day) of domestic wastewater will be produced. At times when the injection well is not operational, the treated domestic wastewater will be discharged to the tundra under the requirements of the NPDES General Permit for tundra disposal. This discharge will be short-term and will only occur during emergency situations. Since this infrequent discharge of domestic wastewater will meet the specific NPDES effluent requirements, it is unlikely to have significant long-term effects on water quality.

Spills and Leaks

Facility operations and maintenance will require the storage of various fuels, lubricants and chemicals that could potentially affect freshwater quality if leaked or spilled. Emergency power will be available from diesel generators, and vehicles and vessels associated with transport of supplies and personnel will be utilized on a regular basis. Storage tanks to fuel the generators, vehicles, and vessels will be located on the Central Processing Facility (CPF) pad. Section 3.13.5 of this Environmental Report (ER) describes the types of materials and storage tanks required for operations activities. Storage tanks will be installed following all applicable ADEC regulations. Tank design and location, and the use of berms and liners will mitigate the risk that spills and leaks could affect freshwater quality.

Under the proposed operations plan, spill cleanup would be required should containers leak and/or berms or other containment fail, or due to accidental spills during use in operations. The size of such spills is likely to be small, and contained within a pad. Spills of chemicals or saline waters into a large lake or river would become diluted very quickly. In small lakes, tundra ponds, and shallow water tracks, spills could be pumped out or neutralized. Impacts from large spills are considered in detail in Section 5.4.

5.1.2.3 Water Removal

Freshwater sources are required to construct onshore and offshore ice roads for project access during winter construction activities. At present, an annual sea ice road connecting the Point Thomson facility to Endicott is not planned for every year; however, use of such an ice road may be required occasionally in the future. Upon melting, water from onshore ice roads would recharge area lakes.

Many of the lakes are shallow and freeze to the bottom each winter. These lakes could only serve as water sources early in the winter in the project area. Several lakes, which may be deeper, have been identified as suitable potential water sources (see Figure 3-19).

Since there are few deep lakes in the region, former mine sites that have now filled with freshwater such as the former mine sites at Badami, Shaviovik Pit, and Point Thomson may be the best sources of year-round freshwater. These sources would not freeze to the bottom and may be suitable as water sources for ice road construction and maintenance throughout the winter. However, these waterbodies could support overwintering fish populations. In the winter, these ice-covered lakes could have low oxygen levels and could be subject to further reduction of oxygen if large volumes of water were removed. Low oxygen levels can be detrimental to the health of fish-bearing lakes, and effect the optimal overwintering habitat for fish. Permit stipulations for the Point Thomson project could limit the amount of freshwater allowed to be withdrawn from area lakes that are found to be fish bearing. For similar projects in the past, water withdrawal has been limited to 15 percent (%) of the available free water under the ice.

During summer construction and throughout the operations period, fresh water will be needed to minimize dust generation on the roads, for human consumption, and for other facility requirements. This water will be obtained from a permitted water source, likely the former gravel mine; and it is anticipated that there will be minimal to no effect to freshwater quality during the summer months.

5.1.2.4 Gravel Removal/Mining

The gravel used for the construction of permanent facilities will be obtained from a permitted site within the project area (see Section 3.0). Improper siting of gravel removal operations can result in impacts to the surface hydrology such as changes in stream channel or lake configuration, stream-flow hydraulics, or lake dynamics, resulting in erosion and sedimentation. These effects can impact freshwater quality. These effects have been considered in siting the location for the Point Thomson gravel mine. Rehabilitation of the site will result in creation of a freshwater lake.

Gravel removal operations will only be conducted in the winter when frozen soils and tundra will be encountered. Impacts on surface hydrology and nearby freshwater quality will be mitigated by the frozen conditions. No increase in sedimentation is expected due to the removal operations. A gravel stockpile containing about 200,000 cubic yards (cy) (153,000 cubic meters [m^3]) will provide for future operations and maintenance needs. Potential runoff from the overburden pile, that could increase the suspended sediment of nearby waters, could be controlled, if necessary. Control measures could include collecting the runoff and allowing the solids to settle before draining to the nearby tundra.

5.1.3 Marine Environment

Activities associated with the proposed project construction and operations potentially could affect nearshore circulation (hydrodynamics) and water quality (hydrography). This section summarizes the potential effects of the dock construction, long-term dock presence, one-time excavation of a dredged channel, and the subsequent ocean dumping of spoils.

5.1.3.1 Placement of Gravel and Obstruction of Circulation

Environmental consequences associated with dock construction and its subsequent long-term presence in the nearshore marine environment potentially could affect marine waters immediately adjacent to the dock. It is anticipated that gravel placement during dock construction would temporarily result in elevated suspended sediment in the water column. The presence of the dock could affect water movement and the water column structure (i.e., vertical salinity profile) in the immediate vicinity of the dock, possibly resulting in observable changes in selected water quality parameters such as salinity and density.

<u>Circulation</u>

Solid-filled structures, including marine docks, influence the alongshore movement of water immediately adjacent to the structure, resulting in variations in the current velocity (i.e., speed and direction), and introduce local vorticity (i.e., wake effects such as eddies and secondary flows). During periods in which the nearshore water movement has an alongshore current component of sufficient speed, a wake eddy typically develops on the lee (down-current) side of the structure. The wake eddy effect has been apparent at the West Dock Causeway (WDC) since the 1976 Dock Head 3 extension (Colonell and Gallaway 1990).

As the wake eddy is established, a secondary vertical circulation soon develops that provides vertical mixing of the water column within the eddy. For stratified water columns, that is water columns with a fresh or brackish surface layer and an underlying higher salinity (i.e., marine) bottom water layer, the vertical mixing within the eddy could result in the transport of higher salinity waters to the surface. This occurs when the surface and bottom waters have similar alongshore current velocities. However, during conditions in which the alongshore currents do not coincide with bottom water movement, the wake eddy formation is restricted to the surface layer because of poor frictional coupling with the bottom layer. If the alongshore current is similar in both surface and bottom layers, the eddy will involve both layers and promote movement of bottom layer waters into the upper part of the eddy, where it is mixed and carried downstream by the alongshore current (Colonell and Gallaway 1990).

Wind-induced upwellings occur naturally and regularly due to east and northeast winds on a regional scale across the North Slope (Colonell and Gallaway 1990). Kinnetic Laboratories, Inc. (1983) conducted oceanographic studies within Lions Lagoon and on the seaward side of the barrier islands. They observed that major exchange of water masses in Lions Lagoon is driven by storm surges and local wind. Gallaway et al. (1991) review of data from the NOAA-9 polar-orbiting satellite indicated that the area between the Colville/Sagavanirktok River Habitat Unit and the Mackenzie River Habitat Unit often had cold, marine waters extending to the shore in open-water season. The Point Thomson Unit coastline falls within this area. Physical oceanographic studies conducted in 1997 and 1998 by URS Corporation in the Point Thomson area correlate with the Kinnetic and NOAA-9 data review (URS 1999).

The proposed dock would provide an alternative mechanism by which upwellings could occur but would not appreciably enhance naturally occurring upwellings. Because the water column within Lions Lagoon in the area of the proposed dock tends to be uniform (URS 2000), both horizontally and vertically, formation of a wake eddy would only mix waters with similar temperature and salinity characteristics.

Water Quality

Dock Construction

The dock is scheduled to be constructed during the winter, thus, sea ice will be present throughout the lagoon waters, entrances and other gaps between the barrier islands, and the Beaufort Sea. Within the construction area, sea ice will be removed to allow gravel placement. Gravel placement will elevate suspended sediment and turbidity in the adjacent nearshore waters. However, it is anticipated that the affected area of the marine environment will be quite limited since most of the dock coincides with the grounded sea ice zone–that is a band of sea ice attached to the seafloor and associated with shallow waters typically found adjacent to the shoreline and extending to the 6-ft isobath. Available bathymetry indicates that the dock will extend to the 7-ft isobath, thus, on average, only a 1-ft water column will be affected by the 750 ft long dock construction. It is anticipated that low current speeds and the relatively shallow water column affected by dock construction will limit the distribution of elevated suspended sediment. A water quality variance from the State of Alaska may be required for this minimal and short-term increase in turbidity that will occur.

Sediment contamination by selected heavy metals and hydrocarbons is anticipated to be negligible, if any, since there have been limited industrial or military activities at the construction site. Sediment quality sampling in support of the Liberty and Northstar Developments demonstrate that the nearshore Beaufort Sea sediments are typically absent of contaminants, and all of the samples to date result in chemical-of-concern concentrations below regulatory screening levels (URS 2000 and 2001).

Long-Term Presence of the Dock

Water quality alterations associated with solid-filled docks and causeways located along the Central Beaufort Sea coast have been documented for numerous years. The area of water quality alteration due to wake eddy development is a function of the relative difference between surface and bottom water salinities, duration of the wake eddy during easterly winds, dock length, and water depth.

It is anticipated that water quality alterations associated with increased surface water salinity will be intermittent yet locally observable down current of the dock; however, the effect will be temporary and restricted in size. During periods of sustained easterly winds coinciding with the summer open-water season, wake eddy formation on the lee (down current) side of the structure effectively mixes the water column within the eddy as bottom waters are brought to the surface. If the nearshore waters immediately adjacent to the dock are uniform, that is the surface and bottom water salinities are similar, vertical mixing will result in little to no detectable changes in surface water character. However, during times when the water column is stratified, that is when the surface waters tend to be notably fresher than the underlying saltier bottom waters, the vertical mixing associated with the wake eddy results in higher saline surface waters immediately down current of the dock. It should be noted that under westerly winds, nearshore waters tend to be relatively uniform and thus vertical mixing due to wake eddies typically results in minimal changes to the surface water salinity.

The hydrographic effects of WDC on Simpson Lagoon were evaluated by Colonell and Gallaway (1990). Persistent easterly winds induce upwelling through various channel entrances to Simpson Lagoon, including the channel between Stump Island and WDC. The wake effect at the tip of WDC promotes upward mixing of the bottom water in the water column. As a result, under persistent easterly winds cold saline marine waters fill the channel between Stump Island and WDC. A review of salinity data from 1976 to 1988 showed that water quality between Stump Island and WDC has not materially changed over this time period, indicating that the wake effect at WDC has a minimal effect compared to region-wide wind driven processes (Colonell and Gallaway 1990).

Lions Lagoon nearshore waters typically exhibit unstratified conditions from breakup and to freeze-up; however, persistent easterly winds and/or strong storm events create temporary stratified marine water conditions in nearshore waters (URS 2000). The water column within Lions Lagoon in the area of the proposed dock tends to be uniform, both horizontally and vertically, even during persistent easterly winds (URS 2000). Hydrographic changes from the formation of a wake eddy at the tip of the proposed dock would mix waters with similar temperature and salinity characteristics. Therefore, potential hydrographic effects due to the proposed dock are anticipated to be minimal compared to the naturally occurring wind driven upwellings.

5.1.3.2 Discharges

Increased turbidity associated with the summer nearshore dredging operation can be considered a discharge to the marine environment. It will be necessary to obtain a water quality variance from the State of Alaska for the short-term increase in turbidity that will occur. In addition, an ocean dumping permit under Section 103 of the Marine Protection, Research, and Sanctuaries Act will be required to dump the dredge spoils at sea.

A known consequence of summer dredging activities related to the 1,000-ft (305 m) temporary dredged channel is a suspended sediment plume; however, the effects will be temporary and generally restricted to lagoon waters within the project area. The distribution of the suspended sediment plume is a function of water depth, sediment grain-size, current velocity, and duration of the dredging. Shallower waters, coarser-grained sediments (i.e., sands, gravel), low current speeds, and abbreviated dredging operations tend to reduce the overall affected area.

During easterly winds, water typically enters the lagoon through Mary Sachs Entrance, and thus it is anticipated that a sediment plume associated with dredging will be attached to the mainland shoreline, effectively reducing the influence of the plume as it is transported into shallower waters. Under westerly winds, the suspended sediment plume is anticipated to move toward the shallow water shoals south of Flaxman Island.

Coarser-grained sediments fall out of the water column within a short distance from the excavation. While there is currently limited information regarding the sediment grain-size in the area of proposed dredging, it is assumed that the sediments will tend to have a coarse-grain component similar to the nearshore surface sediments collected along the proposed Liberty Development pipeline route.

Alongshore current movement is wind-driven, thus, higher wind speeds result in higher current speeds. Typically, storm events have a significant northerly component, regardless if the storm is from the east or west. Thus, higher current speeds should transport the plume to the mainland shore, limiting the overall effected area. Storms themselves create suspended sediment in nearshore waters, raising concentration in excess of 75 milligrams per liter (URS 2000). Similarly, ocean dumping discharge of spoils will create a temporary suspended sediment plume in offshore waters. It is anticipated that the effects related to ocean dumping will be similar to dredging with the exception of possible burial and associated morality of benthos immediately below the discharge.

Accidental discharges due to spills could occur during both construction and operations phases. These spills could consist of diesel fuel and other fluids necessary for vehicle operations, and spills and discharge of fuels or contaminated bilge water from support vessels. Impacts from large spills are considered in detail in Section 5.4.

All storage of fuels and refueling of equipment and machinery will proceed following the procedures outlined in the North Slope Environmental Field handbook and in ExxonMobil's Safety Manual. All employees will be trained in the authorized location and proper methods for refueling. By limiting the locations of fueling and instituting controls for fueling methods, small spills and leaks to the marine environment can be prevented.

5.1.4 Permafrost and Soils

The dominant ice-rich permafrost soils in the project area, if allowed to thaw, will slump and release melt water, could then pond. The ponded water will absorb more radiant energy and increase the area of thawed soils. Thermokarst is the term used for this land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks are formed when the ice melts and the ground settles unevenly. Thermokarst areas can continue well beyond the area of initial disturbance and may take several years to stabilize, even if the soils are only slightly disturbed. The placement of 5-ft (1.5 m) thick gravel on the tundra surface to support project facilities would prevent the degradation of the permafrost. Gravel removal at the mine site location will impact the permafrost in the immediate vicinity.

5.1.4.1 Placement of Gravel

All gravel coverage will take place during the winter months. Facilities requiring gravel placement include the pads, roads, and airstrip. The working surfaces for these structures will be approximately 5-ft (1.5 m) or more above ground level, after compaction, depending on local topography. The active layer beneath the gravel will be reduced to a narrow zone near the existing ground surface. This reduction of annual thaw into the ice-rich soils reduces the risk of thaw settlement under the gravel fill, and degradation of permafrost. Consequently effects to the permafrost are likely to be minimal. The gravel fill for the dock is anticipated to result in colder ground temperature below the sea floor, which would prevent the degradation of subsea permafrost.

5.1.4.2 Gravel Removal/Mining

Excavation and removal of gravel will completely remove the soils and permafrost in the gravel mine footprint. Localized degradation of permafrost areas may occur due to gravel mining activities.

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5.2 BIOLOGICAL RESOURCES

Biological resources of the Point Thomson area include marine benthos, vegetation and wetlands, freshwater and marine fish, birds, marine mammals, and terrestrial mammals. The project actions and the impacts they could potentially produce are likely to be different whether the action occurs as part of winter or summer construction or during operations. Therefore, the potential impacts on the resources due to project actions during different project phases (winter and summer construction and operations) are considered separately. Table 5-2 summarizes the potential impacts associated with each category for the biological resources in the Point Thomson study area and indicates during which project phase the impacts are anticipated. The potential direct and indirect effects of construction and operation of the proposed Point Thomson Gas Cycling Project on biological resources can be grouped into three major categories:

Habitat Effects

- Long-term habitat loss or alteration from gravel extraction at the mine site and from gravel placement for the construction of the airstrip, roads, pads, and dock.
- Temporary habitat modification leading to temporary or localized habitat loss or decreased habitat value. Effects could include changes in wildlife use of habitats that would be altered by ice roads, dust fallout, persistent snow drifts, thermokarst, alteration of water flow, impoundments, and contaminant spills.

Disturbance Effects

- Impacts associated with behavioral reactions of wildlife to noise and visual disturbance from equipment operation and human activity (e.g., drilling, vehicles, heavy equipment, vessels, and aircraft) during project construction and operation. Effects could include energetic and other costs associated with startle responses or with fleeing from the area, and reduced nesting success or clutch sizes of birds nesting too close to facilities.
- Effects associated with loss of habitats (through avoidance or displacement), or reduction in quality of habitats in which wildlife are subject to disturbance.
- Attraction of wildlife to project facilities (e.g., herbivores to areas of early snowmelt in spring, birds to impounded areas adjacent to gravel pads and roads, caribou to gravel pads and pipelines for insect relief, and predator/scavengers to artificial food sources). Other effects could include increased abundance of opportunistic and easily habituated predator/scavengers, including Arctic foxes, grizzly bears, glaucous gulls, and ravens.

Direct and Indirect Mortality

- Injury and mortality of wildlife from collisions with aircraft, vehicles, or structures, or from contact with, or ingestion of, oil or other contaminants.
- Increased predation on prey species by foxes, bears, glaucous gulls, and ravens as a result of their increased abundance, or attraction to oil field facilities.

The following sections discuss the impacts depicted on the table.

Table 5-2 Potential Biological Consequences

BIOLOGICAL RESOURCES	POTENTIAL IMPACTS[1]			
	HABITAT		DISTURBANCE	MORTALITY
	LOSS	ALTERATION		
Marine Benthos	Y (W)	Y (W)	Y (W)	Y(W)
Vegetation/Wetlands	Y (W,S,O)	Y (W,S,O)	N/A	N/A
Freshwater Fish	Y (W)	Y (W)	N	Y (O)
Diadromous Fish	Y (W)	Y (W)	N	Y (O)
Marine Fish	Y (W)	Y (W)	N	Y (O)
Waterfowl and other Water Birds	Y (W,S,O)	Y (W,S,O)	Y (S,O)	Y (S,O)
Tundra –Nesting Birds	Y (W,S,O)	Y (W,S,O)	Y (S,O)	Y (S,O)
Predatory Birds	Y (W,S,O)	Y (W,S,O)	Y (W,S,O)	Y (W,S,O)
Cetaceans	N	N[2]	Y(S,O)	N
Pinnipeds	N	N[2]	Y(W,S,O)	N
Polar Bears	N	N[2]	Y(W,O)	Y(W,O)
Caribou	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (W,S,O)
Muskoxen	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (S,O)
Grizzly Bear	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (S,O)
Arctic Fox	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (W,S,O)
Moose	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (S,O)
Steller's and Spectacled Eiders	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (S,O)
Bowhead Whales	N	N[2]	Y(S,O)	N
Other Mammals	Y (W,S,O)	Y (W,S,O)	Y(S,O)	Y (W,S,O)

[1]Defined in text of Section 5.2
[2]Characterized as disturbance

Notes:
N/A = not applicable
N = no effect
O = operations
S = summer construction
W = winter construction
Y = potential consequence

5.2.1 Marine Benthos

As described in Section 4.5, the benthic community of Lions Lagoon is thought to be composed primarily of infaunal and epifaunal invertebrates similar to other Beaufort Sea coastal lagoons and bays. Since depths within the lagoon do not exceed 20 ft (6 m), the community is likely to be characterized by low density and diversity, as is characteristic of the nearshore zone of the Beaufort Sea (Carey and Ruff 1977 and Carey 1978). Table 5-2 summarizes the potential impacts on the benthic community.

5.2.1.1 Habitat Loss and Mortality Effects

Winter Construction

Effects of winter construction of the dock will be minimal, since the short dock will be mostly contained within the grounded ice zone. Within this zone, the benthic community consists of organisms that move into or recolonize the area after breakup. However, approximately 2 acres (<1 hectare [ha]) of the littoral zone including the area covered by gravel that extends from the shoreline to the 7 feet (ft) (2 meters [m]) depth would be lost as benthic habitat for subsequent open water seasons. Additionally, the area at the end of the dock, in the ice shear zone, is unlikely to support diversified benthic communities. Given the low density and diversity within the nearshore zone of the Beaufort Sea, and the opportunistic nature of the benthic community, loss of this area as habitat will not have a significant effect on the benthic community within Lions Lagoon.

Summer Construction

A proposed shallow channel approximate 0 to 2 ft (0.6 m) deep and approximately 400 ft wide (122 m) by 1,000 ft long (305 m) would be dredged from the end of the dock to the 9-ft (3-m) isobath. Since the dredging activity would take place in the summer, in an area offshore of the typical grounded-ice zone, the benthic community would be impacted. Approximately 9 acres (4 ha) of littoral zone would be directly impacted by the dredging, with additional areas potentially impacted by sediment fallout from the turbidity plume. However, the area directly impacted would likely be quickly recolonized by the opportunistic species found in this community, and the sediment plume effects will be temporary as the sediment is resuspended by wave and current action.

It addition to the dredging action itself, the disposal of approximately 30,000 cy (23,000 m^3) of dredge spoils will create turbid conditions at the location of disposal. The impacts of the disposal will be evaluated under Section 103 of the Marine Protection Research and Sanctuaries Act and will be included in the associated report.

Operations and Maintenance

Operations and maintenance activities will likely have none to minimal habitat loss and mortality impacts on the marine benthic community. These actions would not cause long-term habitat loss or additional mortality.

5.2.1.2 Habitat Alteration and Disturbance Effects

Disturbance effects to benthic organisms occurring in areas adjacent to the dock footprint could occur during winter construction, summer construction, and operations phases of the project. Although they tend to be localized and possibly more intense in a small area, activities such as those listed below can cause physical changes to the benthic habitat related to increased turbidity.

- Dredging of the 1000 ft by 400 ft (305 m by 122 m) channel (summer construction).
- Alteration of local water-flow patterns, and thus the deposition (or erosion) of sediment and organic material in the vicinity of the dock (summer and winter effect).

- Maintenance of the gravel-fill dock structure by placement of sand and gravel, some of which is eroded and then deposited in the nearby benthic community each open-water season (summer construction and operations).
- Tug-and-barge movement during the open-water season could disrupt bottom sediments (summer construction and operations).

During the winter in the grounded land-fast ice zone, impacts or disturbance to the benthic community adjacent to the dock are likely to be minimal. Very few organisms are found in both the grounded land-fast ice and nearshore ice zones for the entire length of the dock.

The increased turbidity that is possible during summer construction and operations activities is likely to be similar, if not smaller, in magnitude to that caused by natural events such as wind induced waves and increased sediment output from rivers during breakup (USACE 1987 and Britch et al. 1983). Based on the results of a five-year study of drilling discharges from the Endicott drilling islands (ENSR 1991), it is anticipated that benthos in adjacent areas are not likely to be affected by changes in water turbidity, and depositional and erosional patterns that may result from the presence and maintenance of the proposed structure.

5.2.2 Vegetation and Wetlands

As described in Section 4.6, about 35.3% of the project area is covered by water and predominant vegetation types are moist sedge, dwarf shrub/wet sedge tundra complexes, and moist sedge, dwarf shrub tundra. Table 5-3 summarizes the Point Thomson proposed facility gravel footprints by vegetation type. Table 5-4 provides the linear ft of proposed Point Thomson project pipeline corridors in each vegetation type.

5.2.2.1 Habitat Effects

Habitat effects in the project area depend upon the relationships between available habitat and resident wildlife species. Although the availability of food, nesting sites, and competition for habitat becomes restrictive at some threshold, there is no data currently available that indicates this threshold has been reached such that tundra habitat limits the size or natural growth rates of the wildlife species (Maki 1992).

Habitat effects can be considered long-term or temporary. Long-term effects occur when tundra is lost due to being covered with gravel or removed to reach gravel deposits. Temporary or short-term alterations of tundra vegetation in the Point Thomson area could be caused by ice roads, dust fallout from gravel roads, pads, and the airstrip, snow dumps, persistent snowdrifts, thermokarst, changes to surface hydrology, and spills and leaks during construction and operations phases.

Gravel Removal and Placement

Direct impacts to the vegetation and wetlands of the Point Thomson area will occur as gravel is placed on the tundra during winter construction of roads, pads, and the airstrip. Gravel placement for the proposed facilities will cover approximately 8,149,933 ft^2 (0.8 km^2) of tundra habitats (Table 5-3). The effects of gravel cover are long-term and vegetation recovery is slow following removal or remediation of gravel fill (Johnson 1987, Walker et al. 1987, and Jorgenson et al.

Table 5-3. Square feet of Point Thomson proposed facility gravel footprints by vegetation type.

Vegetation Type	Level C Vegetation Class	Airstrip	Airstrip Road (from intersection with east road)	Central Processing Facilities Pad	Central Well Pad	Dock	East Well Pad	East Well Pad Road (from CFP to East pad)	West Well Pad	West Well Pad Road (from intersection with east pad road)	Gravel Storage Pad	Overburden Pile	Water Source Access Road	Water Source Pad	Total Gravel Cover	% of Total	Gravel Mine	Total permanent habitat loss (gravel cover and mine)	% of Total
Water	Ia		158	45,971	24,606	130,131	26,359	46,075	8,466	26,900	14,208	219	435	10	325,529	3.99	102,339	427,878	4.35
Salt Marsh		0	0	24,431	74,291	3,129	0	0	0	34,892	0	0	0	0	136,744	1.68		136,744	1.39
	IIIb				26,218										26,218	0.32		26,218	0.27
	Ixh														0	0.00		0	0.00
	IXi			24,431	48,073	3,129				34,892					110,526	1.36		110,526	1.12
Aquatic Graminoid Tundra	IIb							20,122		8,748					28,869	0.35		28,869	0.29
Water/Tundra Complex	IId														0	0.00		0	0.00
Wet Sedge Tundra	IIIa			280,379	45,640			20,859		45,745			3,824		396,447	4.86		396,447	4.03
Wet SedgeTundra/Water Complex	IIIc									28,182					28,182	0.35		28,182	0.29
Moist Sedge, Dwarf Shrub Tundra/ Wet Sedge Tundra Complex		934,840	160,226	82,686	49,288	0	170,743	428,119	67,441	531,572	202,971	303,754	27,450	0	2,959,090	36.31	608,405	3,567,495	36.28
	IIId	620,892	160,226	40,853	40,992			41,169	21,430	198,953	202,971	303,754	23,278		1,654,517	20.30	495,321	2,149,837	21.86
	IIIe			41,834	8,297										50,130	0.62		50,130	0.51
	IVa	313,948					170,743	386,950	46,011	332,620			4,172		1,254,443	15.39	113,084	1,367,527	13.91
Moist Sedge, Dwarf Shrub Tundra		0	183,161	609,743	0	0	2,374	857,835	168,406	1,050,605	267,864	29,869	31,548	13,833	3,201,407	39.28	971,868	4,187,107	42.58
	Va		183,161	509,588			2,374	835,686	168,408	917,667	267,864	29,869	11,123		2,925,739	35.90	748,860	3,674,600	37.37
	Ve			100,154				22,149		132,938			20,425	13,833	275,667	3.38	223,007	512,507	5.21
Moist Tussock Sedge, Dwarf Shrub Tundra	Vb														0	0.00		0	0.00
Dry Dwarf Shrub, Crustose Lichen Tundra	Vc		32,868	32,246				109,366		122,454			3,062		299,996	3.68		299,996	3.05
Dry Dwarf Shrub, Fruticose Lichen Tundra	Vd														0	0.00		0	0.00
Dry Barren/Dwarf Shrub, Forb Grass Complex	IXb							3,560							3,560	0.04		3,560	0.04
Dry Barren/Forb Complex	IXc														0	0.00		0	0.00
Dry Barren/Grass Complex	IXe														0	0.00		0	0.00
Dry Barren/Dwarf Shrub, Grass Complex	IXf														0	0.00		0	0.00
River Gravels	Xa					32,246	26,699	4,868							63,813	0.78		63,813	0.65
Bare Peat, Wet Mud		2,276	4,290	7,585	1,515	0	30,640	70,954	0	27,152	11,932	0	0	0	156,344	1.92	0	156,344	1.59
	XIa	2,276	4,290	7,585	1,515		30,640	70,954		27,152	11,932				156,344	1.92		156,344	1.59
	XIc														0	0.00		0	0.00
Gravel Roads and Pads (and washouts)		0	0	12,303	523,806	0	0	0	0	0	0	0	0	0	536,110	6.58	0	536,110	5.45
	Xc														0	0.00		0	0.00
	Xe			12,303	523,806										536,110	6.58		536,110	5.45
	Total	937,116	380,703	1,095,345	719,147	165,507	258,814	1,561,758	244,315	1,876,251	496,974	333,842	66,319	13,843	8,149,933	100.00	1,682,612	9,832,544	100.00

NOTE: Sum of AREA (Units = Square Feet)

1991). Therefore these effects are considered to be long-term. The vegetation types most affected by gravel placement would be moist sedge, dwarf shrub tundra (39% of the gravel footprint lies in this vegetation type) and moist sedge, dwarf shrub tundra/wet sedge tundra complex (36% of the footprint). No other vegetation type comprises more than 5% of the gravel footprint for the Point Thomson project.

Gravel mine development would cause long-term alteration of 1,682,612 ft^2 (0.2 km^2) of tundra habitats (Table 5-3). The vegetation types that would be most affected by gravel removal are the same as for the gravel footprint (together these two types comprise 94% of the gravel mine footprint) (Table 5-3).

Ice Roads

For the proposed Point Thomson Gas Cycling Project, ice roads on tundra will be used the first winter to support gravel mining, construction of the roads, pads, and airstrip, and during the second winter for pipeline construction. Ice roads typically result in delayed snowmelt and tundra compaction. The effects of delayed snowmelt are confined primarily to the first growing season following use of an ice road. Although some damage to tundra occurs from ice roads, the long-term effects are considerably less than those associated with gravel roads and pads. The magnitude of impacts will depend on the volume of ice in the underlying soil (Adam and Hernandez 1977), the vegetation type present (Racine 1977; Walker et al. 1987, Emers et al. 1995), and the duration of use (Buttrick 1973, Adam and Hernandez 1977).

Ice roads can result in torn and crushed sedge tussocks, and mortality of mosses and lichens (Adam and Hernandez 1977, Johnson and Collins 1980, Walker et al. 1987). Some individual plants may be killed or small areas damaged, but if the tundra organic mat is not torn, plant recovery usually occurs within a few years. However, removal of plant cover (ripped or scraped) or disruption of the soil surface can cause long-term damage or mortality to plants. The effects of ice roads are greater in dry and moist habitats than they are in wet habitats. Based on the pipeline alignment, the vegetation types with the largest proportion of ice road coverage would probably be moist sedge, dwarf shrub tundra/wet sedge tundra complex (37% of pipeline alignment) and moist sedge, dwarf shrub tundra (42% of pipeline alignment; Table 5-4). Areas that are most sensitive to damage from ice roads include ridges, banks, dunes, tussocks, and high centered polygons, which are most common in the following vegetation types: moist sedge, dwarf shrub tundra; moist tussock sedge, dwarf shrub tundra; dry dwarf shrub, crustose lichen tundra; dry dwarf shrub fruticose lichen tundra, and dry barren/dwarf shrub, grass complex. A total of 85,726 linear ft (26.1 kilometers [km]) of the pipeline alignment lies within these vegetation types.

Water Removal

Withdrawal from lakes could potentially alter wetland community structure by changing the hydrologic regime. Potential lakes identified for ice road construction are shown in Figure 3-19. At present, it is planned that the abandoned gravel mine will be used as the freshwater source for camp and operations needs. The abandoned gravel mine at Point Thomson is not known to be fish bearing.

Table 5-4 Linear Feet of Proposed Point Thomson Project Pipeline Corridors in each Vegetation Type

VEGETATION TYPE	LEVEL C VEGETATION CLASS	EAST PIPELINE	SALES PIPELINE	WEST PIPELINE	SUBTOTAL	% OF TOTAL
Water	Ia	2,424	6,070	2,845	11,339	6.34
Salt Marsh		183	187	189	559	0.31
	IIIb				0	0.00
	Ixh				0	0.00
	Ixi	183	187	189	559	0.31
Aquatic Graminoid Tundra	Iib	483	948	937	2,368	1.32
Water/Tundra Complex	Iid		549	567	1,116	0.62
Wet Sedge Tundra	IIIa	1,293	2,490	813	4,596	2.57
Wet SedgeTundra/Water Complex	IIIc		2,727	564	3,291	1.84
Moist Sedge, Dwarf Shrub Tundra/ Wet Sedge Tundra Complex		9,182	45,073	12,325	66,580	37.23
	IIId	2,408	7,835	5,555	15,798	8.83
	IIIe	96	302	148	546	0.31
	Iva	6,677	36,936	6,622	50,236	28.09
Moist Sedge, Dwarf Shrub Tundra		12,613	49,106	13,987	75,706	42.33
	Va	11,720	38,263	13,130	63,112	35.29
	Ve	893	10,844	857	12,594	7.04
Moist Tussock Sedge, Dwarf Shrub Tundra	Vb				0	0.00
Dry Dwarf Shrub, Crustose Lichen Tundra	Vc	2,782	3,229	3,010	9,020	5.04
Dry Dwarf Shrub, Fruticose Lichen Tundra	Vd		1,000		1,000	0.56
Dry Barren/Dwarf Shrub, Forb Grass Complex	Ixb				0	0.00
Dry Barren/Forb Complex	Ixc				0	0.00
Dry Barren/Grass Complex	Ixe				0	0.00
Dry Barren/Dwarf Shrub, Grass Complex	Ixf				0	0.00
River Gravels	Xa	41	781	49	870	0.49
Bare Peat, Wet Mud		715	1,000	693	2,407	1.35
	Xia	715	1,000	693	2,407	1.35
	Xic				0	0.00
Gravel Roads and Pads (and washouts)		0	0	0	0	0.00
	Xc				0	0.00
	Xe				0	0.00
Total		**29,715**	**113,158**	**35,979**	**178,852**	**100.00**

SUM = LENGTH (Units = Feet)

Obstruction of Flow

Impoundments can occur when drainage is impeded adjacent to roads or pads. Impoundments can be temporary, disappearing by mid-June, or they can persist through summer. Depending on the duration of seasonal impoundments, effects on vegetation range from minor to substantial. For the Point Thomson project, culverts will be placed during construction to prevent the formation of long-term impoundments adjacent to roads or pads. Additional culverts or other drainage structures could be installed after construction to drain any long-term impoundments that might form following initial gravel placement. Temporary impoundments probably will occur for brief periods (a week or less) during spring runoff; however, the overall effects of such impoundments on vegetation would be minimal.

Thermokarst

As described in Section 5.1.4, thermokarst is the settling or caving of the ground due to melting of ground ice (Muller 1947). Thermokarst is a natural process, even in undisturbed areas, and can be viewed as having both positive and negative effects. The process occurs whenever the heat absorption or exchange capacity of permafrost soils is altered. Thermokarst areas are typically found on the edges of gravel pads or roads, and are exacerbated by dust fallout or impoundment of water. Thermokarst also can result when the tundra mat is disturbed, often as a result of spill cleanup activities. Although visual and hydrologic effects of thermokarst are long-lasting (Lawson 1986), other ecological changes may benefit plant productivity and wildlife use (Truett and Kertell 1992). Physical and thermal changes may enhance organic matter decomposition, nutrient release, primary production, and nutrient concentrations in plant tissue (Challinor and Gersper 1975, Chapin and Shaver 1981, Ebersole and Webber 1983, and Emers et al. 1995). Thermokarst may increase habitat diversity, species richness, and plant growth on thin gravel fill (Jorgenson and Joyce 1994). Since the Point Thomson facility will be built on gravel pads to insulate ice-laden soils, thermokarst conditions are expected to be limited. Engineering techniques proven in over 25 years of working in permafrost areas on the North Slope will be used to further mitigate potential effects.

Dust Fallout

During the summer construction season, the gravel roads, pads, and airstrip will be graded and compacted. This activity, along with the movement of heavy equipment associated with the construction along the gravel roads, will generate dust. To a lesser extent, operational use of the roads will also create dust.

The effects of dust fallout (fugitive dust that lands on tundra downwind from gravel roads and pads) are most pronounced within 35 ft (11 m) of the source, constituting about 17,950,237 ft^2 (1.7 km^2) around the Point Thomson facilities. The magnitude of dust effects depends on traffic speed and intensity, distance from the source, and substrate acidity (Everett 1980, Walker and Everett 1987, and Auerbach et al. 1997). The effects of dust fallout within this zone could include (from Spatt 1978, Everett 1980, Spatt and Miller 1981, Werbe 1980, Klinger et al. 1983, Walker et al. 1985, Walker and Everett 1987, and Auerbach et al. 1997):

- Advanced snowmelt (up to two weeks) because of increased albedo
- Increased depth of seasonal thaw (to 20 inches (in) in ice-rich areas)
- Thermokarst

- Early green-up of plants
- Increased soil pH
- Reduced photosynthetic capacity of plants
- Lower nutrient levels,
- Decreases in acidophilous mosses (particularly *Sphagnum*) and some lichens (*Cladina* and *Peltigera*)
- Increases in other mosses
- Decreases in some prostrate shrubs (*Dryas* and *Ledum*)
- Barren patches of ground

Cotton-grass sedges, such as *Eriophorum* spp., are more tolerant of dust fallout, perhaps because they occur in wetter areas and are adapted to disturbed sites (Everett 1980).

Dust fallout associated with regrading and compacting of the gravel during the first summer construction phase will likely occur after spring thaw and will not affect snowmelt. Advanced snowmelt due to dust fallout adjacent to the roads, pads and airstrip could result from construction activities and infield traffic during operations. Watering the roads during the summer, an enforcing vehicular speed limits at all times will mitigate potential effects from dust fallout.

Snow Dumps and Snow Drifts

During the winter, snow that accumulates on pad, road, and airstrip surfaces will be plowed to the side. In some cases the snow will be pushed off of the gravel surface and will accumulate on the frozen tundra. In addition, drifted snow can accumulate adjacent to the gravel areas that are of higher relief than the surrounding tundra. The accumulated snow can result in delayed snowmelt and soil compaction. Impacts on vegetation may be long-term because of the chronically reduced growing season, soil compaction, altered moisture regime, and gravel fallout. Since large accumulations of snow are not anticipated for the region, the areas potentially affected by snow dumps and snowdrifts associated with the Point Thomson project are anticipated to be small. In addition, mitigation measures such as ensuring that the snow is stored on the gravel surface as much as possible and relocating snow dump areas from year to year will minimize any effects on vegetation.

Spills and Leaks

Contaminant spills associated with the Point Thomson project could affect plant communities in several ways. The most common accidental spills in the North Slope oil fields are fuels and vehicle/machinery lubricants, although a wide range of other chemicals are used in the industry and may be spilled accidentally (e.g., methanol, glycol). Impacts to vegetation range from minor to severe, depending on the toxicity of the product spilled and the measures taken to clean it up. For the most common spills in the oil field, predictable alterations in the plant community include decreased plant cover, decreased species richness, mortality of woody plants and herbaceous flowering plants, increased relative abundance of graminoid plants (grasses and sedges), and thermokarst and associated changes (ranging from increased to decreased hydrologic variability). The most common spills on the North Slope are relatively small and can be cleaned up with minimal impact on vegetation. Reasonably productive plant cover can be achieved within several years, with some rehabilitation effort. Impacts from large spills are considered in detail in Section 5.4.

5.2.2.2 Disturbance and Mortality Effects

While mortality of vegetation and disturbance to vegetation and wetlands will occur as gravel is placed on the tundra, these direct impacts are discussed in the context of habitat loss and/or alteration (see Section 5.2.2.1, above).

5.2.3 Fish

Potential effects of the Point Thomson Gas Cycling Project on fish species previously discussed in Section 4.8 of this ER are summarized in Table 5-2 and discussed in the following sub-sections.

5.2.3.1 Habitat Effects

Potential habitat effects could result from project activities that cause freshwater and marine fish habitat modification, loss, or decreased habitat value. Arctic cisco (*Coregonus autumnalis*), least cisco (*C. sardinella*), broad whitefish (*C. nasus*), and humpback whitefish (*C. pidschian*) are not known to overwinter or spawn in the Point Thomson area. The Canning River supports round whitefish (*Prosopium cylindraceum*) and Arctic grayling (*Thymallus arcticus*) populations (Section 4.8.3 of this ER). Round whitefish use the main stem of the Canning River, the delta area, and Canning River tributaries throughout their life cycle, but do not migrate extensively (Moulton and Fawcett 1984, WCC 1982). Dolly Varden char (*Salvelinus malma*) use the Canning River perennial warm-water springs for overwintering habitat (WCC 1982). Project activities are not planned close to these areas and, therefore, will not directly impact the overwintering and spawning habitats of these fish species.

<u>**Winter Construction**</u>

Gravel mining activities will take place during one winter season (i.e., removal of tundra overburden, blasting, and mining of the gravel). Ninespine stickleback (*Pungitius pungitius*) are the only documented freshwater fish known to reside in Point Thomson area streams (Section 4.8.3). Ninespine sticklebacks overwinter in deep tundra lakes and rivers. The closest freshwater body to the proposed gravel mine site is an unnamed stream to the east. Due to its small size and probability that is freezes solid during winter, it is unlikely to provide overwintering habitat for ninespine sticklebacks. Gravel mining activities are not anticipated to impact ninespine stickle back overwintering habitat.

Gravel placement for roads, pads, and airstrip could alter flow patterns of streams and wetlands, preventing fish access to some habitats and/or modifying fish habitat. There is rarely a defined channel from perched lakes to river channels; the connection is generally through low-lying wetlands. Perched lakes can provide overwintering and rearing areas for fish. Ninespine stickleback can be found in streams and rivers in the Point Thomson area (Section 4.8.3); however, there are no known perched lakes or streams deep enough to provide ninespine stickleback overwintering or spawning habitat in the project area (see Figure 3-19). Therefore, it is anticipated that gravel placement for roads, pads, and airstrip will not impact ninespine stickleback overwintering and spawning habitats.

Culverts and/or bridges will installed during winter construction at road stream crossings. The method of crossing selected streams will depend on the water-body width. Ninespine sticklebacks forage in freshwater tundra streams and brackish nearshore waters during the summer. These fish were caught along the coastline at stations in Lions Lagoon south of Flaxman Island throughout the openwater season during a 1999 Point Thomson fish study (LGL 2000b). Culverts will be designed to minimize sedimentation and subsequent blockage, and to meet the fish passage requirements of the Alaska Department of Fish and Game (ADF&G) as determined by site-specific conditions. Therefore, it is not anticipated that culverts and/or bridges will inhibit the passage of ninespine sticklebacks and other fish into area streams.

The dock will be constructed during the winter in the land-fast ice zone, and extend out to a water depth of 7-ft (2 m). Placement of gravel fill during the dock construction will eliminate 2 acres (<1 ha) of nearshore summer fish foraging habitat. Foraging habitat is not limited in the nearshore waters; therefore, it is anticipated that the loss of this small area compared to the total nearshore habitat in the Point Thomson area will not impact fish species that use the area during the open water season.

Ice within the land-fast ice zone is frozen to the bottom substrate from the shore to a depth of about 7 ft (2 m). The remaining ice in the land-fast ice zones is floating (from 7 ft to 50 ft [2 to 15 m] water depth). Placement of gravel during dock construction will increase turbidity in the under-ice water column. It is anticipated that sediments released to water under the ice in the land-fast ice zone will settle out close to the construction area due to the large grain size (gravel) of the particles, and the quiescent conditions expected under the ice (LGL et al. 1998). Therefore, fallout from the sediment plume during winter dock construction would not likely affect the integrity of the summer foraging habitat used by diadromous or marine fish in this zone.

Pipeline construction will be conducted during winter using onshore ice roads. Turbidity associated with reworking of channels due to placement of VSMs is expected to be temporary and timed with normal seasonal turbidity increases in streams associated with spring breakup. Gathering and export pipelines are not known to cross any waterbodies supporting fish freshwater overwintering habitat. Therefore, potential impacts on freshwater fish habitats along the pipeline route are not anticipated.

Summer Construction

Re-grading and compaction of gravel roads, pads, airstrip, and dock during the first summer construction period could cause dust and sediment to enter freshwater and marine fish habitats, thereby increasing turbidity in these waters. Watering of gravel surfaces and enforcement of vehicular speed limits will minimize the generation of dust. Potential effects due to re-grading and compaction activities are inferred to be short-term and similar to naturally occurring events in the freshwater and marine environments (e.g., disturbance from ice, river runoff from spring break-up, and storm induced waves). Therefore, any effects from dust and sediment drift to freshwater and marine waters are anticipated to be minimal.

Dredging offshore of the dockhead during the summer and disposal of the spoils at an offshore location will generate turbidity plumes (see Section 5.1.3.2 discussion). Studies have shown that diadromous and marine fishes tolerate waters with turbidity values up to 146 NTU, which equates to a visibility of approximately 2 inches (5 centimeters [cm]) (WCC 1997). It is anticipated that increased turbidity due to dredging and spoils disposal will be temporary and cause minimal effects since naturally occurring events also increase the turbidity of marine waters annually (e.g., disturbance from ice, river runoff from spring break-up, and storm induced waves).

Operations and Maintenance

Vehicular traffic and maintenance of gravel roads, pads, airstrip, and dock surfaces could cause dust to enter freshwater and marine fish habitats. Watering of gravel surfaces, low traffic volumes during operations, and enforcement of vehicular speed limits should minimize the generation of dust from operations traffic and gravel maintenance activities on fish habitat. Potential effects from dust and sediment drift to freshwater and marine waters are anticipated to be minimal and within naturally occurring turbidity variation in the freshwater and marine environments (e.g., disturbance from ice, river runoff from spring break-up, and storm induced waves).

5.2.3.2 Disturbance Effects

"Blockage" of fish movement by a dock does not normally occur due to the physical structure, but is a result of hydrographic changes (i.e., alterations of the distribution of water mass properties such as temperature and salinity) that might be induced by the structures. Potential hydrographic changes are highly dependent upon the location of a dock and the nature of the surrounding environment. In stratified nearshore waters, a wake eddy can cause high salinity/low temperature water to displace the nearshore band of water on the lee side of a dock (see Section 5.1.3.1 of this ER for further discussion). Some fish species are unable or unwilling to swim through such higher salinity areas and are therefore "blocked" from migrating through or foraging in that area.

Prey availability is not thought to be a limiting factor for North Slope diadromous and marine fish; however, the biomass of prey species in North Slope coastal waters has a patchy distribution and is variable between years due to climatic conditions (Craig 1989 and Colonell and Gallaway 1990). Therefore, the variable net worth of feeding habitat along the coastline provides an impetus for the coastal distribution of foraging diadromous and marine fish (Fechhelm et al. 1989).

The summer movement patterns of diadromous fish in the North Slope coastal region are also strongly influenced by wind patterns during the brief open-water season (Moulton 1989). Fechhelm et al. (1989) observed that the eastward dispersal of Arctic and least cisco from the Colville River was dependent on the prevailing wind patterns. The fish traveled in conjunction with westerly winds eastward through the barrier island lagoons, the greater the percentage of westerly winds in a given season the farther the eastward migration. Easterly winds inhibited the eastward movement of younger fish, but did not materially affect adult Arctic cisco. Fechhelm et al. (1989) also noted that dispersal was related to size, with larger, more powerful fish traversing distances quicker than smaller fish.

During the 1999 Point Thomson fish survey, adult diadromous fish from spawning stocks in the Colville River and/or Sagavanirktok River were caught in Lions Lagoon (LGL 2000b). Large numbers of adult least cisco were collected in Lions Lagoon throughout the summer, adult broad whitefish were collected at comparable rates to those previously reported from Prudhoe and Mikkelsen Bays, and adult humpback whitefish were more abundant than expected based on previous studies conducted in Prudhoe and Mikkelsen Bays (LGL 2000b).

Persistent easterly winds are more important than west winds because they assist the westward movement of small Arctic cisco from the Mackenzie River to the Colville River; therefore, interannual easterly wind variability influences the size of each year-class. During a 1999 Point Thomson nearshore marine fish study, young-of-the-year (YOY) Arctic cisco were first collected at the southern end of Mary Sachs Entrance on 7 August after a period of sustained easterly winds switched to a period of mixed east/west winds (LGL 2000b). Young-of-the-year Arctic cisco were found dispersed through out Lions Lagoon for the remainder of the summer.

Colonell and Gallaway (1990) cited numerous tagged fish studies that show Dolly Varden char are powerful swimmers with widespread coastal dispersal exploit to a variety of habitats during their summer foraging. Dolly Varden char are not restricted to warm low-salinity environments. They have been taken as far as 10 mi (16 km) offshore in tow-net surveys and are known to feed on *Apheruisa glacialis* a marine amphipod that concentrates along the underside of floating icepans (Colonell and Gallaway 1990).

Lions Lagoon typically exhibits unstratified marine conditions from breakup to freeze-up (i.e., the water column is uniform from top to bottom). Brackish water conditions prevail in the spring in nearshore areas due to increased freshwater input from streams and rivers. Salinity of the nearshore water gradually increases to marine conditions by mid-September (Section 4.5.3.1 of this ER). The proposed dock would provide an alternative mechanism by which localized upwellings could occur but would not appreciably enhance naturally occurring upwellings. Because the water column within Lions Lagoon in the area of the proposed dock tends to be uniform, both horizontally and vertically, formation of a wake eddy would typically mix waters with similar temperature and salinity characteristics and thus renders no net changes to hydrography (see Section 5.1.3.1 discussion).

The principal source of food for diadromous fish in North Slope nearshore waters is demersal macroplankton, mainly mysids and amphipods, which in turn feed on marine phytoplankton (Craig et al. 1984). These plankton species are of marine origin, demonstrating the importance of marine productivity to the nearshore waters. The upwelling of marine waters into nearshore waters are thought to be the primary factor involved in maintaining the trophic richness of the coastal ecosystem along the North Slope (Colonell and Gallaway 1990). Two channels, Mary Sachs Entrance and at the east end of Flaxman Island, allow marine waters and associated planktonic species to enter Lions Lagoon. The proposed dock location is not likely to block or alter natural marine water upwelling processes or impair the trophic productivity of the nearshore waters.

Both West Dock and Endicott causeways cause localized hydrographic changes. However, there are no significant data indicating Endicott and West Dock causeways impair Arctic cisco YOY migration to rearing and overwintering areas in the Colville and Sagavanirktok Rivers (Moulton 1985, Colonell and Gallaway 1990, and Bickham et al. 1992). Environmental monitoring conducted from 1981 to 1984 at the West Dock Causeway and environmental surveys conducted from 1985 to 1989 at Endicott Causeway have not shown any evidence that Dolly Varden seasonal coastal dispersal is affected by the physical presence or by hydrographic conditions that develop around these structures (Colonell and Gallaway 1990). It is not anticipated that the Point

Thomson dock will disturb fish migrations patterns or cause diadromous or marine fish species to avoid or be displaced from the marine habitats they use in Lions Lagoon.

5.2.3.3 Mortality Effects

Winter water removal for ice road construction could potentially affect freshwater fish overwintering habitat in deep tundra lakes. Under-ice dissolved oxygen concentrations in lakes on the North Slope decrease over the winter. Excessive water withdrawal during the winter could adversely affect overwintering fish populations in deep tundra lakes. Recent water use permits for North Slope developments have limited winter water withdrawal to 15% under-ice water volume in fish bearing lakes to minimize the potential for significant impacts to overwintering fish. It is inferred that permitted water withdrawal volumes are conservative and protective of fish species. Therefore, it is not anticipated that water withdrawal from identified potential water sources (see Figure 3-19) will have adverse effects on overwintering freshwater fish.

Sport fishing conducted by personnel in area streams and rivers and from the marine dock could cause mortality due to direct take of fish species. All personnel will be required to comply with applicable ADF&G sport fishing regulations.

Contaminant spills associated with construction/drilling operations could affect freshwater, diadromous, or marine fish species. It is not anticipated that construction/drilling operations will be conducted near important freshwater fish habitat and diadromous and marine fish are not present in the area during the winter. Minor spills associated with winter construction and drilling activities (e.g., fuel, produced water, and other drilling wastes) can be readily contained and cleaned-up. Contaminant spills associated with operations and maintenance are also expected to be minor. Personnel will be trained in spill prevention and cleanup procedures. It is not anticipated that freshwater or marine fish habitat will suffer long-term adverse effects due to minor contaminant spills. Section 5.4 discusses the risks and impacts of condensate spills in detail.

5.2.4 Birds

Table 5-2 summarizes the potential impacts from the Point Thomson Gas Cycling Project on waterfowl and water birds, tundra-nesting species, and predatory birds.

5.2.4.1 Habitat Loss and Alteration

Loss and/or alteration of bird habitat can be either long-term (i.e., due to burial by gravel placement for roads, pads, and airstrip) or temporary. Temporary loss and alteration of bird habitats could result from ice roads, dust fallout, snow dumps, persistent snowdrifts, thermokarst, impoundments, and contaminants.

<u>Gravel Placement</u>

Gravel placement and gravel mine development for the Point Thomson project would cause long-term alteration of 9,832,544 ft^2 (0.9 km^2) of habitats used by birds (Table 5-3). Mine development and pad, road, and airstrip construction will occur during winter. The most affected vegetation types would be moist sedge, dwarf shrub tundra/wet sedge tundra complex, and moist sedge, dwarf shrub tundra, which together comprise 79% of the project footprint.

Important bird habitats in the Point Thomson area are primarily those containing wet tundra and those with aquatic (ponds/lakes) components that provide food, shelter, and escape cover from predators (water, aquatic graminoid tundra, water/tundra complex, wet sedge tundra, and wet sedge tundra/water complex). Gravel coverage for all these types combined accounts for 779,037 ft^2 (0.07 km^2), about 8% of total acreage affected by gravel coverage and mine development. Salt marsh is another important, but rarer, vegetation type in the Point Thomson area, and is used by brood-rearing geese (brant and snow geese) and shorebirds. Gravel coverage for the Point Thomson development would cause long-term alteration of 136,744 ft^2 (0.01 km^2) of salt marsh, about 1% of total gravel coverage.

Although most bird species in the region exhibit fidelity to nesting areas, studies in the Prudhoe Bay oil field indicated that most birds who lost nests sites to gravel placement were not prevented from nesting in subsequent years, but shifted their nesting efforts to adjacent, undisturbed habitats (Troy and Carpenter 1990 and Troy 2000). In general, the amount of habitat lost due to the Point Thomson project will be small relative to regional habitat abundance. The impacts of long-term habitat loss for birds are anticipated to be minor because nesting habitat is not thought to be a limiting factor.

Ice Roads

Ice roads will be used during winter pipeline construction, and potentially on an occasional basis for pipeline maintenance throughout the life of the project. Ice roads do not melt until after most bird species begin nesting (late May–early June), thereby reducing the availability of nesting sites. In addition, compaction of standing dead vegetation reduces cover needed by most birds for nesting sites. The effects of temporary losses of habitat due to ice roads for the Point Thomson project are anticipated to be minor, as displaced birds would likely nest in adjacent, unaffected habitats. In addition, the effect would be limited to the summer after construction.

Water Removal

Withdrawal of water from lakes could potentially alter wetland community structure by changing the hydrologic regime. A change in regime could potentially affect bird use of waterbodies as nesting areas or as brood-rearing habitat. The changes could alter plant and invertebrate community structures, potentially decreasing the value of habitats used by waterbirds for cover or food. Waterbirds that nest on small islands within tundra lakes could be affected if spring recharge is insufficient to compensate for water withdrawn the previous winter. Potential lakes identified for ice road construction water use are identified in Figure 3-19. As described in Section 5.1.2.3, these lakes will be permitted and permit stipulations will likely limit the amount of freshwater withdrawal. It is assumed that permitted water withdrawal limits are conservative and protective of affected waterbodies.

Obstruction of Flow

Impoundments can occur when drainage is impeded adjacent to roads or pads. Impoundments can be temporary, disappearing by mid-June, or they can persist through summer. Depending on the duration of seasonal impoundments, the effects on bird habitats can range from minor to substantial. Water impounded by gravel roads and pads both displaces and attracts birds, depending on the species (Troy 1986, Kertell and Howard 1992, Kertell 1993, 1994, and Noel et al. 1996). Temporary impoundments preclude nesting by some species (Walker et al. 1987) but may be used by others (e.g., Pacific loon [Kertell 2000]; geese, loons, eiders [Noel et al. 1996]).

Troy (1986) found that some shorebirds and Lapland longspurs avoided a 330-foot-wide zone along the West Road in Prudhoe Bay, whereas other shorebirds and snow buntings (this species nests in pipeline supports) preferred this zone (habitat use exceeded availability). These changes were attributed to temporary impoundments adjacent to the road, early availability of some habitats because of the "dust shadow" produced by traffic, and reduced habitat availability from persistent snow banks created by snow removal and drifting (Troy 1986). For the Point Thomson project, culverts will be placed during construction to prevent long-term impoundments adjacent to roads or pads. Additional culverts or other drainage structures could be installed after construction to drain any long-term impoundments that might form following initial gravel placement. Temporary impoundments probably could occur for brief periods (a week or less) during spring runoff, potentially affecting (both positively and negatively) shorebird and waterfowl use. Population level effects on birds are not anticipated to result from potential impoundments associated with the Point Thomson Gas Cycling Project.

Thermokarst

Thermokarst is a natural effect as well as a potential project effect that can alter the tundra landscape, including changes in microrelief and soil moisture. Changes due to thermokarst can result in increased diversity of wet, moist, and dry habitats or, if severe, can result in the creation of large, deep waterbodies. Many of the ecological changes associated with thermokarst may benefit plant productivity and wildlife use (Truett and Kertell 1992). Thermokarst has been shown to result in increased nutrient concentrations in plant tissue (Challinor and Gersper 1975, Chapin and Shaver 1981, Ebersole and Webber 1983, and Emers et al. 1995). Among birds in the Point Thomson area, geese are strictly herbivorous and selectively graze plants of higher nutritional value and are regularly observed grazing in thermokarst terrain adjacent to facilities. However, the effects of tundra disturbance on secondary production are uncertain (Truett and Kertell 1992). In one study of habitat use by birds, severely disturbed tundra associated with a peat road had higher use (in relation to availability) than most other undisturbed habitats in the Prudhoe Bay area (Murphy and Anderson 1993). Overall, however, data are insufficient to assess the potential effect of thermokarst on wildlife populations (Truett and Kertell 1992).

Dust Fallout

Advanced snowmelt as a result of dust fallout has both positive and negative effects on wildlife. Advanced snowmelt often impounds runoff and causes early "green-up" of plant species (Makihara 1983 and Walker and Everett 1987). The resulting open water and early plant growth attract waterfowl and ptarmigan to habitats near roads and pads (Walker and Everett 1987 and Murphy and Anderson 1993). In the Lisburne Development Area of the Prudhoe Bay oil field, the snow-free areas near roads supported large numbers of foraging geese and swans during pre-nesting, although the birds moved away from roads to rest and sleep (Murphy and Anderson 1993). Troy (1986 and 1988) noted that dust benefited shorebirds within 150 ft to 300 ft (46 m to 91 m) of roads when traffic was relatively light because it melted snow and made habitats available earlier for nesting. However, at higher traffic levels, disturbance offsets these benefits, resulting in lower densities of nesting shorebirds (Troy 1988).

Dust fallout associated with regrading and compacting of the gravel during the first summer construction phase will likely occur after spring thaw and will not affect snowmelt. Advanced snowmelt due to dust fallout adjacent to the roads, pads and airstrip could result from construction activities and infield traffic during operations. Watering the roads during the summer, and enforcing vehicular speed limits at all times will mitigate potential impacts from dust fallout.

Snow Dumps and Snowdrifts

Snow dumps and snowdrifts adjacent to pads or roads that persist into the breeding season could displace nesting birds and may have other long-term effects on habitat quality for birds. Since large accumulations of snow are not anticipated for the region, the areas potentially affected by snow dumps and snowdrifts associated with the Point Thomson project are anticipated to be small (see Section 5.2.2.1). In addition, mitigation measures such as ensuring that the snow is stored on the gravel surface as much as possible and relocating snow dump areas from year to year will minimize any impacts on nesting habitat. In addition, because nesting habitat is not a limiting factor, population-level effects on birds are not anticipated.

Spills and Leaks

Contaminant spills and cleanup efforts can alter bird habitats in various ways. However, the most common spills are relatively small in quantity and affect small areas of tundra. The Point Thomson project is not anticipated to result in population-level effects attributable to habitat alteration by small contaminant spills. Impacts from large spills are considered in detail in Section 5.4.

5.2.4.2 Disturbance Effects

Potential disturbance effects include immediate behavioral responses of affected animals (including energetic or other costs associated with startle or fleeing responses), loss of habitats or degradation of habitat quality (by causing avoidance), and attraction of some species to areas of human activity (particularly predators/scavengers).

Winter Construction

Winter construction activities will occur from January to April for two seasons and will include ice road construction, gravel mining, gravel placement for roads, pads, airstrip, and dock, and pipeline installation. Because most birds are absent during winter months, these activities are unlikely to cause disturbance effects for most species.

Summer Construction

Summer construction activities planned for the Point Thomson project include grading and reshaping road, pad, airstrip, and dock surfaces, a nearshore dredging operation, and installing the modules. The majority of this activity will take place from mid-July to mid-August. During summer, it is likely that several helicopter and airplane trips from Endicott/Prudhoe will be employed each day for equipment and personnel transport. Vessels from Endicott/Prudhoe will be used to support summer construction, also from Endicott/Prudhoe. The dredging operation could employ one or two 12-in (30.5 cm) suction dredges operating in the nearshore area for several weeks, and barge trips to deeper waters to dispose of dredge spoils. One sealift (with approximately three barges) will transport large CPF modules to the Point Thomson Dock after dredging is accomplished. Vehicle traffic will occur on the infield roads as construction on the roads is completed. During summer facilities construction and installation activities, several trips per day can be expected on the infield gravel roads between the pads. Noise from these activities and the physical presence of the equipment both onshore and offshore, could disturb birds in the Point Thomson area.

Any turbidity plume resulting from dredging operations could have impacts on birds foraging or loafing in the nearshore waters affected by the plume. For example, long-tailed ducks occur in the nearshore waters near Point Thomson during the molting and post-molting periods (mid July-mid September; see Figure 4-4) and commonly feed on benthic invertebrates that may be temporarily unavailable if covered by a plume from dredging. Noise and visual disturbance from the dredging operation itself may temporarily displace birds from the area and reduce impacts of the plume on foraging.

The behavioral responses of birds to disturbance by construction and operations activities are well documented for existing oil fields (WCC 1985, Hampton and Joyce 1985, Troy 1986 and 1988, Anderson 1992, Anderson et al. 1992, Burgess and Rose 1993, and Murphy and Anderson 1993). Birds can be sensitive to noise disturbance during any life history stage. However, during nesting, birds are restricted to one site for 2 to 4 weeks, and disturbance during this period can lead to nest failure. The earliest nesting birds (waterfowl and loons) typically initiate nests sometime after 1 June, and all but a few species hatch by 15 July. Therefore, during this period the consequences of behavioral disturbance of birds may be most severe (i.e., loss of productivity). Following nesting, many birds typically move from nest sites to other locations and different habitats, and are generally capable of moving away from disturbance sources (e.g., airstrips or roads), if necessary.

Vehicles are the most ubiquitous source of oil field disturbance, but cause less severe reactions in birds than many other common disturbances, including humans on foot or predators (foxes or gulls). In general, the frequency of bird reactions to vehicles increases with traffic rate, although at higher traffic rates animals may become habituated and react to fewer individual vehicles. Even at higher traffic levels, reaction rates remain high to particularly large, noisy vehicles, and those with unusual profiles, such as boom cranes.

Reactions to traffic vary during the breeding season. In the Lisburne Development Area, birds reacted to vehicles most frequently during brood-rearing, but the strongest reactions were observed during pre-nesting, when birds were attracted close to roads by early snow-melt and green-up (Murphy and Anderson 1993). Most reactions by geese and swans occurred within 500 ft to 700 ft (152 m to 213 m) of roads and pads in the Lisburne area (Murphy and Anderson 1993). Approximately 10% of all vehicle passes elicited reactions from geese and swans (Murphy and Anderson 1993 and ABR, Inc. unpublished data). Birds reacting to vehicles primarily displayed brief alert (head-up) behavior, with a small proportion of birds walking, running, or (rarely) flying (Murphy and Anderson 1993).

Based on these findings, a small percentage of birds likely could show short-term alterations in their behavior. Minor effects on nesting success from Point Thomson project-related disturbance within 700 ft (213 m) of drilling pads (10,925,007 ft^2 [1 km^2]) and within 500 ft (152 m) (90,306,836 ft^2 [8.6 km^2]) of gravel access roads is also possible. Disturbance would be highest during construction, when traffic rates would be higher and larger, noisy vehicles would be more likely to use the infield roads. However, the majority of the construction activities involving ice road construction and gravel hauling and placement will take place in the winter when many of the bird species are not expected to be in the area.

Air traffic associated with the Point Thomson project also could result in behavioral disturbance of birds. Noise levels and potential for disturbance would be highest during takeoffs by large aircraft and helicopters. Based on United States Air Force data (OMEGA 10.8 noise model; Mohlman 1996 personal communication), the area affected by the highest noise levels during takeoff by a Boeing 737-200 (an aircraft that could use the Point Thomson airstrip) can be approximated by a zone extending to 6,300 ft (1,920 m) around the runway (193,888,526 ft^2 [18.4 km^2]), within which noise levels could reach or exceed 85 decibels (A-scale weighting, or dBA) as the engines reach maximum power. Noise levels during landings would be substantially lower than during takeoffs, although the aircraft would be at lower altitudes through a longer approach to the airstrip.

The effects of large fixed-wing aircraft on wildlife have not been thoroughly studied in the Arctic. Most studies of aircraft disturbance in the Arctic have focused instead on low-flying helicopters (LGL 1974, Barry and Spencer 1976, Simpson et al. 1980, and Derksen et al. 1992). Some waterbirds show startle responses to landings and take-offs by Boeing 737s near the Prudhoe Bay and Kuparuk airports, but responses are of short duration and the birds using the area appear to have habituated to the disturbance (ABR, Inc. unpublished data). In the Lisburne Development Area, birds were less habituated to infrequent disturbances than to constant (steady-state) disturbances (Murphy and Anderson 1993). Investigation of impacts of the airstrip at the Alpine Development Project suggests that nesting birds have not been negatively affected to a substantial degree (Johnson et al. 1999b and 2000). Preliminary results suggest that although nest densities varied annually, they did not decline with increasing levels of activity, and the distance of nests from the airstrip during two years of construction did not change from that observed during the pre-construction years. Nest densities were lower within 3,280 ft (1,000 m) of the airstrip as compared to greater distances, but no comparisons were available to indicate if this pattern existed prior to construction. Distance from the airstrip did not have a significant effect on nesting success, although it may have affected nest attentiveness. Birds in areas subjected to regular disturbance by aircraft exhibited habituation, with reduced frequency and intensity of reaction over time.

The siting of the Point Thomson airstrip could result in flight patterns over the offshore lagoon area that is used by thousands of molting and feeding birds during July–September (Noel et al. 2000 and Flint et al. 2001). Disturbance of molting long-tailed ducks, common eiders, and other birds in the lagoon may result from aircraft (particularly larger, noisier types) landing or taking-off from the airstrip and subsequently flying over the lagoon and offshore islands. Little information is available on the effects of aircraft on molting long-tailed ducks, but Petersen et al. (1999) found that flocks along barrier islands scattered and dove in response to high levels of disturbance such as low flying aircraft or boats within 0.6 mi (1 km). At Point Thomson, aircraft traffic is anticipated to be greater during winter construction efforts as compared to summer construction and the operations and maintenance phase. Project-related air traffic would be unlikely to measurably reduce nest abundance or nest success of birds near the airstrip.

Marine traffic at the proposed Point Thomson dock facility could disturb birds in lagoon and nearshore waters. Dock use and marine traffic would occur primarily during late summer (August–September). Marine traffic could have the greatest potential to disturb birds when long-tailed ducks and other ducks are most abundant in the lagoon, between approximately 20 July and 30 September (Noel et al. 2000). Dredging operations as described above could occur from the end of July to mid-August, increasing the potential for disturbance to the ducks. Petersen et al. (1999) found that long-tailed ducks were disturbed (dove or scattered) by boats approaching within 0.6 mi (1 km), but often returned to the same area after the disturbance had passed.

Operations

Operation of the Point Thomson Gas Cycling facility could require a few helicopter trips per week from Prudhoe Bay, and daily by other aircraft. During the open water season about four to five local barge trips can be expected annually. Several vehicle trips on infield roads between pads per day would likely occur during normal operations. Levels and duration of noise from operations equipment (such as compressors generators, and flares) proposed for the Point Thomson project have not yet been characterized, but could be a disturbance concern for birds in the area. Birds that are attracted to camp facilities could also be affected.

During operations, a consequence of both traffic disturbance and increased noise levels is that areas located adjacent to roads, airstrips, or pads could become less attractive, and therefore would be avoided by birds. For some species, high noise levels (e.g., near compression modules) could cause a long-term reduction of bird use in the immediate areas of constant disturbance. Early studies of noise effects on birds in the Arctic found that simulated compressor noise did not affect nesting Lapland longspurs (Gollop et al. 1974), but it decreased habitat use by fall-staging snow geese (Gollop and Davis 1974). More recently, increased noise at the Central Compressor Plant in the Prudhoe Bay oil field caused some water-bird species (spectacled eiders, pre-nesting Canada geese, brood-rearing tundra swans) to shift their distribution (averaging 1,600 ft to 2,000 ft [487 m to 610 m]) away from habitats close to the compressor plant, although most waterfowl species (including nesting Canada geese, brant, greater white-fronted geese, loons, ducks) habituated to the noise levels (Anderson et al. 1992). Wildlife near a new processing facility (CPF-3) in the Kuparuk oil field showed variable responses to disturbance (Hampton and Joyce 1985). Although nesting by waterfowl was significantly lower within 0.5 miles (mi) (0.8 km) of the facility, a brant nesting colony located approximately 0.5 mi (0.8 km) away has not been affected adversely by the constant noise emanating from the facility; the nesting colony has been used continuously since facility operation began (Stickney et al. 1994 and Anderson et al. 1995 and 1996). These studies suggest that some birds may be displaced from the immediate area, within 0.5 mi (0.8 km) surrounding the Point Thomson facilities. In general, the size of the displacement area will depend on the species and the nature of the noise generated by the facilities.

During operations, the marine dock facility at Point Thomson could displace molting long-tailed ducks, and perhaps other birds, that regularly use that area during late summer (Noel et al. 1999a and 2000). Noel et al. (1999a and 2000) found a mean numbers of between 1000 and 1400 long-tailed ducks in the Point Thomson area during aerial surveys along the coast in 1998 and 1999. Displacement of birds in late summer could be highest when boat traffic or Sealift operations are occurring. However, it is not known whether such displacement would be long-term.

Glaucous gulls and common ravens are attracted to garbage and food handouts at human settlements and camps. Although adequate historical records are lacking, biologists generally agree that the populations of these two species have increased because of the availability of these foods from the North Slope oil field operations. Ravens and some raptors are now known to nest on buildings (particularly ravens on processing facilities) and other structures in the existing oil fields, including elevated pipelines (Ritchie 1991 and ABR, Inc., unpublished data). Raptors, gulls, ravens, ptarmigan, songbirds, and shorebirds all perch on elevated pipelines, and snow buntings nest in VSM supports and buildings. The presence of the Point Thomson facilities may cause minor increases in populations of scavenging birds, if any edible garbage is available at the facility. Snow buntings, raptors, and ravens may nest or roost on new buildings and pipelines built for the Point Thomson Gas Cycling Project. Proper handling and disposal of camp solid wastes will serve to partially mitigate the attraction factor.

5.2.4.3 Mortality Effects

Strikes by vehicles (trucks and aircraft) and collisions with structures pose some risk to birds in the Point Thomson area. The risk of vehicle strikes is greatest during summer, when larger numbers of birds move into the area. Herbivores, such as geese and ptarmigan, can be attracted to roadside habitats by early green-up and higher nutrient forage. Although these animals gain access to nutritious forage, their exposure to traffic-related disturbance and risk of vehicle strikes also increases. Vehicle-caused mortality is poorly documented for the Kuparuk and Prudhoe Bay oil fields; however, the number of animals injured or killed by vehicles is thought to be low.

Waterfowl and other birds occasionally collide with oil field structures, including buildings and towers, guy-wires for antennas, and power poles and wires. Bird strikes are most common in areas where large numbers of birds aggregate or pass during migration, such as points of land along the coast, or lagoon molting areas. The incidence of bird strikes also increases during periods of low visibility due to fog or darkness. Anderson and Murphy (1988) studied bird strikes with powerlines in the Lisburne Development Area in Prudhoe Bay and found that most collisions apparently occurred under conditions when visibility was limited. Species in the Point Thomson area that could experience strikes with project facilities include long-tailed duck, common eider, and brant, all of which would be abundant in the area during molting or migration periods. Other species of waterfowl and shorebirds that migrate primarily along the coast could also be subject to occasional strikes. It is difficult to predict the likelihood of bird strikes at a particular site without having detailed knowledge of local bird movements. Although this information is lacking for Point Thomson sites, there is little potential for bird strikes to have population-level consequences for most species in the area. Mitigation measures to reduce bird strikes could include using a color scheme for the buildings and modules that allows them to stand out from the surrounding terrain or be more visible during foggy conditions. However, this measure is at odds with the potential need to reduce visual impacts of the facility for recreational users of the area (see Section 5.3.).

Mortality for birds, particularly during the flightless stage, could occur in the immediate vicinity of the flare. It is not known at this time how significant the heat increase at the base of the 100 ft (30 m) structure will be during flaring events. However, because the area immediately beneath the flare will be fenced, mortality of or injury to flightless or molting birds is unlikely. Flaring will be a relatively rare event and noise associated with the flaring will serve to keep birds with flight ability away from the area during an event.

Contaminant spills also have the potential to result in bird mortality. Contaminants can adversely affect birds through dermal contact, dermal absorption, ingestion, and inhalation. Dermal contact can affect the ability of feathers to insulate or to shed water. For small spills, the chance that birds would be oiled is limited due to the size of the spill, but seasonal timing of spill events and location relative to high-use habitats may increase chances that birds will contact spilled oil or petroleum products. The most common oil field spills (small volume spills of fuels and vehicle/machinery lubricants) are unlikely to have population-level impacts on birds. Impacts from large spills are considered in detail in Section 5.4.

Increased predator populations in the vicinity of oil field developments may increase predation on bird populations (Martin 1997). This impact is inferred from the higher numbers and productivity of foxes (Eberhardt et al. 1982, Burgess et al. 1993, and Burgess 2000), grizzly bears (Shideler and Hechtel 1995b and 2000), and gulls and ravens (Truett et al. 1997 and Day 1998) in the North Slope oil fields. Gulls, ravens, and foxes prey on bird eggs and young, and foxes can also take adult birds. Bears have been known to take bird eggs. Foxes and grizzly bears often cause the complete failure of goose colonies during some breeding seasons in the North Slope oil fields (Burgess and Rose 1993, Burgess et al. 1993, Stickney et al.1993, Johnson 1994 and 2000, and Noel and Johnson 2001a and 2001b). Failure of the Howe Island snow goose and brant colony in six of the last ten years has been attributed to the increased abundance of Arctic foxes and bears in the region (Noel and Johnson 2001a and 2001b). Common eiders are the most abundant colonial nesting species in the Point Thomson area and exhibit susceptibility to Arctic fox predation during nesting (Quinlan and Lehnhausen 1982).

It is anticipated that refuse control efforts, employee environmental sensitivity training, and enforced rules against animal feeding would minimize population-level effects on predators and scavengers, and avoid the potential for these animals to negatively affect populations of birds in the Point Thomson area.

5.2.5 Marine Mammals

Marine mammals that may be encountered at various times of the year in the Point Thomson area include cetaceans (whales), pinnipeds (seals) and polar bears (see Section 4.10). The following sections describe the potential impacts of winter and summer construction efforts and operations activities on the habitat, disturbance, and mortality of these mammals. The potential impacts are summarized in Table 5-2.

5.2.5.1 Habitat Effects

Long-term habitat effects (loss or alteration) on marine mammals are not expected due to winter or summer construction activities associated with the Point Thomson Gas Cycling Project. Increased turbidity from placement of gravel fill at the dock site is expected to be short-term. Habitat or denning sites for polar bears will not be impacted since the construction activities will avoid any active dens.

Short term alteration of the marine habitat from winter and summer construction and traffic noise is discussed as disturbance to marine mammals (see Section 5.2.5.2) rather than as a habitat effect. Impacts of operations on marine mammals are also expected to be related to disturbance. These impacts are discussed in the following sections.