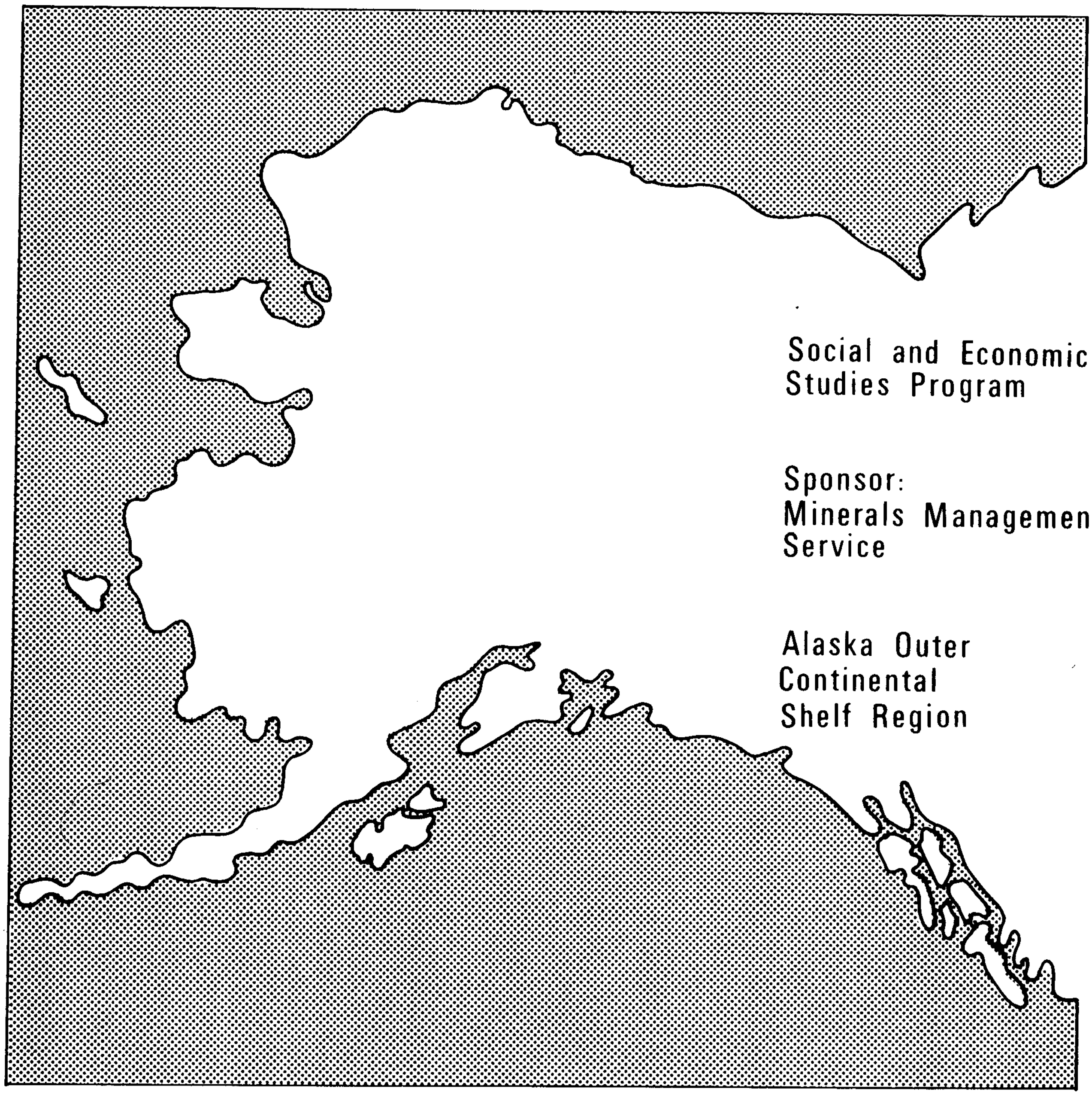
Technical Report
Number **105**



Diapir Field Transportation Systems Impacts Analysis

TECHNICAL REPORT NO. 105 CONTRACT NO. AA851-CT2-34

DIAPIR FIELD (SALE 87)

TRANSPORTATION SYSTEMS EFFECT ANALYSIS

Prepared for:

MINERALS MANAGEMENT SERVICE

ALASKA OUTER CONTINENTAL SHELF REGION

LEASING AND ENVIRONMENT OFFICE

SOCIAL AND ECONOMIC STUDIES UNIT

Prepared by:

Louis Berger and Associates, Inc.

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NOTICE

Minerals Management Service
Alaska Outer Continental Shelf Region
Social and Economic Studies Unit
Diapir Field (Sale 87)
Transportation Systems
Impact Analysis

Prepared by
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ABSTRACT

This report identifies those transportation facilities and services both within and outside the Beaufort Sea region that are likely to be affected by potential oil development resulting from the proposed June 1984 Federal Outer Continental Shelf (OCS) lease offering in the Diapir Field. It also includes a Base Case analysis and forecast of potential transportation impacts from future economic activity in the region in the event the lease offering does not occur, as well as an analysis of the effects on transportation of oil development associated with the June 1984 lease offering based on a mean development associated with the June 1984 lease offering based on a mean development scenario prepared by Minerals Management Service (MMS). Forecasts of additional transportation demands generated by OCS development were prepared and effects determined by comparing transportation demands with and without OCS development to existing and anticipated transportation facilities and services.

The primary focus of this report is on the Prudhoe Bay/Kuparuk area development facilities which is the focus of present oil and gas development and the community of Barrow, the commercial, government and service center for the region. Also addressed are the major transportation infrastructure and services outside the primary study area that are (and likely to be) directly affected by North Slope oil development. These include the Alaska Railroad; the Southcentral Alaska ports of Anchorage, Seward, Whittier and Valdez; the Glenn, Richardson, Alaska and Dalton Highways; and the Anchorage and Fairbanks International Airports.

No major effects are expected to result specifically from this lease offering on the transportation systems that directly and indirectly serve this region. This is largely due to the existing transportation system and support infrastructure presently in place as a result of the ongoing development activities on Alaska's North Slope since the late 1960's. Likewise, in the absence of any activity associated with this lease offering, very little changes to the existing or planned transportation systems are expected because of the reasons noted above.

The report concludes that the most significant effects of this proposed lease offering on the transportation systems are expected to be:

- o Sand and gravel movements throughout the North Slope that will be needed in the construction of gravel islands and caisson-retained islands.
- o Construction of trunk pipelines to connect potential production areas to the existing TAPS system.
- o Increases in the Annual sealift operations necessary to maintain industry's desired development schedules.
- o Increases in passenger traffic at the Deadhorse Airport that will require some additional facilities.
- o Increases in Dalton Highway traffic that will necessitate higher road maintenance expenditures.

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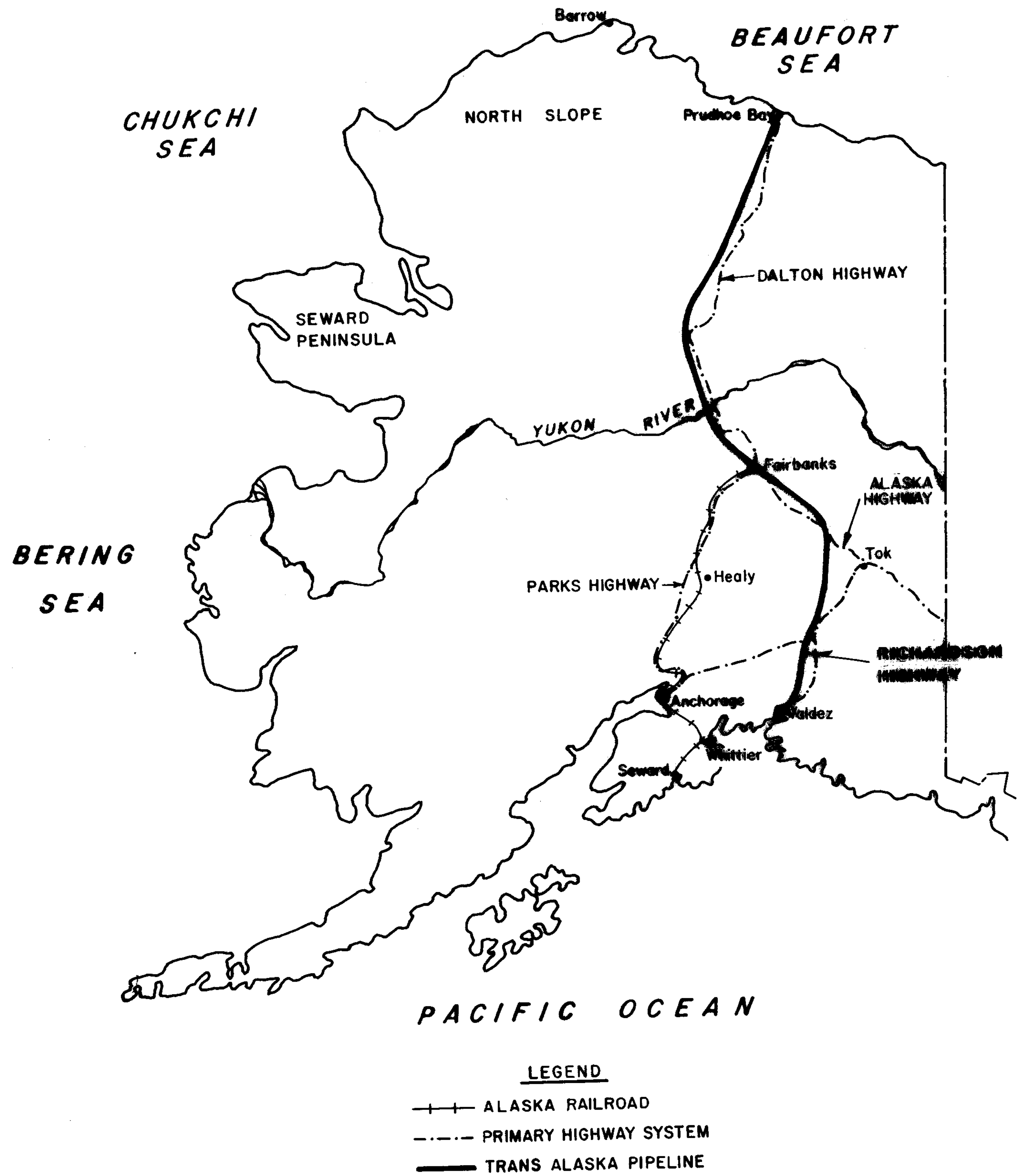


1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to identify and describe those transportation systems that may be affected by potential oil and gas development resulting from the proposed Federal Outer Continental Shelf (OCS) lease offering in the Diapir Field scheduled for June 1984. It also includes a Base Case analysis and forecast of potential transportation impacts from future economic activity in the North Slope region in the event the lease offering does not take place and an analysis of the effects on transportation of OCS oil and gas development resulting from the proposed lease offering.

This study is one of several key study elements of a larger integrated effort by the Minerals Management Service (MMS) to evaluate the broad range of possible socioeconomic effects of the June 1984 lease offering. This effort is part of the Alaska OCS Region Social and Economic Studies Program which seeks to evaluate all federal OCS lease offerings planned for Alaska.

This report has been prepared for use by MMS decision makers in various steps of the Federal OCS leasing process. The study emphasizes the information needs of the environmental impact statement (EIS) and secretarial information document (SID), which must be prepared for the Diapir Field lease offering. It also seeks to develop transportation planning information of use to the Intergovernmental Planning Program (IPP). Through the IPP, the study is expected to aid development of lease-sale stipulations and to provide information to state and local governments on the effects of Federal lease offerings on transportation infrastructure and services.

1.2 Study Scope and Organization

This report contains three major components. Chapter 2 describes the present regional aviation, marine and highway transportation systems as well as those ports, highways, and railroad modes outside the region that are likely to be affected by future Beaufort Sea oil and gas development activity. This baseline examines existing facilities, services and usage demands and also provides information about relevant regulatory controls, levels of service, service rates, regional issues and the trends of change affecting facilities, services and demands. Chapter 3, the Base Case, forecasts future marine, aviation, highway and rail transportation demands and service requirements resulting from expected economic activity in the region without the June 1984 lease offering in the Diapir Field. Chapter 4 analyzes the effects on the transportation system of OCS activities related to exploration, development and production for the medium case scenario for the proposed offering.

1.3 Study Area

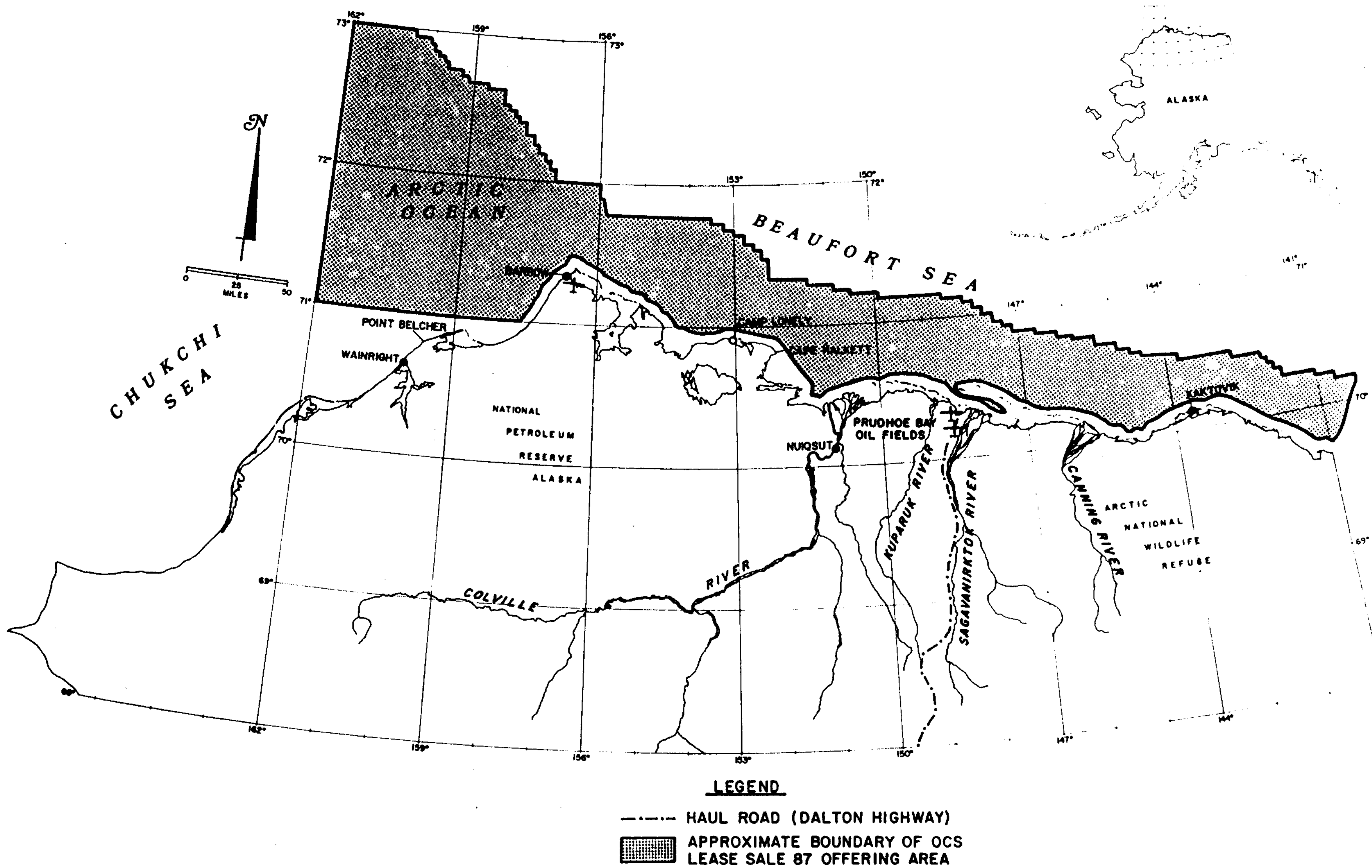
The proposed June 1984 Diapir Field lease offering is the third proposed lease offering in the Diapir Field. The offering generally lies in the Beaufort Sea between 73^{o}N latitude and 69.5^{o} latitude and is bounded by the Canadian border on the east and 162^{o} longitude (see Figure 1.1).

The study area associated with this lease offering incorporates the lease area itself, the OCS area covered in the first Diapir Field lease offering and the North Slope region adjacent to the coast extending from the Canadian border to the community of Wainwright on the Chukchi Sea. Included in this area are the Arctic National Wildlife Refuge and the National Petroleum Reserve Alaska (NPR-A), the Prudhoe Bay/ Deadhorse/Kuparuk Field complex, portions of the Alyeska Pipeline and Haul Road, a number of abandoned military facilities such as Lonely and Oliktok which have been or could be used to support petroleum development and several native communities. From east to west, these are Kaktovik, Nuiqsut, Barrow, Atkasook and Wainwright.

The primary focus of this report is on the Prudhoe Bay area development facilities which is the focus of present oil and gas development, and the community of Barrow which is the commercial, government and service center for the North Slope region. Also addressed are the major transportation infrastructure and services outside the primary study area that are directly affected by North Slope petroleum development (Figure 1.2). This includes the Alaska Railroad, the Southcentral ports of Anchorage, Whittier, Seward and Valdez, and the Fairbanks and Anchorage International Airports.

FIGURE 1.1

LOCATION OF OCS LEASE SALE 87 OFFERING AREA



2. EXISTING TRANSPORTATION SYSTEM

This chapter defines the present condition of those transportation facilities and services that could be affected by OCS activity in the Diapir Field region. These are described by mode: marine, aviation, highway and rail. The Alyeska pipeline is also addressed in section 3.4. The primary focus of this discussion are the systems available within the region to serve community and industry needs. Also described are the facilities and services available in other areas of the state to serve future industry related demands for development of the Diapir Field.

2.1 Marine Mode

The marine system in the Diapir Field region provides a vital seasonal link for the movement of fuel and general cargo to the coastal communities and military facilities along the Arctic coast. It is also used by the oil industry to ship modules and other bulk items required in oil field development and production from Seattle to Prudhoe Bay. All movements are handled by ocean-going tug and barge combinations. Aside from Prudhoe Bay and Oliktok Point (northwest of Kuparuk) where there are dock facilities, goods are delivered over the beach. Furthermore, because of shallow coastal waters, none of the communities or installations (except the oil industry facilities) can accomodate ocean-going barges. Goods are either transferred at Kotzebue to shallow draft coastal barges or lightered from barges anchored off shore.

Outside the Diapir Field region, the ports of Southcentral Alaska (Anchorage, Seward, Whittier and Valdez) serve as a gateway for goods delivered to the North Slope by rail/highway and air.

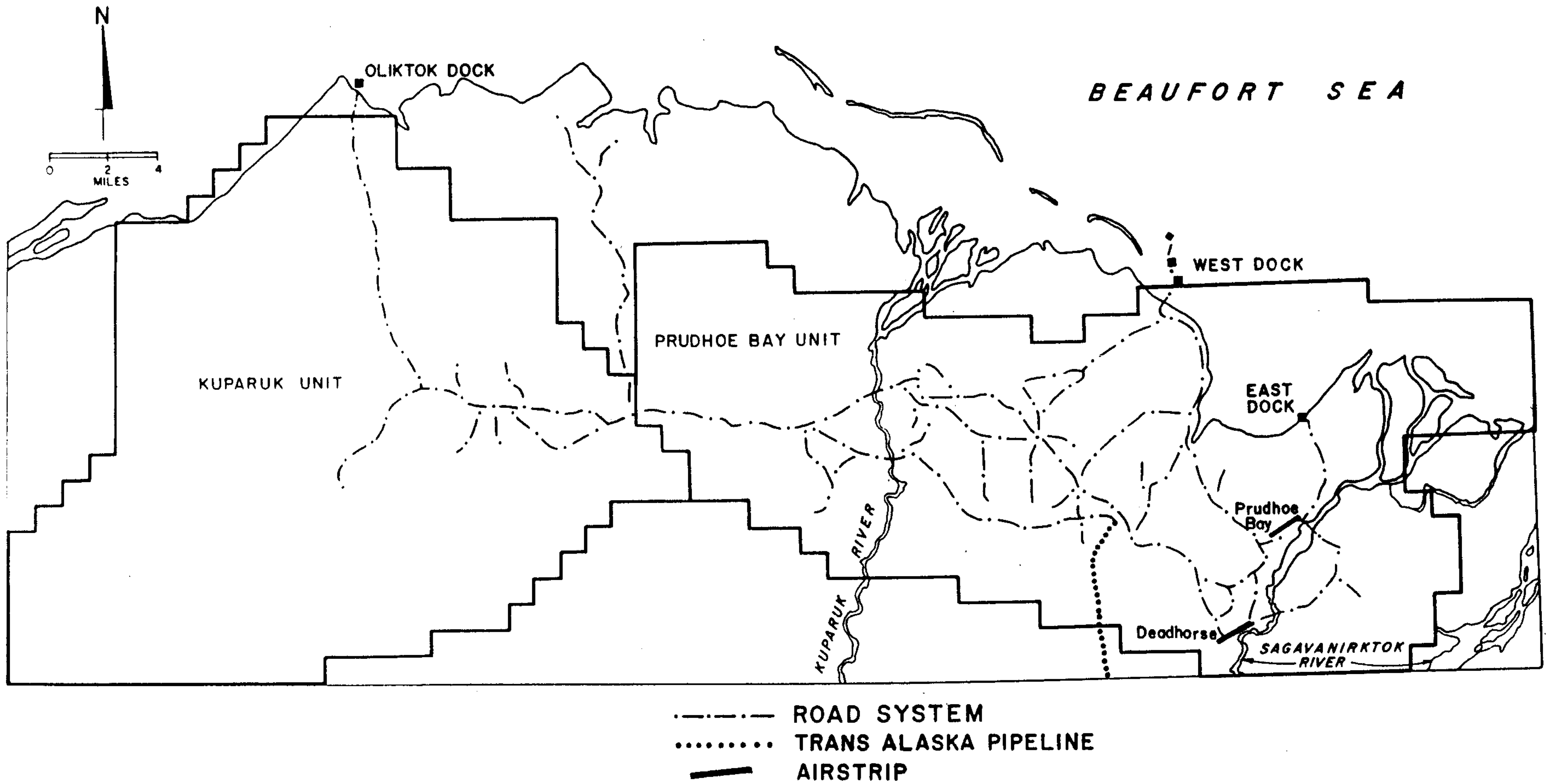
2.1.1 Infrastructure and Traffic

2.1.1.1 Prudhoe Bay

There are three barge unloading facilities at Prudhoe Bay, one at the East Dock and two at the West Dock (see Figure 2.1). East Dock (Dock #1), constructed in 1969, is located in the southeast area of the Bay at the end of a 335m by 9m (1,100 ft.

FIGURE 2.1

PRUDHOE BAY AREA DEVELOPMENT FACILITIES



by 30 ft.) gravel causeway. Lighterage barges are grounded seasonally to provide a 31m by 82m (100 ft. by 270 ft.) wharf with 1.4m (4.5 ft.) alongside. This dock was used prior to 1981 for unloading the smaller MacKenzie River barges and since then, for loading gravel onto shallow-draft barges for use in the construction of artificial islands (Peter Eakland and Associates, 1981; Phil Bellamy, ARCO, personal communication, Anchorage, 1983).

West Dock is situated in the northwest part of the Bay. It consists of a 3,100m by 12m (10,100 ft. by 40 ft.) gravel causeway with two unloading facilities. One, constructed in 1974, is 1,400m (4,500 ft.) from shore and has a draft of 2m (six feet) (Dock #2). The second facility at the end of the causeway has a 3m (10 ft.) draft and is currently used for unloading the 31m by 120m (100 ft. by 400 ft.) modular barges associated with the sealift operation.

There have been several changes to the West Dock in recent years associated with construction and operation of the waterflood project. A 1.6km (mile-long) gravel causeway and island were built in 1982 to accommodate the water intake facility and the West Dock causeway has been widened for an elevated pipeline utilidor which will carry water to a treatment plant at a staging area near the landside base of the dock.

During the winter of 1982 ARCO constructed a 69m by 300m (225 ft. by 975 ft.) gravel causeway and dock with 1.8m to 2.4m (six to eight feet) alongside at Oliktok Point to the northwest of the Kuparuk Field (Dock #3). During 1983 the facility was expanded to 100m (324 ft.) wide. According to the Corps of Engineers it was used in the summer of 1983 to offload modules for Kuparuk Field development. The oil industry also intends to use this facility for any future waterflood project at Kuparuk.

Table 2.1 shows the number of barges and associated tonnages for Crowley Maritime sealifts from 1968 to 1983. The largest shipments occurred in 1970 prior to Haul Road construction and Prudhoe Bay development activities (170,000MT (187,000 short tons) and 36 barges) and in 1975 (139,000MT (153,000 short tons)). The 1983 sealift of 114,000MT (126,000 short tons) is the largest since 1975 and results primarily from cargo associated with the waterflood project and Kuparuk Field development activities.

TABLE 2.1

PRUDHOE BY SEALIFT TRAFFIC
(Short Tons)[a]

YEAR	TONNAGE	# TUGS	# BARGES
1968	7,000[b]	2	3
1969	75,000	16	32
1970	185,000	18	36
1971	16,000	3	6
1972	3,000	1	2
1973	21,000	4	8
1974	67,000	8	16
1975	153,000	24	48
1976	65,000	11	22
1977	46,000	4	7
1978	40,000	5	10
1979	10,000	1	2
1980	47,000	5	10
1981	70,000	7	14
1982	69,000	8	15
1983	126,000	13	26

[a] Short Ton equals 2,000 lbs.
[b] Estimated.

Sources: Technical Report No. 65, Alaska OCS Socioeconomic Program, Beaufort Sea Transportation System Analysis 1981.

Jack Pearl, ARCO, Anchorage, 1983.

Anchorage Daily News, "Sealift Approaches Prudhoe Bay", August 17, 1983.

2.1.1.2 Other North Slope Marine Facilities

Aside from Prudhoe Bay and Oliktok Point, there are no marine facilities for off-loading supplies on the North Slope. At Barrow and other North Slope communities, dry cargo is delivered over the beach with unloading equipment carried onboard the vessel and delivered by rough terrain forklift (about 3,600kg (8,000 lb.) capacity) or by a truck mounted hydraulic crane of about 27MT (30-ton) capacity (ERE Systems, Ltd., 1983). Eight-inch floating hose is available at Barrow for delivery of liquid cargo. Tanker barges are brought close to shore and the hose connected to small pipelines which run from the beach site to storage tanks.

Cargo shipments to Barrow typically consist of fuel, construction equipment and material, and consumables. The profile of fuel and construction-related material shipments changes yearly depending on the number and location of construction projects funded by the North Slope Borough as described in its Capital Improvement Program.

Accurate data on the volume of cargo delivered to Barrow and other North Slope communities are difficult to obtain as the U.S. Army Corps of Engineers does not develop waterborne commerce statistics for Arctic coast ports. Data presented here are approximate and represent the "best guess" of individual shippers and carriers. These include Crowley Maritime (COOL BARGE) which ships fuel and general cargo to various government installations on the North Slope, including the DEW Line station at Barrow; Bowhead Transportation Company, the Barrow village corporation owned common carrier which provides scheduled and contract service to North Slope communities; and Blackstock Construction which arranges the transportation of material for North Slope Borough construction projects.

COOL BARGE shipments to Barrow for the years 1977 to 1981 are shown in Table 2.2. These have declined substantially since 1979 because of the closure of the Naval Arctic Research Laboratory (NARL) by the Federal government. In 1982, Bowhead Transportation delivered about 2,040MT (2,250 tons) of dry cargo and 5.7 million liters (1.5 million gallons) of liquid bulk to Arctic coastal communities. The exact quantities to each village are unknown; however, Bowhead estimates that most of this

TABLE 2.2

COOL BARGE ACTIVITY AT BARROW
1977 - 1981
(Tons)

YEAR	LIQUID BULK	DRY BULK	TOTAL
1977	6,166	393	6,559
1978	5,027	2,078	7,105
1979	5,683	199	5,882
1980	2,076	117	2,193
1981	1,254	63	1,317

Source: ERE Systems, LTd., Barrow Arch (Sale 85) Baseline Transportation Conditions. Technical Memorandum BA-1, 1983.

goes to Barrow. The company predicts that it will move 4,100MT (4,500 tons) of dry cargo and 28.4 million liters (7.5 million gallons) of liquid bulk to the North Slope in the summer of 1983 as a result of the Bureau of Indian Affairs' dropping its traditional scheduled service to North Slope communities. In 1983, Blackstock will barge approximately 18.9 million liters (5 million gallons) of fuel and 6,400MT to 9,100MT (7,000 to 10,000 tons) of general cargo to North Slope Borough coastal communities. According to Blackstock's transportation manager, about two-thirds of this is destined for Barrow.

2.1.1.3 Anchorage

The Port of Anchorage consists of four deep-draft terminals owned and operated by the Municipality of Anchorage and six private docks which serve specialized barge shipments and are used sesonally for break-bulk and dry bulk cargo.

Terminal No. 1 is a 180m by 14m (600 ft. by 47 ft.) concrete and steel wharf. It can handle container, roll-on/roll-off and general cargo ships and also serves as an alternate petroleum dock.

Terminal No. 2 is a 64m by 21m (210 ft. by 69 ft.) wharf which also serves container, roll-on/roll-off and general cargo ships as well as petroleum tankers. Sea-Land has a preferential use agreement for this terminal.

Terminal No. 3 is a 275m (900 ft.) wharf, including a 55m (180 ft.) extension which permits loading and unloading of Totem Ocean Trailer Express (TOTE) roll-on/roll-off ships. TOTE has a preferential use agreement for this terminal.

The Petroleum Terminal is 190m (612 ft.) long and is equipped with multiple petroleum headers, electric hose handling hoists and six and eight inch product lines.

The dock face of the four public terminals is maintained at 11m (35 ft.) MLLW by the Corps of Engineers. Handling equipment available for the general cargo terminals includes two 25MT (27.5 ton) container handling cranes and four level-luffing gantries with 36MT (40 ton) capacities. Two portable transfer ramps for roll-on/roll-off operations are also available.

Public warehouse facilities at the Port include a heated 4,900 square meter (52,500 square ft.) concrete and steel transit shed at Terminal No. 1. An adjacent rail-truck apron with an elevated cargo dock is used for truck and rail cargo loading and unloading. Mainline rail service is available from the Port to Fairbanks and Seward.

Total cargo throughput at the Port of Anchorage declined about four percent during the period 1971 to 1982 (Table 2.3). This decline is the direct result of construction of a petroleum pipeline from Nikiski to Anchorage and a refinery at North Pole which have substantially reduced Anchorage and Fairbanks dependence on imported petroleum. Bulk petroleum shipments aside, Port of Anchorage tonnage has steadily increased during this period. Table 2.4 shows a breakdown of input and output tonnage by commodity and cargo handling category and origin and destination in 1978, the most recent year for which data available in this format at the Port of Anchorage. 1978 is considered a typical post-pipeline year in terms of commodity distribution, except for liquid bulk. In that year about 52 percent of the total cargo was containerized and most of this was inbound (Peter Eakland and Associates, 1981). The remaining tonnage in decending order consisted of liquid bulk, dry bulk, and neo-bulk shipments.

2.1.1.4 Whittier

The Port of Whittier was constructed during World War II as a terminal for petroleum products and now serves cargo of all types moved by rail from Canada and the Lower 48. Existing facilities include a rail-barge transfer facility operated by the Alaska Railroad, a military fuel pier and a State-owned ferry terminal. A 19km (12 mi.) rail line through two tunnels connects Whittier to the Seward-Anchorage mainline at Portage.

The Alaska Railroad wharf is a 300m (1,000 ft.) wharf with 9m to 12m (30 to 40 ft.) alongside and barge slips and steel transfer bridges at either end. Barge Slip No. 1 provides berthing space along the wharf with a minimum depth of 6.4m (21

TABLE 2.3

PORT OF ANCHORAGE CARGO ACTIVITY
1971 - 1982
(Tons)

YEAR	GENERAL CARGO	LIQUID BULK	TOTAL
1971	398,296	1,440,802	1,839,098
1972	483,941	1,501,184	1,985,125
1973	504,344	1,507,994	2,012,338
1974	659,508	1,595,667	2,255,175
1975	931,755	1,920,065	2,851,820
1976	1,072,149	1,695,000	2,767,149
1977	1,077,239	1,130,986	2,208,225
1978	1,095,895	977,599	2,073,494
1979	993,711	678,008	1,671,719
1980	1,174,172	589,580	1,763,752
1981	1,289,713	365,997	1,664,710
1982	1,461,676	304,914	1,766,590

Source: Port of Anchorage, 1983.

TABLE 2.4

PORT OF ANCHORAGE
SUMMARY OF WATERBORNE COMMERCE: 1978
(tons)

RECEIPTS

CARGO CATEGORY COMMODITY	FOREIGN	SOUTHERN CALIFORNIA	NORTHERN CALIFORNIA	PACIFIC NORTHWEST	COOK INLET	OTHER	TOTAL
CONTAINER							
Farm Products				30,630			30,630
Nonmetallic Minerals	624			14,533		223	15,380
Food Products				112,454			112,454
Wood Products				36,215			36,215
Furniture				10,255			10,255
Pulp & Paper	111			10,052		186	10,349
Chemicals & Allied Products	229	8,149		11,671		530	20,579
Petroleum Products				16,190		155	16,345
Primary Metal Products	14,250			21,962		430	36,652
Fabricated Metal Products	495			19,201			19,596
Machinery	6			12,656		22	12,684
Special Items	45			399,559		3,795	403,499
Other	2,394			14,954		50	17,398
Total	18,164	8,149		710,432		5,391	742,136
REEFER							
Food Products				70,922		225	71,147
Other	27			89		63	179
Total	27			71,011		288	71,326
NEO/BREAKBULK							
Lumber				57,186		8	57,194
Other				578		1,329	1,907
Total				57,764		1,337	59,101
DRY BULK							
Coal				15,492		12	15,504
Asphalt			25,610	20,310		21	45,941
Cement	11,968		1,826	106,685	2,946	61	123,486
Other				5,449			5,449
Total	11,968		27,436	147,936	2,946	94	190,380
LIQUID BULK							
Crude Petroleum	100,539						100,539
Fuels	365,234		128,838	7,557	194,379		696,058
Other	2			644			646
Total	465,775		128,838	8,201	194,379		797,243
MOTOR VEHICLES	2,668			19,739		91	22,498

SHIPMENTS

CARGO CATEGORY COMMODITY	PACIFIC NORTHWEST	KODIAK	ALEUTIANS	OTHER	TOTAL
CONTAINER					
Furniture	6,997	3,585			6,997
Primary Metal Products	5,913	181			6,913
Machinery	26,169				26,169
Misc. Manufactured Products	26,935	3,585	19	32	30,571
Special Items	26,926	181		5	27,112
Other	4,704	42		46	4,792
Total	98,644	3,808	19	83	102,554
REEFER					
Fish	11,189	142		159	11,490
Food Perishables	9,798	1,674			11,472
Total	20,987	1,816		159	22,962
NEO/BREAKBULK					
Scrap	9,530				9,530
Other	430				430
Total	9,960				9,960
DRY BULK					
Miscellaneous	260	111			371
LIQUID BULK					
Fuels	98		3,197		3,295
MOTOR VEHICLES	15,417			52	15,469

Source: Alaska Consultants, Inc. and PRC Harris, Southcentral Region of Alaska Deep-Draft Navigation Study, 1981.

ft.), while Barge Slip No. 2 provides 110m (350 ft.) of berthing space with a minimum depth of 11m (35 ft.).

Table 2.5 shows a breakdown of the Port of Whittier throughput by handling category and commodity in 1978. Inbound shipmentswere nearly three times outbound shipments and 60 percent of the total tonnage was containerized.

2.1.1.5 Seward

There are five dock facilities in the City of Seward. These include the Federally owned and operated Alaska Railroad Dock, two City docks, the University of Alaska Dock and the small boat harbor.

The Alaska Railroad Dock is the largest facility. It has a 61m by 224m (200 ft. by 735 ft.) steel and concrete finger pier with a 180m (600 ft.) face on either side and a water depth from 9m to 11m (30 to 35 ft.). The dock is equipped with two gantry cranes with a maximum capacity of 41MT (45 tons) and forklifts of up to 32MT (35 tons). Storage space includes 2,300 square meters (24,000 square feet) of covered warehouse and 34m (112 ft.) of uncovered space. Railroad spurs serve both sides of the pier; however, the port does not have a rail-barge facility.

The City owned Fourth Avenue Dock has a 60m (190 ft.) face and can serve up to 120m (400 ft.) vessels with a 24m (80 ft.) draft. A 41MT (45 ton) and 127MT (140 ton) crane and stevedoring services are available. The University of Alaska Dock, adjacent to the Fourth Avenue Dock, has a 43m (140 ft.) face and a depth of 12m (40 ft.) alongside. Its use is restricted to University Marine Institute research vessels.

The City of Seward has embarked on a major port construction effort at Fourth of July Creek. When completed the Seward Industrial Marine Center will include a shelter basin for ship servicing; a shiplift with dry berth facilities to handle ships over 91m (300 ft.) long and weighing up to 3,300MT (3,600 tons) and a floating wharf. The City is currently studying the economic feasibility of constructing a rail spur to the Center. Also scheduled for construction at Seward is a bulk coal exporting facility between the Railroad Dock and the Small Boat

TABLE 2.5

PORT OF WHITTIER
SUMMARY OF WATERBORNE COMMERCE: 1978
(tons)

RECEIPTS (TONS)

CARGO CATEGORY COMMODITY	FOREIGN	PACIFIC NORTHWEST	BRITISH COLUMBIA	COOK INLET	TOTAL
CONTAINER					
Nonmetallic Minerals	500	602	3,129		4,231
Food Products	430	32,741	483		33,654
Wood Products	13	21,023	78		21,114
Pulp & Paper		9,116	76		9,192
Chemicals & Allied Products	45	7,807	1,694		9,546
Stone, Clay & Glass Products	3,657	1,409	373		5,439
Primary Metal Products	90	15,464	2,028		17,582
Fabricated Metal Products	144	7,370	181		7,695
Machinery	43	7,963	244		8,250
Special Items	41	9,468			9,509
Other	136	17,562	1,911		19,609
Total	5,099	130,525	10,197		145,821
REEFER					
Food Perishables	5	16,597			16,602
NEO/BREAKBULK					
Lumber	5,342	32,264	7		37,613
Other	1,711	471			2,182
Total	7,053	32,735	7		39,795
DRY BULK					
Sand & Gypsum		3,426	391		3,817
Cement		21,351	346		21,697
Other	265	1,962			2,227
Total	265	26,739	737		27,741
LIQUID BULK					
Fuels	1,492	1,330		8,429	11,251
Chemicals NEC	389	6,740	920		8,049
Total	1,881	8,070	920	8,429	19,300

SHIPMENT (TONS)

CARGO CATEGORY COMMODITY	FOREIGN	PACIFIC NORTHWEST	BRITISH COLUMBIA	PRINCE WM. SOUND	ALEUTIANS	TOTAL
CONTAINER						
Primary Metal Products		3,217				3,217
Fabricated Metal Products		3,872				3,872
Machinery	1,081	35,634	3,095			39,810
Special Items		9,781				9,781
Other		1,199				1,199
Total	1,081	53,703	3,095			57,879
REEFER						
Fish		1,192				1,192
Food Perishables		1,040				1,040
Total		2,232				2,232
NEO/BREAKBULK						
Lumber	3,244					3,244
Scrap	531	19,208				19,739
Total	3,775	19,208				22,983
LIQUID BULK						
Fuels				775	532	1,307
MOTOR VEHICLES	71	4,803				4,874

Source: Alaska Consultants, Inc. and PRC Harris, Southcentral Region of Alaska Deep-Draft Navigation Study, 1981.

Harbor. It will be dredged to 18m (60 ft.) and capable of handling ships of more than 91,000MT (100,000 dead weight tons (dwt)). Initial shipments through the facility will be about 14,000MT (15,000 tons) in 1984 and will reach 726,000MT (800,000 tons) per year by 1986.

In 1978, cargo through the Port of Seward totalled nearly 91,000MT (100,000 tons). More than 70 percent of this was inbound and about half the inbound shipments were containerized (see Table 2.6). Fuel was also a significant inbound movement. Wood products from the Louisiana Pacific Chip plant dominated outbound shipments in 1978; however, this facility has operated only intermittently in recent years because of the poor market for wood products in the Orient.

2.1.1.6 Valdez

Port facilities at Valdez consist of three deep draft docks, several commercial barge facilities, a small boat harbor and the four-berth crude oil shipment facility at the terminus of the Alyeska Pipeline. In 1982, the City of Valdez completed a new single-berth container terminal for handling dry goods. The facility includes a 215m by 3m (700 ft. by 9 ft.) concrete dock on piles, mooring dolphins with an expanse of about 370m (1,200 ft.) and a reported water depth alongside of about 13m (44 ft.) MLLW. The wharf is accessed by two 31m by 17m (100 ft. by 54 ft.) concrete ramps connected to the mainland by a trestle and causeway. An adjacent 8.5 hectare (21 acre) marshalling yard can accommodate 560, 12m (40 ft.) containers and is equipped with 380 electrical outlets for reefers. Handling equipment includes a track-mounted crane with an outreach of 35m (115 ft.) and a lifting load capacity of 41MT (40 long tons).

The Valdez City Dock is a timber pile pier with a 180m (600 ft.) face and about 10m (33 ft.) of water alongside. The facility is used for general cargo and is equipped with two 113MT (125 ton) crawler cranes and two 23MT (25 ton) forklift trucks.

The Valdez Petroleum Dock is a T-head pier with a 61m (200 ft.) face and dolphins on both sides. It is constructed on timber pilings and is equipped with eight product pipelines up to eight inches in diameter.

TABLE 2.6
PORT OF SEWARD
SUMMARY OF WATERBORNE COMMERCE: 1978
(tons)

RECEIPTS (TONS)

CARGO CATEGORY COMMODITY	PACIFIC NORTHWEST	PRINCE WM. SOUND	COOK INLET	OTHER	TOTAL
CONTAINER					
Food Products	510				510
Wood Products	774	25,439			26,213
Petroleum Products	622				622
Fabricated Metal Prod.	1,226			1	1,227
Machinery	888			438	1,326
Transport Equipment	1,178				1,178
Other	2,200			176	2,376
Total	7,398	25,439		615	33,452
NEO/BREAKBULK					
Lumber	1,635				1,635
DRY BULK					
Fertilizer	12,024				12,024
Other	222				222
Total	12,246				12,246
LIQUID BULK					
Fuels	1,170	6,953	14,677		22,800
Other	714				714
Total	1,884	6,953	14,677		23,514
MOTOR VEHICLES	779				779

SHIPMENTS (TONS) SEWARD

CARGO CATEGORY COMMODITY	FOREIGN	PACIFIC NORTHWEST	OTHER	TOTAL
CONTAINER				
Wood Products	24,823			24,823
Primary Metal Products	907			907
Fabricated Metal Products	838		125	963
Machinery	225	160	145	530
Other	141	70		211
Total	26,934	230	270	27,434

Source: Alaska Consultants, Inc. and PRC Harris, Southcentral Region of Alaska Deep-Draft Navigation Study, 1981.

Two infrequently used private barge docks are located in the old Townsite. The Crowley Dock is a timber bulkhead wharf backfilled with soil and with 100m (325 ft.) of berthing space, a 1.5m (5 ft.) draft and 61m (200 ft.) of berthing space for railcar barges with a minimum depth of 1.5m (5 ft.). Two product pipelines serve tanker barges, and a railcar transfer bridge is also available. The Valdez Alaska Terminal is a backfilled grounded barge with 73m (240 ft.) of wharf space and 1.5m (5 ft.) alongside.

Crude oil exports from the Alyeska Pipeline are handled at the Alyeska Terminal. This facility has four deep-draft tanker loading piers with depths ranging from 50m (160 ft.) (Berth No. 1) to 23m (75 ft.) for the other three piers. Each berth provides 340m to 450m (1,100 to 1,480 ft.) of berthing space with dolphins, is equipped with four 12 to 16 inch loading arms and is served by 42-inch crude pipelines and 48-inch ballast pipelines.

Since 1977 when the Alyeska Marine Terminal began operation, almost all cargo activity at the Port of Valdez has been in the form of crude oil exports to West Coast ports through that facility. In 1978, outbound crude oil shipments totalled about 48 million MT (53 million tons), while container, dry bulk and liquid cargo handled at other Valdez port facilities approximated 231,000MT (255,000 tons). Table 2.7 provides a summary by commodity and cargo handling category of Port Valdez traffic in 1978.

2.1.2 Carriers

Marine carriers operating in the Diapir Field region typically fall into two categories, common and contract carriers and lighterage services. Since the BIA cargo ship North Star III ceased its North Slope service in 1982, the service provided in the region is exclusively by tug and barge.

TABLE 2.7
PORT OF VALDEZ
SUMMARY OF WATERBORNE COMMERCE: 1978
(tons)

RECEIPTS

CARGO CATEGORY COMMODITY	SOUTHERN CALIFORNIA	NORTHERN CALIFORNIA	PACIFIC NORTHWEST	KODIAK	ALASKA PENNINSULA	OTHER	TOTAL
CONTAINER							
Special Items			1	1,410			1,411
Other			67	190		12	269
Total			68	1,600		12	1,680
NEO/BREAKBULK							
Lumber			96	2			98
DRY BULK							
Cement			136				136
Other						14	14
Total			136			14	150
LIQUID BULK							
Fuels	6,347	38,494	84,327	241	120,841	242	250,492

SHIPMENTS

CARGO CATEGORY COMMODITY	FOREIGN	EAST COAST	SOUTHERN CALIFORNIA	NORTHERN CALIFORNIA	PACIFIC NORTHWEST	OTHER	TOTAL
CONTAINER					2,410		2,410
Machinery					10		10
Total					2,420		2,401
LIQUID BULK							
Crude Petroleum	18,707,782	1,006,883	12,545,903	13,081,046	7,350,897	406,841	53,099,352
Fuels						94,829	94,629
Total	18,707,782	1,006,863	12,545,903	13,081,045	7,350,897	501,470	53,193,981

Source: Alaska Consultants, Inc. and PRC Harris, Southcentral Region of Alaska Deep-Draft Navigation Study, 1981.

2.1.2.1 Common Carriers

Common carriers advertise themselves to the public and are required to publish scheduled routes and sailing dates and transportation rates and charges. Common carriers providing services from Seattle to Arctic coastal communities include Pacific-Alaska Lines (PAL-West) and Bowhead Transportation Company. Bowhead operates as a non-vessel carrier that charters space from contract carriers (ERE Systems, Ltd., 1983). Both carriers serve Barrow and other North Slope coastal communities.

Typically, each carrier has two or three scheduled trips per season. PAL-West generally uses two 4,200-horsepower tugs and two 120m by 23m (400 ft. by 76 ft.) container barges with a 8,000MT (9,000 dwt) capacity. Most carry their own cargo handling equipment.

Common carriers providing scheduled service to the Southcentral ports of Anchorage, Whittier, Seward and Valdez include Sea-Land, TOTE (Totem Ocean Trailer Express), Alaska Hydro-Train, a subsidiary of Crowley Maritime, and Aqua-Train operated by the Canadian National Railways. Sea-Land operates a container steamship service to Anchorage, Kodiak, Cordova and the Aleutian Chain. Ships operating the Seattle to Anchorage service have reinforced hulls to permit winter operations in Cook Inlet. In 1983, Sea-Land served Anchorage three times weekly; however, during the height of the pipeline boom in 1976-1977, five ships provided four round-trips a week between Anchorage and Seattle. TOTE provides twice weekly roll-on/roll-off trailer van service to Anchorage from Seattle.

2.1.2.2 Contract Carriers

On the North Slope, contract carriers are used by major shippers such as oil firms and construction companies or the military to move specialized or oversized cargo. Crowley Maritime has handled most of the Prudhoe Bay traffic since 1968; however, in 1981, Kodiak Marine Transportation, a subsidiary of Nabors Drilling, made a sealift of mostly fuel to Prudhoe with a fleet of five barges and two tugs. Northern Transportation Co., Ltd., a Canadian Crown Corporation, has also provided service to Prudhoe via the MacKenzie River in the past, but according to ARCO this carrier has not been used since 1981.

A Crowley Maritime subsidiary, Alaska Puget United Transportation Company (APUTCO) is the contract operator of the COOL BARGE which transports dry cargo, reefer and petroleum to military and other Federal installations along the Arctic coast, including the DEW Line station at Point Barrow. If space is available APUTCO can also offer services to the communities it serves as part of its military and/or Federal commitments.

2.1.3 Tariffs

Marine carriers operating in the Diapir Field region typiclly fall into two general categories: (1) common and contract carriers and (2) lighterage carriers. All services are by tug and barge. The carriers are regulated by either the Interstate Commerce Commission (ICC) and/or the Federal Maritime Commission (FMC).

2.1.3.1. Interstate Carrier Tariffs

Scheduled interstate carrier tariffs are generally presented as point-to-point rates by class[1] and commodity[2] to regular points of call, or ports where direct shipment are provided. Rates usually include loading and unloading cargo at the port-of-call or dock, but these are sometimes linehaul rates to the ships' anchorage combined with rates associated with lighterage charges. Tariffs to points served on an irregular basis are based on the point-to-point rates to the next furthest regulating scheduled port-of-call. Loading and unloading of cargo at irregular points, when performed by a tug and barge line, is charged an additional incremental rate by all carriers. Irregular points which are served by connecting carriers such as Arctic Lighterage and United Transportation, Inc., publish point-to-point tariffs separately with the FMC. These are discussed

[1]Class rates are defined by the ratio of weight to volume of any item. This group of different commodities with similar weight-to-weight characteristics constitutes a given class.

[2]Commodity rates relate to a specific commodity such as bulk petroleum, building materials, and fish, and are quoted in centers per 100 pounds. Commodity rates will vary depending upon commodity type, shipment size, volume, and weight.

below. Charges associated with handling, storage, consolidation or special handling or shipping are additional.

2.1.3.2 Other Tariffs

Other tariffs include those of intrastate coastal and barge lighterage tariffs and are made on a contract basis. Tug and barge and lighterage tariffs are published and available at the ICC and FMC. Like interstate carrier tariffs, they are generally presented as point-to-point rates by class and commodity and are a function of distance, type and amount of commodity transported, loading and unloading characteristics, and competitive considerations. Lighterage tariffs are generally incorporated into the linehaul commodity rates from Seattle. Tariffs are quoted primarily in dollars per 100 pounds (see Table 2.8).

2.2 Aviation

The aviation system in the Diapir Field region comprises the single most extensive all-season conventional mode of transportation and provides a wide range of transportation services throughout the study area (see Figure 2.2). Aircraft landing facilities abound throughout the region; however, only two, Barrow and Deadhorse, are State-owned and operated. Several small community airports are operated by the North Slope Borough, while other facilities are associated with active and inactive military installations. Still others such as the ARCO-owned facility at Prudhoe Bay are privately owned and used by industry for petroleum related activities.

The aviation system is organized into three separate yet interconnected types of operations. A significant operation in terms of activity is related to petroleum activity. The second type could be described as hub and spoke operations. This type of operation provides linehaul service between the regional hub communities, i.e., Barrow, Deadhorse, Fairbanks and Anchorage, with feeder service between the hubs and smaller regional communities such as Nuiqsut and Wainwright. The third organized aviation system involves patrol, training, and resupply operations for military installations, e.g., DEW Line stations, within the study area.

TABLE 2.8

Tariffs for Selected Commodities[a]
Seattle to Barrow
(1983)

Commodity	Tariff ($ per 100 lbs.)
Appliances, household	62.19
Automobiles	45.53
Cement, packaged	16.74
Furniture, set up	55.32
.... broken down	36.39
Groceries	17.50
Houses, knockdown	41.50
.... portable	22.51[b]
Lumber	18.26
Oil (55 gal. drums)	17.39
Pipe, insulated plastic	52.94
Snow and ice vehicles	67.20
Tanks, empty (100 to 5,000 gal.)	136.74

[a]Includes lighterage costs; less than container Lot (LCL) only.

[b]Per square foot.

Source: Personal communication with Stacey Veidt, Crowley Maritime, Seattle, 1983.

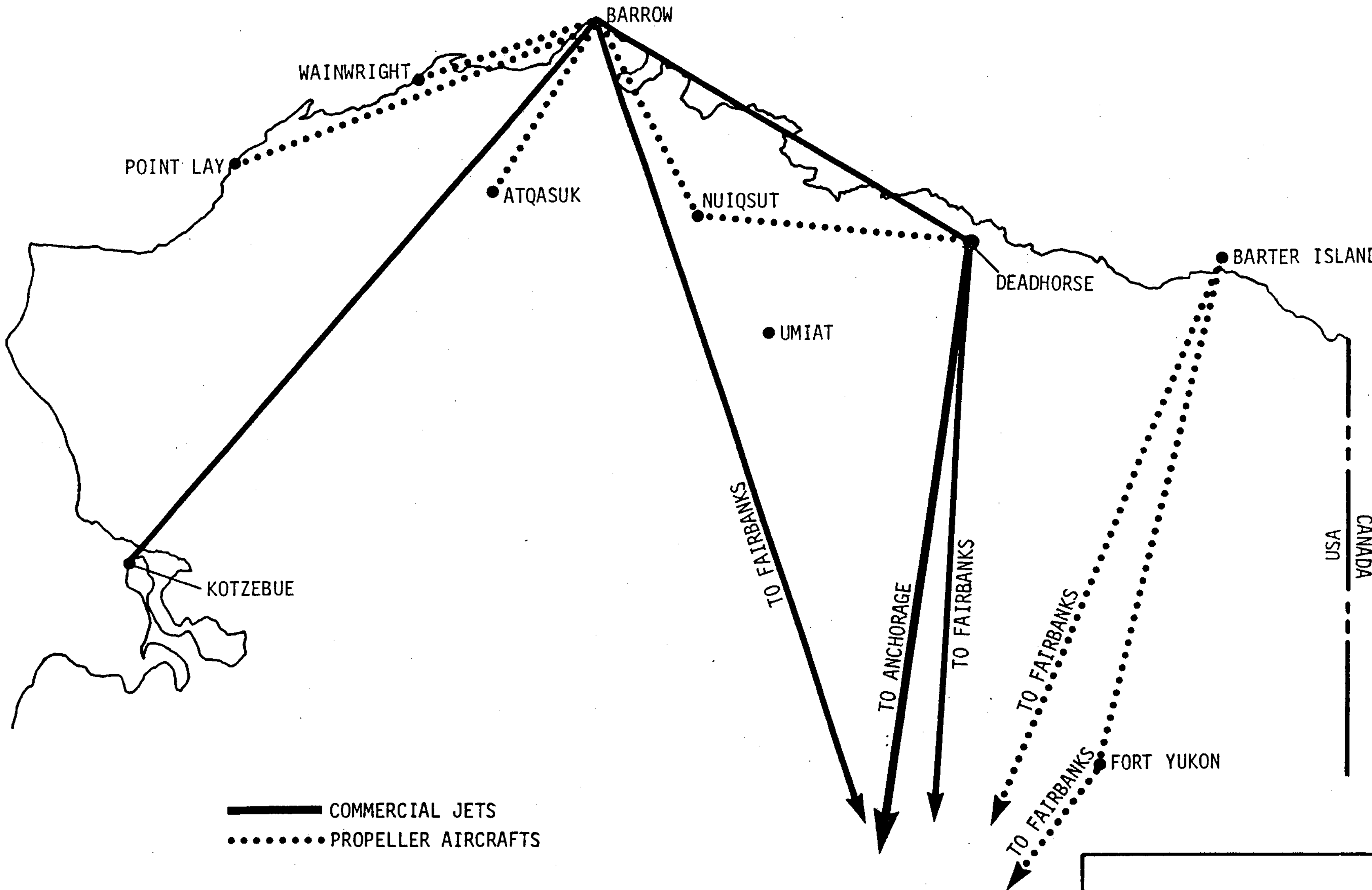


FIGURE 2.2

SCHEDULED ROUTE SYSTEM
ARCTIC COAST/NORTH SLOPE
REGION

For many years, Barrow served as the air hub for the entire North Slope region; however, with the development of Prudhoe Bay, the focus of regional aviation activity has shifted over the past decade to Deadhorse. In 1982, there was more scheduled air service to Deadhorse than to Barrow and during the period 1976 to 1979, more than double the number of passengers enplaned at Deadhorse than at Barrow (see Tables 2.9, 2.10 and 2.14).

Activity notwithstanding, Barrow is in a sense more of a regional center than Deadhorse. It has scheduled nonstop flights to seven northern Alaska communities, while Deadhorse has nonstop links to only two. Nearly all Deadhorse traffic is oil industry related and originates in or is destined for points outside Alaska in the Lower 48. Although Fairbanks serves as the gateway for air service to northern, western and interior Alaska communities, Deadhorse's main air link to Alaska and point outside the State are through Anchorage. For this reason, the aviation baseline discussion addresses facilities and operations at Anchorage and Fairbanks as well as those within the Diapir Field study area.

The following sections discuss the infrastructure, traffic, service and fleet characteristics at these terminals.

2.2.1 Infrastructure and Traffic

2.2.1.1 Barrow

Wiley Post-Will Rogers Memorial Airport serves the community of Barrow and functions as a transportation center for the North Slope communities of Wainwright, Atkasook, Nuiqsut and Point Lay. The airport is owned and maintained by the State of Alaska. It is classified by the State Aviation System Plan as a "regional center" (TRA/Farr and Louis Berger and Associates, Inc., 1982) and its service type is designated by the Federal Aviation Administration (FAA) as "air carrier". The airport has an attended FAA Flight Service Station and a U.S. Weather Service station in the city at a distance of about .4km (one-quarter mile). The terminal building and adjacent storage building are owned and operated by Wien Air Alaska as are fuel tanks with a 190,000 liter (50,000 gallon) storage capacity for use only by Wien aircraft. Several combination hangar-office buildings are occupied by air taxi operators.

TABLE 2.9

BARROW AIRPORT ESTIMATED ANNUAL AIRCRAFT OPERATIONS

YEAR	NUMBER OF OPERATIONS	PERCENT INCREASE/DECREASE
1976	11,412	N/A
1977	11,772	3.2
1978	13,306	13.0
1979	12,656	- 4.9
1980	13,141	3.8
1981	14,019	6.7

Source: Alaska Transportation Consultants, Airport Development and Land Use Plans, 1983.

TABLE 2.10

AIRPORT OPERATIONS - AIR CARRIER DISTRIBUTION 1981

Carrier	Number of Operations	Percent of Total	Predominant Types of Aircraft: Single and Multi-Engine under 12,500 pounds gross weight	Multi-Engine 12,500-60,000 pounds gross weight	Hercules C130/133	Two-Engine Turbojet
Wien Air Alaska	2192/a	16.00	X(20%/c)	X(20%/c)		X(60%/c)
Jen Air	2595/b	19.00	X	X		
Cape Smythe	7290/b	52.00	X	X		
Alaska International Air	590/a	4.00			X	
Northern Air Cargo	19/b	.10			X	
Other Air Taxi	1333/b,c	10.00	X			
Total	14019	101.10				

a/actual b/projected from intermittent quarterly information c/estimated

Source: Alaska Transportation Consultants, Airport Development and Land Use Plan, 1983.

The runway is 2000m (6,500 ft.) long by 50m (150 ft.) wide, is paved with asphalt and can bear high load traffic such as jet aircraft. It runs east-west and is oriented 60° to 240°. The first 425m (1,400 ft.) of the east end of the runway are subject to dips and frost waves. There is a turn-around area at the east end of the runway and another located about a third of the way up the runway. Two taxiways paved to a width of 23m (75 ft.) connect to parking aprons (see Figure 2.3).

The airport is not towered, but there is a Flight Service Station attended weekdays during business hours to provide airport advisories and handle flight plans. Unscheduled large aircraft carrying passengers are expected to obtain approval in advance to land.

The airport is well equipped with radio aids to navigation. There is a non-directional beacon (NDB) at the field and another NDB at Browerville on a bearing of 19° to 2.6km (1.6 mi.) from the field. A very high frequency omnidirection course beacon is co-located with a omnidirectional ultra-high frequency course beacon.

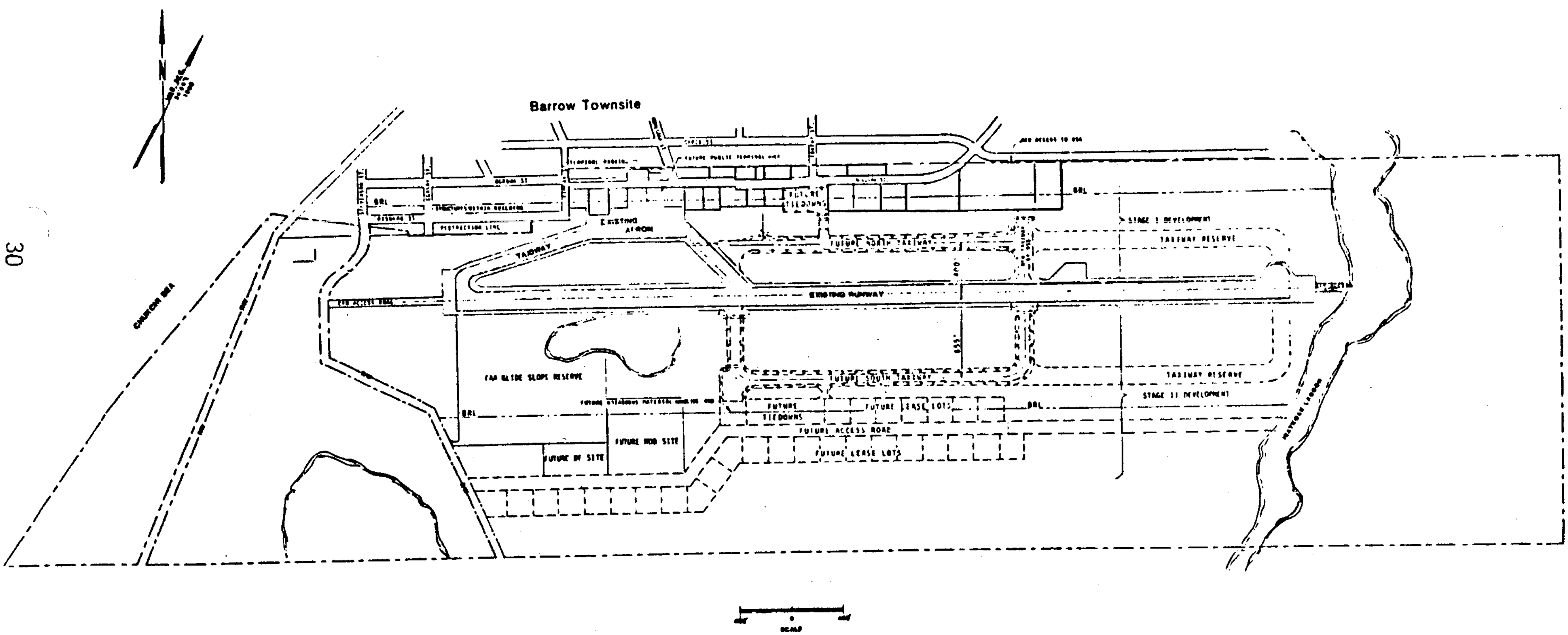
Airport lighting consists of high-intensity field and taxiway lighting controlled by the Flight Service Station. Other lighting consists of a 66cm (26 in.) double-end rotating beacon, runway end identifier lights (REIL) on runway 24, a medium intensity approach lighting system (MALS) on runway 6 and visual approach slope indicators (VASI) on both runways.

In 1981 there were approximately 14,000 aircraft operations at the Barrow airport, an increase of about 33% over the 1976 level (see Table 2.9). Table 2.10 shows the distribution of these by carrier and aircraft type. Aircraft operations at Barrow are highly seasonal with average daily operations during July (52) and August (50) nearly double those during January (24) and February (27). In fact, more than 25% of the airport's total operations occur during these two months when construction and tourist activity are particularly heavy (Alaska Transportation Consultants, 1983).

From 1977 to 1981, passenger enplanements and deplanements at Barrow increased nearly 80% or 13% annually (see Table 2.11). Wien accounted for about three-quarters of the total and Cape Smythe, a local air taxi, for most of the remainder. The growth

FIGURE 2.3

WILEY POST - WILL ROGERS MEMORIAL AIRPORT LAYOUT



Source: Alaska Transportation Consultants, Airport Development and Land Use Plans Barrow Airport, 1983.

TABLE 2.11

ESTIMATED PASSENGER ENPLANEMENT AND DEPLANEMENTS
1976-1981

YEAR	WIEN AIR ALASKA	CAPE SMYTHE	OTHER	TOTAL PASSENGERS
1976	32,809[a]	N/A	2,000[b]	34,809
1977	30,584[a]	11,288[c]	1,000[b]	42,872
1978	39,644[a]	12,827[b]	1,000[b]	53,471
1979	45,529[a]	13,942[b]	1,000[b]	60,471
1980	49,184[a]	14,374[a]	1,000[b]	64,558
1981	46,760[a]	14,938[a]	1,000[b]	62,698

[a]Actual

[b]Estimated

[c]First Year of Operation

Source: Alaska Transportation Consultants, Airport Development and Land Use Plans, 1983.

of air cargo traffic through the Barrow airport has been much slower than both aircraft operations and air passenger traffic. From 1976 to 1980, cargo carried by certified air carriers increased from 460MT to 520MT (509 to 570 revenue tons), an overall increase of about 11% and an average annual growth of about 2.9% (see Table 2.12).

2.2.1.2 Deadhorse

Deadhorse is the main airport serving Alaska's North Slope oil industry centered in Prudhoe Bay. Virtually all traffic into and out of Deadhorse Airport is related to petroleum development. The airport is owned and operated by the State of Alaska and its radio navigation aids are maintained by the FAA. The airport is located several kilometers south of Prudhoe Bay and immediately adjacent to the settlement of Deadhorse. Wien and Alaska Airlines own and maintain separate terminal facilities. The 1,500 square meter (15,800 square foot) Wien terminal includes a passenger holding and ticketing area, restrooms and warm storage. Wien also operates its own fueling facility. The Alaska Airlines terminal is 2,200 square meters (24,000 square feet) and contains areas for cargo storage and handling, passengers, office space and employee housing and dining. Deadhorse is classified as a "regional" center airport by the State Aviation Systems Plan and as an "air carrier" airport by the FAA.

The asphalted runway is 2000m (6,500 ft.) long by 50m (150 ft.) wide and capable of bearing high loads. It runs west-southwest to east-northeast at an orientation of 40° to 22°. There is a 61m (200 ft.) gravel overrun area at each end of the runway and three exit taxiways lead to extensive ramp areas (see Figure 2.4).

There is no active control tower at Deadhorse, but there is a full-time Flight Service Station to assist arriving and departing aircraft and an airport advisory service for pilots. An automatic terminal information service (ATIS), a continually broadcast recording, informs pilots as to the active runway, altimeter adjustment and wind conditions.

There is a very high frequency omnidirectional range (VOR) colocated with an ultra-high frequency distance measuring

TABLE 2.12

ENPLANED CARGO BY CERTIFIED AIR CARRIERS

BARROW AIRPORT
(1976-1980)

YEAR	AIR FREIGHT[a]	AIR MAIL	TOTAL
1976	289.98	291.14	509.12
1977	210.41	318.65	529.06
1978	187.51	226.49	414.00
1979	279.18	399.62	678.80
1980	306.50	264.03	570.53

[a]Figures in revenue tons.

Source: Airport Activity Statistics for certified route air carriers, Federal Aviation Administration and Civil Aeronautics Board.

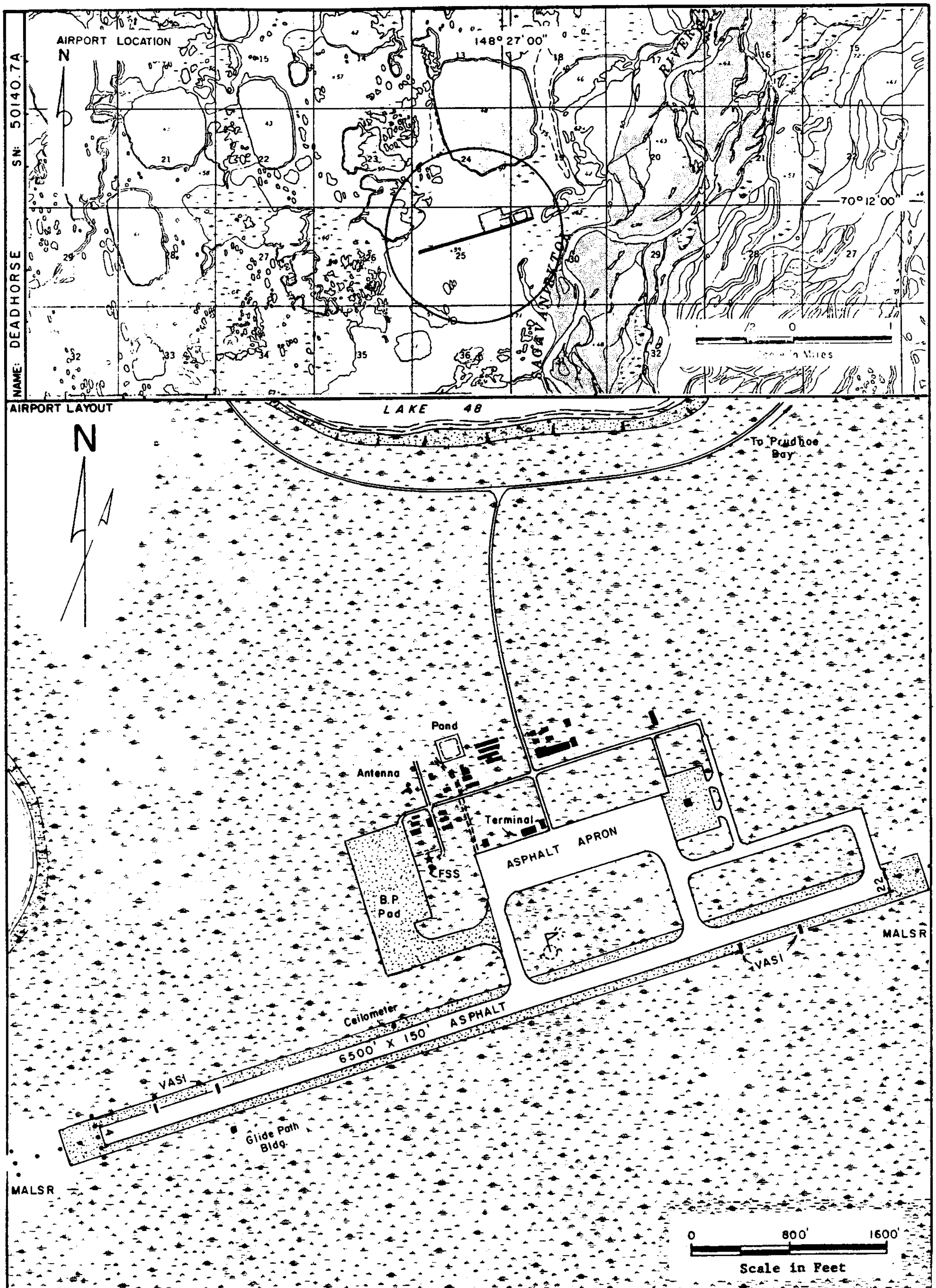


FIGURE 2.4 FAA MASTER PLAN - DEADHORSE AIRPORT LAYOUT

equipment unit (DME) at the field. A non-directional beacon (NDB) is situated 3.7km (2.3 statute miles) from the field on magnetic bearing of 80°. Very high frequency direction finding service (VHF/DF) and an instrument landing system (ILS) are also available.

A flashing white, green, white rotating beacon marks the runway ends. There are also high intensity runway lights, runway centerline lights, and sequenced flashing lights. Red and white vertical slope indicator (VSI) lights at each end of the runway assist aircraft in final descent.

The airport is attended from 9:00 a.m. to 10:30 p.m. daily and unscheduled commercial carriers arriving with passengers are asked to request advance permission to land. Caribou occasionally stray onto the runway.

Table 2.13 shows enplaned revenue passengers and cargo carried by certified route air carriers at Deadhorse Airport for the period 1976 to 1980. Despite a decline in 1979, enplaned revenue passengers increased 16% during the five year period. Enplaned revenue tons of cargo, on the other hand, declined from a high of 1,100MT (1,210 tons) in 1977, a pipeline year, to 644MT (710 tons) in 1980. Present air cargo shipments average roughly 0.9MT (one ton) per North Slope employee plus 2 percent of drilling supplies.

Although enplaned passengers increased from 1976 to 1980, the total number of aircraft departures by certified route carriers actually declined. This results from an increased reliance on the larger capacity Boeing 737 aircraft and a reduction in the use of smaller twin piston and twin turbine aircraft (see Table 2.14). In 1980, a load factor of 50 passengers per scheduled air carrier was reached.

Terminal data collected by the FAA show that scheduled route air carrier traffic is only one aspect of the traffic at Deadhorse (Table 2.15). Air taxi and commuter operations gained an increasing share of the total traffic and operations from 1976 to 1979. In 1979, air taxis accounted for 20% of the total passengers enplaned and 73% of the total aircraft operations.

Current traffic levels at Deadhorse are up considerably over those in the late 1970's. In 1983, these are twice the number of

TABLE 2.13

ENPLANED REVENUE PASSENGERS AND ENPLANED REVENUE TONS
OF CARGO BY CERTIFIED ROUTE AIR CARRIERS FOR DEADHORSE, ALASKA
(1976-1980)

YEAR	PASSENGERS	AIR FREIGHT	AIR MAIL	TOTAL CARGO
1976	62,285	1,098.19	9.33	1,107.52
1977	61,152	1,129.42	80.21	1,209.63
1978	61,272	913.11	61.17	974.28
1979	57,761	659.72	19.17	678.89
1980	72,389	682.27	28.71	710.98
Average Annual Growth	+4.0%	(-11.2%)	+32.4%	(-10.5%)

Source: Airport Activity Statistics for certified route air carriers, Federal Aviation Administration and Civil Aeronautics Board.

TABLE 2.14

AIRCRAFT DEPARTURES BY CERTIFIED ROUTE AIR CARRIERS BY TYPE OF AIRCRAFT FOR DEADHORSE

(1976-1980)

YEAR	TWIN PISTON	F-27's & FH-227	BOEING 737	TOTAL
1976	---	17	1,480	1,497
1977	215	3	1,120	1,338
1978	95	3	1,302	1,400
1979	5	1	1,235	1,241
1980	11	--	1,475	1,486

Source: FAA Airport Activity Statistics. All reported operations are by Wein Air Alaska and its subcontractors.

TABLE 2.15

PASSENGER ENPLANEMENTS AND AIRCRAFT OPERATIONS
BY CATEGORY OF OPERATION FOR DEADHORSE
(Enplanements and Operations in Thousands)

YEAR	PASSENGER ENPLANEMENTS			TOTAL
	AIR CARRIER	AIR TAXI	COMMUTER	
1976	59	2	0	61
1977	63	5	0	68
1978	62	15	0	77
1979	58	15	0	73

YEAR	AIRCRAFT OPERATIONS				TOTAL
	AIR CARRIER	AIR TAXI COMMUTER	GENERAL AVIATION	G.A. LOCAL	
1976	2	2	10	1	15
1977	3	4	1	6	14
1978	3	10	1	0	14
1979	3	11	1	0	15

Source: Terminal Area Forecasts, Fiscal Years 1981-1982, Federal Aviation Administration, Department of Transportation scheduled flights into Deadhorse than were offered in 1979, and many of these flights are on Alaska Airlines B-727's which have more capacity than Wien's B-737's. The FAA estimates that there were about 40,000 operations at Deadhorse in 1982.

2.2.1.3 Anchorage International Airport

The State-owned Anchorage International Airport serves as the principal airport for the Anchorage metropolitan area and provides essential statewide and international service as well. Anchorage International serves as the the air link for passengers bound to and from Deadhorse and the Lower 48.

The facility has two east-west runways over 3,000m (10,000 ft.), runway 6R-24L and 6L-24R. Both these runways are served by a parallel east-west taxiway north of the runway system. A new north-south runway (14-32), also over 3,000m (10,000 ft.), accommodates cross-wind conditions and alleviates aircraft noise impacts east of the airport by putting the majority of aircraft operations over water. This runway is used primarily for aircraft arrivals (see Figure 2.5). According to the most recent Master Plan (State of Alaska Department of Transportation and Public Facilities, 1981), the facility was operating at about 50% capacity in 1980. The completion of a new international terminal in 1982 provides substantial additional space at the existing terminal for domestic traffic and increases capacity.

Table 2.16 presents aircraft operations by category of operator for the period 1976 to 1981. Total aircraft operations declined about 27% during this period primarily as a result of decreases in general aviation operations (from 154,000 in 1976 to 76,000 in 1981). This reflects the increasing reluctance of small aircraft to compete for runway and airway space with large aircraft and the existence of a number of alternative facilities catering to local and general aviation. Air carrier operations have also declined in the past several years because of the increased use of larger capacity aircraft.

According to statistics compiled by Anchorage International Airport accounting staff, total passengers enplaned at the facility increased roughly 22% from 1977 to 1982. All the growth is attributable to domestic passengers as the number of international enplaned passengers declined as a result of

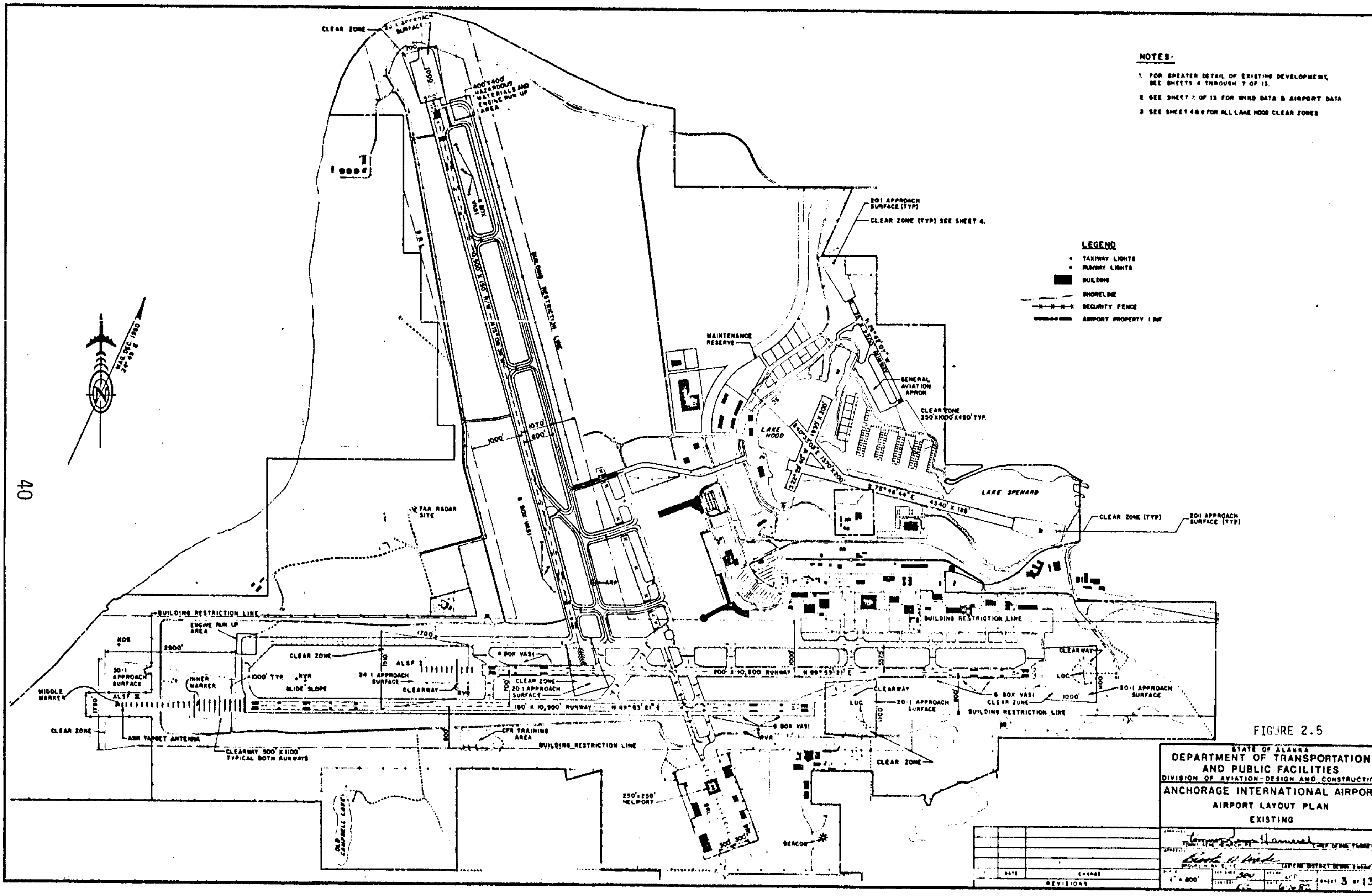

NOTES:
1. FOR GREATER DETAIL OF EXISTING DEVELOPMENT, SEE SHEETS 4 THROUGH 7 OF 13.
2. SEE SHEET 2 OF 13 FOR WIND DATA & AIRPORT DATA
3. SEE SHEET 4&8 FOR ALL LAKE HOOD CLEAR ZONES
LEGEND
TAXIWAY LIGHTS
RUNWAY LIGHTS
BUILDING
SHORELINE
SECURITY FENCE
AIRPORT PROPERTY LINE
CLEAR ZONE
BUILDING RESTRICTION LINE
6 BOX VASI
4 BOX VASI
MAINTENANCE RESERVE
GENERAL AVIATION APRON
LAKE HOOD
LAKE SPENARD
CLEAR ZONE (TYP)
20:1 APPROACH SURFACE (TYP)
CLEAR ZONE (TYP) SEE SHEET 6.
FAA RADAR SITE
ENGINE RUN UP AREA
INNER MARKER
MIDDLE MARKER
ASR TARGET ANTENNA
GLIDE SLOPE
CLEARWAY
CLEARWAY 500' X 1100' TYPICAL BOTH RUNWAYS
CFR TRAINING AREA
20:1 APPROACH SURFACE
34:1 APPROACH SURFACE
50:1 APPROACH SURFACE
200' X 10,600' RUNWAY
150' X 10,900' RUNWAY
250'x250' HELIPORT
BEACON
OLD CAMPBELL LAKE
FIGURE 2.5
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
DIVISION OF AVIATION-DESIGN AND CONSTRUCTION
ANCHORAGE INTERNATIONAL AIRPORT
AIRPORT LAYOUT PLAN
EXISTING
REVISIONS
DATE
CHANGE
SHEET 3 of 13

TABLE 2.16

ANCHORAGE INTERNATIONAL AIRPORT OPERATIONS
(FY1976 - FY1981)

YEAR	AIR CARRIER	AIR TAXI	GENERAL AVIATION	MILITARY	TOTAL
1976	57,369	21,424	154,206	3,145	236,144
1977	54,836	46,703	197,381	2,823	301,743
1978	61,099	50,663	147,307	2,069	261,138
1979	61,923	32,817	110,220	2,791	207,751
1980	58,923	33,724	82,012	2,415	177,074
1981	55,758	38,215	76,326	2,444	172,743

Source: Terminal Area Forecasts.
Federal Aviation Administration.

scheduled changes on the part of carriers such as Northwest Airlines and Japan Air Lines (Table 2.17). CAB certificated carriers account for about 80% of the total airport traffic.

The Anchorage facility serves an important role in freight transportation to and within the State. In 1982, throughput tonnage amounted to 135,952,033kg (299,717,891 lbs.), about 86% more than the 1977 throughput. This increase was accommodated by larger aircraft and a greater use of all cargo flights. Transshipment of goods arriving at Anchorage by water and flown to remote Alaska communities accounts for outbound cargo being about 65% greater than inbound cargo (see Table 2.18) (Peter Eakland and Associates, 1981).

2.2.1.4 Fairbanks International Airport

The Fairbanks International Airport serves as the principal airport for Fairbanks and the surrounding area and the gateway for air service to interior, northern and western Alaska communities. The State-owned and maintained facility has three runways. The major runway is asphalted and 3,000m (10,000 ft.) long by 46m (150 ft.) wide. Two other gravel runways are less than 1,100m (3,500-ft.) long (see Figure 2.6). Construction of a 4000 square meter (40,000 square foot) expansion of the terminal building was underway in the summer of 1983.

In 1980, total operations at the Fairbanks airport were 174,528, about 60% more than occurred in 1970 (106,970) but down considerably from the peak year of 1977 when there were 208,221 aircraft operations (see Table 2.19). Overall, operations increased at an average annual rate of 5.7 percent during the ten year period. General aviation (itinerant and local) operations account for an increasingly larger share of total operations (70% in 1970 and 78% in 1980), whereas the proportion represented by air carrier and air taxi traffic has declined from 29% in 1970 to 20% in 1980.

Growth in passenger traffic through the Fairbanks airport shows similar trends. Enplaned passengers increased 40% from 1970 to 1979, but 1979 levels were considerably below those experienced during the peak pipeline year of 1976 (see Table 2.20). Enplaned cargo, on the other hand, declined from 62,120MT (68,474 tons) in 1970 to 44,269MT (48,797 tons) in 1979 (down 29

TABLE 2.17

ANCHORAGE INTERNATIONAL AIRPORT

ENPLANED AIR PASSENGERS
(1977-1982)

YEAR	ENPLANED PASSENGERS DOMESTIC	INTERNATIONAL	TOTAL
1977	905,486	56,906	962,392
1978	930,023	49,613	979.636
1979	992,010	26,549	1,018,535
1980	981,497	26,038	1,007,535
1981	1,045,554	27,534	1,073,088
1982	1,148,169	29,548	1,177,717

Source: Accounting Department, Anchorage International Airport, 1983.

TABLE 2.18

ANCHORAGE INTERNATIONAL AIRPORT

AIR FREIGHT ACTIVITY

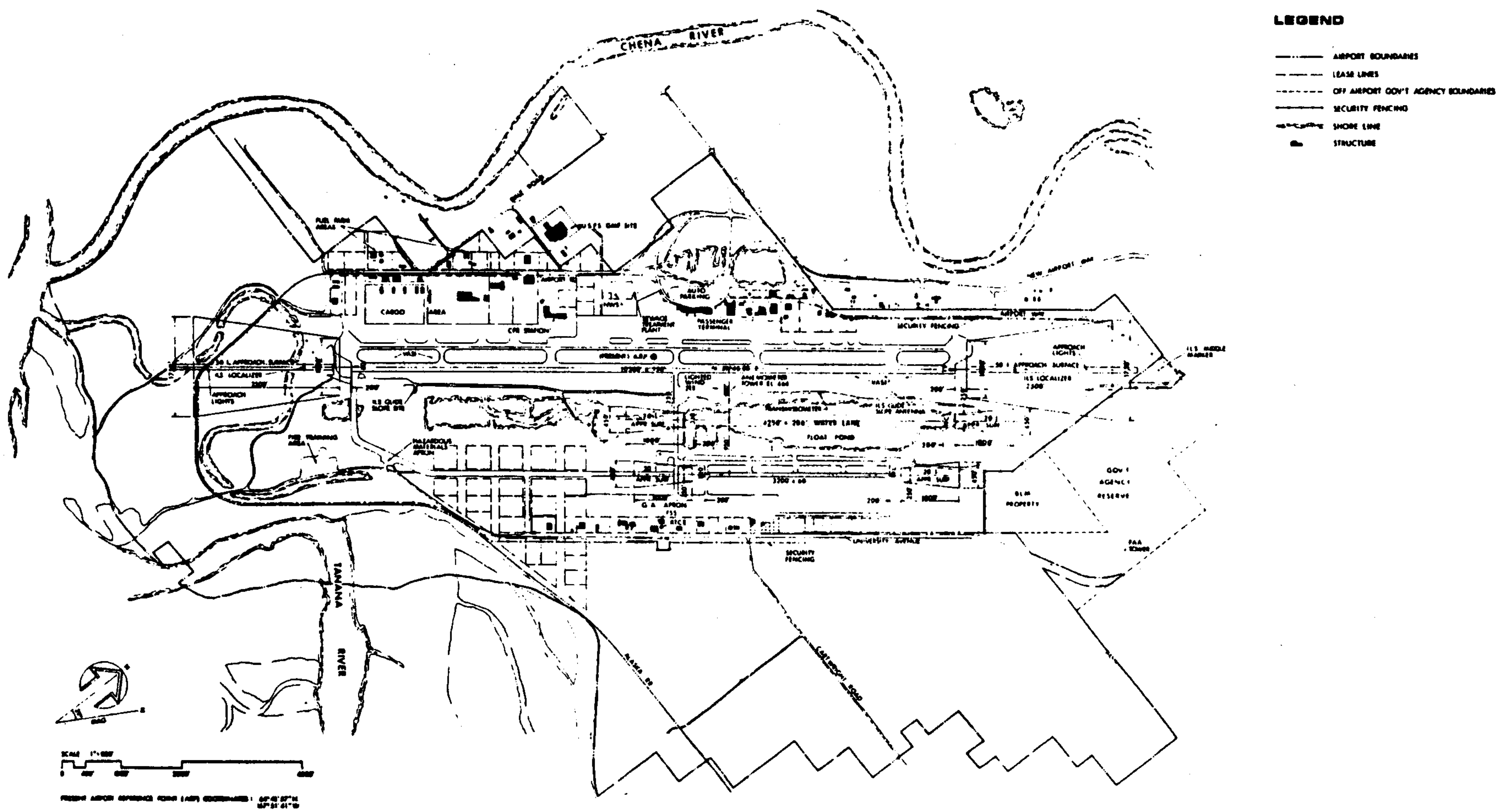
(1977-1982)

YEAR	INBOUND (Lbs)	OUTBOUND (Lbs)	TOTAL (Lbs)
1977	94,276,412	162,304,099	256,580,511
1978	99,358,565	162,669,378	262,027,943
1979	103,589,738	155,885,827	259,475,565
1980	95,800,920	157,068,269	252,869,189
1981	119,343,401	186,479,223	305,822,624
1982	118,323,615	181,394,276	299,717,891

Source: Accounting Department, Anchorage International Airport, 1983.

FIGURE 2.6

FAIRBANKS INTERNATIONAL AIRPORT LAYOUT



Source: Airport Master Plan Study, Fairbanks International Airport, (Unwin, Scheben, Korynta & Huttle, et. al, 1980)

TABLE 2.19

HISTORICAL AIRCRAFT OPERATIONS

FAIRBANKS INTERNATIONAL AIRPORT
(Fiscal Years 1970-1980)

YEAR	AIR CARRIER	AIR TAXI[a]	GENERAL AVIATION ITINERANT	GENERAL AVIATION LOCAL	MILITARY	TOTAL OPERATIONS
1970	31,277	--	42,880	32,089	724	106,970
1971	19,331	--	41,716	36,494	1,186	98,727
1972	14,536	--	48,497	42,194	1,934	107,161
1973	11,561	--	54,759	57,355	2,200	125,875
1974	13,056	--	67,531	59,624	2,062	142,273
1975	18,490	46,218	51,154	63,013	1,490	180,365
1976	19,334	37,272	49,633	83,877	1,358	191,474
1977	15,872	32,731	54,644	103,563	1,411	208,221
1978	13,205	26,905	49,413	74,932	1,398	165,853
1979	19,292	15,139	47,262	63,649	1,485	146,827
1980[b]	21,434	14,361	59,917	76,799	2,017	174,528

[a] Not reported until FY 1975. Includes commuter airlines operations.

[b] Federal Aviation Administration Air Traffic Control Tower records.

Source: Unwin Scheben, Korynta & Huettl, Fairbanks International Airport Master Plan, 1980-2000, 1980.

TABLE 2.20

HISTORICAL ENPLANED PASSENGER AND CARGO TRAFFIC

FAIRBANKS INTERNATIONAL AIRPORT
(Fiscal Years 1970-1979)

YEAR	ENPLANED PASSENGERS	ENPLANED CARGO[a] (tons)	REVENUE LANDINGS
1970	172,805	68,474	18,970
1971	149,589	43,621	11,525
1972	146,635	38,604	9,977
1973	142,073	33,765	8,189
1974	164,183	69,662	13,669
1975	293,429	188,413	28,556
1976	357,359	105,863	22,601
1977	327,990	59,955	12,717
1978	265,202	63,817	14,298
1979	242,783	48,797	13,136

Note: Data in this table include the activity of CAB-certificated airlines and commuter airlines.

[a]Enplaned cargo data include freight, express, and mail.

Source: Unwin, Scheben, Korynta & Huettl, Fairbanks Airport Master Plan, 1980-2000, 1980.

percent), and the tonnage enplaned in 1979 was 74% less than during the peak year of 1975.

According to the Fairbanks International Airport Master Plan (Unwin,Scheben, Korynta & Huettl, 1980), CAB certificated carriers accounted for 92% of the enplaned passengers at the airport in 1979, while commuter airlines enplaned only 8%. Commuter airlines, however, enplaned considerably more cargo than the certificated carriers (82% versus 18%, respectively), reflecting the role the facility play as a transshipment point for cargo to outlying communities.

2.2.2 Fleet Utilization and Service

2.2.2.1 Fleet Utilization

The fleet utilized in the Diapir Field study area involve a wide variety of aircraft. These include the multi-engine Boeing 727 and 737 jet aircraft operated by Wien and Alaska Airlines, large cargo aircraft such as the DC-8 and Hercules, smaller piston and propellor driven aircraft and single and twin engine propellor airplanes. Rotary wing aircraft are heavily used by the oil industry. The following paragraphs describe the characteristics of the fleet in commercial service on the North Slope. Table 2.21 describes the runway length limitations for selected aircraft types.

Boeing 727-200. This is a higher horsepower, higher capacity "stretch" version of the regular B-727. It is powered by three 48,000 horsepower jet engines, is 47m (153 ft.) long with a wingspan of 33m (108 ft.), has a gross take-off weight of 86,000kg (191,000 lbs.), and can carry a payload of 18,000kg (40,000 lbs.) or 145 passengers. The aircraft cruises at 1,000km (622 mi.) p/hr with a range of 3,900km (2,400 mi.).

Boeing 737-200. The Boeing 737-200 operated by Wien in its North Slope service is a stretch version of the standard B-737. It has two 32,000 horsepower jet engines, is 30.5m (100 ft.) long with a wingspan of 27.4m (90 ft.), and has a gross weight of 56,700kg (125,000 lbs.). Its payload is 15,500kg (34,000 lbs.) or 115 passengers depending upon configuration. It cruises at 922km (573 mi.) p/hr with a range of 2,900km (1,800 mi.).

Table 2.21

Runway Length Limitations
Selected Aircraft Types
(feet)

	Capacity Full	Partial	Comments
Boeing 727-200	6000	6000	
Boeing 737-200	5000	5000	
C-130 Hercules	5100	5100	Under favorable weather conditions runways less than 5100 feet can be used.
Twin Otter	1500	1200	
Piper Navajo	3000	2800	
Dash 7	2500	2200	Under favorable weather conditions aircraft has worked on 2000 foot runways.

Source: Personal communication with Janice Frank, Office of Aircraft Services, U.S. Department of Interior, Anchorage.

C-130 Hercules. Alaska International Airlines is the major operator of this high capacity cargo aircraft. It is a high wing, rough-field aircraft powered by four, 16,200 horsepower turbo-prop engines, is 40m (130 ft.) long with a wingspan of 41m (133 ft.) and has a maximum gross take-off weight of 70,000kg (155,000 lbs.). The C-130 can carry as much as 24,000kg (53,000 lbs.) and cruises at 422km (262 mi.) per hour. It often operates from temporary airfields or even pack ice and is used primarily to supply the needs of the oil industry.

Twin Otter. The Canadian-built Twin Otter is a rugged, high-wing bush aircraft. It has twin, 1,300 horsepower turbo-prop engines, a maximum gross take-off weight of 5,670kg (12,500 lbs.) and can carry 16 to 18 passengers. It has a cargo hold and often is flown in a convertible cargo-passenger configuration. The Twin Otter is a slow airplane, cruising at about 250km (155 mi.) per hour, and has a range of about 1000km (620 mi.). It is used both as a scheduled air taxi and as a charter aircraft to supply the oil industry.

Dash 7. The Dash 7, manufactured by the Canadian firm, Dehavilland, is a rugged, twin engine aircraft, currently used on the North Slope by ERA. It has a cargo capacity of 5,500kg (12,000 lbs.) and can carry up to 50 passengers.

Piper Navajo. The Piper has twin piston driven engines of 850 horsepower, is 11m (35 ft.) long with a wing span of 13m (41 ft.) and has a gross weight of 3,500kg (7,800 lbs.). It has a payload of 1,300kg (2,800 lbs.), cruises at 435km (270 mi.) per hour and has a range of 2,000km (1,250 mi.). It is used primarily as an air taxi.

Cessna. This single engine propellor aircraft is popular among air taxi operators. Various models carry four to seven passengers and up to 500kg (1,100 lbs.) of cargo.

Helicopter. Helicopters are chartered and used to serve the oil industry. They are particularly useful during spring break-up when fixed-wing aircraft are unable to land on the frozen pack ice and when dirt fields are too wet and soft. Bell and Sikorski turbine helicopters are most popular.

2.2.2.2 Service

The Alaska Transportation Commission (ATC) regulates all common carriers operating within the State and, with the Civil Aeronautics Board (CAB), jointly regulates those carries operating intrastate routes. The ATC issues permits in three categories, air taxi operators, scheduled carriers and contract carriers. Scheduled carriers currently operate only fixed-wing aircraft, while both rotary and fixed-wing aircraft are available from contract and air taxi operators. (Peter Eakland and Associates, 1981).

Air Taxi Operators. Air taxi carriers operate from fixed bases of operation specified in their operating rights. Although most operate aircraft with gross take-off weights less than 5,670kg (12,500 lbs.), the ATC can grant air taxi certificates to operators having larger aircraft. Operators must provide "safe, adequate, efficient and continuous service from and maintain bases of operation at listed locations" as required by the CAB. Air taxi operators specialize in serving remote locations inaccessible by highway and typically receive subcontracts from larger carriers for mail routes. Under subcontract to Wien, Cape Smythe Air Service, based in Barrow, provides mail service to Wainwright, Nuiqsut, Atkasook and Point Lay. Other air taxi operators based in the study area include Jen-Air and Barrow Air (both based in Barrow) and Alaska International Air, ERA Helicopters, SEAIR, and Audi Enterprises all based in Deadhorse.

Contract Carriers. Contract carriers are private for-hire carriers which generally are not restricted by location in their operating rights. Principal contract carriers currently involved in North Slope activities are Northern Air Cargo and Alaska International Air (AIA) which has office/hangers at both Deadhorse and Barrow. Its activity is about equally divided between North Slope Borough villages and petroleum exploration and development. Scheduled carriers may also engage in contract operations where the point of origin is on a scheduled route. Alaska Airlines, for example, operates a twice daily Boeing 727 service from Anchorage to Deadhorse for SOHIO.

Three carriers are licensed by the ATC and have operating authority to provide charter helicopter service from Deadhorse. These are ERA Helicopter, SEAIR and Evergreen Helicopter of Alaska. Each of these carriers also has available servicing and maintenance facilities at Deadhorse Airport.

Air Logistics made application to the Alaska Transportation Commission for an extension of its operating authority to include Deadhorse Airport in 1982, however, the application was denied in light of protests from the three carriers with operating authority. The other carriers alleged that existing poor business did not justify the inclusion of another carrier into the marketplace. Air Logistics representatives indicate that they will reapply to the ATC for an operating extension for Deadhorse as OCS development activities increase (Maletto, 1983).

In addition to ERA, SEAIR and Evergreen, other Alaskan carriers, e.g., Air Logistics occasionally provide contract service for oil industry activities on the North Slope. These services can legally be provided to the oil industry or any other contracting agency. However, charter services cannot be provided by these carriers to the general public.

Operating data reported to the Alaska Transportation Commission suggest that only limited helicopter services were provided from Deadhorse by ERA, SEAIR and Evergreen in 1982. Almost 1,700 pilot hours of flight time were reported by ERA. Evergreen performed approximately 300 hours of flight time, while SEAIR provided no helicopter service. Although not evident in the statistics provided by the ATC, Air Logistics indicates that it also provided helicopter support to the oil industry during 1982; however, all of these flights originated from its Fairbanks facilities. The volume of contracted helicopter support by other Alaskan carriers was not obtained on a statistical basis for this report. However, discussions with helicopter service representatives suggest that their services were significantly less than those provided by ERA and Evergreen.

<u>Scheduled Carriers.</u> The ATC has only one category of scheduled carrier, but the CAB distinguishes between major truck airlines and commuter services. The CAB considers a trunk airline one that offers flights of more than 800km (500 mi.) usually with jets, while a commuter service flies aircraft with a gross weight less than 5,670kg (12,500 lbs.). At the present

time, there are no commuter airlines in the study area. Table 2.22 shows the level of service provided between Barrow, Deadhorse, Fairbanks and Anchorage and major cities. Table 2.23 shows the time and cost characteristics of these services. Air cargo rates from Anchorage to Barrow and Deadhorse are shown in Table 2.24.

Two trunk airlines currently operate service to the study area, Wien and Alaska Airlines. A third, Mark Air, commences in March (1984). Most traffic to Deadhorse and Barrow has an origin or destination outside the region or the State. Carriers providing connection service with Fairbanks and Anchorage are affected by development in the region. Trunk airlines providing such service are Wien, Alaska, Northwest Airlines, Western, United and Flying Tiger (cargo only).

Wien currently operates B-737 jets in either the all-passenger and mixed passenger-cargo configuration depending upon traffic demand to both Deadhorse and Barrow from Fairbanks and Anchorage. Wien's 1983 summer scheduled service to the North Slope included two flights a day to Barrow from Anchorage (with an enroute stop in Fairbanks) and four flights a day to Deadhorse from Anchorage, two of which stop enroute in Fairbanks. Service is somewhat less during the winter. Wien has 34 summer flights weekly from Anchorage to Fairbanks and 33 weekly flights from Anchorage to Seattle. In addition, the carrier directly serves the Lower 48 cities of Boise, Salt Lake City, Reno, Phoenix, Portland and Denver.

Alaska Airlines serves Deadhorse with three flights daily from Anchorage, one with an enroute stop in Fairbanks. The carrier concentrates on linking Anchorage and Seattle (45 flights per week in the summer of 1983), but it also serves Fairbanks from Seattle daily.

Northwest Airlines also provides nonstop Fairbanks to Seattle service. Its Boeing 727 service operates daily during the summer and five days per week during the winter. From Anchorage the carrier provides two daily DC-10 flights to Seattle and during the summer, one daily DC-10 nonstop flight to Chicago. Northwest also operates a B-747 cargo only flight between Seattle, Anchorage and Tokyo three times weekly.

TABLE 2.22

PASSENGER SERVICE PROVIDED BY SCHEDULED CARRIERS

SCHEDULED CARRIER	ROUTE	SUMMER 1983 SERVICE
Alaska	Anchorage-Fairbanks	42 flights/week
	Anchorage-Seattle	42 flights/week
	Fairbanks-Seattle	07 flights/week
	Anchorage-Deadhorse	21 flights/week
	Fairbainks-Deadhorse	07 flights/week
Northwest	Anchorage-Seattle	14 flights/week
	Anchorage-Chicago	05 flights/week
	Fairbanks-Seattle	07 flights/week
Western	Anchorage-Seattle	35 flights/week
Wien	Anchorage-Seattle	33 flights/week
	Anchorage-Fairbanks	34 flights/week
	Anchorage-Barrow	--
	Anchorage-Deadhorse	14 flights/week
	Fairbanks-Barrow	14 flights/week
	Fairbanks-Deadhorse	14 flights/week

Source: Carriers' Schedules

TABLE 2.23

SERVICE CHARACTERISTICS FOR SCHEDULED PASSENGER SERVICE TO NORTH SLOPE AND POINTS OUTSIDE THE REGION

LINK	CARRIER	STATUTE MILES	COACH FARE	¢/MILE	ELAPSED TIME
Seattle-Anchorage	Alaska	1,448	$ 309.77	21.4	3:05
Seattle-Fairbanks	Northwest	1,533	$ 377.29	24.6	3:05
Chicago-Anchorage	Northwest	2,839	$ 508.49	17.9	5.35
Anchorage-Fairbanks	Alaska	261	$ 101.00	38.7	0:55
Fairbanks-Barrow	Wein	503	$ 196.00	39.0	1:25
Fairbanks-Deadhorse	Wein	377	$ 145.00	38.5	1:05
Anchorage-Barrow	Wein	725	$ 250.00	34.5	1:50
Anchorage-Deadhorse	Wein	631	$ 245.00	38.8	1:40

Source: Peter Eakland and Associates, Technical Report No. 65, Beaufort Sea Transportation Systems Analysis 1981.

Current Airline Fares (February 1984).

TABLE 2.24

Wien Air Alaska
General Freight Tariff to North Slope Communities

Anchorage to Barrow		Anchorage to Deadhorse	
Weight (lbs.)	**Tariff ($)**	**Weight (lbs.)**	**Tariff ($)**
Up to 44	26.00	Up to 37	21.00
44 to 99	.60/lb.	37 to 99	.56/lb.
100 to 999	44.10/100 lbs.	100 to 999	41.00/100 lbs.
1000 to 3999	37.00/100 lbs.	1000 to 2999	40.00/100 lbs.
4000 to 5000	36.00/100 lbs.	3000 to 3999	37.00/100 lbs.
		4000 to 5000	33.00/100 lbs.
Type A Container (Igloo)			
to 4000	1440	to 4000	1300
4000 to 8000	32.00/100 lbs.	4000 to 8000	32.00/100 lbs.

Source: Personal Communication with Kevin Bohnert, Wien Air Alaska Rate Office, Anchorage, 1983.

Western Airlines offers 45 flights per week from Anchorage to Seattle using either a DC-10 or Boeing 727, seven flights per week from Anchorage to Portland, and three flights per week from Anchorage to Honolulu. The carrier also has three daily flights from Anchorage to Fairbanks.

United Airlines began scheduled daily service to Anchorage from Chicago and San Francisco using a DC-8 in the summer of 1983. Its service will be expanded to include a daily DC-8 Anchorage to Honolulu service in the fall of 1983.

Flying Tigers plays an extremely important role in the movement of air cargo into the State. It operates a scheduled service between Seattle and Anchorage, but generally Anchorage is an intermediate stop between flights from the Lower 48 and the Orient. Most flights are with a Boeing 747, although it occasionally uses a DC-8. In the summer of 1983, flights averaged three daily on the eastbound leg and two daily on the westbound leg. Most cargo is inbound, although fish is flown seasonally both to the Orient and the Lower 48. According to the carrier its total throughput at Anchorage International is currently about 21.8 million metric tons (24 million tons) per year.

Mark Air will begin service to Fairbanks and Barrow from Anchorage starting March 1, 1984. Both comunities will receive two flights daily from Anchorage. Mark Air will operate B-373 jets, and will carry both passengers and cargo as warranted. They plan to expand their service to Prudoe Bay (one flight daily) from Fairbanks and Anchorage in mid-April.

2.2.3 Regulation

The regulation of air carriers and air transportation facilities in the State of Alaska is the responsibility of four Federal and state agencies: the Civil Aeronautics Board (CAB), an independent Federal agency; the FAA of the U.S. Department of Transportation; the State of Alaska Department of Transportation and Public Facilities (DOT/PF); and the Alaska Transportation Commission (ATC).

The FAA is charged with regulating air commerce to foster aviation safety, and its responsibilities extend to aircraft, airmen, airports and navigational facilities. It also provides a large percentage of matching funds used in the State to expand, improve, and construct upgrade runways and landing aids at airports. Grants can be provided to either the state of local government depending upon the airport ownership. The State of Alaska owns and maintains a large number of airports in the State, including Barrow, Deadhorse, and Fairbanks and Anchorage International Airports.

Fares and routes are regulated by the CAB for interstate carriers and the ATC for intrastate carriers. The CAB's current policy of deregulation is designed to increase service while at the same time maintaining acceptable profits for the carriers. Interstate air freight transportation has been deregulated and interstate deregulation of passengers is proceeding on a five-year timetable. Guidelines are being established to guarantee essential service to small communities.

2.3 Highway

The highway network serving oil exploration and development on the North Slope includes three major highway systems: the Alaska Highway which serves to move a small amount of goods and industry related supplies originating in Canada and the continental U.S.; the Parks Highway, over which goods from Anchorage and Alaska Railroad interchange traffic from Whittier move; and the Dalton Highway (formerly Haul Road) onto which both Alaska and Parks Highway traffic converges and where traffic interchanged from the Alaska Railroad at Fairbanks and other Fairbanks traffic originates. Some truck traffic destined for the North Slope currently moves over the Richardson Highway from Valdez. Special shipments of pipe and related materials are shipped through Valdez on an irregular basis. Figure 1.2 indicates the location of major highways serving the oil industry related development on the North Slope. Highways serving the region are all designated as Federal primary roads with the exception of the Dalton Highway which is a Federal secondary road.

In addition to the major Alaska highways, North Slope area oil development is also served by an extensive network of seasonal and year-round roads which connect Prudhoe Bay with adjacent points and facilities, docks, oil rigs, gravel quarries and other exploration and development areas. Figure 2.1 indicates the location of these roads.

2.3.1 Infrastructure and Traffic

2.3.1.1 Parks Highway

The Parks Highway is a 576km (358 mi.) road link which begins north of the Anchorage metropolitan area and extends north by Denali National Park to Fairbanks. The highway is a two-lane bituminous concrete, sheet asphalt and rock asphalt road. Small segments of the highway along the Nenana Ridge between Fairbanks and Nenana have truck passing lanes. The highway is 8m (26 ft.) wide most of its length.

The overall road surface condition of the Parks Highway can be characterized as good. Similarly, traffic capacity constraints are virtually non-existent (Louis Berger and

Associates, Inc., 1983; DOT/PF, 1983). Performance ratings made by the DOT/PF in evaluating highways in terms of their road condition, ability to handle traffic and frequency of accidents, gives the Parks Highway an overall high rating (Louis Berger and Associates, Inc., 1983; Peter Eakland and Associates, 1982). The Interior Alaska Transportation Study discusses the status of Parks Highway condition and the criteria used for evaluation of the Parks Highway segments that were evaluated by DOT/PF during 1979 and 1980. With the exception of one segment, the evaluated portions of the Parks Highway have composite values greater than average for the state as a whole. Only one segment (the first seven miles of the highway around Wasilla) has a service value related to traffic capacity less than average, only one segment (between Healy and Nenana) has a road service condition below average, and only one segment has a poor accident rating. Selected problem areas identified for the Parks Highway are presented in Table 2.25.

Traffic on the Parks Highway is higher than most highways in Alaska. Average Annual Daily Traffic Volumes (AADT) exceed 5000 vehicles at only one location (first 11km (7.0 mi.)) on the highway. In only a few locations are traffic volumes greater than 1000 AADT.[1] Traffic volumes for selected representative segments are presented in Table 2.26.

Truck traffic on the highway ranges from less than five percent on segments with high AADT to 12 percent between Nenana and Ester (Louis Berger and Associates, Inc., 1983) Between 100 and 200 trucks a day move over portions of the Highway.

2.3.1.2 Alaska Highway

The Alaska Highway stretches 518km (322 mi.) from the Canadian border to Fairbanks. The highway is a two-lane bituminous concrete, sheet asphalt and rock asphalt road with the exception of approximately 32km (20 mi.) between a point just beyond Eielson AFB and Fairbanks which is four lanes. Two-lane portions of the highway range in width from 6m to 7.5m (20 to 24 ft.). Portions of the 6m (20 ft.) sections are being upgraded to 7.5m (24 ft.) by DOT/PF. Four-lane sections are all 15m (48 ft.) wide.

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[1] DOT/PF Annual Traffic Reports.

TABLE 2.25

PARKS HIGHWAY SELECTED PERIODIC ROAD CONDITION PROBLEM AREAS

ROAD MILE LOCATION[1]	PROBLEM
181.8	Poor alignment, sharp bridge curve
182.0	Icing
196.8	Slumping cut slopes
197 to 204	Pits
198	Settling roadway from melting permafrost
203	Rough bridge deck
204	Marginal highway alignment with bridge
204.9	Icing
205.5	Falling rock from high cut slope
206	Icing
209.5	Setting roadway from melting permafrost
210	Road cracking and sliding on clay
217.5	Falling rocks
218.2	Seasonal frost heave
224.0	Permafrost sliding
235.0	Icing
251.5	Heaving roadway due to seasonal frost. Poor foundation.
252 to 269	Seasonal heaving, longitudinal cracks, road settling.
271 to 271.4	Rock slide area
271.8	Bank erosion
302.5	Cut slope failure, pavement heaving
304.2	Road alignment and landslide problems
313.0 to 313.2	Road settling, poor foundation

[1]Refers to road mile as defined by Alaska Department of Transportation & Public Facilities.

Source: Louis Berger & Associates, Inc., Interior Transportation Study, 1983.

TABLE 2.26

PARKS HIGHWAY TRAFFIC
1973 - 1981

	TRAFFIC (IN AADT)				
YEAR	AT WASILLA[1]	NEAR WILLOW[2]	BETWEEN CANTWELL AND WILLOW[3]	NEAR NENANA[4]	NEAR ESTER[5]
1973	n/a	737	334	595	637
1974	n/a	793	387	623	854
1975	n/a	943	516	791	1136
1976	n/a	1077	452	789	994
1977	n/a	1024	481	873	814
1978	n/a	1158	468	991	820
1979	5436	1248	442	914	834
1980	5599[7]	1288	468	946	874
1981	5757[7]	1367	610	1125	991
30th highest hour for year of highest traffic [6]	n/a	278	116	137	144
DOT/PF design hourly volume	n/a	n/a	460	440	630

[1]Represents highest traffic volumes on Parks Highway.

[2]At route mile 36.

[3]At route mile 150.6.

[4]At route mile 26.

[5]At route mile 315.

[6]The 30th highest hour is utilized by many states as the design criteria for rural highways.

[7]Estimated rather than from traffic counts.

Source: Peter Eakland and Associates, Beaufort Sea Transportation Systems Analysis, 1982, and Louis Berger & Associates, Interior Transportation Study, 1983.

In terms of condition, the Alaska Highway varies dramatically depending upon the highway segment. Much of the road surface can be described as being in poor condition. Performance ratings by the Alaska DOT/PF indicate that road condition is well below average for a considerable portion of the highway. Accident level values (indexes) are also 50 (average) or above the length of highway. The result is that only one segment falls below the average condition when viewed by its composite value. Selected problem areas experienced on the Alaska Highway are presented in Table 2.27.

Traffic on the Alaska Highway varies substantially depending upon the segment of the highway. Near the Canadian border, traffic volumes have historically been less than 500 AADT. North of Delta Junction, recent traffic volumes have ranged from below 1000 AADT to over 10,000 AADT near Fairbanks as indicated in Table 2.28.

Truck traffic over most of the highway ranges from 5 to 7 percent. From Eielson to Fairbanks the total volume of truck traffic increases, but as a percentage of total traffic volume it is negligible (Louis Berger and Associates, Inc., 1983).

2.3.1.3 Dalton Highway

The James B. Dalton Highway extends from Fox,[1] on the edge of the Fairbanks metropolitan area, 800km (500 mi.) to Prudhoe Bay. For the first 16km (10 mi.), the highway is a 7m (24 ft.) wide, two-lane rural primary road, with a surface of bituminous concrete, sheet asphalt and rock asphalt. The remainder of the highway is a 2-lane gravel secondary arterial which is 10m (34 ft.) wide between Livengood and the junction of the Elliot Highway and 9m (28 ft.) wide elsewhere. A small section of the road between Livengood and the Elliot Highway junction (6km (4 mi.)) is unimproved and only 4m (12 ft.) wide. Another section in this same segment (23km (14 mi.)) is 7m (22 ft.) wide (Louis Berger and Associates, Inc., 1983). Both sections have been scheduled by DOT/PF for improvements.

[1]Technically, the Dalton Highway begins at Livengood rather than Fox; however, for analytic purposes, the Fox to Livengood segment of the Elliot Highway has been addressed here.

TABLE 2.27

ALASKA HIGHWAY SELECTED PERIODIC ROAD CONDITION PROBLEMS

ROAD MILE LOCATION[1]	PROBLEM
31.0 to 48.5	Failing fill and cut sections[2]
48.5 to 81.5	Substandard curves, failing fill section, front heave problems
84.0 to 84.5	Failing fill sections, poor soils
105.0 to 108.0	Severe icing problems, fill stress[2]
116.0 to 118.0	Periodic severe flooding, aggradation beneath bridges
140.0 to 141.0	Settling
159.5 to 164.0	Thaw settlements
164.0 to 167.0	Heaving and settlement problems
175.0 to 194.0	Poor materials
210.6	Fill settling, permafrost thawing
211.0	Fill settling, permafrost thawing
216.5	Icing
220.2 to 221.5	Severe settling, permafrost melting
223.6 to 227.0	Settling
230.0	Bank sloughing
235.4	Differential settling
240 to 240.8	Settling
258.5	Minor flooding

[1]Refers to road mile as defined by Alaska DOT/PF.

[2]Scheduled for reconstruction.

Source: Louis Berger & Associates, Inc., Interior Transportation Study, 1983.

TABLE 2.28

ALASKA HIGHWAY TRAFFIC

YEAR	TRAFFIC (IN AADT) NEAR CANADIAN BORDER[1]	NEAR TOK[2]	SOUTH OF DELTA JUNCTION[3]	NORTH OF DELTA JUNCTION[4]	EILESON - NEAR NORTH POLE[5]	NEAR FAIRBANKS[6]
1973	252	630	178	451	4717	6693
1974	256	350	200	456	4074	7783
1975	327	490	345	643	5918	10153
1976	292	440	310	595	5283	11266
1977	285	450	334	699	5700	11145
1978	235	360	284	730	4742	11022
1979	198	300	260	493	5083	9944
1980	211	550	251	574	4033	9501
1981	279	n/a	n/a	569	n/a	10665
30th highest hour for year of highest traffic[7]	53	n/a	n/a	113	n/a	1019
DOT/PF design hourly volume	165	195	196	280	n/a	n/a

[1] At Gardiner Maintenance Station.
[2] Tok to Tanacross Road Junction.
[3] Dot Lake to Delta Junction
[4] At Birch Lake Maintenance Station.
[5] Eielson AFB to North Pole.
[6] Peter Eakland and Associates.
[7] The 30th highest hour is utilized by many states as the design criteria for rural highways.

Source: LBA, ITS, 1983. Alaska DOT/PF, Traffic Volume Reports, 1980, 1981, Peter Eakland & Associates, 1982.

The condition of the Dalton Highway varies from location to location, but overall it is in poor condition. In 1980, truckers using the route issued complaints concerning the safety and level of maintenance the road received. A 1980 study for Atlantic Richfield Company by Tetra-Tech identified surface problems related to the absence of adequate road material, depleting of fill, soft shoulders, erosion and permafrost related problems. The study also noted safety hazards at bridges due to inadequate clearances and decking surfaces and inadequate enforcement of speed limits (Peter Eakland and Associates, 1982). DOT/PF performance ratings have been made only for the first 12.9km (8.0 mi.) of the highway. Even this paved section has a condition value of 44, which is below average and a composite value of 55 (slightly better than average). A condition survey performed in the Western and Arctic Alaska Transportation Study (WAATS) indicated that of the approximately 241km (150 mi.) of road in the study area,[1] approximately 40 percent was in good condition, 50 percent in fair condition and 10 percent in poor condition in 1979 (Louis Berger and Associates, Inc. 1980). During the summer of 1983 the State DOT/PF performed about $4 million in bridge and surface rehabilitation work on the highway; nevertheless, the surface condition remains in only fair condition in most areas (personal communication with Interior Region DOT/PF, 1983).

Historical traffic levels along the Dalton Highway are presented in Table 2.29. As can be seen, traffic levels peaked during the pipeline construction years, dropped dramatically shortly after, and have increased gradually in recent years. Traffic volumes are very low, and north of the Elliot Highway consist to a significant degree of trucks moving goods and equipment to the North Slope. This predominance of truck traffic, however, is expected to change some due to the opening of the road to other than permit traffic.[2] Nevertheless, the road is expected to continue to be primarily a truck haul road.

[1] The Western and Arctic Alaska Transportation Study area included the road north of the Atigun River.

[2] On June 1, 1981, the Dalton Highway was opened to the public on a seasonal basis as far north as Dietrich (which is approximately 12km (20 mi.) south of the North Slope Borough). Prior to that time only vehicles on official business were able to cross the Yukon River Bridge. This fall (1983) a decision was made by the DOT/PF to keep the road open on a year round basis to Dietrich.

TABLE 2.29

DALTON HIGHWAY TRAFFIC

YEAR	TRAFFIC (IN AADT) FOX TO LIVENGOOD[1]	LIVENGOOD TO ELLIOT HIGHWAY JUNCTION[2]	ELLIOT HIGHWAY TO NORTH SLOPE/PRUDHOE[3]	YUKON BRIDGE TO NORTH SLOPE % Trucks
1973	62	--	--	--
1974	263	225	--	--
1975	750	750	--	--
1976	750	750	381	45
1977	470	470	231	38
1978	400	400	99	48
1979	399	231	71	59
1980	444	300	103	66
1981	n/a	n/a	139[4]	n/a

[1]Adjusted to disregard suburban, short hop traffic from Fairbanks area.

[2]Includes both truck and vehicle traffic, estimated.

[3]Based on traffic counts conducted at Yukon Bridge.

[4]Based on traffic count at Caribou Maintain at Mile 186.

Source: Louis Berger & Associates, Inc., Interior Transportation Study, 1983; Peter Eakland & Associates, 1982; and Annual Traffic Volume Report, 1981, DOT/PF.

2.3.1.4 Other Roads

In addition to the major highways, a number of local roads serve the area around Prudhoe Bay (see Figure 2.1). The most heavily traveled road near Prudhoe Bay is the Spine Road. This connects Prudhoe with the Kuparuk Field area and the recently constructed Kuparuk Industrial Center. A major bridge is located along this road.

Ice roads are also used to haul gravel and other materials to gravel islands, well sites and drilling pads, as well as to haul gravel for road construction, water for drilling of wells and moving drill rigs when conditions are suitable for this type of operation.

Traffic estimates on roads in the North Slope are scanty and in most cases non-existent. However, a substantial amount of traffic and goods move over these roads (Louis Berger and Associates, Inc., 1980). For purposes of identifying order-of-magnitude movements of this nature, selected freight movements are presented in Table 2.30. Although these movements are not comprehensive, they give a general impression of traffic moving over winter and other roads.

Besides existing seasonal and year-round roads, there are proposals to develop new routes on the North Slope. One such route is a proposed connection of the Dalton Highway to Barrow. Although such a route is currently being discussed it has met with stiff opposition from the North Slope Borough (North Slope Borough officials, 1983). Further, the cost associated with the route in relation to the benefits derived from traffic may make construction prohibitive. Based on these observations this link is assumed not to be developed during the time frame of this study.

2.3.2 Carriers

Approximately a dozen motor carriers have historically moved 80 to 90 percent of all truck traffic over the Dalton Highway to the North Slope. The key carriers include: Lynden Transport, Inc., Frontier Transportation Company, K&W Trucking, Sourdough Express, Drilling Mud Haulers, Kodiak Oilfield Haulers, 4-Star Terminals, Weaver Brothers, Pacific West, Alaska West Express,

TABLE 2.30

OFF-ROAD SURFACE FREIGHT MOVEMENTS IN NATIONAL PETROLEUM RESERVE-ALASKA AREA
1977 - 1979

ORIGIN	DESTINATION	NUMBER OF TRIPS	POUNDS OF FREIGHT*
Barrow	Wainwright		160,000
Barrow	Atkasook	4	12,000 gallons
Lonely	E. Simpson	8	630,000
Lonely	Ikpikpuk	8	296,000
Lonely	Ikpikpuk	12	72,000 gallons
Lonely	N. Kalikpik	44	1,626,000
N. Kalikpik	Ikpikpuk	51	1,887,000
Peard Bay	Kugura	35	1,400,000
Peard Bay	Tunalik	31	1,147,000
E. Simpson	J.W. Dalton	80	2,960,000
Foran	Drew Point	31	1,147,000
Harrison Bay		130	4,810,000
Harrison Bay	Kugura	16	600,000
Fish Creek	N. Kalikpik	110	4,070,000
Husky Point	Tunalik	72	4,521,000
Liz-C	Peard Bay	15	555,000
S. Meade	E. Simpson	31	1,147,000
S. Meade	Peard Bay	3	18,000 gallons
S. Simpson	S. Meade	160	5,920,000
Not Specified	Tunalik	97	3,589,000
Not Specified	Tunalik	50	2,400,000
TOTAL			38,865,000

* Commodity 015 - Fuel is in gallons.

Source: Louis Berger & Associates, Western Arctic Alaska Transportation Study, 1980.

TABLE 2.30

OFF-ROAD FREIGHT MOVEMENTS IN PRUDHOE BAY AREA
1976 - 1979

ORIGIN	DESTINATION	NUMBER OF TRIPS	POUNDS OF FREIGHT*
Prudhoe Bay	69°41'N-148°	Not Specified	3,000 (1)
	28'W		
"North Slope"	Point Thomson -	768	16,896,000
	Ice Roads	Not Specified	1,400,000 (1)
Mouth of Sag	Beaufort Sea		
River		1	3,000 (1)
Sec. 9 - T1N	Ugnogavik		
R10E	River	Not Specified	450,000
Staines River	Sec. 17 T9N		
	R24W	1038	51,900,000
Point Thomson	Not Specified	1024	54,272,000
Duck Island	Not Specified	4	60,000
Ignek Hill	Not Specified		
Rig 128 -		72	1,800,000
W. Beach	Not Specified		
Rig 97-		1536	38,400,000
Sag Delta	Not Specified		
Rig 29 -		2224	55,600,000
Kuparuk	Not Specified	Not Specified	15,000
Sea Ice #24	Not Specified	113	1,006,000
W.Mike Bay		2	55,000
W. Dock			
Pt. Thomson		5	50,000
#2		26	160,000
Reindeer Is.	Not Specified		
Not Specified		1	90,000
T59N R24E			
Sec. 9 T11N		Not Specified	1,200,000
R10E	Not Specified	5	100,000
Deadhorse	Loffland Rig #162	Not Specified	291,000
Deadhorse	Point Thomson #2	3	9,000
	Howe & Duck Is.	26	540,000
	Reindeer Island	188	4,800,000
	Point Thomson		

TABLE 2.30

OFF-ROAD SURFACE FREIGHT MOVEMENTS IN PRUDHOE BAY AREA
1976 - 1979

ORIGIN	DESTINATION	NUMBER OF TRIPS	POUNDS OF FREIGHT*
Deadhorse	Oliktok	6	220,000
Deadhorse	Oliktok/ Nuiqsuit	2	121,000
Deadhorse	Nuiqsuit	25	375,000
Deadhorse	Colville	44	630,000
Deadhorse	Duck Island	Not Specified	228,000 (1)
Deadhorse	Ignek Hill	4	89,000
Deadhorse	Powerline	Not Specified	14,000
Deadhorse	Point Thomson	378	10,489,000
Prudhoe Bay	Point Thomson		450,000 (1)
Deadhorse	Sag Delta #2	5	64,000
Deadhorse	Sag Delta #4	16	115,000
Deadhorse	Shell Pingo		
Deadhorse	West Beach	3	50,000
Prudhoe Bay	Reindeer Island	Not Specified	2,400,000 (1)
Prudhoe Bay	Kuparuk	Not Specified	405,000 (1)
Sagwon	Alyeska Haul Road	16	480,000
Beechey Point	Arctic National Wildlife Refuge	Not Specified	400,000 (1)
Umiat	Deadhorse	Not Specified	405,000
Staines	Deadhorse	4	150,000
W.Mikkelon	Deadhorse	1 Not Specified	1,200,000
Sag Delt #24	Sag Delta #2	Not Specified	1,200,000
Service City	Point Thomson	5	117,000
Point Brower	Howe & Duck Island	4	3,000
Far Creek	Sagwon	Not Specified	960,000
Pat River Oxbow	Sec. 23 T1N, R14E	Not Specified	9,750,000
ARCO Flow Station #1	ARCO Flow Station #2	Not Specified	349,000 (1)
Kuparuk River Flood Plain	Kuparuk River Gravel C Sec. 1, T1N-R12E	Not Specified	1,467,000 (1)

TABLE 2.30

OFF-ROAD SURFACE FREIGHT MOVEMENTS IN PRUDHOE BAY AREA 1976 - 1979

ORIGIN	DESTINATION	NUMBER OF TRIPS	POUNDS OF FREIGHT*
	Duck Island	694	17,362,000
	Ignek Hill	4	60,000
	Rig 128 - W. Beach	64	1,600,000
	Rig 97 - Sag Delta	1212	30,300,000
	Rig 29 - Kuparuk	1904	47,600,000
	Sea Ice #94	12	180,000
	W. Dock	2	110,000
		TOTAL OF ALL PAGES	358,442,000 or 159,222 TONS[2]

[1] These figures contain rough estimates of weights for parts of the freight movements.

[2] There is some fuel included in the freight movements that cannot be extracted.

Source: Louis Berger and Associates, Western Arctic Alaska Transportation Study, 1980

Mukluk Freight Lines and Big State Motor Freight. In addition to these carriers, numerous other smaller carriers also move products to the North Slope. These include Waggoner's and Transportation Inc.[1]. Table 2.31 gives the most current monthly Dalton Highway traffic for each of the major carriers. Table 2.32 indicates the percentage of total truckload shipments attributable to major shippers and shipper groups.

From a historical perspective, the major carriers maintained fleets of as many as 100 to 120 trucks during the 1974-1976 pipeline years. The companies were contract carriers, trucks were company owned, and union drivers were employed. After the peak pipeline years when traffic volumes and corresponding demand for trucking services decreased, many companies began leasing arrangements with non-union individuals who owned their own vehicles. Company owned fleets were gradually reduced so that today many carriers actually own less than 10 percent of their own fleet.[2] Fleet sizes were also reduced overall to the point where the largest companies, such as Lynden Transport and Frontier Transportation operate approximately 50 trucks. K&W, Sourdough Express, Drilling Mud Haulers, and Kodiak Oilfield Haulers operate approximately 25 to 30 vehicles, while the remaining carriers operate 25 or less.[3]

From the trucking industry's perspective, three key trends have affected the industry: the relaxation of ICC Traffic Regulations, which has increased outside independent competition, the trend for common carriers to lease, rather then own trucks, and economic conditions outside of Alaska where a depressed trucking industry looked for new markets in Alaska. These factors in association with a decrease in a tonnage shipped to the North Slope have resulted in a very competitive and sensitive time for major Alaskan carriers.

Carriers, which although to some extent are homogeneous, vary significantly in terms of operating procedures and the manner in which they service various shippers. To some extent, carriers tend to specialize in particular products or types of

[1]For a more complete listing of truckers see Table 2.31 footnotes.
[2]Exceptions to this generalization include Frontier Transportation and Weaver Brothers which operate company owned trucks.
[3]Interviews with major trucking firms.

TABLE 2.31

MONTHLY DALTON HIGHWAY TRAFFIC BY MAJOR CARRIER
(May 1982 to April 1983)

CARRIER	TRAFFIC (NUMBER OF TRUCKLOADS) MAY	JUNE	JULY	AUGT	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APRIL	TOTAL
Frontier Trans. Co.	211	474	211	289	347	195	247	283	139	143	n/a	82	2621
Lynden Transport Inc.	228	235	154	216	216	236	88	67	104	123	n/a	117	1784
K&W Trucking	98	208	100	138	138	108	132	193	201	70	n/a	91	1477
Sourdough Express, Inc.	123	68	75	93	90	93	75	110	68	105	n/a	44	944
Drilling Mud Haulers	48	86	92	74	47	86	58	66	50	65	n/a	28	700
Kodiak Oilfield Haulers	69	160	81	63	55	61	39	108	138	99	n/a	96	969
4-Star Terminals	71	127	110	69	60	79	44	64	51	75	n/a	66	816
Weaver Brothers	78	75	94	76	48	59	37	12	53	65	n/a	40	637
Pacific West	49	63	56	39	38	52	43	44	n/a	n/a	n/a	n/a	384
Alaska West Express	76	65	107	26	27	30	19	22	54	74	n/a	49	549
Mukluk	10	15	31	23	26	10	10	9	n/a	n/a	n/a	n/a	134
Big State Motor Freight	28	40	35	17	19	14	18	30	57	70	n/a	36	364
76 Aviation	8	21	9[a]	17	9[a]	10[a]	n/a	n/a	n/a	n/a	n/a	68	142
Waggoners	3	0	n/a	n/a	4	n/a	14	n/a	58	98	n/a	26	203
Transportation, Inc.	0	3	13[a]	10	49	5[a]	n/a	n/a	n/a	30	n/a	35	145
Sagger	0	0	n/a	n/a	21	6[a]	19	25	46	38	n/a	n/a	155
Other[b]	80[c]	132[c]	n/a	101[d]	145[d]	81[d]	111[d]	43[d]	134[d]	166[d]	n/a	161[d]	1154
TOTAL	1180	1772	1168	1251	1339	1125	954	1076	1153	1221	n/a	939	13,178

[a]Estimates based on monthly allocations and minimum shipment criteria.

[b]Other firms include: Northern Express, Sig Wold Storage and Transfer, ANCO, Chiodo Trucking, Totem Toter, Quality Transport, C&H Transportation, Cadwallader, Canadian LTL, Wrightway Auto, Huster's, D-8 Hauling, Kipperud Transportation, Bishop Trucking, Tachick Freight Lines, Inc., Northland Dairy, Rico Shippers, Big Wheels and other truckers.

[c]Represents 100% other truckload traffic.

[d]Represents the majority of other truckload traffic.

Source: Lynden Transport, Inc., 1983.

TABLE 2.32

MONTHLY DALTON HIGHWAY TRAFFIC BY MAJOR SHIPPER
(May 1982 to April 1983)

SHIPPERS	PERCENT OF TOTAL TRUCKLOAD SHIPMENTS											
	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APRIL
ARCO	45.1	61.9	n/a	33.7	31.1	33.6	44.7	54.1	48.9	25.6	n/a	19.3
SOHIO	14.4	16.6	n/a	13.6	14.6	13.7	8.6	5.3	12.5	19.5	n/a	13.1
Other Oil Companies[1]	1.4	0.7	n/a	2.0	--	--	1.0	0.8	1.1	4.2	n/a	3.2
Alyeska	8.2	3.3	n/a	4.8	5.7	7.2	6.3	4.1	5.2	5.4	n/a	6.3
Oil Company Agents and Contractors[2]	27.0	12.7[3]	n/a	24.5	23.3	28.3	11.3	18.8	22.5	20.5	n/a	28.1
Other	3.9	4.8[3]	n/a	21.4	25.3	17.2	28.1	16.9	9.8	24.8	n/a	30.0

[1] Includes Shell, Conoco and Exxon.
[2] Includes engineering and construction firms, support firms and others.
[3] Allocated on a percentage basis.
[4] Includes some agents and contractors and support firms not distinctly identified.

Source: Lynden Transport, Inc., 1983.

service, or serve particular shippers. For example, Drilling Mud Haulers, as the name might imply, moves a large proportion of North Slope drilling muds. Other companies move predominately pipe, or are favored for moving less than truckload (LTL) shipments. K&W, with a stateside parent company, moves freight which is forwarded from Lower 48 states; Sourdough serves the shipper Alyeska more predominantly than it does other shippers and the majority of Alyeska's freight is moved by Sourdough. Other shippers have in their fleets specialized vehicles, such as refrigerated cars (Lynden Transport).

2.3.3 Tariffs

Rate information for carriers is filed with the Interstate Commerce Commission (ICC) and is also maintained by the Alaska Transportation Commission (ATC). Rates are frequently adjusted, and are described differently from carrier to carrier. Rates are expressed on a point-to-point, truckload-per-ton-mile or a commodity basis. Consequently, they are difficult to compare. Typical tariffs are shown in Table 2.33.

Due to the increasingly competitive conditions existing in the trucking industry, rates for North Slope shipments have been gradually reduced. It is estimated that on the average, carrier rates have declined overall an average of 10 percent during the last four to five years (Lynden Transport, the Alaska Railroad and industry sources, 1983). Major shippers have also expressed concerns about firms' survival and the financial positions of companies that might cause them to lower service standards (ARCO, 1983).

Recently, as a result of ICC rulings deregulating the trucking industry, many independent contract carriers have filed and have obtained permits to operate in Alaska. These carriers compete directly and effectively with major local firms. The trucking industry can be characterized as highly competitive with some experiencing financial difficulties, others withdrawing from or entrenching themselves in a specific market and others in the process of considering modifying or adjusting operational and institutional procedures (Lynden Transport, ARCO Alaska Trucking Association, 1983).

TABLE 2.33

Trucking Tariffs
($ per hundred weight)

Freight	MINIMUM QUANTITY (lbs.)	SEATTLE to ANCH. TOTE	SEATTLE to ANCH. SEALAND	SEATTLE to FBKS. TOTE	SEATTLE to FBKS. SEALAND	ANCH. to FBKS.[a]	FBKS. to Prudhoe Bay[b]
BUILDING MATERIALS							
-General	40,000					3.38	
	42,000	8.46		12.71			
-Lumber	38,000		8.20		10.86		
	52,000						8.05
	76,000	5.54			7.70		
	114,000	5.37			7.22		
-Plywood	38,000		6.70		9.07		
	76,000		6.26		7.67		
	114,000		5.37		7.22		
-Insulation (Bat-type)							
less than	4,000		64.16		83.10		
	4,000		55.00		68.19		
	8,000		37.19		43.40		
-Cement (Bulkers)							
	52,000						8.05
DEPARTMENT STORE MERCHANDISE							
	15,000		15.66		20.62		
	30,000		14.72		19.61		
	34,000	11.53		13.07			
	45,000		14.13		N/A		
	60,000		13.52		18.35		
FREIGHT-ALL KINDS							
	38,000	11.69		14.71			
	40,000					3.38	

(continued)

TABLE 2.33 (cont.)

Freight	MINIMUM QUANTITY (lbs.)	SEATTLE to ANCH. TOTE	SEATTLE to ANCH. SEALAND	SEATTLE to FBKS. TOTE	SEATTLE to FBKS. SEALAND	ANCH. to FBKS.[a]	FBKS. to Prudhoe Bay[b]
GROCERIES/FOODSTUFFS							
	15,000	23.26		28.06			
	24,000		10.03		12.73		
	40,000	16.07		23.79			
	60,000		7.15		9.82		
	70,000	10.05		14.51			
	90,000		5.67		8.04		
	99,000		5.29		7.94		
	140,000	8.15		12.66			
PETROLEUM (drums)							
	40,000		7.19		10.41		
	42,000	7.08		10.25			
	60,000		6.94		10.17		
	80,000		5.74		8.90		
PETROLEUM (tank trailer)							
	gasoline					.2065 per gallon	
	diesel					.2315 per gallon	
	general (8,000 gal.)						.50 per gallon
PIPE	52,000						8.05

[a]Weaver Brothers   [b]Sourdough

Source: Louis Berger and Associates, Inc., Interior Alaska Transportation Study, 1982.

2.4 Rail

Alaska's rail system consists of about 1,050 track kilometers (650 mi.) of mainline, passing and yard track, siding and spurs. The system, known as the Alaska Railroad (ARR), extends from Seward via Anchorage to Fairbanks, Six branch lines include a line from the Port of Whittier, a branch to Anchorage International Airport, a branch between Matanuska and Palmer, a branch between Healy and Suntrana, a branch between Fairbanks and Eielson Air Force base and a Fairbanks International Airport branch. Figure 1.2 illustrates the location and layout of the railroad.

The ARR is unique in a number of aspects. It is the northernmost operating railroad in North America and the only federally-owned railroad. On January 14, 1983, President Reagan signed the Alaska Railroad Transfer Act of 1982, authorizing the sale of the ARR to the State of Alaska. The Act specifies that the United States Railway Association (USRA) will determine the ARR's fair market value within nine months of the date of enactment.

On October 14, 1983, USRA gave the State and Congress its evaluation of the net worth of the ARR ($22.3 million). The State has until July 14, 1984 to decide if it wants to purchase the railroad. If the State decides against the purchase of the ARR, then the Alaska Railroad Transfer Act directs the Secretary of Transportation to find another buyer. For the purposes of this analysis, it is assumed that the ARR will eventually be transferred to the State (Alaska Railroad and State Rail Planning officials, 1983). If this happens (as appears probable) the state intends to continue present operations of the railroad, and possibly expand it for resource development purposes.

2.4.1 Operations and Service

The Alaska Railroad can be characterized as a light density railroad in which little switching and yard classification work and minimal interchange of traffic with other carriers occurs (Louis Berger and Associates, Inc., 1983). Train operations display a great degree of seasonality, particularly as they relate to the movement of specific commodities, such as gravel (shipments peak in summer), and oil industry pipe (predominantly winter).

The ARR is typically directed toward the service and movement of five major commodities which display relatively simple traffic patterns and have a limited number of origins and destinations. Gravel, which in the last three years has accounted for over half of the total tonnage handled by the railroad, moves from Palmer to Anchorage. Coal, the second largest commodity shipped in terms of total tonnage moves from Healy to military bases along the railroad, Fairbanks and to Seward for eventual export. Refined petroleum products move southbound between the North Pole Refinery near Fairbanks and Anchorage and northbound between Anchorage and Fairbanks. Railcars move between Whittier and Anchorage and Anchorage and Fairbanks. Pipe and pipe fittings associated with oil development move from Seward to Fairbanks for eventual North Slope shipment. The railroad also moves in smaller quantities a number of other commodities such as cement, machinery, manufactured iron and steel, chemicals and forest products. Most of these move between Whittier and Anchorage and Anchorage and Fairbanks. Passenger traffic is also carried by the railroad, most of which travels 20km (12.4 mi.) between Whittier and Portage and between Anchorage and Fairbanks. Table 2.34 indicates the trip frequency of trains during 1981 by type of service.

From the perspective of supporting oil development, the most important rail movement is the shipment of pipe to Fairbanks. Besides pipe which comes primarily from Seward, to a lesser extent other materials also travel from Whittier and Anchorage to Fairbanks for eventual North Slope shipment.

2.4.2 Infrastructure and Traffic

Facilities owned and operated by the ARR related to the transportation of goods supporting oil development include the docks and yards operated by the railroad, the fleet used to accommodate the goods shipped, and the rail over which the shipments are carried.

2.4.2.1 Docks and Yards

The Alaska Railroad operates docks and/or yards at Seward, Whittier, Anchorage, Healy, Nenana and Fairbanks. Facilities at

TABLE 2.34

TYPICAL ALASKA RAILROAD TRAIN SERVICE

TRIPS PER WEEK FREQUENCY

	SUMMER 1981	WINTER 1980-81
FREIGHT SERVICE		
Anchorage-Seward	Bi-monthly	One/week
Anchorage-Whittier[a]	One/week	One/week
Anchorage-Whittier[b]	Every 9 days	Bi-monthly
Anchorage-Palmer (Local)	Bi-monthly	Bi-monthly
Anchorage-Fairbanks	Four/week	Three/week
Fairbanks-Healy	Three/week	Three/week
MIXED SERVICE (Combined Freight & Passenger Service)		
Anchorage-Fairbanks	Three/week	Three/week
PASSENGER SERVICE		
Anchorage-Fairbanks	Seven/week	-----------
Anchorage-Whittier	Nine/week	-----------

[a] Alaska Hydro-Train Railcar Barges
[b] Canadian National Railway Railcar Barges

Source: Louis Berger & Associates, Inc. Interior Transportation Study, 1983.

Healy are directed exclusively toward the movement of coal and Nenana facilities are directed almost exclusively to the transshipment of goods via commercial barge (Yutana) to Yukon River communities. At Seward, Whittier, Anchorage and Fairbanks, facilities are used to transport oil development related commodities.

The railroad-owned Seward dock facility receives primarily pipe and fittings with foreign origins. Most of the rail traffic coming from Seward at this time is generated by oil industry development (Alaska Railroad, 1983). The railroad-owned dock and shipping yard currently operates at well below its Trans-Alaska Pipeline peak when nearly 10,000 carloads and over 136,000MT (150,000 tons) of freight moved through the facility (Annual Report of the Alaska Railroad, FY 1975; Louis Berger and Associates, Inc., 1983). A 1979 Congressional appropriation for dock maintenance and rehabilitation has enabled the railroad to maintain the facility's condition. Future export of coal from Seward will be from a separate State-funded facility and will not reduce Seward's ability to handle oil development related shipments.

The railroad's Whittier dock and yard is used to serve barge ships. Whittier handles Alaska Hydro-Train (AHT) and Canadian National Railway (CNR) railcar barges coming from Seattle and Western Canada (see Section 2.1.1.4). Both AHT and CNR carry a variety of commodities such as container cars, construction materials, manufactured goods and machinery (Louis Berger and Associates, Inc., 1983) In the winter, CNR barges come only bimonthly. Like Seward, Whittier facilities suffer little capacity constraints and are capable of handling additional traffic. Whittier facilities also received special Congressional maintenance and rehabilitation appropriations in 1979 and continue to be upgraded and improved. During the period 1980 to 1983, yearly rail traffic originating at Whittier has averaged approximately 270,000MT (300,000 tons) (Louis Berger and Associates, Inc., 1983).

Anchorage is the ARR's major classification yard. Switching services are operated to make and break through-road freight trains to serve container cars for AHT and CNR barges at Whittier, as well as the local needs of Anchorage International Airport, Elmendorf AFB and Fort Richardson (Louis Berger and Associates, Inc., 1983). The ARR's Anchorage facility also serves vessels directly from the Port of Anchorage. The Anchorage yard has additional traffic handling and expansion capabilities.

The Fairbanks facility consists of a small classification yard. It serves local industrial and container facilities, as well as Fort Wainwright, Eielson Air Force Base, the North Pole Refinery and the Fairbanks International Airport. Currently, the AAR's oil development related facility requirements in Fairbanks are significantly less than those required during the Trans-Alaska Pipeline era. Consequently, there is little capacity constraint.

2.4.2.2 Fleet

The ARR's fleet can be divided into two categories: locomotives and rolling stock. Locomotives consist of some 65 units, of which 31 units are comparable to the "modern" locomotive unit. These units are 2400 to 3000 horsepower road switcher locomotives built or rebuilt in the late 1970's and early 1980's and a few 1600 horsepower engines rebuilt in 1977. The older locomotives are 1500 and 1600 horsepower engines built in the 1950's and are used in service yards or as backups around the system.

Rolling stock consists of over 2000 cars, most of which are open freight types (i.e. flatcar, gondolas, open hoppers, dump and ballast cars) used for handling bulk materials. Recent acquisitions to the fleet include freight cars used to handle coal and gravel shipments for Healy exports and increased gravel movements to Anchorage. Although a large portion of the rolling stock is aged and of lower capacity than comparable cars on other railroads, they are serviceable and, as has been the case with cars associated with gravel and coal movements, are capable of being replaced should traffic demands warrant. Therefore, fleet capacity limitations are of negligible concern.

2.4.2.3 Track

Track condition on the ARR varies markedly along the line. In some areas, the line is in excellent condition. In other areas, track shows excessive wear and requires excessive maintenance due to severe subsidence or frost jacking actions.

In the spring, as much as a third of the line north of Denali National Park is subject to slow order report.[1] However, despite permafrost related problems, the overall railroad condition is considered adequate. This is due to the light traffic density occurring over most of the line and recent improvements which have been made on more heavily used sections.[2] Also the railroad track has been upgraded as operating requirements and revenues permit (Alaska Railroad, 1983).

2.4.2.4 Traffic

Traffic on the ARR has increased markedly during the past three years. As indicated in Table 2.35, the most significant increase in total railroad tonnage has been related to the increased movement of sand and gravel. Gravel, together with bulk petroleum and coal shipments, have accounted for over 70% of total railroad traffic since 1979 and over 80% of traffic since 1981 (Louis Berger and Associates, Inc., 1983).

While traffic volumes for commodities and total traffic movements have fluctuated from year to year, particularly with respect to the three major commodities comprising the bulk of railroad traffic, traffic patterns have remained relatively constant. Each commodity has historically traveled from the same origin to the same destination year after year, the only exception being that coal movement from Healy to Seward is a relatively new phenomenon.[3] This observation implies that traffic volumes have fluctuated as a result of shifts in the levels of economic activity affecting traffic rather than as a result of the dynamics or type of service provided by the railroad.

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[1] Slow order report places speed restrictions on sections of the rail line well below other sections of the line.

[2] For example, the rehabilitation on the heavily travelled gravel run between Palmer and Anchorage.

[3] In 1981, Usibelli Mines in the Healy area exported their first shipment of coal to Korea via the railroad.

TABLE 2.35

ALASKA RAILROAD REVENUE TONS OF MAJOR COMMODITIES
(Amounts for Fiscal Years in Thousands of Tons)

COMMODITY	1979	1980	1981	1982	1983*
Sand and Gravel	637	396	1,797	2,754	4,000+
Bulk Petroleum	220	252	379	439	N/A
Coal	524	590	653	654	N/A
Iron & Steel Pipe & Fittings	33	37	83	165	N/A
Piggyback	89	92	113	122	N/A
Forest Products	55	109	101	77	N/A
Manufactured Iron & Steel	12	10	8	19	N/A
Cement	33	32	43	51	N/A
Machinery & Machines	24	16	28	24	N/A
Manufacturers & Miscellaneous Nos.	25	26	11	0	N/A
Other	156	181	146	198	N/A
TOTAL	1,808	1,741	3,362	4,503	6,000+

*Fiscal year 1983 figures had not ben released prior to this writing. Sand and gravel estimates and total estimates provided by the ARR.

Source: Alaska Railroad.

In terms of supporting oil development, the only commodity moving over the railroad which has more than a minor incremental effect on traffic is iron and steel pipe and fittings. In 1981 approximately 60% of this commodity group was related to oil development. In 1982, approximately 80% of this commodity group was related to oil development (Alaska Railroad, 1983).

With respect to total railroad traffic, iron and steel pipe and fittings accounted for less than three percent in 1981 and less than four percent of total traffic during the peak year in 1982.[1] Oil development related movements under this commodity classification accounted for less than two percent in 1981 and less than three percent during 1982. Further, 1983 oil development related traffic under this commodity class, which is not currently available in published form, has decreased dramatically and is estimated to be one-third to one-quarter of 1982 levels (Alaska Railroad, 1983). Based on these observations, although shipment of oil industry related iron and steel pipe and fittings can be a significant component of traffic in this commodity class, and although traffic levels have increased 4.5 times between 1980 and 1982, the level of traffic related to this commodity is relatively minor when compared to total railroad traffic and that virtually no effect on Railroad traffic capacity or utilization considerations. This conclusion is further enhanced when one considers that the Alaska Railroad is a light density line, and that even during peak service periods, train frequency for any part of the railroad does not exceed three trains per week. Furthermore, pipe and fittings generally are moved during the winter when traffic is generally at its lowest levels.

2.4.2.5 Rail-Truck Interchange

All railroad traffic destined for Prudhoe Bay or other North Slope exploration and production areas must be interchanged

[1] It should be noted that the 1982 figure represents the second highest volume of traffic moving under this commodity class in railroad history. The only time this figure (150,000MT (165,000 tons)) was exceeded were during the peak Trans-Alaska Pipeline year of 1976 when 158,000MT (174,000 tons) was shipped over the railroad.

from the rail to the trucking mode. Rail shipment of pipes, chemicals, construction materials and other commodities either move on the railroad from Whittier or Seward to Anchorage where they are interchanged or from Whittier, Seward and Anchorage to Fairbanks where transshipment occurs. Tubulars, casing and pipe, generally are shipped from Whittier (domestic) and Seward (foreign) directly to Fairbanks.[1] Other freight such as timber, lumber, drilling materials and chemical compounds travel on the railroad only between Whittier and Anchorage where truck transfer occurs. Less than truck load (LTL) shipments are usually consolidated at Anchorage freight terminals and shipped via truck through Fairbanks rather than moved by rail to Fairbanks and then transshipped to the North Slope by truck.

2.4.3 Financial Considerations

From a financial standpoint, the ARR has historically been a marginal enterprise. Were it not for federal ownership and the significance of the railroad in supplying military installations, it is doubtful that the railroad would be in operation today (Louis Berger and Associates, Inc., 1983). Net income has been negative every year in the last decade, with the exception of 1975 and 1976 when Trans-Alaska Pipeline related traffic affected the railroad's financial situation. In 1981, 1982, and 1983 increases in coal, petroleum, gravel and pipe related movements have increased the railroad's profitability. The railroad's profitability is understated due to the fact that Congressional appropriations of additional funds for capital expenditures are excluded from financial profit statements. From a financial point of view, the ARR is a light density railroad which must maintain certain minimal levels of operation, is extremely sensitive to changes in revenues generated from incremental traffic rather than cost factors. In other words, marginal increases in traffic have little impact on costs, but a great deal of impact on profits.

To the extent that oil industry related traffic, specifically pipe, can be considered incremental traffic, the effect of a two to three percent increase in traffic has had a

[1]Generally, pipe from foreign countries is purchased FOB Fairbanks and moves entirely by rail.

proportionally greater increase on revenues.[1] Historically, profitability has been almost directly related to oil industry development (Alaska Railroad, 1983).

Oil industry related rail shipments generally move under Alaska Railroad Tariff 3095, a joint class ocean-rail tariff from Seattle, or Tariff 3016, a local and proportional class and commodity rate between Alaska points that includes rail-truck tariffs.

Historically, tariffs on container cars, chemicals, drilling mud, machinery and building materials have increased modestly as a result of increased operating costs. However, with respect to the oil industry pipes, tariffs have decreased. This decrease is not related to a decrease in railroad tariffs, but rather a decline in the motor carrier portion of the joint carrier class pipe rate. A recent decline in the amount of pipe shipped to the North Slope and a corresponding increase in the number of trucking firms involved in the transshipment of railroad pipe has resulted in a highly competitive situation leading to the tariff decline.

2.4.4 Tariffs

The Alaska Railroad publishes tariffs which cover most of its passenger and commodity traffic, including contract tariffs covering building materials between Seattle and Alaskan points. Rates are published for intrastate as well as interline movements involving the Burlington Northern, Union Pacific, Southern Pacific, Alaska Hydro Train, Canadian National Railroad, connecting truck lines and Yutana Barge Lines. A summary of principal Alaska railroad tariffs is presented in Table 2.36. Each published tariff describes in detail the classification of commodities, application of rates and a variety of conditions of transportation.

1 Revenues for moving pipe, drilling mud, chemicals, machinery and other oil industry related materials generate significantly higher revenues per ton than bulk commodity movements. Consequently, from a financial standpoint, they are more significant than from a traffic volume perspective.

TABLE 2.36

SUMMARY OF PRINCIPAL ALASKA RAILROAD TARIFFS

TARIFF NUMBER	BETWEEN	CONTENT
3065	Prince Rupert, B.C. and Alaska	Joint & Proportional Rail-Water-Motor Class and Commodity Rates
3095	Washington and British Columbia and Alaska	Joint & Proportional Rail-Water-Motor Class and Commodity Rates (Seattle area-Alaska Rail-Water Tariff)
3101	British Columbia, Idaho, Montana, Oregon, Washington, Wyoming & Alaska	Joint Rail-Water-Rail Carload Commodity Rates (North Coast-Alaska Commodity Tariff)
9049	Alaska Railroad	Car Demurrage Rules and Charges
92	Wasilla-Palmer & Turnagain	Sand, Gravel, Crushed Rock or Riprap Tariff
3016	Alaska Points	Local & Proportional Class and Commodity Rates, Distribute Class & Commodity Rates, also Distance Rates
105	Healy & Fairbanks to selected ARR Stations	Coal Tariff
8	Selected ARR Stations	Petroleum Products
3058	Alaska Railroad Station & Points on Tanana and Yukon Rivers & Tributaries	Rail-River Rates
9003	Alaska Railroad	General Rules Tariff
9037	Seward, Alaska	Wharfage Charges, Terminal Services
3022	Alaska Railroad	Private Car Mileage Allowance
4106	Oregon-Washington to Anchorage, Alaska	Joint & Proportional Commodity Rates, Applying on Vehicles
85	Alaska Railroad	Passenger Tariff

Source: Alaska Statewide Rail Systems Study and the Alaska Railroad

On the Alaska Railroad, freight rates can be determined in two ways: by class rate or by commodity. Tariffs derived by class rates follow these procedures: First the applicable rating or class of commodity is determined from the Uniform Freight Classification Code published by the Uniform Freight Classification Committee. Next, a base rate provided by the railroad between stations, is applied. Using the rate base, the appropriate rate by commodity class is determined with surcharges added as necessary.

Commodity tariffs are tariffs applied to specific commodity groups and are generally lower and more commonly applied than class tariffs. Commodity tariffs on the Alaska Railroad cover products most commonly carried by the Alaska Railroad, including coal, petroleum products and sand gravel. Other commodity tariffs cover agricultural products, container car shipments, lumber products, logs, and others.

3. BASE CASE (WITHOUT OCS DEVELOPMENT)

3.1 Introduction

This chapter describes future conditions which are likely to influence the transportation system which will serve the Diapir Field area without the lease offering scheduled for June 1984. The analysis first identifies the socioeconomic factors which will affect transportation, then it provides forecasts of transportation demand by mode and finally it focuses on future changes in the transportation system.

In chapter four, the additional transportation demand, as a result of this lease offering, is added to the Base Case described below, in order to determine the effects of the lease offering.

3.2 Socioeconomic Factors Affecting Transportation

There are two principal types of future development which will affect the transportation system described above. These are (1) population growth in North Slope communities and other transportation centers and (2) North Slope oil and gas development activities.

3.2.1 Population Growth

Population growth in most Alaskan communities is closely related to economic opportunities, particularly for communities in close proximity to resource development areas. In one sense, all of Alaska can be considered a resource development area which attracts migration from the other states. This affects the population of Anchorage and Fairbanks (among others) and is modelled in some detail by ISER's MAP Model.

The results of the latest MAP Model forecasts for Anchorage, are presented in Table 3.1. Average 5-year forecast growth rates range from 0.7% to 5.5% for employment and 0.7% to 4.6% for population. Annual MAP Model forecasts fluctuate over an even greater range, and sometimes predict a decrease in total employment (but not population) from one year to the next.

TABLE 3.1

BASE CASE POPULATION FORECASTS

	ANCHORAGE				FAIRBANKS				NORTH SLOPE			
			AVERAGE GROWTH/YR		TOTAL POPULATION		AVERAGE GROWTH/YR		TOTAL OIL-RELATED		AVERAGE GROWTH/YR	
YEAR	TOTAL POPULATION	EMPLOYMENT	POPULATION	EMPLOYMENT	MAP MODEL	INTERIOR	MAP	INTERIOR	POP.	EMPLOY.	POP.	EMPLOY.
1983	203,600	111,500	--	--	62,900	62,900	--	--	4,510	4,900	--	--
1985	221,700	124,200	4.4%	5.5%	68,900	66,500	4.7%	2.8%	4,729	4,500	2.4%	-1.7%
1990	240,900	128,800	1.7%	0.7%	74,400	74,000	1.5%	2.3%	5,325	4,000	2.4%	-2.3%
1995	259,900	135,900	1.5%	1.1%	77,500	82,700	0.8%	2.1%	5,996	3,500	2.4%	-2.6%
2000	276,600	144,000	1.3%	1.2%	81,500	91,400	1.0%	2.0%	6,751	3,500	2.4%	0.0%
2005	297,300	155,600	1.5%	1.6%	86,900	100,900	1.3%	2.0%	7,600	3,250**	2.4%	-1.5%
2010	325,800	172,100	1.8%	2.0%	94,300	106,000	1.6%	1.0%	8,558	3,000**	2.4%	-1.6%
2020*	389,400	209,800	1.8%	2.0%	111,000	117,100	1.6%	1.0%	10,850	2,500	2.4%	-1.8%

*Same growth rate as 2005 to 2010 was assumed.

Note: Anchorage and Fairbanks totals rounded to nearest 100.

Source: Table I-11, I-12, I-18 from MAP model run of June 1983 for Sale 87, Draft North Slope Socioeconomic Study. SESP/MMS, January 1983, and Louis Berger & Associates, Inc., Interior Alaska Transportation Study Working Paper Socioeconomic Forecasts, June 1982.

Since transportation forecasts for land modes are available from the Interior Alaska Transportation Study, a comparison was made of population forecasts for Fairbanks from the Interior Study and from the MAP Model. Although they were made from very different assumptions, the two forecasts are very close through 1990. After that date, the Interior Study forecast grows slightly faster up to 2005, and total population under that forecast is 5% higher than the MAP Model by the year 2020. This difference is small enough to allow use of either forecast for Base Case purposes.

The population growth of the North Slope communities also affects the transportation system in the Base Case. Population forecasts were provided by the MMS, and are based on an assumed growth rate of 2.4% per year. Oil related employment on the North Slope is expected to decline from a 1983 high of 4,900 as oil production decreases. These figures are also shown in Table 3.1.

3.2.2 North Slope Oil and Gas Development Activities

Several oil fields are currently in production on the North Slope. Others are assumed to go into production or under exploration in the near future based on the latest available information. (See Table 3.2). The dominant production field is now Prudhoe Bay which will be in declining production after 1987, but is still expected to produce more than any other onshore field up to the year 2000. Water flooding plants and steam injection will be used to increase oil recovery from this field. Equipment for water flooding was a major item in this year's sealift.

The Kuparuk River field next to Prudhoe Bay (see Figure 2.1) is just starting to produce, and is assumed to be joined in the future by Lisburne-Point Thompson, National Petroleum Reserve-Alaska (NPR-A) and other onshore fields in the 1990's.

Two offshore fields, the 1979 joint Federal-State Beaufort lease offering and the 1982 lease offering in the Diapir Field, are also assumed to come into production in the next several years. First exploration, then production activities will contribute to transportation demand from these areas. This is

TABLE 3.2

CUMULATIVE DAILY OIL PRODUCTION ON NORTH SLOPE FROM PROVEN AND HYPOTHETICAL RESERVOIRS

	Producing Field[1/] (10^3 bbl/day)								
Year	Prudhoe Bay	Kuparuk River*	Lisburne Pt. Thomson[2/]	NPR-A[3/]	Beaufort Sea 1979	Other Onshore[4/]	Subtotal[5/]	Sale 71	Total[6/]
1981	1,500	0	0	0	0	0	1,500	0	1,500
1982	1,500	80	0	0	0	0	1,539	0	1,539
1983	1,480	80	50	0	0	0	1,558	0	1,558
1984	1,448	100	100	0	0	0	1,690	0	1,690
1985	1,490	100	200	0	0	0	1,771	0	1,771
1986	1,540	100	200	0	0	50	1,808	0	1,808
1987	1,540	100	200	0	0	50	1,906	0	1,906
1988	1,370	100	200	66	0	50	1,745	0	1,745
1989	1,050	100	200	132	0	50	1,465	0	1,465
1990	800	90	200	132	0	50	1,377	0	1,377
1991	765	81	180	132	41	100	1,295	0	1,292
1992	570	73	162	132	110	100	1,289	345	1,634
1993	450	66	146	132	148	100	1,279	876	2,155
1994	370	59	131	132	151	100	1,185	1,161	2,346
1995	310	53	118	132	151	100	1,112	1,096	2,208
1996	250	48	106	119	151	100	1,094	803	1,897
1997	200	43	96	107	148	100	1,013	548	1,561
1998	160	39	86	96	145	100	935	384	1,319
1999	130	35	77	87	142	100	867	282	1,149
2000	100	31	70	78	132	100	791	214	1,005
Recoverable Resource Estimates (10^6 bbl)[7/]	7,830	750	1,250	1,850	750	NA	12,430	2,380	14,810[6/]

1/ Data source for all producing fields except OCS sale 71 is Tussing, "Outlook for Alaska North Slope Crude Oil Production 1991-2000," 1981. The yearly production data for all fields except sale 71 are taken from Tussing, 1981, Table 3-A, at a 50-percent confidence level. The data source for each field production schedule is:

Prudhoe Bay Unit: Doschers Group, Inc., "Analysis of Results of Numerical Simulation of the Sadlerochit Reservoir Prudhoe Bay Field" (prepared for Alaska Legislature Joint Gas Pipeline Committee, 1980); Forecast from Simulation No. 233.

Kuparuk River: Tussing, 1980.

Cape Lisburne, Point Thomson: Tussing, 1980.

Other Onshore: Tussing, 1980.

NPR-A: U.S. DOI, Office of Minerals Policy and Research Analysis, "Draft Report of the 105(b) Economic and Policy Analysis," July 31, 1979. Forecasts from Policy Scenario No. 2.

Beaufort Sea 1979 Sale: BF FEIS (USDI, 1979). Forecast from Table I.B.4.b.-2, "Intermediate Case" Development Scenario.

Proposed OCS Sale 71: USGS, Alaska Conservation Division, Memorandum: Beaufort Sea sale 71 Resource Estimates and Development Scenarios, October 17, 1980.

2/ Includes the resources estimated in Prudhoe Bay Lisbourne Reservoir and the Sagavanirktok Delta, Duck Island, Point Thomson, and Flaxman Island areas.

3/ Represents delivered oil volumes for all NPR-A activity areas studied in the DOI 105(b) report. Although the acreage subject of resource evaluation and production scheduling in the 105(b) study is much larger than that selected by BLM for the December 1981 sale, the resulting resource estimates are relatively close in both cases (1.8 versus 1.6 x 10^9 bbl recoverable oil, respectively).

4/ Includes onshore and offshore state and federal lands not a part of the above identified fields; also includes Arctic Slope Regional Corporation lands. Does not include the Arctic National Wildlife Refuge.

5/ Taken from Tussing, 1981, Table 2, at 50-percent confidence.

6/ Addition of the "Subtotal" and "sale 71" columns. Note that this estimate does not carry 50-percent statistical confidence. The true 50-percent confidence estimate would be derived from statistical procedure.

7/ Data source for state acreage: Alaska Department of Natural Resources, Division of Minerals and Energy Management, "Proven and Probable Oil and Gas Resources, North Slope Alaska," September 25, 1980, Table 1. Data sources for federal acreages indicated in above footnote 1.

* New production estimates are available through peak production in the late 1980's. ARCO will have facilities capable of handling 250,000 barrels/day by 1986. However, no alternative production elements are available for production after 1989.

analyzed in the Base Case transportation demand in the following sections, following the timing shown in Table 3.2.

The major transportation implications of these oil field developments are related to the construction of base camps, drilling platforms and service facilities (frequently in modular form), drilling supplies (such as pipe and drilling mud), fuel, and gravel for artificial islands in the offshore fields. Each of these categories is discussed in further detail under each transportation mode.

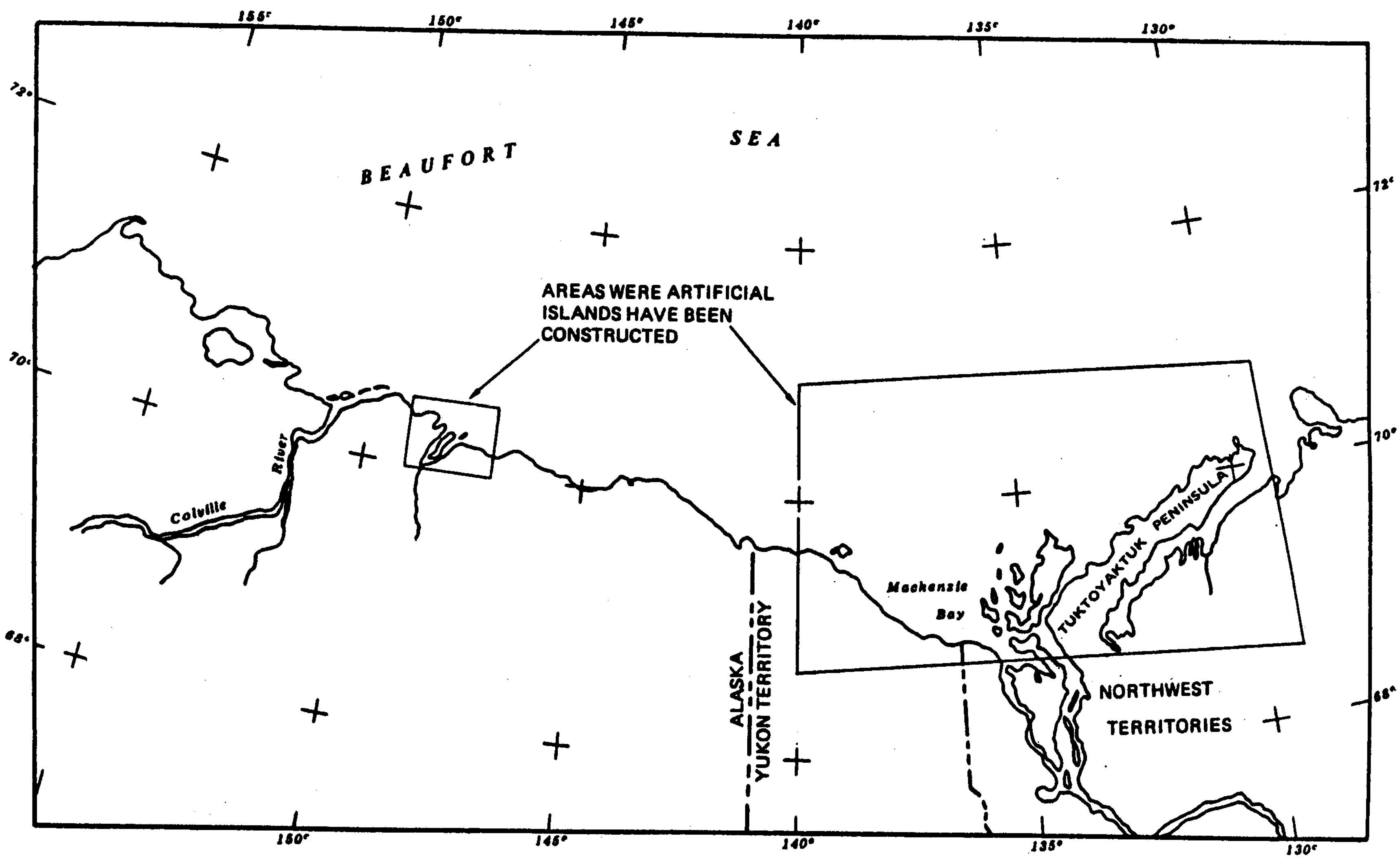
3.2.3 Artificial Island Development

Artificial islands have been constructed in the southern Beaufort Sea by various oil and gas interests to serve as drilling platforms for both exploration and production wells since 1972 (see Figure 3.1). There are currently eleven artificial islands (see Figure 3.2) which have been developed by SOHIO, Exxon, and Shell (Robertson, 1983). Development of these islands continues to have a significant impact upon local roads and sources of sand and gravel in the Prudhoe Bay area. Fill requirements have necessitated the hauling of onshore sand and gravel by truck via local roads, and by ice roads in the winter. These movements have also led to greater use of both conveyors and barges. As indicated in Table 3.3, almost 3.1 million cubic meters (four million cubic yards) of sand and gravel have been extracted and relocated for the purpose of artificial island construction in the Alaskan Beaufort Sea since 1977.[1]

Within the Diapir Field area, plans for the development of more artificial islands are already being contemplated or prepared by, at least, Shell, Mobil and Exxon. The potential location and anticipated magnitude of these projects are summarized in Table 3.3. The information presented in Table 3.3 is based upon limited discussions with oil industry representatives and other sources of available information.

[1] While significant amounts of offshore dredging have taken place only in the Canadian Beaufort Sea, small mechanical dredging operations have taken place in the Alaskan Beaufort Sea on the offshore islands, e.g. Niakuk 3.

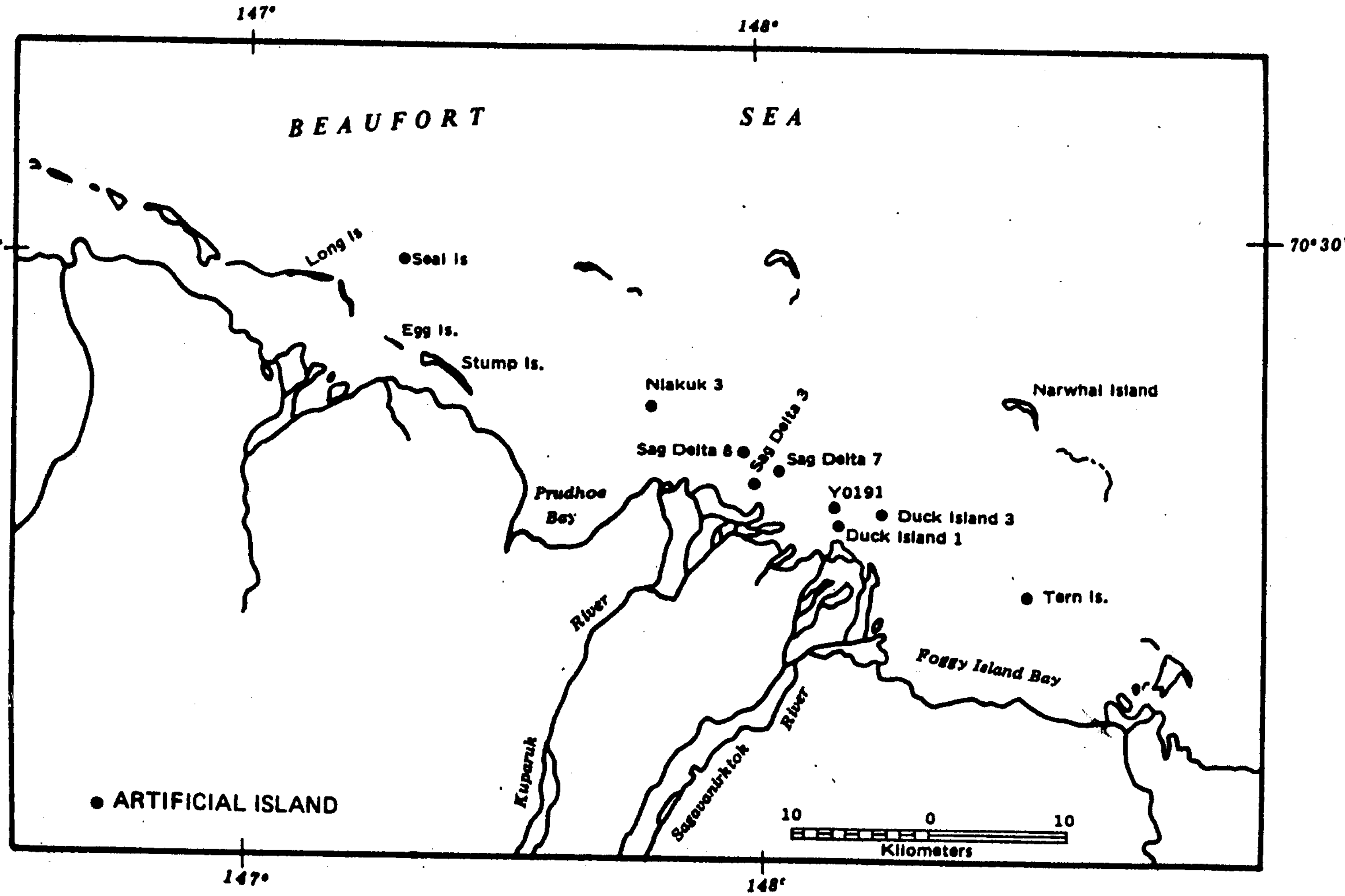
FIGURE 3.1



SOUTHERN BEAUFORT SEA

Source: U.S. Department of Interior, Minerals Management

FIGURE 3.2



ARTIFICIAL ISLANDS – ALASKAN BEAUFORT SEA

Source: U.S. Department of Interior, Minerals Management Service, 1982

TABLE 3.3

CHARACTERISTICS OF ARTIFICIAL ISLANDS IN THE ALASKAN BEAUFORT SEA

ISLAND NAME	DEVELOPER	YEAR(S)	WATER DEPTH (FEET)	CONSTRUCTION METHOD	SURFACE SIZE (FEET)	FREEBOARD (FEET)	FILL REQUIREMENTS (CUBIC YARDS)	REFERENCES
Sag Delta (D)	Sohio	1977	3	Winter Construction Trucks Over Ice	400 X 235	4	52,000	Cox, 1978
Duck Island 1 (D)	Exxon	1978	4-5	Winter Construction Trucks Over Ice	300 Dia	6	61,000 (100,000)*	Alaska Report (PI) 1978, Evans, 1978
Niakuk	Sohio	1979	10	Winter Construction Trucks Over Ice	300 X 400		131,000	AEIDC, 1978
Sag Delta 7 Endeavor (D)	Sohio	1980	11	Summer Construction Barge	350 Dia	13	158,000 (166,000)*	Northern Technical Services, 1981
Sag Delta 8 Resolution	Sohio	1980	7.4	Summer Construction Barge	350 Dia	13	131,000	Northern Technical Services, 1981
Duck Island 3 (D)	Exxon	1981	10	Winter Construction Trucks Over Ice			126,000 (180,000)*	Alaska Report PI, 1980
OCS Y 0919 (D)	Exxon	1981	18	Winter Construction Trucks Over Ice	480 Dia	11	301,000 (337,500)*	Exxon, 1980
Tern Island	Shell	1982	21.5	Winter Construction Trucks Over Ice	400 + 25 Dia		350,000	Woodward-Clyde Consultants, 1981
Seal Island	Shell	1982	39	Winter Construction Trucks Over Ice	400 + 25 Dia	25 + 5	750,000	Woodward-Clyde Consultants, 1981
Goose Island	Shell	1983	n/a	Winter Construction Trucks Over Ice	450 dia	15	140,000	Shell Oil Company, 1983
Mukluk Island	Sohio	1983	48	Winter/Summer Construction - Trucks Over Ice - Conveyor and Barge	350 Dia	21	1,250,000	Fairbanks News Miner

(D) - Hydrocarbon Discovery
Sohio - Sohio Alaska Petroleum Company (British Petroleum)
Exxon - Exxon Company, U.S.A.
Shell - Shell Oil Company
( )* - Data from MMS, 1982

Source: U.S. Department of Interior, Minerals Management Service et al, 1982.

Given the early stage of offshore oil project development, it is impossible to accurately assess future fill requirements for these and other potential artificial island developments. However, it is estimated that island developments occurring over the next 10 years will likely require about 14.5 million cubic meters (19 million cubic yards) of fill material (MMS, 1982).

Another related factor affecting the type of future island construction is the availability of onshore sand and gravel. The use of 2.3 to 3.1 million cubic meters (3 to 4 million cubic yards) of sand and gravel has already depleted much of the onshore borrow material available from existing sand and gravel sites in the Prudhoe Bay area. The lack of accessible sand and gravel resources in the region has already prompted private investment interests to consider the commercial transport of sandstone from the MacKenzie Delta in Canada to the Alaskan Beaufort Sea (Shehla Anjum, North Slope Borough Planning Department, personal communication, 1983). Limited available information generally suggests that untapped sources of surficial sand and gravel exist in the vicinity of Harrison Bay, as well as west of the Colville River (south of the Kogro River and Teshekpuk Lake).

Even with this untapped resource availability, oil industry interests have not been encouraged to the point of proposing expansion of road development into these areas. Such development is not expected until significant successful exploration warrants construction of other onshore infrastructure west of the Colville River.

In light of the growing depletion of accessible onshore borrow sources and the rising costs of transporting sand and gravel from various onshore locations, the MMS also anticipates that dredging of fill material from the OCS... "may be the most economical and feasible source for fill material in artificial island construction" (MMS, 1982). Consequently, a gradual change in the type of technology used for artificial island construction, from shore base fill to offshore dredging, can be expected during the next ten years. A recent trend has been the development of caisson-type units which considerably reduce the amount of fill material required to construct or install man-made islands. Some of these structures use sea water as ballast.

The preparation of plans for the development of at least four more artificial islands in the Diapir Field area is already underway. However, the projects identified in Table 3.4 reflect only the tentative short-term plans of various oil and gas industry interests. The longer term plans of the industry beyond the calender year 1993 cannot realistically be estimated in light of the numerous changing variables which affect industry decisions to pursue or "shelve" plans for future oil and gas exploration.

3.2.3.1 Methodology

With this perspective, an estimate and related schedule of anticipated artificial island construction projects was prepared for the short term, i.e., 1983 to 1996 (See Table 3.5). This estimate is based primarily upon previous MMS assumptions made concerning the schedule of development and production for the 1979 BF and 1982 lease offerings held in the Diapir Field (Alaska OCS Office, 1982), which are the only two offshore offerings in the Base Case. New artificial island construction in the Diapir Field will occur only within these two previous lease offerings without implementation of the 1984 lease offering. Further, available sources of onshore gravel can be feasibly transported to most of the now-selected 1982 lease offering blocks.

In order to convert the projections for the 1982 lease offering into Base Case estimates of anticipated artificial island construction without the June 1984 lease offering, assumptions were made regarding the likely proportion of gravel and caisson/artificial islands, offshore platforms, and other technology. In addition, limited discussions with oil and gas industry representatives were also made to improve the reliability of the projections in terms of the amount and schedule of anticipated artificial island construction.

3.2.3.2 Assumptions

In calculating anticipated fill requirements it was assumed that, given the generally shallow depths encountered on the lease offerings BF and 71, all platforms would be on artificial islands. One island is generally required for each exploration well, and up to 40 production wells can be drilled from one production platform (MMS, 1982).

TABLE 3.4

ANTICIPATED ARTIFICIAL ISLANDS PROJECTS

ALASKAN BEAUFORT SEA

ISLAND NAME	DEVELOPER	POTENTIAL LOCATION	ESTIMATED PROJECT START	CONSTRUCTION METHOD	SURFACE SIZE (feet)	FILL REQUIREMENT (cubic yards)
Fur Seal	Texaco	Harrison Bay	1984	Deep Sandbag	400 dia.	850,000
Harvard	Shell	Harrison Bay	UND	UND	400x350	UND
--	EXXON	Harrison Bay	1984	Deep Sandbag CIDS	400 dia.	1,200,000
--	SOHIO/ MOBIL	Harrison Bay	1984	Deep Sandbag	350 dia.	1,250,000

UND Undetermined at the time of this report.

CIDS Concrete Island Drilling System.

Source: Selected Oil and Gas Industry Representatives

TABLE 3.5

BASE CASE SCENARIO
ANTICIPATED ARTIFICIAL ISLAND DEVELOPMENT

	NUMBER OF WELLS*				TOTAL NUMBER OF ARTIFICIAL ISLANDS BUILT WITH OFFSHORE BORROW SOURCES*		TOTAL NUMBER OF ARTIFICIAL ISLANDS BUILT WITH ONSHORE BORROW SOURCES		FILL REQUIREMENTS (MILLION YD^3)	
	BF 1979 SALE		LEASE SALE 71							
YEAR	EXPL.	PROD.	EXPL.	PROD.	EXPL.	PROD.	EXPL.	PROD.	OFFSHORE	ONSHORE
1983	6(6)	--	--	--	1	--	5	--	1.10	1.80
1984	7(7)	--	--	--	1	--	6	--	1.10	2.16
1985	2(2)	(1)	4(4)	--	2	1	4(2)	--	3.90	3.34
1986	1(1)	3(1)	9(9)	--	2(1)	--	8(2)	1	3.15	5.56
1987	--	12(1)	10(10)	--	3(1)	--	7(2)	1	4.25	5.20
1988	--	21	9(9)	--	3(1)	--	6(3)	--	4.25	5.01
1989	--	24	--	--	--	--	--	--	--	--
1990	--	18	--	(3)	--	3	--	--	5.10	--
1991	--	12	--	60(5)	--	4(1)	--	1(1)	8.85	2.85
1992	--	10	--	90(4)	--	4(2)	--	--	10.90	--
1993	--	4	--	90	--	--	--	--	--	--
1994	--	4	--	90	--	--	--	--	--	--
1995	--	2		42	--	--	--	--	--	--
TOTAL	16(16)	110(3)	32(32)	372(12)	12(3)	12(3)	36(9)	3(1)	42.60	26.92

* Peter Eakland and Associates, 1981; number in parenthesis indicates number of platforms.

Source: MMS, Arctic Sand & Gravel leave sale, November 1982, number in parenthesis indicates number of caisson islands (25%) among total number of islands for that year.

Given the general bathymetric conditions in the area, it was assumed that 25 percent of all islands would be designed as caisson retained islands in water 20 to 25m (65 to 80 feet) deep, and that all others would be sand bag retained islands, in average depth of 10m (30 feet). Future use of these construction methods in the Canadian and Alaskan Beaufort Sea is highly dependent on the operational success of each technique in future projects. For example, oil industry representatives suggest that a potential "high" success in SOHIO's Mukluk Island operation will increase industry optimism toward attempting the development of deeper sandbag retained islands in deeper nearshore waters.

Related estimates of island fill requirements are based on general design criteria for deep sandbag-retained islands at a 9m (30 ft.) depth, and caisson-retained islands, with a sand center, at a 24m (80 ft.) depth (Jahns, 1979). Using these criteria, theoretical onshore and offshore fill requirement were calculated for a 120m (400 ft.) diameter artificial exploration island, and 180m (600 ft.) diameter artificial production island. These are presented in Table 3.6 below.

3.2.3.3 Anticipated Island Construction and Related Fill Requirements

Estimated total fill requirements in this Base Case are 32.57 million cubic meters (42.60 million cubic yards) from offshore sources (dredging) and 19.82 million cubic meters (25.92 million cubic yards) from onshore sources. The yearly variations suggest a gradual, but strong transition toward the use of offshore sand and gravel sources. Those volumes translate into tonnage requirements of 54.4 million and 32.66 million metric tons (60 million and 36 million tons) of sand and gravel from offshore and onshore sources, respectively. (See Table 3.5)

In addition to sand and gravel fill requirements, caissons would have to be prefabricated where such facilities are available (e.g. Seattle and Japan), and transported to temporary offshore locations where they would be floated and towed to their respective island sites. Assuming that 4-100m (328 ft.) long caissons of 7,000MT (7,700 tons) each are required for an exploration island and 4-150m (492 ft.) long caissons of 10,400MT (11,500 tons) each are required for a production island, total caisson tonnage would be 335,000MT (370,000 tons)

TABLE 3.6

MATERIAL REQUIREMENTS FOR OFFSHORE ARTIFICIAL ISLANDS

	EXPLORATION ISLANDS	PRODUCTION ISLANDS
Top Diameter	120 m. (400 ft.) (caisson length 100 m.)	180 m. (600 ft.) (caisson length 150 m.)
Slope		
gravel island	1:3 trucked; 1:15/1:3 dredged	1:3 trucked; 1:15/1:3 dredged
caisson base	1:6 trucked; 1:15/1:6 dredged	1:6 trucked; 1:15/1:6 dredged
Average Depth		
gravel island	10 m. (30 ft.)	10 m. (30 ft.)
caisson island	25 m. (80 ft.)	25 m. (80 ft.)
Unit Fill Requirements, Onshore Sources		
gravel island	360,000 cu. yd.	780,000 cu. yd.
caisson island*	1,310,000 cu. yd.	2,850,000 cu. yd.
Unit Fill Requirements, Offshore Sources		
gravel island	1,100,000 cu. yd.	1,700,000 cu. yd.
caisson island*	2,050,000 cu. yd.	3.750,000 cu. yd.

* Caissons would require less fill than a gravel island at this depth (25 m.). Also, 80,000 m^3. less fill would be required if caissons with seawater ballast are used.

Source: Louis Berger and Associates, Inc.

for the 12 exploration islands and 168,000MT (185,000) for the 4 production islands, or a total of 503,000MT (555,000 tons), spread over a 8 year period, from 1985 to 1992, which would correspond to an approximate yearly tonnage of 63,500MT (70,000) over that period.

These figures represent maximum amounts, since caissons and CIDS type units are reusable. When the drilling of exploration/delineation well(s) at one site is complete, the caisson(s) can be refloated and moved to another site. Hence, the number of caisson units, actually built and transported, may be less than the sixteen units mentioned above.

3.3 Transportation Demand Forecasts

Base Case demand without the June 1984 Diapir Field offering is forecast for each transportation mode in the following sections. These forecasts are related to the factors previously described which will govern future traffic on the transportation system. They are not designed to be definitive, but rather to establish a basic point of reference for a detailed analysis of effects

3.3.1 Pipeline System Forecasts

A total of 264 km (164 mi.) of pipeline will be laid during the two-year period 1990 to 1991 to support development of the 1982 Diapir Field lease offering. Gathering pipelines serving separate producing fields will be buried offshore at a depth of at least 1.8m (6 ft.). These will connect with a trunk pipeline which would also be buried offshore. The trunk line may continue offshore to Prudhoe Bay or landfall at Oliktok Point east of the Colville River Delta, thereby bypassing both Harrison Bay and the river delta. The trunk line will connect with either the Kuparuk common carrier pipeline or TAPS at Pump Station #1 (oil) or the proposed Alaska Naturala Gas Transportation System (ANGTS). If the trunk line ties into the Kuparuk pipeline, the specification of the delivered hydrocarbons will be made compatible with Kuparuk pipeline requirements. If Kuparuk capacity is not sufficient to accommodate production, it can be expanded with additional pumping stations and/or a looped parallel line.

An alternative assumption is that gathering pipelines would be brought immediately to shore with the trunk pipeline running on shore and connecting with existing pipelines. The final location decision will balance the environmental impacts of onshore pipelines with the higher costs and potential for oil spills associated with offshore pipelines.

3.3.2 Marine Transportation Forecasts

3.3.2.1 Prudhoe Bay and Oliktok

The basis for determining the anticipated sealift traffic to Prudhoe Bay is generated by relating exploration and development activities to total transportation needs. Subsequently, total transportation needs are allocated by mode between the maritime route (sealift) and the Haul Road. Traffic bound for the Alaskan Beaufort via the MacKenzie River is anticipated to remain low, particularly since ARCO discontinued use of this route in 1981.

There are four types of cargo requirements to the North Slope. They are the dry cargo drilling supplies needed to drill the exploration and production wells, the fuel and drill water needs, the module requirements for plants and building units, and the construction material needs for the establishment of artificial islands.

The dry cargo drilling supply requirements were determined based on the anticipated schedule of well drilling and assumed tonnages required on a per well basis. It is estimated that 1,653MT (1,822 tons) and 1,092MT (1,204 tons) of dry cargo drilling supplies are required for each exploration and production well, respectively. These supplies typically include 40 percent of the drill pipes of diameter ranging from 5 inch tubing to 36 inch pipes, and 60 percent of dry bulk commodities or "mud", composed of bentonite (50 percent), cement (25 percent) and barite (25 percent). Therefore, the total dry cargo drilling supplies were developed assuming that supplies destined for each of the fields would be transported through the Prudhoe Bay area. The only exception to this is NPR-A. Ninety percent of NPR-A requirements are assumed to come through Wainwright and Camp Lonely, the historical routing for material destined for NPR-A exploration (see Table 3.7). The remainder is assumed to be landed on the beaches adjacent to the project sites. The allocation of the dry cargo drilling supplies by mode is shown on Table 3.8.

The fuel and drill water needs are also directly related to the number of exploration and production wells. The total fuel requirements are typically equal in tonnage to the dry cargo drilling supplies and two tons of drill water are required for every ton of fuel. Fuel comes from the ARCO tapping plant located at Prudhoe Bay and drill water is also manufactured locally. Fuel and water are trucked from those plants to the wells as described in Section 2.3.

Forecasting the demand for modules is rather difficult as it does not always match such indicators of activity as total oil

TABLE 3.7

FORECASTS OF NORTH SLOPE DRILLING ACTIVITIES AND ASSOCIATED DRILLING SUPPLY[1] TONNAGE REQUIREMENTS

Activity	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000
Beaufort Sea Sale -1979																		
Exploration	6	7	2	1														
Development				3	12	21	24	18	12	10	4	4	4	2				
Beaufort Sea Sale 71																		
Exploration	0	0	4	9	10	9												
Development									60	90	90	90	90	42				
Kuparuk																		
Phase 1																		
Later Phases	10	20	15	10	5													
Pt. Thompson-Lisburne																		
Exploration	3																	
Development	10	20	35	30	25	25	15	10										
Waterflood Project																		
Drilling	50	50																
Prudhoe Bay Development	20	20	15	15	15	10												
NPR-A																		
Exploration	3	4	5	5	2	3												
Development					30	30	60	75	60	60	60	30	30					
TOTAL EXPLORATION	9	7	7	11	10	9	0	0	0	0	0	0	0	0				
TOTAL DEVELOPMENT	90	110	65	58	60	59	45	36	78	106	100	97	97	44				
Prudhoe Bay Tonnage[2]	125	146	91	90	90	87	54	43	94	128	120	117	117	53				
Wainwright and Camp Lonely Tonnage[3]	5	7	9	9	36	37	65	81	65	65	65	33	33					

Notes:

[1]Tonnage for dry goods only, i.e. drill pipes (40%) and dry bulk (Bentonite, cement and barite) 60%. Fuel requirements are to be added and are equal in weight to dry good requirements. Assumed tonnage is 1,822 of dry good for each exploration well, and 1,204 for each development well.

[2]Prudhoe Bay area inbound tonnage requirements for drilling supplies. 100% from all fields except for NPR-A (10%).

[3]90% of NPR-A supplies.

Source: Peter Eakland and Associates, 1981, updated by Louis Berger & Associates, 1983.

TABLE 3.8

BASE CASE DRY CARGO DRILLING SUPPLIES REQUIRED AND ALLOCATION BY MODE FOR PRUDHOE BAY AREA

YEAR	TOTAL DRY CARGO DRILLING SUPPLIES[1] (1000T)	SEALIFT TO PRUDHOE BAY OR OLIKTOK[2] (1000T)	McKENZIE RIVER TRAFFIC[3] (1000T)	SALE 71 TRUNK PIPELINE TONNAGE[4] (1000T)	HAUL ROAD TRUCK LOADS[5]
1983	125	13	6	0	9,500
1984	146	15	7	0	11,080
1985	91	9	5	0	6,900
1986	90	9	5	0	6,830
1987	90	9	5	0	6,830
1988	87	9	4	0	6,600
1989	54	5	3	0	4,100
1990	63	4	2	25	5,500
1991	94	9	5	16	8,560
1992	128	13	6	0	9,714
1993	120	12	6	0	9,107
1994	117	12	6	0	8,880
1995	117	12	6	0	8,880
1996	53	5	3	0	4,022
1997[6]	0	0	0	0	0
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0

[1]Excluding modules (plants, buildings, etc.), fuel and drill water.

[2]10 percent of sealift tonnage is composed of drilling supplies as indicated by Sohio, 1983, based on historic data breakdown. The remaining 90 percent is composed of modules.

[3]MacKenzie River barge load figures assume five percent drilling tonnage will go by this route and average loads of 1,000 tons per barge. Route abandoned by ARCO in 1981.

[4]98 miles in 1990 and 66 miles in 1991, USGS, 1981. Assumes 250 tons per mile required including fuel.

[5]Haul Road Truck Loads are based on following assumption: 85 percent of drilling tonnage and 100 percent of gas pipeline tonnage will go north from Fairbanks by truck, truck capacity of 28 tons, and a factor of 2.5 to account for smaller than capacity loads and shipment of miscellaneous freight.

[6]All forecast drilling is to be completed by 1997.

Source: Peter Eakland and Associates, 1981, updated by Louis Berger & Associates, 1983.

production, exploration, or development efforts. A number of factors can affect demand; for example, the sharing of facilities by fields and the transfer of facilities among fields will reduce demand. The assumption used for forecasting purposes is that the historical one-to-one tonnage relationship of dry cargo drilling supply and module shipments will continue. It has been estimated that 10 percent of the dry cargo drilling supplies are shipped by sealift to the North Slope (Peter Eakland and Associates, 1981) and that drilling supplies currently added to the sealift convoy also compose 10 percent of total tonnage hauled. The remaining 90 percent is modules (Crowley Maritime, personal communication, 1983). Without the need for the sealift modules, drilling supplies would all transit via Southcentral ports and the Dalton Highway, except for those destined for NPR-A fields which are mostly routed via Wainwright and Camp Lonely. Modules destined for eastern NPR-A would be routed via Oliktok. Table 3.9 summarizes the anticipated level and schedule of sealift movements of modules to such locations as Prudhoe Bay and Oliktok and dry drilling supplies to Prudhoe Bay, Oliktok, Camp Lonely and Wainwright.

Traffic throughput at Prudhoe Bay and Oliktok is 95 percent inbound (Louis Berger and Associates, Inc., 1980) and is expected to remain at this same level as the large construction modules which compose 90 percent of the sealift are not expected to be returned.

As shown in Table 3.9, traffic at Prudhoe Bay is expected to slow down to a 64,000MT (70,000) ton level until 1988, and 45,000MT (50,000 ton) level thereafter until 1996, assuming the Base Case oil development. Conversely, Oliktok is anticipated to increase in importance as activities at the Kuparuk Field continue and exploration and development in the NPR-A expand. Sealift traffic at Oliktok is expected to remain in the neighborhood of 45,000MT (50,000 tons) up to 1989 at which point it will steadily increase to a maximum of 114,000MT (126,000 tons) in 1992 and 1993 before dropping down to 23,000MT (25,000 tons) in 1996. Sealift traffic by tugs and barges is shown in Table 3.10.

TABLE 3.9

BASE CASE ANTICIPATED SEALIFT TONNAGE

TO SUPPORT ANTICIPATED NORTH SLOPE OIL INDUSTRY ACTIVITIES
(1000 tons)

	PRUDHOE BAY			OLIKTOK			CAMP LONELY			WAINWRIGHT			TOTAL SEALIFT[7]		
YEAR	MOD.[1]	D.S.[2]	TOTAL	MOD.[3]	D.S.[4]	TOTAL	MOD.	D.S.[5]	TOTAL	MOD.	D.S.[6]	TOTAL	MOD.	D.S.	TOTAL
1983	85	9	94	31	4	35	-	2	-	-	2	-	116	17	133
1984	95	10	105	44	5	49	-	3	-	-	3	-	139	21	160
1985	60	7	67	28	3	31	-	4	-	-	4	-	88	18	106
1986	62	7	69	31	4	35	-	4	-	-	4	-	93	19	112
1987	63	7	70	49	6	55	-	16	-	-	16	-	112	45	157
1988	69	8	77	39	5	45	-	17	-	-	17	-	108	47	155
1989	42	5	47	65	7	72	-	29	-	-	29	-	107	70	177
1990	31	3	34	81	9	90	-	36	-	-	36	-	112	84	196
1991	45	5	50	97	11	108	-	29	-	-	29	-	142	74	216
1992	59	7	66	113	13	126	-	29	-	-	29	-	172	78	250
1993	53	6	59	113	13	126	-	29	-	-	29	-	166	77	243
1994	53	6	59	81	9	90	-	15	-	-	15	-	134	45	179
1995	53	6	59	81	9	90	-	15	-	-	15	-	134	45	179
1996	25	3	59	22	3	25	-	-	-	-	-	-	47	6	53
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: MOD. = Modules; D.S. = Drilling Supplies

[1]Beaufort Sea Sale 1979 = 100%; Beaufort Sea Lease Sale 71 = 50%; Pt. Thompson-Lisburne = 100%; Waterflood Project = 75%; Prudhoe Bay Development = 100%.

[2]10% of total sealift traffic to Prudhoe Bay.

[3]Beaufort Sea Lease Sale 71 = 50%; Kuparuk = 100%; NPR-A = 100%.

[4]10% of total sealift traffic to Oliktok.

[5]45% of drilling supplies to NPR-A.

[6]45% of drilling supplies to NPR-A.

[7]Excluding shipment of caissons for construction of artificial islands.

Source: Louis Berger & Associates, 1983.

TABLE 3.10

BASE CASE SEA LIFT TRAFFIC
(1000 tons)

Year	Tonnage	# Tugs[a]	# Barges[b]
1983	133	14	28
1984	160	17	33
1985	106	11	22
1986	112	12	23
1987	157	17	33
1988	155	16	32
1989	177	19	37
1990	196	21	41
1991	216	23	45
1992	250	26	52
1993	243	25	50
1994	179	19	37
1995	179	19	37
1996	53	6	11

[a] Based on historical experience it is assumed that one tug carries two barges

[b] A figure of 4,820 tons per barge is assumed based on the five year average tons per barge experienced during the years 1979 to 1983

3.3.2.2 Camp Lonely and Wainwright

Camp Lonely, a former DEW-Line station located 161km (100 mi.) southeast of Barrow at Pitt Point, has been used in the past as the major shipping point to NPR-A exploration sites. Drilling equipment has been brought ashore at two other locations, one east and the other west of Wainwright.

Financing considerations might necessitate more flexibility in the supply of drilling equipment than offered by the Arctic sealift beyond Point Barrow. Therefore, it is anticipated that Wainwright, located west of Point Barrow, with a 70 day navigation season (see Figure 3.3) will get as much of the total shipments of drilling equipment as Camp Lonely would, even though it is located further from the most promising NPR-A fields. Cat trains would be used to haul equipment inland from the two marine delivery sites at Wainwright to drilling locations in the eastern, northern and northwestern sections of NPR-A, believed to have the greatest potential. Table 3.9 depicts anticipated demand at Camp Lonely and Wainwright resulting from NPR-A activities.

3.3.2.3 Barrow

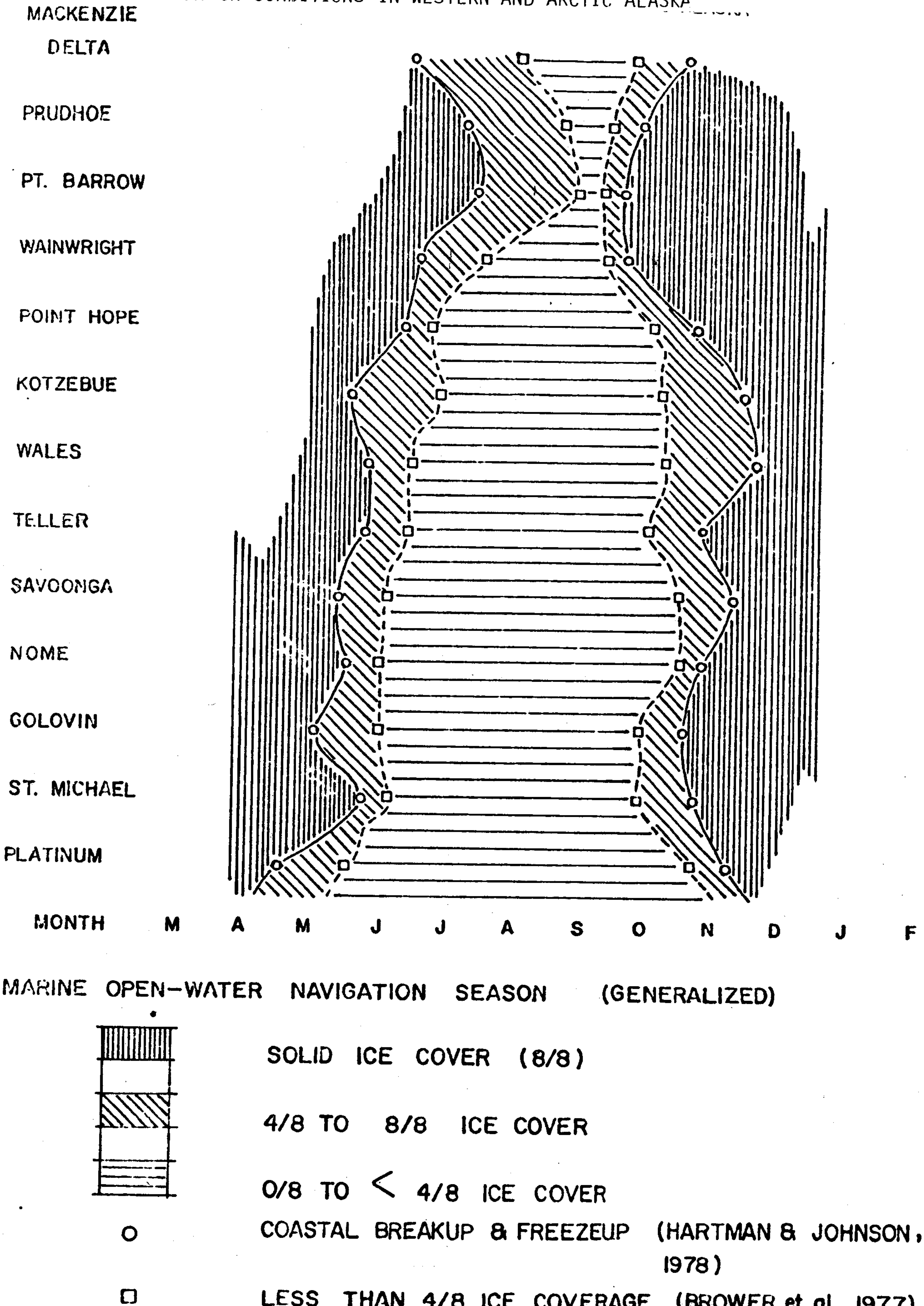
Three types of traffic are encountered at Barrow (see section 3.1.1.2). The portion carried by Bowhead Transportation from Seattle is the recurring part of total traffic related to population levels. The SCIMP output run corresponding to the June 1984 Diapir Field lease offering and the corresponding Base Case North Slope population growth is used for forecasting purposes.

The supply of dry and liquid bulk cargo by COOL BARGE to the NARL and DEW Line stations is anticipated to be reduced as a result of the 1981 closure of NARL. 1982 traffic is used as the forecasting base, and this traffic is likely to remain approximately the same throughout the forecast period (see Table 3.4).

The final portion is carried by private contractors involved in the large-scale North Slope Borough Capital Improvement Program. Related tonnage is expected to continue at the high 1982 and 1983 levels through 1986, then decrease as construction activity declines.

FIGURE 3.3

NAVIGATION CONDITIONS IN WESTERN AND ARCTIC ALASKA



urce: LBA, Inc., Navrin Basin (Sale 83) Transportation Impact Analysis, 1983.

The financing of the required yearly supply for Barrow and neighboring villages has posed some problems in the past and has resulted in the occasional use of air transport as a short run alternative. Consequently, there could be occasional short-term drops in the marine shipment forecasts shown in Table 3.11.

3.3.2.4 Southcentral Ports

Tables 3.12 to 3.15 show the Base Case anticipated demand at 10 year intervals for the ports of Anchorage, Whittier, Seward and Valdez as determined in the 1981 "Southcentral Region of Alaska Deep Draft Navigation Study", conducted by the U.S. Army Corps of Engineers (COE).

The results of the COE study concerning demand forecasts were summarized in Technical Report 65 (Peter Eakland and Associates, 1981). This study accounted for the impact of the construction of a refinery at North Pole and of the pipeline connecting Nikiski to Anchorage. It stated:

> "For Anchorage, the Corps of Engineers made two separate forecasts. In one, it was assumed that Anchorage would continue to handle all containerized cargo with a Fairbanks destination. In the other, it was assumed instead that Valdez would attract fifty percent of this traffic. The 218,000MT (240,000 ton) difference between the two scenarios for the year 2000 is substantial.
>
> Valdez's ability to attract 50 percent of Fairbanks containerized traffic appears to be overly optimistic. Such a condition assumes an equal attraction to Anchorage and Valdez by large shippers. Although the road mileages to Fairbanks from Valdez and Anchorage are virtually the same, Anchorage will continue to maintain a much higher level of marine service and also offers excellent intermodal transfers to air and rail transportation. Therefore, it is assumed that all containerized freight to Fairbanks will continue to pass through the Port of Anchorage (see Table 3.12).
>
> Seward is expected to receive increases in both containerized and neobulk cargo. By 2000, tonnages for the two categories together will still be less than 82,000MT (90,000 tons).

TABLE 3.11

MARINE TRANSPORT FORECASTS AT BARROW[1]
(tons)

	CARRIERS						Total Tonnage		
	Bowhead Transportation		COOL Barge		Private Carrier				
	Dry Cargo	Fuel	Dry Cargo	Fuel	Dry Cargo	Fuel	Dry Cargo	Fuel	Total
1982	4,500	5,400[2]	70	1,250	8,500	18,000[3]	13,070	24,650	37,720
1983	4,600	5,530	70	1,250	8,500	18,000	13,170	24,780	37,950
1984	4,700	5,660	70	1,250	8,500	18,000	13,270	24,910	38,180
1985	4,830	5,800	70	1,250	8,500	18,000	13,400	25,050	38,450
1986	4,950	5,940	70	1,250	8,500	18,000	13,520	25,190	38,710
1987	5,070	6,080	70	1,250	6,500	15,000	11,640	22,330	33,970
1988	5,190	6,230	70	1,250	4,500	11,000	9,760	18,480	28,240
1989	5,310	6,380	70	1,250	2,500	7,000	7,880	14,630	22,510
1990	5,440	6,530	70	1,250	1,500	3,000	7,010	10,780	17,790
2000	6,900	8,280	70	1,250	1,500	3,000	8,410	12,530	21,000
2010	8,750	10,500	70	1,250	1,500	3,000	10,320	14,750	25,070
2020	11,100	13,310	70	1,250	1,500	3,000	12,670	17,560	30,230

[1]Nearly exclusively inbound.

[2]1.5 million gallons.

[3]5.0 million gallons, including 3.0 million specifically for Barrow.

Source: Shipper's interviews.

TABLE 3.12

MARINE TRANSPORT FORECASTS AT VALDEZ

Valdez - Forecasts of Inbound and Outbound Cargo

BASELINE & DEVELOPMENT POTENTIALS INBOUND

1980 to 2030

(Alternative Routing: Port of Anchorage Handles Interior Alaska General Cargo)

CARGO HANDLING CATEGORY	THOUSAND TONS 1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	1.9	2.8	3.9	4.9	5.9	6.9
Alpetco	-	2.0	1.0	1.0	-	-
Alaska Gas Pipeline	-	101.0	-	-	-	-
Total	1.9	105.8	4.9	5.9	5.9	6.9
NEOBULK/BREAKBULK						
Baseline	.1	.1	.1	.2	.2	.2
Alpetco	-	375.0	-	-	-	-
Alaska Gas Pipeline	-	248.0	-	-	-	-
Total	.1	623.1	.1	.2	.2	.2
DRY BULK						
Baseline	-		-	-	-	-
LIQUID BULK						
Baseline	250.3	250.3	250.3	250.3	250.3	250.3

Source: Southcentral Region Deep-Draft Port Study, prepared by Alaska Consultants, Inc. and PRC Harris, Inc. for U.S. Corps of Engineers. 1981.

Valdez - Forecasts of Inbound and Outbound Cargo

BASELINE & DEVELOPMENT POTENTIALS OUTBOUND

1980 - 2030

(Alternative Routing: Port Anchorage Handles Interior Alaska General Cargo)

CARGO HANDLING CATEGORY	THOUSAND TONS 1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	2.4	2.4	2.4	2.4	2.4	2.4
Alpetco	-	78.0	78.0	78.0	-	-
Alaska Gas Pipeline	-	88.0	-	-	-	-
Total	2.4	168.4	80.4	80.4	2.4	2.4
NEOBULK/BREAKBULK						
Baseline	-	-	-	-	-	-
DRY BULK						
Baseline	-	-	-	-	-	-
LIQUID BULK						
Baseline	55294.4	55294.4	-	-	-	-
Alpetco	-	7340.0	7340.0	7340.0	7340.0	-
Prudhoe Bay	-	-	55294.4	55294.4	55294.4	55294.4
Total	55294.4	62634.4	62634.4	62634.4	62634.4	55294.4

(1) Alpetco
- Outbound container and liquid bulk movements begin in 1985 and are expected to continue to 2005. These throughputs are allocated to the 1990, 2000 and 2010 decade potentials.

(2) Alaska Natural Gas Pipe Line
- Outbound container cargo peaks in 1985 and is allocated to the 1990 decade potential.

(3) Prudhoe Bay Ongoing Development/Arctic Long-Range/Beaufort OCS
- Liquid bulk assumes various developments maintain present levels of crude shipment through TAP line beyond exhaustion of currently proved reserves.

TABLE 3.13

Port of Anchorage - Forecasts of Inbound and Outbound Cargo

BASELINE & DEVELOPMENT POTENTIALS INBOUND

(Alternative Routing: Port of Anchorage Handles Interior Alaska General Cargo)

CARGO HANDLING CATEGORY	THOUSAND TONS 1980	1990	2000	2010	2020	20[illegible]
CONTAINER						
Baseline	808.6	1183.3	1726.1	2069.4	2492.8	291[illegible]
Prudhoe Bay	-	126.0	23.0	23.0	-	-
Arctic Longrange	-	-	5.0	40.0	18.0	1[illegible]
Beaufort Sea OCS	-	16.0	16.0	7.0	7.0	[illegible]
Alaska Gas Pipeline	-	152.0	-	-	-	-
Healy Coal	-	1.0	2.0	2.0	2.0	[illegible]
Susitna Hydro	-	8.0	17.0	-	-	-
Total	808.6	1486.3	1789.1	2141.4	2519.8	293[illegible]
NEOBULK/BREAKBULK						
Baseline	54.4	66.0	79.2	91.3	103.7	11[illegible]
Prudhoe Bay	-	36.0	4.0	4.0	-	-
Arctic Longrange	-	-	2.0	20.0	5.0	5.[illegible]
Beaufort Sea OCS	-	5.0	5.0	2.0	2.0	-
Alaska Gas Pipeline	-	372.0	-	-	-	-
Susitna Hydro	-	-	3.0	-	-	-
Total	54.4	479.0	93.2	117.3	110.7	12[illegible]
DRY BULK						
Baseline	218.6	375.7	542.9	690.0	847.2	1004.[illegible]
Susitna Hydro	-	10.0	70.0	-	-	-
Total	218.6	385.7	602.9	690.0	847.2	100[illegible]
LIQUID BULK						
Baseline	990.7	990.7	990.7	990.7	990.7	99[illegible]

BASELINE & DEVELOPMENT POTENTIALS OUTBOUND

1980 to 2030

(Alternative Routing: Port of Anchorage Handles Interior Alaska General Cargo)

CARGO HANDLING CATEGORY	THOUSAND TONS 1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	140.9	140.9	140.9	140.9	140.9	140.9
Alaska Gas Pipeline	-	74.0	-	-	-	-
Total	140.9	214.9	140.9	140.9	140.9	140.9
NEOBULK/BREAKBULK						
Baseline	10.0	10.0	10.0	10.0	10.0	10.0
DRY BULK						
Baseline	.3	.3	.3	.3	.3	.3
LIQUID BULK						
Baseline	3.3	3.3	3.3	3.3	3.3	3.3

Source: Southcentral Region Deep-Draft Port Study, prepared by Alaska Consultants, Inc. and [illegible] Inc. for U.S. Corps of Engineers, 1981.

TABLE 3.14

Whittier - Forecasts of Inbound and Outbound Cargo

Projections of Inbound Baseline and Development Resource Cargo Potential 1980 -2030 (Thousands of Tons)

CARGO HANDLING CATEGORY	1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	160.0	242.3	336.5	420.2	507.3	594.4
Prudhoe Bay	-	12.0	2.0	2.0	-	-
Arctic Longrange	-	-	1.0	4.0	2.0	2.0
Beaufort Sea OCS	-	2.0	2.0	3.0	3.0	-
Healy Coal	-	-	-	1.0	1.0	-
Susitna Hydro	-	2.0	7.0	-	-	-
Total	160.0	256.3	348.5	429.2	513.3	596.4
NEOBULK/BREAKBULK						
Baseline	40.1	48.7	58.4	67.3	76.4	85.6
Prudhoe Bay	-	4.0	1.0	1.0	-	-
Arctic Longrange	-	-	-	2.0	-	-
Beaufort Sea OCS	-	1.0	-	-	-	-
Total	40.1	53.7	59.4	70.3	76.4	85.6
DRY BULK						
Baseline	32.6	56.1	79.5	103.0	126.4	149.9
LIQUID BULK						
Baseline	19.3	19.3	19.3	19.3	19.3	19.3

(1) Pruchoe Bay Ongoing Development
- Inbound container and neobulk ca-go flows peak in 1982 and are allocated to the 1990 decade potentials.

(2) Arctic Longrange
- Inbound container and neobulk cargoes peak during the 2000 through 2009 time frame and are allocated to the 2010 decade potentials

(3) Beaufort Sea OCS
- Inbound container and neobulk cargoes peak during the 1985 to 1995 time frame and are allocated to both the 1990 and 2000 decade potentials.

(4) Healy Coal
- Inbound container cargo peaks in 2011 and is allocated to the 2020 decade potential.

(5) Susitna Hydro Electric
- Inbound container cargo peaks in 1993 and is allocated to the 2000 decade potential.

Projections of Outbound Baseline and Development Resource Cargo Potentials 1980 - 2030 (Thousands of Tons)

CARGO HANDLING CATEGORY	1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	64.8	64.8	64.8	64.8	64.8	64.8
NEOBULK/BREAKBULK						
Baseline	23.0	23.0	23.0	23.0	23.0	23.0
DRY BULK						
Baseline	-	-	-	-	-	-
LIQUID BULK						
Baseline	1.3	1.3	1.3	1.3	1.3	1.3

Source: Southcentral Region Deep-Draft Port Study, prepared by Alaska Consultants, Inc. and PRC Harris, Inc. for U.S. Corps of Engineers. 1981.

TABLE 3.15

Seward - Forecasts of Inbound and Outbound Cargo

PROJECTION OF OUTBOUND BASELINE CARGO
1980 to 2030
(Thousands Tons)

CARGO HANDLING CATEGORY	1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	2.6	2.6	2.6	2.6	2.6	2.6
NEOBULK/BREAKBULK						
Baseline	-	-	-	-	-	-
DRY BULK						
Baseline	-	-	-	-	-	-
LIQUID BULK						
Baseline	-	-	-	-	-	-

Healy Coal Development

- Dry Bulk cargo will increase from one million tons in 1990 to 2.5 million tons in 2020.

PROJECTION OF INBOUND BASELINE AND
RESO''RCE DEVELOPMENT CARGO POTENTIAL
1980 to 2030
(Thousand Tons)

CARGO HANDLING CATEGORY	1980	1990	2000	2010	2020	2030
CONTAINER						
Baseline	38.6	61.0	83.8	106.2	128.7	151.3
NEOBULK/BREAKBULK						
Baseline	1.5	1.8	2.2	2.5	2.8	3.2
DRY BULK						
Baseline	-	-	-	-	-	-
Healy Coal		1000.0	1500.0	2000.0	2500.0	2500.0
LIQUID BULK						
Baseline	16.6	16.6	16.6	16.6	16.6	16.6

Source: Southcentral Region Deep-Draft Port Study, prepared by Alaska Consultants, Inc. and PRC Harris, Inc. for U.S. Corps of Engineers. 1981.

The Port of Valdez handled only 4,000MT (4,400 tons) of dry goods in 1980. Unless the port can attract a significant percentage of the freight destined to interior Alaska which is now going through Anchorage, the baseline tonnage will still be less than 9,000MT (10,000 tons) by the year 2000. The Port of Valdez had been expected to handle major tonnages for the Alpetco project."

Population-related tonnage for the Port of Anchorage will continue to dominate inbound freight movements. Only Prudhoe Bay development and the Alaska gas pipeline project are expected to produce substantial tonnage unrelated to population. Based on 1990 forecasts of cargo through the Port of Anchorage, these two projects will produce approximately 20 percent of all inbound dry cargo (containerized, neobulk, and breakbulk). Except for neobulk/breakbulk cargo, tonnage for each category for a given period is greater than for the preceding period. Containerized tonnage, which was 75 percent of the inbound tonnage in 1980, is forecast to increase 121 percent to 1.63 million metric tons (1.8 million tons) by the year 2000. The imbalance between inbound and outbound cargo is expected not only to continue, but become more pronounced (see Table 3.13).

Anchorage originally had been selected as the location for the export of Healy coal to South Korea, but major expenditures would have been necessary to correct poor soil conditions. Anchorage decided to eliminate itself as a contender and apparently continue to specialize in containerized freight.

Whittier (Table 3.14) is not expected to benefit substantially from development activities taking place during the remainder of this century, according to the COE report. Steady growth in baseline demands are expected to occur for all inbound freight categories except liquid bulk. Outbound freight is expected to remain at present levels. Dry goods are forecast to show a 159 percent increase from 1980 to 2000.

The COE study assumed that Seward would become the major Southcentral port for the export of bulk shipments, such as coal and mineral ores. Coal exports are forecast at 900,000MT (1.0 million tons) by 1990 and 1.45 million metric tons (1.6 million tons) by 2000. The design of the coal loading facility proceeds at present. No decision has been taken yet concerning the financing of this $6.3 million project (see Table 3.15).

3.3.3 Aviation Forecasts

Three different but related approaches were used for air transportation demand forecasts in this report. For the large international airports at Anchorage and Fairbanks, detailed master plans have already been prepared with associated demand forecasts. These forecasts were also used in the Alaska Aviation System Plan. Consequently they have been adopted for the Base Case forecasts without change.

For Deadhorse and Prudhoe Bay the aviation forecasts are related to oil and gas development and production activities which dominate their use now and will continue to do so in the future. Barrow, on the other hand, will have air traffic which relates to North Slope economic conditions and population growth, as well as to oil and gas activities in a less direct way.

Each forecast is described below.

3.3.3.1 Anchorage and Fairbanks Airports

The forecasts presented in Table 3.16 contain long term forecasts from the master plans for these two airports. Both airports expect a relatively high growth rate (7-10% per year) through 1985 in passenger and freight traffic, followed by a lower growth in passengers (4-6%) through the end of the century. Fairbanks shows a drop in cargo growth to match the passenger traffic, but Anchorage cargo growth is expected to continue strong through 1990.

In both airports the number of aircraft operations is expected to grow more slowly than passenger or freight traffic. This is due to the expected change in fleet mix as shown in Table 3.17. Future increases in widebody jets will strongly influence traffic and increase average loads per aircraft operation at both airports.

3.3.3.2 Deadhorse and Prudhoe Bay Airports

The forecast of demand for services and facilities at Deadhorse Airport was done for anticipated aircraft operations, enplaned passengers, and air cargo (see Table 3.18).

TABLE 3.16

AVIATION DEMAND FORECASTS FOR ANCHORAGE AND FAIRBANKS

	ANCHORAGE INTERNATIONAL AIRPORT			FAIRBANKS INTERNATIONAL AIRPORT		
YEAR	OPERATIONS[1] (1000)	PASSENGERS (1000)	CARGO[2] (1000) Tons	OPERATIONS[3] (1000)	PASSENGERS[3] (1000)	CARGO[3] (1000) Tons
1983	514	1410	794	186	312	63
1984	524	1566	867	193	325	65
1985	534	1713	990	200	339	68
1986	544	1858	1105	207	353	71
1987	552	1987	1234	215	368	74
1988	562	2130	1377	223	384	77
1989	573	2282	1538	231	400	80
1990	584	2431	1717	240	417	83
1991	596	2601	1917	246	435	87
1992	610	2794	2141	251	453	90
1993	624	2986	2390	257	472	94
1994	638	3188	2670	263	492	98
1995	653	3418	2982	269	513	102
1996	668	3653	3331	275	535	107
1997	683	3909	3721	282	557	111
1998	699	4182	4156	288	581	116
1999	715	4475	4642	295	605	121
2000	731	4788	5185	302	631	126
2010	918	9419	15678	380	955	191
2020	1152	18527	47346	478	1445	290

[1]Two times landings, including air carriers and general aviation, growth extrapolated after 1996.

[2]Cargo includes in, out and transit cargo.

[3]Average of low and high forecasts.

Source: State of Alaska, Department of Transportation & Public Facilities, Anchorage International Airport, Master Plan Study, Final Report, April 1981, pp 144,152,
Fairbanks International Airport Master Plan 1980-2000, December 1980, pp 2-28.

TABLE 3.17

FORECAST FLEET MIX FOR ANCHORAGE AND FAIRBANKS

INTERNATIONAL AIRPORTS

		AIRCRAFT CATEGORY				
AIRPORT	YEAR	AA	A	B	C	D & E
Anchorage	1985	5%	3%	26%	27%	39%
	1990	8%	3%	29%	28%	32%
	2000	11%	3%	31%	28%	27%
Fairbanks	1985	3%	1%	19%	32%	45%
	1990	5%	1%	21%	34%	39%
	2000	7%	1%	24%	36%	32%

Note:	TYPE	Aircraft Category Definitions
	AA	2-4 engine wide-body jet (e.g., B-747, DC-10, L-1011).
	A	4-engine standard body jet (e.g., B-707, DC-8 Caravelle, DH Camerot, CV-880, CV-990).
	B	2- and 3-engine standard body jet, 4-engine piston, and turboprop (e.g., B-727, B-737, DC-6, L-Electra, DC-9, BAC-111, CV-580).
	C	Executive jet and transport type twin-engine piston (e.g., Learjet, DC-3, Nord-262, Gulfstream, DH-125, CV-240).
	D/E	(Combined into one group) Light twin-engine piston and single-engine piston (e.g., Piper Apache and Aztec, Cessna Series, Beaver, Twin Bonanza, Beech Queen Air).

Source: Louis Berger & Associates in TRA/Farr 1982.

TABLE 3.18

FORECAST DEMAND FOR DEADHORSE AIRPORT

YEAR	AIRCRAFT OPERATIONS	ENPLANED PASSENGERS	AIR CARGO (Tons)
1983	45,400	130,830	7,400
1984	39,800	114,810	7,220
1985	41,700	120,150	6,320
1986	45,400	130,830	6,700
1987	39,800	114,810	6,100
1988	37,100	106,800	5,740
1989	37,100	106,800	5,080
1990	37,100	106,800	4,860
1991	32,400	93,450	5,380
1992	32,400	93,450	6,060
1993	32,400	93,450	5,900
1994	32,400	93,450	5,840
1995	32,400	93,450	5,840
1996	32,400	93,450	4,560
1997	32,400	93,450	3,500
1998	32,400	93,450	3,500
1999	32,400	93,450	3,500
2000	32,400	93,450	3,500
2005	30,100	86,775	3,250
2010	27,800	80,100	3,000
2020	23,200	66,750	2,500

Source: Louis Berger & Associates, 1983.

These projections are based on the most recent 1982 data. The Federal Aviation Administration provided base year estimates for both aircraft operations and enplaned passengers. Base year air cargo estimates were developed using information provided by SOHIO Alaska Petroleum Company and ARCO Alaska.

Future aircraft operations were assumed to be directly proportional to enplaning passengers at Deadhorse Airport since aircraft mix is expected to remain the same in the future. The number of future enplaning passengers was assumed to be a direct function of future oil industry employment on the North Slope (26.7 enplaned passengers per year per employee). Estimates for anticipated cargo were related to (1) forecasts of North Slope drilling activities and associated tonnage (Peter Eakland and Associates, 1981) and (2) estimated oil industry employment. Based on 1982 data, factors of .9MT (1 ton) per oil-related employee per year plus 2% of total drilling supply tonnage were developed. These factors were multiplied by employment and supply tonnage to obtain the forecasts of air cargo.

The forecasts presented in Table 3.18 suggest a sustained service and facility demand for Deadhorse Airport during anticipated oil and gas exploration efforts in the 1980's. As these activities decrease and oil and gas production activities become predominant in later years aircraft operations, enplaned passengers, and cargo are expected to steadily decrease.

3.3.3.3 Barrow Airport

In a recent study of airport development and land use for the Barrow airport (Alaska Transportation Consultants, 1983) several factors were identified that will influence the future growth of air traffic. These were:

- the growth of Barrow as a regional administrative center
- the future pattern of tourism development
- the indirect effect of oil and gas development
- the effects of a possible future road connection from Barrow to the Dalton Highway.

Barrow is expected to continue growing as a regional center with administrative functions and close ties to the other North Slope communities. In addition, oil and gas development will influence Barrow through direct contacts between industry and government and indirectly through tax receipts which give rise to other activities. This will exert a stabilizing influence on future growth in Barrow. The influence of the present high level of construction activities creates a high Base Case from a transportation viewpoint which lowers future freight growth rates.

Tourism has grown rapidly in Barrow in past years and is expected to grow more in the future. However hotels are expected to reach a saturation point in 1995 for overnight tourists, which will slow its longer range growth. This has a major effect on future air passenger flows.

The possible influence of a road between Barrow and the Dalton Highway could be important, but is somewhat speculative at this time. If it is built, the major effect on air transportation would be to switch some freight and passengers from air to highway modes, and thereby decrease future aircraft operations at Barrow.

The forecasts in Table 3.19 take into account all the above factors. The original ATC forecasts have been adjusted slightly to take into account the latest figures on oil and gas development described earlier in Section 3.2.1.

3.3.4 Highway Forecasts

Base Case highway traffic forecasts outline anticipated traffic growth on key segments or at key locations of the major highways that are used to move oil industry related freight. Forecasts are related to a variety of demographic, economic, and other developments and are assumed to be a function not only of OCS related Base Case development, but also of area population and employment growth, and other anticipated developments such as resource development and tourist traffic. To a large degree, the assumptions and methods used to forecast traffic and the forecast themselves are derived from the Interior Transportation Study (ITS) (Louis Berger and Associates, Inc., 1983). Where necessary, ITS forecasts were adjusted to reflect OCS Base Case

TABLE 3.19

FORECAST AVIATION DEMAND FOR BARROW

YEAR	OPERATIONS	PASSENGERS	CARGO (Tons)
1983	14,400	67,000	11,400
1984	14,700	68,500	11,300
1985	14,900	70,000	11,300
1986	15,100	71,600	11,300
1987	15,400	73,200	11,300
1988	15,600	74,800	11,200
1989	15,900	76,400	11,200
1990	16,100	80,000	11,200
1991	16,400	82,400	11,200
1982	16,600	85,000	11,200
1993	16,900	87,600	11,200
1994	17,100	90,200	11,200
1995	17,400	93,000	11,200
1996	17,700	94,700	11,300
1997	18,000	96,500	11,300
1998	18,300	98,300	11,400
1999	18,600	100,100	11,400
2000	18,900	102,000	11,500
2010	22,300	122,700	12,000
2020	26,300	147,600	13,000

Source: Alaska Transportation Consultants, 1983, growth extrapolated after 2000, and adjusted for oil related employment.

development assumptions. Traffic forecasts by highway, and the assumptions used to generate them, are presented below.

3.3.4.1 Parks Highway

For traffic forecasting purposes, it is assumed that three key traffic segments along the Parks Highway would be sensitive to OCS related development. These areas are considered to be representative or typical of the types of traffic and road conditions which exist along the entire length of the highway. Key interval areas include the first 11km (7.0 mi.) of the highway near Wasilla, where traffic is highest; a segment south of Nenana[1] where road condition is considerably poorer than elsewhere along the highway and where traffic volumes are about average for the highway as a whole; and outside of Fairbanks (south of Ester), where a combination of moderate to low traffic, steep grades and moderate to good road conditions prevail. Any impacts, whether related to condition or traffic capacity, which might result from incremental OCS associated traffic would logically be manifested at these locations on the highway.

Traffic forecasts for the segment at Wasilla are based upon a traffic model which calibrates traffic growth to anticipated dwelling units, employment and historic trip generating factors.[2] Traffic growth rates developed in this model are approximately 9 percent per year to the year 2001 and 1.2 percent per year thereafter. Forecasts assume that the Knik Arm crossing will not be built and that a proposed Wasilla bypass will also not be constructed.[3] Forecasts are presented in Table 3.20.

Traffic forecasts for the area south of Nenana and near Ester are derived from the Interior Transportation Study (Louis Berger and Associates, Inc., 1983). These forecasts are based

[1]Between Nenana and Anderson.

[2]Knik Arm Crossing Draft Corridor Alternatives Analysis. 1983.

[3]If either the Knik Arm Crossing or the four lane bypass are constructed, traffic will be directed from the Alaska highway segment. Traffic volumes would decrease approximately 50 percent by 1989 with the crossing and a comparable at the date of bypass completion.

TABLE 3.20

PARKS HIGHWAY TRAFFIC FORECASTS
(IN AADT)

YEAR	TRAFFIC AT WASILLA[a]	TRAFFIC NEAR NENANA	TRAFFIC NEAR ESTER
1981	5762[b]	1125	991
1983	6846	1228	1102
1984	7462	1340	1175
1985	8134	1464	1250
1986	8866	1583	1298
1987	9663	1711	1344
1988	10533	1849	1393
1989	11481	1999	1443
1990	12514	2162	1493
1991	13640	2330	1549
1992	14868	2512	1605
1993	16207	2708	1662
1994	17665	2920	1722
1995	19255	3094	1785
1996	20988	3307	1842
1997	22877	3536	1904
1998	24936	3780	1967
1999	27180	4040	2032
2000	29626	4327	2104
2005	34214	6105	2481
2010	36317	6740	2932
2020	40918	8217	4097

[a]Assumes that Knik arm crossing and Wasilla by-pass are not built.

[b]Adjusted 1979 base figure at 6 percent traffic growth rate for two year.

Source: Knik Arm Crossing Draft Comidor Alternatives Analysis, 1983;
Louis Berger & Associates, Interior Transportation Study,1983.

(AADT) = Average Annual Daily Traffic

upon growth rates associated with population growth near the area, forecast tourist traffic and potential resource development. South of Nenana, traffic is expected to increase at a rate of 9.1 percent through 1985, 8.1 percent through 1990, 7.8 percent to 1995, 6.9 percent through 2000 and 7.1 percent in 2005. After 2005, traffic is assumed to increase at a 2 percent per year rate. South of Ester, traffic is assumed to increase at annual rates of 6.6 percent through 1985, 3.6 percent to 1995 and 3.4 percent thereafter. Traffic forecasts for these locations are presented in Table 3.20.

3.3.4.2 Alaska Highway

On the Alaska Highway, four areas are assumed to characterize the highway traffic segments which would be sensitive to OCS related developments. These include a traffic segment near the Canadian border which has a low traffic volume and a poor surface condition; an area south of Delta Junction[1] which has low traffic volumes but a mostly good surface condition; an area north of Delta Junction[2] which supports moderate traffic volumes and is in fair to poor condition, and a segment outside of Fairbanks which is a heavily traveled, four lane highway with a relatively good surface condition.

Traffic forecasts for the first three segments (near the Canadian border, north and south of Delta Junction) were generated in the Interior Transportation Study (Louis Berger and Associates, Inc., 1983). Forecasts were developed by differentiating local traffic, based on population growth trends, and through traffic, based on forecast tourism development and anticipated mineral resource development in the vicinities of the road segments. The sum of local and through traffic was used to derive total highway forecasts. Traffic growth on these segments was estimated at between 2.2 and 7.0 percent for five year intervals. Forecasts are presented in Table 3.21.

Traffic forecasts for the Alaska Highway near Fairbanks are based on historical traffic, forecast population growth and the

[1]Between Dot Lake and Grant Creek Junction.
[2]Between Lost Lake Road and Hadley Lake Junction.

TABLE 3.21

ALASKA HIGHWAY TRAFFIC FORECASTS
(IN AADT)

YEAR	NEAR CANADIAN BORDER	SOUTH OF DELTA JUNCTION	NORTH OF DELTA JUNCTION	NEAR FAIRBANKS
1981	279[a]	251[b]	669	10,665
1983	271	288	682	11,591
1984	264	303	691	12,083
1985	257	318	700	12,597
1986	275	330	721	13,088
1987	294	343	743	13,599
1988	315	356	765	14,129
1989	337	369	788	14,680
1990	360	383	811	15,253
1991	378	396	835	15,802
1992	397	410	860	16,371
1993	417	424	886	16,960
1994	438	438	912	17,570
1995	460	452	941	18,203
1996	483	464	962	18,822
1997	507	475	983	19,462
1998	533	486	1004	20,123
1999	559	498	1027	20,808
2000	586	509	1048	21,515
2005	749	571	1168	23,754
2010	827	640	1304	26,267
2020	1000	804	1621	31,970

[a]High 1981 traffic counts exceed forecasts; traffic forecasts interpolated through 1985.

[b]1980 base year.

Source: Louis Berger & Associates, Interior Transportation Study, 1983.

(AADT) = Average Annual Daily Traffic

historical relationship between Fairbanks area growth and Alaska Highway traffic. For purposes of this analysis it is assumed that the rate of traffic growth is 1.7 times forecast Fairbanks area population growth based on average population-traffic comparisons.[1] Based on this assumption, traffic levels are expected to rise 4.25 percent per year through 1985, 3.9 percent per year through 1990, 3.6 percent per year through 1995 and 3.4 percent per year through 2005 and 2 percent per year thereafter. Traffic forecasts are presented in Table 3.21.

3.3.4.3 Dalton Highway

For analytic purposes, the Dalton Highway is divided into three forecasting segments which span almost the length of the highway. The first segment includes all of the highway from Fox to Livengood[2], which is influenced by Fairbanks local area and Livengood gold extraction activity traffic. The second segment extends between Livengood and the junction of the Elliot Highway which is influenced by through traffic moving from the Dalton to the Elliot Highway. The final segment extends from the Yukon Bridge north to Prudhoe Bay. Traffic on this segment is predominantly oil industry related traffic with a small amount generated by government agencies, and in recent years minimal tourist generated traffic.

Traffic forecasts for the Fox to Livengood and Livengood to Elliot Highway Junction segments, presented in Table 3.22, are based upon forecasts developed in the Interior Transportation Study. Traffic was disaggregated into components, such as through traffic and local traffic, and forecast based upon anticipated population growth rates, population-traffic growth factor differentials, and tourist and mineral development activity attributed to the area. Based on Interior Transportation Study analysis, traffic growth rates were between

[1] The Fairbanks area includes Fairbanks, North Pole, Eielson AFB, Fox and Ester.

[2] Technically, the Dalton Highway begins at Livengood rather than Fox; however for analytic purposes, the Fox to Livengood segment of the Elliot Highway has been addressed here.

TABLE 3.22

DALTON HIGHWAY TRAFFIC FORECASTS

(IN AADT)

YEAR	FOX TO LIVENGOOD	LIVENGOOD TO ELLIOT HIGHWAY JCT.	NORTH OF YUKON BRIDGE/ TO N.S./PRUDHOE BAY
1980/ 1981	444[a]	300[a]	139[b]
1983	537	395	160
1984	591	423	163
1985	651	465	150
1986	702	507	157
1987	758	536	149
1988	818	574	134
1989	884	619	143
1990	894	656	152
1991	941	699	164
1992	991	741	163
1993	1044	785	164
1994	1099	832	167
1995	1156	877	143
1996	1206	920	124
1997	1258	965	126
1998	1312	1010	126
1999	1368	1063	133
2000	1428	1115	136
2005	1771	1413	150
2010	1955	1552	169
2020	2384	1874	222

[a]1980 base traffic year.

[b]1981 base year.

Source: Louis Berger & Associates, Interior Transportation Study, 1983; DOT/PF Annual Traffic Volume Report, 1981; Consultant's Estimates.

9.6 and 4.4 percent per year for the two segments over a 25 year time frame. For purposes of this analysis, traffic was assumed to increase 2 percent per year to the year 2020.

Dalton Highway traffic north of the Yukon Bridge was forecast seperately, to incorporate OCS Base Case exploration, development and related traffic assumptions. In this manner, Dalton Highway traffic was disaggregated and forecast in three components: (1) existing Prudhoe Bay support truck and vehicle traffic; (2) oil development truck traffic associated with incremental Base Case OCS exploration and development and non-truck related traffic associated with North Slope development, government related traffic; and (3) private vehicles related to road community traffic and tourist traffic. Prudhoe Bay support traffic was forecast by calculating the average number of trucks moving materials to the North Slope during a five-year post-pipeline development period and assuming a proporational relation to oil-related employment over the forecast period. Vehicle traffic other than trucks was estimated by assuming a baseline truck-other vehicle rate (60 percent trucks, 40 percent other vehicles) for baseline other vehicle traffic and assuming a traffic growth rate of 4 percent. Incremental OCS related traffic was calculated based upon the assumptions that 85 percent of OCS related drilling tonnage moves north from Fairbanks by truck, average truck capacity of 25MT (28 tons) is the standard truck load, and a 2.5 adjustment factor was applied for smaller than capacity loads for shipment of miscellaneous freight (Peter Eakland and Associates, 1982). In this manner the number of truck-loads of material was calculated (see Table 3.23). Truckloads were then converted to AADT by multiplying by 2 (coming and going) and dividing by 365.

TABLE 3.23

COMPONENT TRAFFIC FORECASTS FOR THE DALTON HIGHWAY
NORTH OF THE YUKON BRIDGE
(In AADT)

YEAR	PRUDHOE SUPPORT[1]	OCS EXPLORATION AND DEVELOPMENT TRUCK TRAFFIC[2]	OTHER TRAFFIC[3]	TOTAL TRAFFIC
1983	62	52	37	160
1984	65	61	40	163
1985	71	38	47	150
1986	62	37	49	157
1987	58	36	51	149
1988	58	23	53	134
1989	58	30	55	143
1990	51	47	57	152
1991	51	53	60	164
1992	51	50	62	163
1993	51	49	64	164
1994	51	49	67	167
1995	51	22	70	143
1996	51	0	73	124
1997	51	0	75	126
1998	51	0	75	126
1999	51	0	82	133
2000	51	0	85	136
2005	47	0	103	150
2010	43	0	126	169
2020	36	0	186	222

[1] Includes truck and vehicle traffic related to existing Prudhoe Bay operations. Forecast based on oil-related North Slope development.

[2] Assumes 85 percent of drilling tonnage associated with OCS activity moves over the Dalton Highway on turcks. Truck capacity is 28 tons, and a factor of 2.5 accounts for smaller than capacity roads and shipment of miscellaneous freight.

[3] Includes government and tourist traffic. Based on a 4 percent per year growth factor.

Source: Louis Berger & Associates, Interior Transportation Study, 1983; Peter Eakland Associates, 1982, MMS Technical Memorandum of Resource Estimates Production Assumptions and Impact Assessment. 1983.

3.3.5 Railroad Forecasts

Forecasting long range railroad traffic is complicated by a number of factors. The most important is the relationship between the commodities that comprise the bulk of railroad traffic and economic activities or events which are unique, dramatic, or subject to significant changes over relatively short time periods.[1]. For this reason, forecasting long term traffic based on historical trends is somewhat conjectural. Forecasts must allow for the incorporation of a number of assumptions about future economic activity as they relate to railroad traffic. Doing so requires considering developments occurring in areas affecting individual commodity movements and forecasting on a commodity-by- commodity basis. Estimates of future railroad traffic are obtained by aggregating commodity forecasts.

Detailed railroad traffic forecasts on a commodity by commodity by basis were developed in the Interior Transportation Study (Louis Berger and Associates, Inc., 1983). These forecasts are presented in Table 3.24. Commodity forecasts were related to population growth, anticipated future resource developments and expected developments in key industries.

Because the Interior Transportation Study dealt only with commodities travelling into or through the Interior region of Alaska, sand and gravel forecasts were not made. Similarly, forest products, machinery and machines, and other commodities were forecast on a percentage basis disaggregating Fairbanks and

[1]For example, gravel movements which have increased tenfold in three years are related to wild fluctuations in construction demand in Anchorage. Future coal traffic movements are closely tied to world market prices, East Asia demand and petroleum-coal price differentials. Bulk petroleum movements are related to the constantly changing cost differentials between transporting diesel and jet fuels from the North Pole Refinery by rail to Anchorage or shipping crude to Kenai refineries, refining and then shipping comparable fuels and distillates to Anchorage. Gravel, refined petroleum and coal have accounted for over 80 percent of railroad traffic.

TABLE 3.24

FORECASTS OF ALASKA RAILROAD
REVENUE TONS OF MAJOR COMMODITIES PASSING
WITHIN OR THROUGH THE INTERIOR REGION[a]

COMMODITY	1985	1990	1995	2000	2005
Sand and Gravel[b]	--	--	--	--	--
Bulk Petroleum[c]	416	486	539	596	658
Coal[c]	1538	1601	1930	2371	2919
Iron & Steel Pipe & Fittings[c]	150	166	183	202	223
Piggyback[c]	126	141	157	173	191
Forest Products[d]	41	46	51	57	63
Manufactured Iron & Steel[c]	9	10	11	12	14
Cement[c]	48	54	60	66	73
Machinery and Machines[e]	15	18	20	22	25
Mfrs. and Misc. Nos.[e]	5	6	8	8	9
Other[e]	70	77	86	96	106
TOTAL	2418	2605	3045	3603	4281

[a]The Interior Region was defined as all of the railroad north of Summit, near Healy.

[b]Commodity not forecast because it did not pass through or within the Interior Region.

[c]Represents 100% of this commodity moving on the railroad.

[d]Represents 37% of forest product traffic on the railroad.

[e]Represents 50% of traffic on the railroad.

Source: Louis Berger & Associates, Inc., Interior Transportation Study, 1983.

Anchorage demand. Further, iron and steel pipe and fittings forecasts were based upon optimistic North Slope oil exploration and development assumptions.[1] To update the Interior Transportation Study forecasts to incorporate all railroad operations, sand gravel forecasts and incremental traffic forecasts for forest products, machinery and machines and other commodities were made. These forecasts must also be extended out to the time frame of associated OCS related activity (i.e. 2020), and must be generated by years between the five year intervals used in the Interior Study. Based on these observations, railroad traffic assumptions and forecasts by commodity are presented in the following sections. Aggregated forecasts are presented subsequently.

3.3.5.1 Coal

Coal traffic forecasts in the Interior Transportation Study were based on assumptions about the future demand for coal for generating plants and the demand associated with export markets. As coal traffic will not be related to North Slope oil developments, forecast assumptions and corresponding forecasts are assumed to apply. For purposes of forecasting generating plant demand beyond the Interior Transportation Study's forecast time frame, it was assumed that growth rates applicable in the year 2005 could be applied until the year 2020. Coal export demand however, was assumed to decrease to 2% per year growth. Table 3.25 presents coal traffic forecasts and the assumptions associated with them.

3.3.5.2 Petroleum

Petroleum traffic forecasts are dependent upon gasoline demand in the Interior, particularly the Fairbanks area, and North Pole Refinery shipments of diesel and jet fuel distillates to Anchorage. For forecasting purposes, it was assumed that the price differentials that currently allow for these movements will continue. That is, the structural flow of petroleum products on

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[1]Forecasts assumed a 15 percent increase in traffic per year to 1985 and a 2 percent increase per year thereafter.

TABLE 3.25

COAL TRAFFIC FORECASTS

(in 1000s of tons, rounded to nearest 500 tons)

	POWER GENERATION/HEATING						EXPORT	
YEAR	UNIVERSITY OF ALASKA[a]	MUS[b]	FT. WAINWRIGHT[c]	EILSON AFB[c]	CLEAR AFB[c]	COAL BUNKER[d]	KOREA/ FAR EAST[e]	TOTAL
1983	64.5	159.5	178.0	134.5	82.0	10.0	500.0	1128.5
1984	64.5	164.5	178.0	134.5	82.0	10.5	900.0	1534.0
1985	65.5	169.5	178.0	134.5	82.0	12.0	900.0	1540.5
1986	64.5	178.0	178.0	134.5	82.0	13.0	900.0	1550.0
1987	64.5	190.5	178.0	134.5	82.0	13.5	900.0	1563.0
1988	64.5	202.0	178.0	134.5	82.0	14.0	900.0	1575.0
1989	64.5	214.0	178.0	134.5	82.0	15.0	900.0	1588.0
1990	64.5	226.5	178.0	134.5	82.0	16.0	900.0	1601.5
1991	64.5	240.5	178.0	134.5	82.0	17.0	945.0	1661.5
1992	64.5	254.5	178.0	134.5	82.0	17.5	992.5	1723.5
1993	64.5	270.0	178.0	134.5	82.0	18.0	1042.0	1789.0
1994	64.5	286.5	178.0	134.5	82.0	19.0	1094.0	1858.5
1995	64.5	303.5	178.0	134.5	82.0	19.5	1148.5	1930.5
1996	64.5	321.5	178.0	134.5	82.0	20.0	1206.0	2006.5
1997	64.5	341.0	178.0	134.5	82.0	21.0	1266.5	2087.5
1998	64.5	361.5	178.0	134.5	82.0	22.0	1329.5	2172.0
1999	64.5	383.0	178.0	134.5	82.0	23.0	1396.0	2261.0
2000	80.5	406.0	178.0	134.5	82.0	24.0	1466.0	2371.0
2005	80.5	543.5	178.0	134.5	82.0	30.0	1871.0	2919.5
2010	80.5	612.0	178.0	134.5	82.0	33.0	2065.5	3185.5
2020	80.5	746.0	178.0	134.5	82.0	40.5	2518.0	3779.5

[a]Assumes added capacity requirements in the year 2000 increasing coal consumption by 25 percent.

[b]Assumes an increase of 3 percent per year through 1985, a 6 percent per year increase between 1986 and 2005 and a 2 percent per year increase thereafter.

[c]Assumes coal consumption remains at historical levels and no increase in coal consumption.

[d]Assumes an historical 6 percent per year rise in coal consumption to 1990, a 4 percent per year rise until 2005 and a 2 percent per year rise thereafter.

[e]Based on contractural arrangements to the year 1990 and assumes 5 percent per year increase from 1991 to 2005 and a 2 percent per year increase thereafter.

the railroad will not change during the forecast period. This assumes that no new refinery facilities will be built in Fairbanks and that gasoline consumption will be related to anticipated population increases experienced in the Interior. Since these factors are independent of OCS activity, petroleum traffic forecasts will not change despite OCS activity. Petroleum forecasts, therefore, need not be modified. Expansion of petroleum forecasts to 2020 and for years between its five year forecast intervals are presented in Table 3.26.

3.3.5.3 Sand and Gravel

Sand and gravel on the Alaska Railroad moves exclusively between Palmer and Anchorage and is related directly to the level of construction in the Anchorage area. Anchorage area construction is a function of population, employment and economic factors which historically, have exhibited dramatic fluctuations. For purpose of this analysis, gravel movements are related directly to Anchorage area employment forecasts which take into account OCS related and anticipaated economic developments. Therefore, demographic projections for the Base Case derived from the MAP econometric model are applied to base gravel shipments. Sand and gravel forecasts are presented in Table 3.27.

3.3.5.4 Container Freight

Because container freight movements are exclusively Anchorage to Fairbanks movements, they have been assumed to be a function of Fairbanks area population. Based on Interior Transportation Study forecasts, container freight traffic will increase at rates of 2.70% to 1985, 2.27% to 1990, 2.14% to 1995 and 2.02% thereafter. These rates are assumed to apply to baseline forecasts. Container freight traffic is presented in Table 3.27.

3.3.5.5 Iron and Steel Pipe and Fittings

Iron and steel pipe and fittings traffic on the Alaska Railroad is to a great extent related to oilfield development. In 1981, 60 percent of traffic under this commodity category was

TABLE 3.26

PETROLEUM TRAFFIC FORECASTS
(Thousand of Tons)

YEAR	NORTHBOUND TRAFFIC	SOUTHBOUND TRAFFIC	TOTAL TRAFFIC
1983	234.8	156.8	391.6
1984	242.1	161.6	403.7
1985	249.6	166.4	416.0
1986	257.3	171.4	428.7
1987	265.3	176.5	441.8
1988	273.5	181.8	455.3
1989	282.0	187.3	469.3
1990	291.6	194.4	486.0
1991	297.7	198.3	496.0
1992	304.0	202.3	506.3
1993	310.4	206.3	516.7
1994	316.9	210.4	527.3
1995	323.4	215.6	539.0
1996	329.9	219.9	549.8
1997	376.5	224.3	560.8
1998	343.2	228.8	572.0
1999	350.1	233.4	583.5
2000	357.6	238.4	596.0
2005	394.8	263.2	658.0
2010	414.9	290.6	705.5
2020	458.3	354.2	812.5

Source: Louis Berger & Associates, Interior Transportation Study, 1983.

TABLE 3.27

SAND, GRAVEL AND CONTAINER FREIGHT TRAFFIC FORECASTS
(in 1000 tons)

YEAR	1000's OF TONS SAND AND GRAVEL	CONTAINER FREIGHT
1983	4000[a]	119
1984	4192	123
1985	4452	126
1986	4701	129
1987	4278	132
1988	4021	135
1989	3901	138
1990	3862	141
1991	3877	144
1992	3947	147
1993	4014	150
1994	4046	153
1995	4079	157
1996	4115	160
1997	4161	163
1998	4210	166
1999	4265	170
2000	4325	173
2005	4675	191
2010	5054	201
2020	5906	222

[a]Preliminary estimate, Alaska Railroad, 1983.

Source: Louis Berger & Associates, 1983.

destined for North Slope oilfield development. In 1982, this ratio increased to 80 percent.

For Base Case forecasting purposes, it is necessary to differentiate non-oil industry related pipe movements from those associated with oil field development. Based on 1981 and 1982 traffic movements, an average of approximately 29,937.6MT (33,000 tons) of pipe moved on the railroad that were not related to petroleum development. Assuming this average as the baseline condition, non-petroleum industry pipe movements will increase 2 percent per year over the forecast period.

Petroleum industry related pipe movements will be related to the total Base Case tonnage forecast to support drilling activity. For purposes of estimating Base Case pipe movements, it is assumed that 85 percent of these supplies will move by surface mode and that of this, 20% is pipeline which moves by rail.

Table 3.28 presents pipe and fitting forecasts for the railroad through year 2020.

3.3.5.6 Manufactured and Other Products

Manufactured and other products include such commodities as forest products, manufactured iron and steel (excluding pipe and fittings), cement, machinery and machines and other miscellaneous products such as chemicals. A small component of railroad traffic in this combined commodity class is generated by oil development activity occurances.[1] Similarly, in terms of total tonnage these commodities are relatively small compared to pipe and fitting movements. For baseline forecasting purposes then, it is assumed that railroad traffic under these classifications will be related to developments in the Anchorage and Fairbanks areas and are related to population growth rates. Table 3.29 indicates the amount of railroad traffic under these commodity classifications moving to the respective area and the traffic estimates generated by them.

[1]These commodities are generally moved by sealift to the North Slope.

TABLE 3.28

PIPE AND FITTINGS FORECASTS

(1000's of tons)

YEAR	NON OIL INDUSTRY PIPE[1]	INDUSTRY RELATED PIPE AND FITTINGS	TOTAL PIPE & FITTINGS
1983	33	27	60
1984	34	31	65
1985	34	19	53
1986	35	19	54
1987	36	19	55
1988	36	18	54
1989	37	11	48
1990	38	22	60
1991	39	28	67
1992	39	27	66
1993	40	26	66
1994	41	25	66
1995	42	25	67
1996	43	11	54
1997	44	0	44
1998	44	0	44
1999	45	0	45
2000	46	0	46
2005	51	0	51
2010	56	0	56
2020	69	0	69

[1] Assumes a 2 percent per year increase to 2020.

[2] Assumes 20 percent of total drilling supply material is composed of pipe and casing and that 90 percent of this pipe moves over the Railroad.

Source: Louis Berger & Associates, Interior Transportation Study, 1983. Alaska Railroad, Peter Eakland & Associates, 1983, Kodiak Oilfield Haulers, 1983.

TABLE 3.29

MANUFACTURED AND OTHER PRODUCT FORECASTS

TOTAL TRAFFIC (1000's OF TONS)

YEAR	FOREST PRODUCTS[1]	MANUFACTURED IRON & STEEL[2]	CEMENT[3]	MACHINERY/ MACHINES[4]	OTHER[5]
1983	79.8	19.5	52.4	24.8	204.8
1984	82.9	20.1	53.9	25.7	211.9
1985	86.1	20.6	55.4	26.6	219.7
1986	89.4	21.1	56.6	27.5	277.3
1987	91.3	21.6	57.9	28.1	232.0
1988	92.4	22.1	59.2	28.3	235.3
1989	93.7	22.6	60.6	28.9	239.1
1990	94.9	23.1	61.9	29.5	242.8
1991	96.6	23.6	63.6	30.0	247.1
1992	98.5	24.1	64.6	30.6	252.1
1993	100.6	24.6	66.0	31.2	257.5
1994	102.1	25.1	67.4	31.8	261.7
1995	103.6	25.6	68.8	32.2	265.8
1996	105.1	26.2	70.2	32.7	270.0
1997	106.7	26.7	71.7	33.3	274.5
1998	108.3	27.2	73.1	33.8	278.9
1999	110.0	27.8	74.6	34.3	283.6
2000	111.7	28.3	76.1	34.9	288.3
2005	121.4	31.3	84.1	38.1	306.3
2010	129.9	32.9	88.4	40.9	328.8
2020	150.6	36.3	97.6	46.6	375.3

[1]Assumes that 37% of Forest Product Railroad Traffic moves to Fairbanks, 63 to Anchorage.

[2]Assumes that 100% of Manufactured Iron and Steel Products moving on the Railroad move to Fairbanks.

[3]Assumes that 100% of Cement Traffic on the Railroad moves to Fairbanks.

[4]Assumes that 50 percent of Machinery and Machines Traffic moves to Fairbanks, 50 percent to Anchorage.

[5]Assumes that 50 percent of Other Products Traffic moves to Fairbanks, 50 percent to Anchorage.

Source: Louis Berger & Associates, Interior Transportation Study 1983.

MMS, OCS, Statewide and Census Division Demographics and Economic Systems, Diapir Field (Sale 87) Impact Analysis, Revised Population Figures, 1983.

3.3.5.7 Total Railroad Forecasts

Total railroad forecasts are derived by summing the freight tonnages for the respective commodity classifications. Total railroad forecasts appear in Table 3.30.

3.4 Transportation System Capacity and Use Analysis

This section examines key transportation infrastructure use for each mode and relates this use to capacity. Ports, airports, highways, railroad and pipeline modes are discussed in turn below.

3.4.1 Port Capacity and Use Analysis

The primary consideration in the analysis of the marine transportation system capacity is the land side facilities, i.e., port wharves or piers and storage space. The shipping industry can easily expand its capacity by putting more vessels, tugs or barges into the Arctic Alaska trade as well as to accommodate bulk liquid traffic out of Valdez.

In this section, port capacities are calculated and anticipated facility utilization evaluated by comparing traffic forecasts to system capacity. Given the economic complexity involved in the precise calculation of capacity, a capacity range has been used; from the "threshold" capacity (the throughput level corresponding to a vessel waiting time to service time ratio of 0.10), to the "practical" capacity, corresponding to a ratio of 0.25.

3.4.1.1 Port Capacity and Use at Prudhoe Bay and Oliktok

The docks at Prudhoe Bay and Oliktok are unique in that the cargo transportation and handling systems are tailored to equipment, materials and supplies specifically used for oil field exploration and production during a short navigation season.

Due to the short shipping season and high priority placed both by the oil companies and Crowley Maritime on delivering all cargo for the coming year operations and ensuring that the

TABLE 3.30

RAILROAD FORECASTS
(Rounded to Nearest 1000 tons)

	COMMODITY									
YEAR	SAND & GRAVEL	BULK PETROLEUM	COAL	IRON & STEEL PIPE FITTINGS	PIGGBACK	FORREST PRODUCTS	MANUFACTURED IRON & STEEL	CEMENT	MACHINERY/ MACHINES	OTHER	TOTAL
1983	4000	392	1129	60	119	80	20	52	25	205	6082
1984	4192	404	1534	65	123	83	20	54	26	212	6713
1985	4452	416	1541	53	126	86	21	55	27	220	6997
1986	4701	429	1550	54	129	89	21	57	28	227	7285
1987	4278	442	1563	55	132	91	22	58	28	232	6901
1988	4021	455	1575	54	135	92	22	59	28	235	6676
1989	3901	469	1588	48	138	94	23	61	29	239	6590
1990	3862	486	1602	60	141	95	23	62	30	243	6604
1991	3877	496	1662	67	144	97	24	63	30	247	6707
1992	3947	506	1724	66	147	99	24	65	31	252	6861
1993	4014	517	1789	66	150	101	25	66	31	258	7017
1994	4046	527	1859	66	153	102	25	67	32	262	7139
1995	4079	539	1931	67	157	104	26	69	32	266	7270
1996	4115	550	2007	54	160	105	26	70	33	270	7390
1997	4161	561	2088	44	163	107	27	72	33	275	7531
1998	4210	572	2172	44	166	108	27	73	34	279	7685
1999	4265	584	2261	45	170	110	28	75	34	284	7856
2000	4325	596	2371	46	173	112	28	76	35	288	8050
2005	4675	658	2920	51	191	121	31	84	38	306	9075
2010	5054	706	3186	56	201	130	33	88	41	329	9824
2020	5906	813	3780	69	222	151	36	98	47	375	11497

Source: Louis Berger & Associates, 1983.

convoy can return to Seattle prior to the end of the shipping season, maximum efforts are devoted to expediting handling operations using the most appropriate equipment. These factors, as well as the expertise and experience of logistics managers and operators, enable much higher throughput rates that those obtained at other Alaskan ports.

The annual sealift to Prudhoe Bay from Seattle is designed like a military amphibious landing and each barge is loaded in accordance with the planned unloading sequence at the destination. The actual unloading rates depend on the proportion of modules, pipe and general cargo, and the density of barge loading (5,500MT (6,000 tons) for a mixed module and general cargo load to 13,000MT (14,000 tons) for pipe). If barges are berthed at each of the three docks, with shore based (oil company) and Crowley crews at each of the three docks, the practical cargo throughput rate per dock is estimated to range between 1,100MT (1,200 tons) per day for mixed loads to 2,700T (3,000 tons) per day for pipes.

As one barge is emptied, it is reballasted and replaced by a waiting barge (Arctic Marine Freighters, Cargo Operations Dept., 1983). Under these conditions, the port throughput capacity for a 45-day season would range between 147000MT (162,000 tons) for mixed module-general cargo loads and 367,000MT (405,000 tons) if all the docks would accommodate barges loaded with pipe. Assuming a seasonal shipment consisting of 75 percent mixed modules and general cargo, and 25 percent pipe and other dense cargo, the throughput for a 45-day season would be 243,000MT (268,000 tons). This level is considerably higher than the 1970 delivery of 170,000MT (187,000 tons), but could well require an expansion of the existing 14.16 hectare (35 acre) storage area.

The major constraint at Prudhoe Bay is the uncertain length of the shipping season, which is frequently shorter than the 45 days used in this estimate. If a conservative estimate of 30 days is used to account for the risk of not being able to return the barges to Seattle (equivalent to waiting time factor in standard capacity analysis), then the "threshold" capacity is 162,000MT (179,000 tons).

This daily rate of 5,500MT (6,000 tons) matches the rate anticipated to be achieved by SOHIO on the 1983 sealift. SOHIO estimates that it would take 10 days to unload the 14 (out of 26)

SOHIO barges carrying some 59,000MT (65,000 tons) of equipment, corresponding to a rate of 5,500MT (6,000 tons) per day with a three shift operation.

Accounting for the fact that the cargo is heavy equipment and modules and high-density material such as drill casings and drilling mud, the storage density is estimated conservatively to be 0.14MT per square meter (0.15 tons per square foot). Assuming an average storage time of 14 days, average usable space of 45 percent of the available storage space (14.16 hectares (35 acres) of 142,000 square meters (1,525,000 square feet)), and a 70 percent utilization rate, the storage capacity needed for a 45-day and 30-day shipping seasons would be 208,000MT (230,000 tons) and 139,000MT (153,000 tons) respectively (WAATS, 1981).

The "threshold" storage capacity is therefore three times as large as the typical 45,000MT (50,000 ton) annual shipment received at Prudhoe Bay over the past decade. Because of the availability of additional open storage space, the apron "threshold" and practical capacities of 162,000MT (179,000 tons) and 243,000MT (268,000 tons) are considered limiting, rather than the storage capacity.

At Oliktok, similar unloading methods are employed, resulting in a 1,800MT (2,000 ton) per day unloading capacity (3 shifts), which corresponds to a 54,000MT (60,000 ton) "threshold capacity" for a 30 day shipping season, or a 82,000MT (90,000 ton) "practical capacity" assuming a 45 day shipping season.

Sealift demand is not anticipated to exceed 95,000MT (105,000 tons) at any time in the future at Prudhoe Bay in the Base Case forecast. This tonnage is lower than the capacity threshold determined earlier of 162,000MT (179,000 tons) for a shipping season, conservatively assumed to only last 30 days. There is, therefore, no major constraint to be expected over the planning period at Prudhoe Bay.

Sealift demand will start exceeding "threshold capacity" at Oliktok in 1989. The capacity shortfall reaches a maximum of 60,000MT (66,000 tons) in 1992 and 1993. Given the relative proximity of the Prudhoe Bay dock and the expected excess capacity of 91,000MT (100,000 tons) at Prudhoe Bay during this period, it is anticipated that the excess demand will flow through Prudhoe Bay unless the location of any major NPR-A discovery finds is such that it would be more economical to add a second dock at Oliktok and expand the storage area there.

3.4.1.2 Port Capacity and Use at Camp Lonely and Wainwright

At the present time, there is no port infrastructure at either Lonely or Wainwright. Cargo has been unloaded "over the beach." However, when traffic requirements become significant in 1987 with 14,500MT (16,000 tons) of drilling supplies to Camp Lonely and the same amount to to Wainwright, operating conditions, rather than capacity conditions might necessitate the construction of a dock.

3.4.1.3 Port Capacity and Use at Barrow

There is no dock facility as such at Barrow. Goods are delivered to the community "over the beach". Beach capacity is technically unlimited, regardless of how complicated lightering and unloading operations are and how short the navigation season is.

Marine transportation traffic is anticipated to decrease from present levels of 12,000MT (13,000 tons) of dry cargo and 23,000MT (25,000 tons) of liquid bulk to 6,000MT (7,000 tons) and 10,000MT (11,000 tons) in 1990. It will then rise progressively to 12,000MT (13,000 tons) and 16,000MT (18,000 tons), respectively, in 2020 (see Table 3.11). As a result, existing conditions are technically adequate to accommodate anticipated traffic.

Anticipated traffic will remain too low to justify the construction of a major dock with deep draft access and jetty protection in the Base Case. However, smaller scale projects could be implemented to improve operating conditions (WAATS Phase III, Volume III). The problem results from difficulties arising from transporting commodities from the low water mark to the highwater mark because of the low bearing capacity of the soils. Unloading problems could be alleviated by installing surface matting over the soft soil to facilitate the movement of unloading equipment. A review of existing types of mats for soils of low bearing capacity has indicated that the matting material adopted by the U.S. Marine Corps with the trade name of

"Mo-Mat"[1,2] could be used at Barrow. The flexible matting has been adopted commercially in northern Canada for crossing muskeg (a wet organic soil underlain with permafrost). Its main advantages are the speed with which it can be assembled at the beginning of the shipping season and dismantled at its end, its ease of repair and its low costs. Estimated savings could be quite significant as unloading rates could nearly double.

3.4.1.4 Southcentral Ports

Estimates of port capacity by cargo type were analyzed quite extensively for Anchorage, Whittier, Seward, and Valdez ports in the 1981 Corps of Engineers "Southcentral Region Deep-Draft Navigation Study". Capacity estimates derived from this study are presented in Table 3.31.

The Corps report also addressed the marginal impact of the entire Beaufort Sea OCS development on the Baseline Case as shown in Section 3.3.1 applicable to both the Base Case and with the total Beaufort Sea OCS development. This marginal demand impact includes the anticipated impact of all three Diapir Field lease offerings. Graphic representations of demand and capacity forecasts are included in Chapter 3 of the Corps report.

The findings in Technical Report 65 are adequate in summarizing base case forecasts for these Southcentral Ports. This report stated that:

> "Only two situations are forecast before 2000 where capacity problems at southcentral ports would exist in the Base Case. None of them is affected by activities on the North Slope. The Port of Anchorage is expected to reach the low capacity threshold for containerized cargo early in the 1990's. The

[1]Mo-Mat is made of a fiberglass-reinforced plastic developed by the Stratoglas Division of the Air Logistics Corporation at Pasadena, California.

[2]Any use of trade names and trademarks in this report is for descriptive purposes only and does not constitute an endorsement by the consultants.

TABLE 3.31

PORT CAPACITIES[1] BY CARGO TYPE

(thousand of tons)

Cargo Type	NAME OF PORT							
	ANCHORAGE		WHITTIER		SEWARD		VALDEZ	
	TC[2]	PC[3]	TC	PC	TC	PC	TC	PC
Containers	1,400	2,000	460	640	1,300	1,900	0	0
Dry Bulk	950	1,500	0	0	250	520	0	0
Neo Bulk	4,500	n/a	0	0	700	1,000	260	510
Liquid Bulk	0	0	0	0	480	680	n/a	n/a

Note: [1]Capacity Range, between TC and PC.

[2]TC = "Threshold" Capacity (minor improvements required, of operational type.)

[3]PC = "Practical" Capacity (major improvements required, of structural type.)

Source: U.S. Army Corps of Engineers, Southcentral Region of Alaska Deep Draft Navigation Study, 1981.

existing port of Seward will exceed its capacity for dry bulk cargo soon after it begins coal shipments. It is likely that a major dry bulk facility eventually will be constructed in the Fourth of July Creek area. The second location with potential capacity problems is the TAPS marine terminal at Valdez. Should oil shipments closely approach TAPS' ultimate capacity of 2.0 million barrels per day, a fifth terminal, for which preliminary planning has already been done, would have to be constructed.

A slight impact related to marine carriers can be expected. Crowley Maritime operates the Arctic sealift as well as the Hydro-train service between Seattle and Whittier. In 1981, it reassigned several of the Hydro-train barges to the sealift. This practice could create short-term capacity problems during summer months when the demand is highest if TOTE, Sealand, and Canadian National (the other rail-barge carrier operating to Whittier) are unable to handle all diverted traffic. Otherwise, major carriers can be expected to gradually increase the number of vessels serving Southcentral ports."

3.4.2 Airport Capacity and Use Analysis

3.4.2.1 Anchorage and Fairbanks International Airport

Both of these major airports are presently undergoing expansion of terminals and other facilities in line with forecast traffic demand. Since their facilities are programmed by the State of Alaska to expand as needed, no capacity constraints are expected to occur in the future (see USKH, 1980 and DOT/PF, 1981).

3.4.2.2 Deadhorse Airport

The capacity of the runway at Deadhorse is estimated by the application of FAA Advisory Circular 150/5060-1A at approximately 60 operations per hour or 80,000 operations per year. Since this level substantially exceeds the highest forecast use of the airport, no capacity problem is expected.

Terminal capacity at Deadhorse is more than adequate since there are two terminals now in use. As Deadhorse is classified as a "regional airport" in the Alaska Aviation System Plan, no specific terminal standards apply. It must respond in this case to industry needs, and the industry does not require more elaborate facilities in this case at present demand levels. Cargo handling facilities also appear adequate according to industry sources.

The State of Alaska is planning to study future land use and development requirements for the Deadhorse Airport in the future and will further specify any needs at this time.

3.4.2.3 Barrow Airport

According to a recent capacity analysis of the Barrow airport (Alaska Transportation Consultants, 1983), the capacity of the runway is approximately 80,000 operations per year, and this easily accommodates the traffic forecast through 2020. Runway length is adequate for present aircraft, and taxiways are suitable, though less than FAA standards.

The terminal space is adequate for one major air carrier but should be increased if another carrier commences service to Barrow. Further air taxi space may also be needed.

Aircraft parking space for general aviation is also constrained, and should be provided in areas away from the larger scheduled aircraft, in order to meet FAA guidelines.

The Barrow airport appears to have room to accommodates a substantial amount of growth in use above and beyond the forecast demand through 2020.

3.4.3 Highway Capacity and Use Analysis

Highway capacity is a measurement of the ability of a route to accommodate a flow of vehicle traffic. Capacity is a function of highway surface condition, design characteristics, the types of vehicles travelling over the route, and other factors, such as weather. It is linked to a level of service concept which describes congestion levels rather than a strict physical limit.

Level of service is a qualitative measure which incorporates such factors as speed, comfort, and safety. Levels of service are rated from "A" to "F" and are generally defined as follows (ERE Systems, LTD., 1983):

- Level of Service A - describes a condition of free flow, with low volumes and high speeds. Traffic density is low, with speeds controlled by driver desires, speed limits, and physical roadway conditions. There is little or no restriction in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.

- Level of Service B - is within the zone of stable flow, with operating speeds becoming restricted by traffic conditions. Drivers still have reasonable freedom to select speed and lane without the likelihood of restricting traffic flow. The lower limit (lowest speed, highest volume) of this level of service has been associated with service volumes used in the design of rural highways.

- Level of Service C - is also within the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. Most of the drivers are restricted in their freedom to select their own speed, change lanes, or pass. A relatively satisfactory operating speed is still obtained, with service volumes perhaps suitable for urban design practice.

- Level of Service D - approaches unstable flow, with tolerable operating speeds being maintained through considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver, and comfort and convenience are low, but conditions can be tolerated for short period of time.

- Level of Service E - represents operations at much lower operating speeds than level of service D, with volumes at or near the capacity of the highway. At capacity, speeds are typically, but not always, in the neighborhood of 30mph. Flow is unstable, and there may be stoppages of momentary duration.

- Level of Service F - describes forced flow operations at low speeds, where volumes are above capacity. These conditions usually result from queues of vehicles backing up from a restriction downroad. Speeds are reduced substantially and stoppages may occur for short or long periods of time because of the downroad congestion. In the extreme, both speed and volume can drop to zero.

Level of service is best measured for an hourly flow of traffic, and capacity is therefore related to the hour or peak hour traffic. For rural highways, the 30th highest hour in the year is often utilized as the peak hour for highway capacity purposes. This peak is related to average annual daily traffic (AADT) and usually falls between 10% and 20% of AADT on major highways.

For determination of highway service level capacities and the associated AADT, Alaska DOT/PF design hourly volume designations were used as presented in the Interior Transportation Study. Using these designations, three major highways were analyzed for capacity constraints: the Parks Highway, the Alaska Highway and the Dalton Highway. Design hourly volumes for these highways range between 150 and 700 vehicles per hour for 2-lane segments.[1] This indicates capacity between 7,500 and 70,000 vehicles per day.

3.4.3.1 Parks Highway

Traffic on the Parks Highway, although higher than most highways in Alaska from a capacity standpoint, is relatively light. Average Annual Daily Traffic Volumes (AADT) only exceed 5000 vehicles at only one location on the highway during the first 11km (7.0 mi.). In only a few locations are traffic volumes greater than 1000 AADT. Traffic volumes for selected

[1] Taken from DOT/PF "100% design plans" for each highway segment.

representative segments were presented in section 2.3.1. As can be noted by the comparison of 30th highest hour figures (116-278 vehicles per hour) with DOT/PF hourly design criteria (440-530 vehicle per hour), traffic does not even approach hourly design standards. Consequently the Parks Highway can be viewed as having a substantial additional traffic carrying capacity.

3.4.3.2 Alaska Highway

Traffic on the Alaska Highway varies dramatically depending upon the segment of the highway. Near the Canadian border, traffic volumes have historically been less than 500 AADT. North of Delta Junction, recent traffic volumes have ranged from below 1000 AADT to over 10,000 AADT near Fairbanks (see Section 2.3.1) Despite relatively high traffic volumes, the traffic capacity of even the most heavily traveled segments of the highway are considerably in excess of capacity limitations since areas with high traffic volumes are serviced by a four lane divided highway. On two-lane segments the peak traffic is 53-113 vehicles per hour compared with design hourly volumes of 165-280 vehicles per hour.

3.4.3.3 Dalton Highway

Dalton Highway capacity greatly exceeds traffic (Louis Berger and Associates, Inc., 1983). A preliminary estimate of vehicle capacity of the highway was made (Louis Berger and Associates, Inc., 1980) and even assuming a worst condition scenario, with as much as 70 percent truck traffic and a low capacity range conditions the minimum daily capacity would be 600 vehicles for the worst section of road north of Livengood (Louis Berger and Associates, Inc., 1980). This far exceeds forecast traffic levels which remain under 300 vehicles per day on this section. Based on this evaluation, traffic capacity limitations appear minimal.

3.4.4 Railroad Capacity and Use Analysis

The capacity of the Alaska Railroad is a function of the number of trains per day using the track and the number of cars per train. The maximum number of trains that could potentially use the single track main line is difficult to calculate with accuracy because it involves trains passing each other at specific siding locations. However, this number is undoubtedly greater than 30 per day. At present and forecast levels of operation (1-2 trains per day) this capacity is clearly not approached for the Alaska Railroad.

Actual capacity constraints on the railroad will be reached first through the availability of rail cars or through handling and transfer facilities that may develop back logs. There will in fact be no constraints due to cars since these are purchased as needed or leased to meet demand. With the exception of coal and sand and gravel, which will have separate handling facilities no handling constraints are expected for major tonnage items. Pipe which accounts for the major tonnage in Seward is not forecast to exceed the Trans-Alaska Pipeline peak, and, therefore does not cause constraint. Containers and other products shipped through Whittier are expected to increase significantly, but there is ample excess capacity (over 50%) in Whittier and therefore no capacity problems are expected there until after 2010. Both the Fairbanks and Anchorage rail yards are also substantially under capacity, and the forecast increases are not expected to cause constraints in these locations.

In summary no rail constraints are expected for the forecast period in areas that could relate to shipments of oil and gas development materials on the Alaska Railroad.

3.4.5 Alyeska Pipeline Capacity and Use Analysis

The design capacity of the Alyeska pipeline is 2.0 million barrels of oil per day on the average for a year. It is capable of carrying up to 10% more than this for short periods of time (according to ARCO staff).

The present level of use averages approximately 1.6 million barrels per day including Prudhoe Bay and Kuparuk Field production. As shown in Table 3.2 this level is expected to rise slightly, then decline in the late 1980's, as onshore production replaces the declining production from Prudhoe Bay.

In the 1990's Beaufort Sea production from the combined state and federal sale in 1979, and potential production from Sale 71 could increase demand 17% over the 2 million barrel per day level for all production (see Table 3.2). This dramatic increase depends primarily on the pattern of production for Sale 71, which will probably be more spread out over time, if necessary, to meet pipeline capacity constraints. Under these conditions, the pipeline will be at capacity for roughly a 5-year period from 1993 to 1997. Oil storage may be necessary, but it seems likely for cost reasons that lower pumping rates would be used rather than the construction of oil storage facilities.

3.4.6 Transportation System Summary Analysis

Based upon the various oil and gas activities and assumptions for Alaska's North Slope, and in consideration of the region's existing transportation systems (including Anchorage, Fairbanks, Southcentral ports, etc.), no significant changes are expected to occur over the forecast period of this Base Case analysis. The preceding analysis has concluded that the future demands (forecasts) and supply (capacity and use analysis) expected on the inter and intra regional transportation systems will not result in major constraints on the existing and/or planned highway, air, marine, and railroad facilities. However, the Alyeska pipeline will probably reach capacity for a five year period between 1993 to 1998.

In some instances, we have identified additional transportation infrastructure needs (i.e., second dock at Oliktok), but the overall operating characteristics of these facilities and support infrastructure suggest that sufficient transportation alternatives are available to respond to forecast needs. This conclusion is further reinforced by consideration of the financial alternatives that are available to private industry and the present programs of the State of Alaska to expand and improve the key infrastructure facilities necessary to support these activities.

The adverse weather conditions on the North Slope, particularly winter, can have a major effect on transportation activity. The marine mode is the most susceptible to weather constraints due to the limited "window" of ice free days in which the annual sealift (see Section 3.4.1.1) must perform its operations.

To date, there has only been one year out of the 16 year history of the sealift in which major problems were encountered. In 1975, portions of the sealift had to turn back before reaching the North Slope. Two of the barges got caught in an early freeze-up, and consequently, had to remain in place until the following summer. A permit was obtained by industry to build a causeway to the barges to unload them via trucks. For those barges that had to turn back, they were offloaded in Anchorage, Whittier and Seward and the materials were transported to the North Slope by rail and truck combinations. Several thousand additional truck trips were necessary that year to transport the needed materials. The total cost to industry for this problem was difficult to estimate, but it was very expensive, as well as disruptive to their annual construction plan (Phil Bellamy, ARCO, personal communication, 1983).

Depending upon the composition of the sealift (i.e., modules, mud, pipe, and general cargo) in any given year, surface and air transportation alternatives do exist. As noted in this report, these two modes have existing capacities to assist in this type of a situation. However, in some cases the heavy construction materials being transported by the sealift to the North Slope are not economically conducive to air or highway transportation. Also, depending upon the final destination of the materials, these two alternative modes have some operating limitations (i.e., some form of a road and landing strip) that could physically prevent them from delivering the materials to their ultimate location on schedule.

It appears that industry, after many years of sealift experience, weather observation, and general operations on the North Slope, can deal with this problem when necessary. Cost is a major concern in dealing with this problem, but when viewed in relation to the total industry operational costs it has not been a major prohibiting development factor.

4. EFFECTS OF OCS DEVELOPMENT

4.1 Introduction

This chapter analyzes the effects on the transportation system of OCS activities related to exploration, development and production for the medium case scenario for the proposed June 1984 lease offering in the Diapir Field. During the exploration phase, lease holders will decide whether or not to continue with the commercial development of the field. The medium scenario used here assumes that the tracts leased, as a result of this offering, can produce sufficient oil to justify the sizeable investment needed to bring this field into production. Gas is not considered in this analysis because it is not forecasted to be economically producible in this century.

The following paragraphs describe in detail anticipated lease offering events and associated material requirements, as well as transportation demand generated by population growth and lease offering-related employment. These demands are then allocated by mode and the impact on each mode is analyzed.

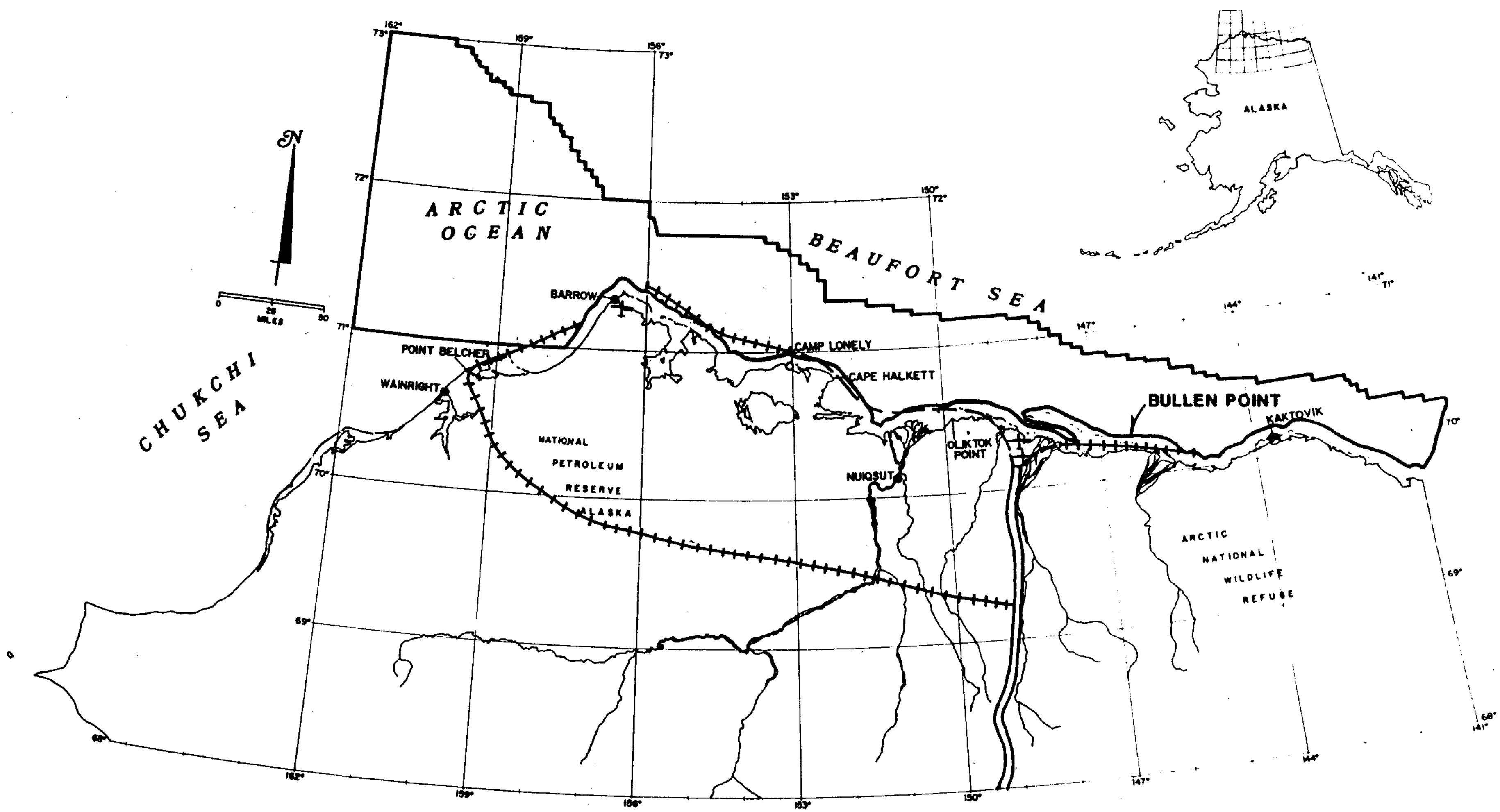
4.2 Expected OCS Events and Material Requirements

The exploration and delineation of oil deposits on tracts leased in the June 1984 Diapir lease offering are expected to occur over the period of 1985 through 1990. Full-scale construction of land based facilities and offshore pipelines for production is expected to begin in 1990 and extend through 1997. Approximately 26 exploration and 13 delineation wells will be drilled. Oilfield development is assumed to begin in 1991 and continue through 1997. During this seven year period, a total of 155 oil production wells will be drilled.

The primary support base for the development phase will probably be located in the Prudhoe Bay/Deadhorse area. However, if commercial finds are developed, three additional support bases may also be developed at Bullen Point east of Prudhoe Bay, at Camp Lonely west of Prudhoe Bay, and at Oliktok Point northwest of Kuparuk, where a recently constructed dock is being used to support Kuparuk Field development (see Figure 4.1).

FIGURE 4.1

TRUNK PIPELINES ASSUMED FOR THE DIAPIR FIELD LEASE OFFERING



- OCS LEASE SALE 87 OFFERING AREA
- ASSUMED TRUNK PIPELINES FOR SALE 87 PRODUCTION
- ASSUMED TRUNK PIPELINE FOR AREAS ALREADY LEASED
- TRANS ALASKA PIPELINE (TAPS) and HAUL ROAD (DALTON HIGHWAY)

Source: Minerals Management Service, 1983

Exploration activities are described below in Section 4.2.1. Production activities are described in Section 4.2.2 following.

4.2.1 Exploration and Delineation Activities

4.2.1.1 Technology Options and Development Assumptions

Industry's selection of a type of exploration/delineation platform for an exploration site depends upon the consideration of various factors, e.g., cost, risk, offshore depth, distance to borrow material sources, confidence and experience with different technologies and other related concerns. As indicated earlier in Section 3.2.3, past and current industry efforts in the Alaskan Beaufort have primarily used gravel island construction for the development of nearshore drilling platforms. It is expected that gravel islands will continue to serve as platforms for exploratory/delineation sites in shallower nearshore waters in light of the industry's successful experience with this construction technology.

As the industry gains more experience with artificial island construction and offshore exploration technology, the development and use of other technological options in the Diapir Field can also be expected. Examples of the type of technologies anticipated are described in the MMS Technical Report Number 79, Chukchi Sea Petroleum Technology Assessment (Dames and Moore, 1982), and are briefly summarized in Table 4.1. The development and use of these alternative technologies are primarily aimed at (1) decreasing the cost and risk of offshore exploration and production; and (2) increasing the mobility of offshore platforms.

One example of upcoming future technology is "CIDS" (Concrete Island Drilling System) which is currently being built in Japan for subsequent use by Exxon in the Beaufort Sea (Alaska Economic Report, 1983). The unit has been designed for towing to and from selected exploratory sites. The structure is to be ballasted to the ocean bottom by seawater (which would reduce fill requirements significantly if CIDS were used for nearshore platforms instead of gravel islands). Upon completion of drilling operations, the platform can be deballasted and towed to another exploratory site.

TABLE 4.1

ANTICIPATED EXPLORATION/DELINEATION PLATFORM TECHNOLOGY

DIAPIR FIELD

Alternative Technology Options	Approximate Maximum Offshore Depth of Use (feet)
- Artificial gravel island[a]	50
- Caisson retained gravel drilling island	90
- Conical drilling unit, other ice-strengthened floating platform	120
- Conical drilling unit/round drill ship	200
- Ice-reinforced semi-submersible, drill ship and turret moored drill ship	200
- Mobile caisson rig	200

[a]The term "gravel island" is generally used in this report to refer to any type of artificial island, or underwater berm for structural foundation support, constructed from fill materials obtained from onshore and offshore sources.

Source: Dames and Moore. Chukchi Sea Petroleum Technology Assessment, OCS Lease Sale No. 85. Alaska OCS Socioeconomic Studies Program, Technical Report No. 79. 1982.

As CIDS and other newer technologies will take time to become useable, the use of other readily available technological options, e.g., caisson retained islands, is anticipated in the interim. The primary industry motivation for use of caisson retained islands will be their ability to feasibly explore nearshore areas which are beyond 15m (50 ft.) in depth. Considerable success with Caisson Retained Island (CRI) technology has already been achieved in the Canadian Beaufort Sea with the construction of Tarsiut at an offshore depth of 22m (72 ft.) (Roberts and Tremont, 1982). The Semi-Submersible Drilling Caisson (SSDC) is also being used in the Canadian Beaufort Sea. Tarsiut and other artificial island construction efforts using prefabricated drilling caissons have been sufficiently promising that Dome Petroleum and Gulf Oil are now preparing plans for the development of two more caisson retained islands at 49 to 52m (160 to 170 ft.) depths in 1984 (MMS, 1982).

Industry's decisions to use existing or new technologies to explore and delineate various offshore sites in the Diapir Field are significant due to their different requirements for construction, transportation, and drilling materials. Material requirements for the exploration and delineation phases will generally include:

(a) Drilling supplies, including pipe, dry bulk (mud), fuel and drill water, and evacuated drill cuttings

(b) Sand and gravel for artificial islands

(c) Concrete caisson and sand fill for caissons

(d) Dredging and hauling equipment and fleet for island construction

(e) Drilling equipment, e.g., rigs

In order to further define these requirements, the preceding technology and development assumptions were correlated with MMS development and production projections. From this comparison, the number and type of artificial islands expected to be constructed in the exploration and delineation phases were determined (Table 4.2). For this estimate, the following additional assumptions were made:

TABLE 4.2

ASSUMPTIONS REGARDING TYPES OF
ISLANDS BUILT FOR EXPLORATION AND DELINEATION

YEAR	EXPLORATION		DELINEATION		TOTAL	
	GRAVEL	CAISSON	GRAVEL	CAISSON	GRAVEL	CAISSON
1984	-	-	-	-	-	-
1985	2	1	-	-	2	1
1986	1	1	-	-	1	1
1987	1	2	-	-	1	2
1988	1	3	1	-	2	3
1989	1	2	0	1	1	3
1990	-	-	-	-	-	-
1991	-	-	-	-	-	-
	6	9	1	1	7	10

Source: Louis Berger and Associates, Inc.

(a) One-half of the wells will be drilled from gravel or caisson retained islands.

(b) Shallow water gravel islands will likely be built earlier than caisson-retained islands in deeper near shore waters.

(c) The other half of exploration platforms will use new technology (e.g., CIDS).

(d) Due to the rising cost of extracting and transporting sand and gravel from onshore sources, 75 percent of the exploration islands will be filled with dredged material from offshore deposits.

Table 4.3 summmarizes the assumed timing and technology for exploration and delineatiton wells and their related platform and shore terminal requirements.

4.2.1.2 Material Requirements

The specific assumptions and methodology used in quantifying each of the five types of material requirements are described in the following paragraphs.

Drilling Supplies. The anticipated requirements for drilling supplies (Table 4.4) were determined using the methodology applied in the Base Case, i.e., 1,653MT (1,822 tons) of dry good supplies for each well, 40 percent of which are pipe and casings and 60 percent mud (bentonite, cement and barite). Fuel requirements are assumed equal to dry cargo tonnage, and drill needs are twice as large as fuel requirements. Evacuated drill cuttings are assumed to be 1,680MT (1,850 tons) per well (MMS, 1983).

Caisson Requirements. Caissons would be constructed in Seattle and brought north by the sealift and floated out to the site. The example of the construction by Dome Petroleum of the Tarsiut caisson retained artificial island in 22m (72 ft.) of water can be used to estimate total caisson requirements. Two seasons of construction were used to build this four-caisson

TABLE 4.3

JUNE 1984 DIAPIR FIELD LEASE OFFERING

ESTIMATED SCHEDULE OF EXPLORATION FOR THE MEDIUM CASE

YEAR	TYPE OF PLATFORM FOR EXPLORATION WELLS (ONE PER WELL)			TYPE OF PLATFORM FOR DELINEATION WELLS (OIL AND GAS)			TYPE OF PLATFORM FOR EXPLORATION AND DELINEATION WELLS			LEVEL OF ACTIVITY				
										NUMBER OF WELLS			NUMBER OF RIGS FOR EXPLORATION & DELINEATION	NUMBER OF OF SHORE TERMINALS
											DELINEATION			
	GRAVEL/ CAISSON	NEW TECH.	TOTAL	GRAVEL/ CAISSON	NEW TECH.	TOTAL	GRAVEL/ CAISSON	NEW TECH.	TOTAL	EXPL.	OIL	GAS		
1984	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1985	3	1	4	-	-	-	3	1	4	4	-	-	3	0.3
1986	2	1	3	-	-	-	2	1	3	3	1	-	3	0.7
1987	3	3	6	-	-	-	3	3	6	6	2	-	6	-
1988	4	4	8	1	-	1	5	4	9	8	1	1	7	-
1989	3	4	7	2 (1)	1	3 (2)	5 (4)	5	10 (9)	7	2	1	7	-
1990	-	2	2	-	4 (3)	4 (3)	-	6 (5)	6 (5)	2	3	1	4	-
1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	15	15	30	3 (2)	5 (4)	8 (6)	18 (17)	20 (19)	38 (36)	30	9	3	7	1.0

Note: Numbers in parenthesis reflect conditions without gas development.

Source: Louis Berger and Associates, Inc.

TABLE 4.4

FORECASTS OF JUNE 1984 DIAPIR FIELD LEASE OFFERING
EXPLORATION AND DELINEATION ACTIVITY AND ASSOCIATED DRILLING SUPPLY REQUIREMENTS

YEAR	EXPLORATION AND DEVELOPMENT WELLS	NUMBER OF RIGS	DRILLING SUPPLIES (1000 tons)				DRILL CUTTINGS (1000 tons)
			PIPES	MUD	FUEL	DRILL WATER	
1984	-	-	-	-	-	-	-
1985	4	3	2.9	4.4	7.3	14.5	7.4
1986	3	3	2.2	3.3	5.5	10.9	5.6
1987	6	6	4.4	6.6	10.9	21.9	11.1
1988	8	7	5.8	8.7	14.6	29.2	14.8
1989	7	7	5.1	7.7	12.8	25.5	13.0
1990	2	4	1.5	2.2	3.6	7.3	3.7

Source: Louis Berger and Associates, Inc.

island. The dimensions used are 69m (226 ft.) long, 15m (49 ft.) wide, and 11.5m (38 ft.) high. The caissons were prefabricated in Vancouver and transported to the Beaufort Sea in July 1981 on submersible barges. At Herschel Island west of MacKenzie Bay, the barges were flooded to float the 4MT (5.3 ton) caissons and haul them to the site. At the site, the water ballast in each caisson was displaced with sand (Roberts and Tremont, 1982).

Assuming four caissons per island and 13 caisson islands built between 1985 and 1989 (five years), and a caisson length of 100m (328 ft.) instead of 69m (226 ft.), the caisson-related material requirements will be 362,000MT (400,000 tons) of concrete (52 caissons). Thus, 73,000MT (80,000 tons) of concrete caissons would move to the North Slope each year for five years (1985 to 1989). As in the Base Case, this represents a maximum which would be reduced if reusable caisson technology is selected by the oil companies.

Sand and Gravel. Over a five year period extending from 1985 to 1989, a total of 18 islands are expected to be built for exploration and delineation. It is assumed that these will be seven gravel islands and 11 caisson retained islands. The quantities of fill material required are estimated to be 3.6 million cubic meters (4.7 million cubic yards) of sand and gravel from onshore sources and 16.7 million cubic meters (21.9 million cubic yards) dredged material from offshore borrow locations (see Figure 4.2).

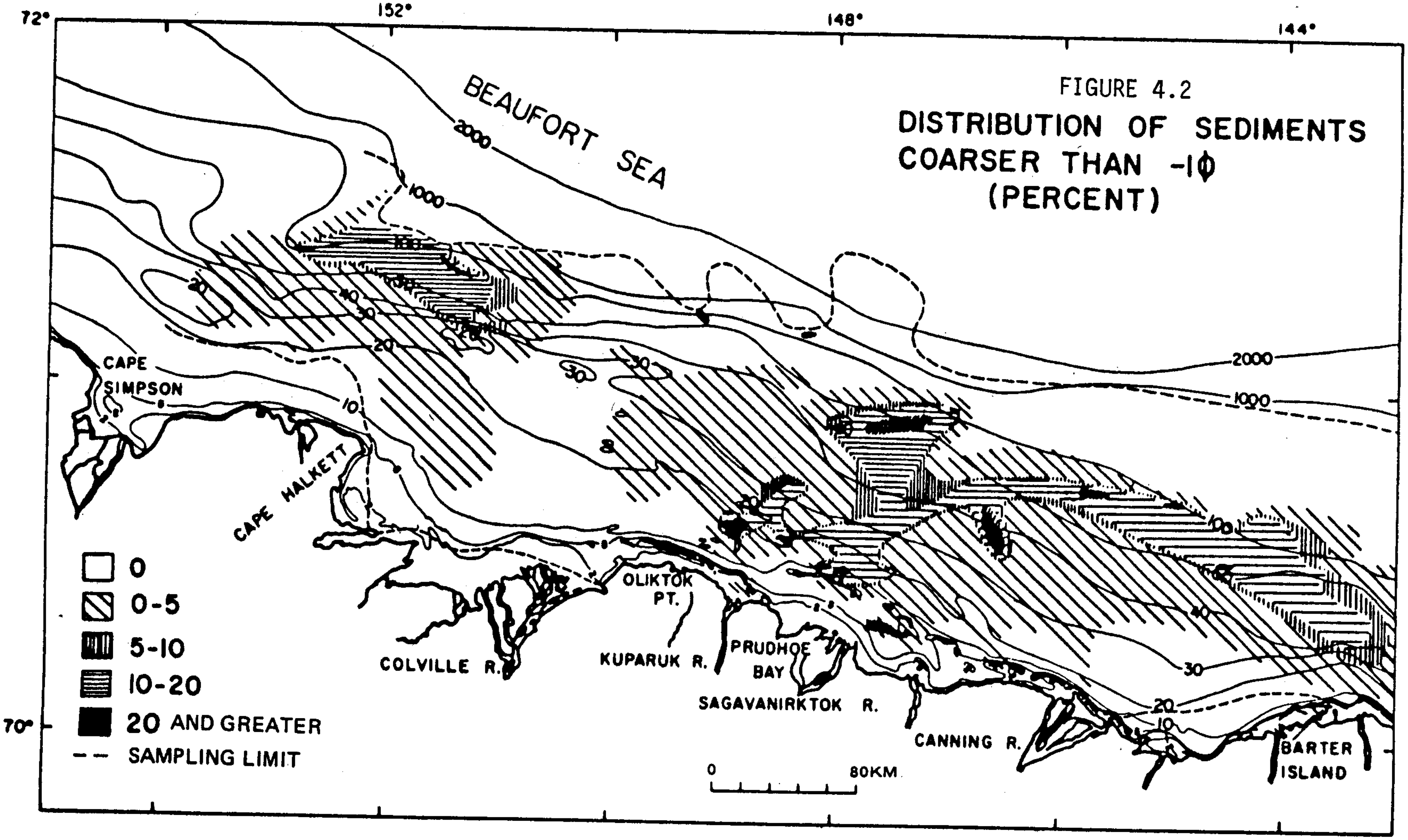
It was assumed that gravel islands will be built in approximately 9m (30 ft.) of water and caissons be used at an average depth of 24m (80 ft.). The estimated sand and gravel requirements per island are given in Table 4.5 and based on the assumptions from Technical Paper No. 7 (Roberts and Tremont, 1980). Annual sand and gravel tonnage requirements (one-fifth of total five year exploration requirements) will be:

- Onshore sources - 1,450,000MT (1,600,000 tons) (1985 to 1989)[1]
- Offshore sources - 5,500,000MT (6,100,000 tons) (1985 to 1989)

[1]Includes sand requirements to fill ballasts of caissons.

FIGURE 4.2

DISTRIBUTION OF SEDIMENTS COARSER THAN -1ϕ (PERCENT)



PERCENT GRAVEL (COARSER THAN 2 mm) IN SURFACE SEDIMENTS

Source: Rodeick, 1979.

TABLE 4.5

MATERIAL REQUIREMENTS FOR EXPLORATION AND DELINEATION ISLANDS
JUNE 1984 DIAPIR FIELD LEASE OFFERING

Top Diameter	120 m. (400 ft.) (caisson lenghth 100 m.)
Slope	
gravel island	1:3 trucked; 1:15/1:3 dredged
caisson island	1:6 trucked; 1:15/1:6 dredged
Average Depth	
gravel island	10 m. (30 ft.)
caisson island	25 m. (80 ft.)
Fill Requirements Onshore Source	
gravel island	360,000 cu. yd.
caisson island*	1,310,000 cu. yd.
Fill Requirements Offshore Source	
gravel island	1,100,000 cu. yd.
caisson island	2,050,000 cu. yd.
Number of Islands	
gravel (onshore source)	2
caisson (onshore source)	3
gravel (offshore source)	5
caisson (offshore source)	8
Material Requirements	
onshore sources	4.7 million cu. yd. (6,580,000 tons)
offshore sources	21.9 million cu. yd. (30,660,000 tons)
onshore sand fill for caissons	1.0 million cu. yd. (1,370,000 tons)
concrete caissons	0.20 million cu. yd. (400,000 tons)

* Caissons would require less fill than a gravel island at this depth (25 m). Also, 80,000 m^3 less fill would be required if caissons with seawater ballast are used.

Source: Louis Berger and Associates, Inc.

Dredging and Hauling Equipment and Fleet for Island Construction. The following equipment is needed for the construction of an exploration gravel island/caisson island assuming that offshore borrow sources are used during a 70 day construction period:[1]

- 2 to 3 cutterhead suction dredges (24 inch pipe or 21,000 cubic meters (27,000 cubic yards)/day)
- 3 to 4 barges (1,360MT (1,500 ton) capacity)
- 2 derrick barges
- 12 work boats
- 2 ice breakers
- 2 crew quarter barges
- 2 caterpillar tractors

Anticipated annual equipment and fleet requirements are presented for a typical year within the exploration period in Table 4.6. These estimates assume the construction of about three to four islands at any given time during the exploration period, and include those island construction efforts which exceed one-year in duration.

As dredges are anticipated to become increasingly sophisticated, the trend toward dredging fill material as opposed to using onshore borrow sources will accelerate. Dome Petroleum is planning to use a special Arctic super dredge tailored to the construction of deep water islands. This dredge can fill its 25,000 cubic meter (33,000 cubic yard) hopper capacity in two hours (Roberts and Tremont, 1982).

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[1]SF/Braun, a subconsultant to Dames & Moore (See Bibliography, Dames & Moore, December 1982, and July 1983), assumes availability of gravel sources within direct dredge pumping distance (about one kilometer (.6 mile)) and a 70-day open water construction season. If depth exceeds 20 meters (65.6 feet), two construction seasons would generally be required (Roberts and Tremont, 1982).

TABLE 4.6

TOTAL FLEET REQUIREMENTS FOR THE CONSTRUCTION OF EXPLORATION ISLANDS

USING OFFSHORE BORROW SOURCE - JUNE 1984 DIAPIR FIELD LEASE OFFERING

YEAR	NUMBER OF DREDGED ISLANDS	CUTTERHEAD SUCTION DREDGES[a]	1500 TON BARGES	DERRICK BARGES	WORK BOATS	ICE-BREAKERS	CREW QUARTERS	CAT TRACTOR
1984	-	-	-	-	-	-	-	-
1985	3	9	12	6	36	6	6	6
1986	3	9	12	6	36	6	6	6
1987	4	12	16	12	48	8	8	8
1988	4	12	16	12	48	8	8	8
1989	4	12	16	12	48	8	8	8
1990	-	-	-	-	-	-	-	-

[a] 24 inch pipe, 21,000 M3 /day

Source: Louis Berger and Associates, Inc.

Drilling Equipment, Rigs. A maximum of seven rigs will be used in the exploration and delineation phases (Table 4.3). Some of those rigs, particularly the first ones, will be used for exploration drilling on the artificial islands. The remaining drilling units, to be used at deeper locations, will be either ice-resistent or ice-breaker drill ships, ice-breaker semi-submersible rigs, or conical drilling units. Four of these units are assumed.

4.2.2 Production Activities

4.2.2.1 Technology and Development Assumptions

Industry's selection of appropriate technology for production platforms is difficult to predict since no offshore production platforms have yet been built in the Alaskan or Canadian Beaufort. However, even though Arctic offshore production technology is less advanced than related development for exploration, a number of speculative assumptions can be made.

Much of the same technology used for exploration is also quite appropriate for production purposes. Consequently, the alternative technologies available to industry for exploration (Table 4.1) are generally adaptable to production as well. For example, artificial gravel islands may also be used for production as long as future design criteria provide for a considerably longer design life, e.g., 20 to 30 years (Roberts and Tremont, 1982). The artificial production island must be able to withstand exposure from various oceanographic conditions such as storm surges, extreme wave heights, onshore currents and ice forces for a design life which is roughly 10 times longer than that of an artificial exploration island.

Similar to exploration platforms, the anticipated effects upon transportation will be primarily related to the materials required to build and place offshore platforms. In order to quantify the estimated material requirements, the following general assumptions were used:

(a) Eight production platforms will be developed in the 1989 to 1994 production period (MMS, 1983).

(b) Four of the production platforms will be gravel or caisson retained islands.

(c) Four other platforms will be such prototypes as mobile caisson production rigs, or steel or concrete monocone/gravity islands.

Table 4.7 summarizes the assumed timing and technology for production wells and their related platform and shore terminal requirements.

4.2.2.2 Material Requirements

Similar to exploration, the development of production platforms will generate requirements for the following types of construction, transportation and drilling materials:

(a) Drilling supplies (including pipe, dry bulk (mud), fuel and drill water, and evacuated drill cuttings).

(b) Sand and gravel to construct production islands.

(c) Concrete caissons and sand fill for caissons.

(d) Dredging and hauling equipment, and fleet for island construction.

(e) Drilling equipment, rigs

The more specific assumptions and methodologies used to quantify these requirements are discussed in the following paragraphs:

Drilling Supplies. Drilling supply requirements (Table 4.8) were determined using the methodology applied in the Base Case, i.e., 1,092MT (1,204 tons) of dry good supplies for each production well, 40 percent of which is pipe and 60 percent mud (bentonite, cement, barite). In addition, 1,100MT (1,200 tons) of fuel and 2,185MT (2,408 tons) of drill water are needed, and 1,680MT (1,850 tons) of drill cuttings must be evacuated, usually on site.

TABLE 4.7

JUNE 1984 DIAPIR FIELD LEASE OFFERING
ESTIMATED SCHEDULE OF PRODUCTION FOR THE MEDIUM CASE

TYPES OF PLATFORMS FOR OIL PRODUCTION WELLS			LEVEL OF ACTIVITY			
YEAR	GRAVEL/ CAISSON	NEW TECH.	NUMBER OF WELLS OIL	NUMBER OF RIGS	MILES OF TRUNK PIPELINE OIL	NUMBER OF SHORE TERMINALS
1989	1	-	-	-	-	-
1990	2	-	-	-	50	0.3
1991	-	-	16	2	100	0.3
1992	-	1	46	6	50	0.3
1993	-	-	31	6	50	0.4
1996	-	1	16	4	100	0.3
1995	-	-	15	2	50	0.3
1996	-	-	16	2	-	0.3
1997	-	-	15	2	-	0.3
1998	-	-	-	-	-	-
TOTAL	3	2	155	6	400[a]	2.5[b]

[a]250 miles required to support the area west of Point Barrow excluded.

[b]0.5 shore terminal at 50/50 share with Canada for environmental control.

Source: Louis Berger and Associates, Inc.

TABLE 4.8

FORECASTS OF JUNE 1984 DIAPIR FIELD LEASE OFFERING

PRODUCTION ACTIVITY AND ASSOCIATED DRILLING SUPPLY REQUIREMENTS

YEAR	NUMBER OF DEVELOPMENT WELLS	NUMBER OF RIGS	DRILLING SUPPLIES (1000 TONS)				DRILL CUTTINGS (1000 TONS)
	OIL		PIPES	MUD	FUEL	DRILL WATER	
1989	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-
1991	16	2	7.7	11.6	19.3	38.5	29.6
1992	46	6	22.2	33.2	55.4	110.8	85.1
1993	31	6	25.5	38.3	63.8	127.6	98.1
1994	16	4	13.5	20.2	33.7	67.4	51.8
1995	15	2	7.2	10.8	18.1	36.1	27.8
1996	16	2	7.7	11.6	19.3	38.5	29.6
1997	15	2	7.2	10.8	18.1	36.1	27.8
1998	-	-	-	-	-	-	-

Source: Louis Berger and Associates, Inc.

Sand, Gravel and Caissons. Over a three year period, extending from 1989 to 1992, the construction of four gravel or caisson-type of artificial islands is anticipated. Given the large quantities of sand and gravel required for the construction of production islands, it is assumed that the use of caisson-retained gravel islands will be favored. Table 4.9 shows the related set of assumptions used to establish material requirements for these islands.

Using these assumptions, annual sand and gravel requirements for production (one-fifth of total five year production requirements) are estimated as follows:

- Onshore sources - 336,000MT (370,000 tons) (1989 to 1992)[1]
- Offshore sources - 3,402,000MT (3,750,000 tons) (1989 to 1992)
- Concrete caissons - 21,0000MT (23,000 tons) (1989 to 1992)[2]

Dredging and Hauling Equipment and Fleet for Island Construction. Based on the assumptions stated earlier regarding equipment requirements for exploration and delineation islands and the premise that production island fill volumes are about twice as large as exploration island volumes, it is estimated that the following equipment will be needed at every island construction site:

- 2 to 3 cutterhead suction dredges (32 inch pipe or 70,000 cubic meters (92,000 cubic yards)/day)
- 8 barges (1,360MT (1,500 ton) capacity)
- 4 derrick barges
- 18 work boats
- 3 icebreakers
- 3 crew quarter barges
- 3 caterpillar tractors

[1]Includes sand requirements to fill caisson ballasts.
[2]Assuming twelve 150m (492.1 ft.) long caissons for three caisson-retained islands.

TABLE 4.9

MATERIAL REQUIREMENTS FOR PRODUCTION ISLANDS
JUNE 1984 DIAPIR FIELD LEASE OFFERING

Top Diameter	180 m. (600 ft.) (caisson length 150 m.)
Slope	
gravel island	1:3 trucked; 1:15/1:3 dredged
caisson island	1:6 trucked; 1:15/1:6 dredged
Average Depth	
gravel island	10 m. (30 ft.)
caisson island	25 m. (50 ft.)
Fill Requirements Onshore Source	
gravel island	780,000 cu. yd.
caisson island*	2,850,000 cu. yd.
Fill Requirements Offshore Source	
gravel island	1,700,000 cu. yd.
caisson island	3,750,000 cu. yd.
Number of Islands	
gravel (onshore source)	1
caisson (onshore source)	0
gravel (offshore source)	0
caisson (offshore source)	3
Material Requirements	
onshore sources	780,000 cu. yd. (1,100,000 tons)
offshore sources	11,250,000 cu. yd. (15,100,000 tons)
onshore sand fill for caissons	340,000 cu. yd. (480,000 tons)
concrete caissons	70,000 cu. yd. (140,000 tons)

* Caissons would require less fill than a gravel island at this depth (25 m). Also, 80,000 m^3 less fill would be required if caissons with seawater ballast are used.

Source: Louis Berger and Associates, Inc.

Assuming a two-year construction season for each of the three islands, two construction sites will be active every year from 1989 to 1991. Total requirements for any one year during this period are shown in Table 4.10.

Drilling Equipment, Rigs. A maximum of six rigs will be used in the production phase as shown on Table 4.7. Some of these rigs, particularly the first ones, will be used for production drilling on the artificial islands. The other rigs (two or three) which could be steel or concrete monocone gravity islands and caisson production rigs, will be used at deeper locations (40m or 130 ft. and deeper).

4.2.3 Pipelines

4.2.3.1 Selection

According to the National Petroleum Council, conventional non-Arctic pipe laying methods are not applicable to Diapir Field conditions (National Petroleum Council, 1981). However, a sophisticated technical base does exist and can be adjusted to Arctic conditions. The type of method selected for pipe laying is important in assessing the material requirements. Four general methods have been developed: (1) the bottom pull or bottom tow method; (2) the flotation method; (3) the reeled pipe method; and (4) the lay-barge method. The National Petroleum Council favors the bottom-tow method which uses a conventional ship-type lay vessel to pull and lay as much as 60km (35 mi.) of pipe in a 50-day open-water season, assuming a pipe diameter ranging from 22 inches to 30 inches.

To avoid problems of bottom scour and gouging from ice, the pipe would be buried to a depth of 2m (7 ft.) in waters up to 25m (80 ft.) deep and to a depth of 1m (3 ft.) in deeper waters.

On-shore sections and connections with the Trans-Alaska Pipeline (TAPS) can be designed using well established methods and would not present critical problems (MMS, 1983).

TABLE 4.10

TOTAL JUNE 1984 DIAPIR FIELD LEASE OFFERING FLEET REQUIREMENTS FOR THE CONSTRUCTION OF PRODUCTION ISLANDS USING OFFSHORE BORROW SOURCES

YEAR	NUMBER OF DREDGED ISLANDS (Caisson)	CUTTERHEAD SUCTION DREDGES[a]	1500 TON BARGES	DERRICK BARGES	WORK BOATS	ICE-BREAKERS	CREW QUARTER BARGES	CAT TRACTION
1988	-	-	-	-	-	-	-	-
1989	1	6	16	8	36	6	6	6
1990	1	6	16	8	36	6	6	6
1991	1	6	16	8	36	6	6	6
1992	-	-	-	-	-	-	-	-

[a]32 inch pipe, 70,000 M3 /day.

Source: Louis Berger and Associates, Inc.

4.2.3.2 Material Requirements

The estimated schedule of development and production of the Diapir Field June 1984 lease offering (MMS, 1983) indicates that 650km (400 mi.) of pipeline would be required to connect with the TAPS and 320km (200 mi.) of gas pipeline to connect with the hypothetical Alaska Natural Gas Transportation System (ANGTS). An additional 400km (250 mi.) of pipeline are also assumed needed to support the area west of Point Barrow if it were developed. The following operations are required to complete construction.

- Trenching, using conventional plow or jetting techniques, or dredging
- Construction of a gravel causeway for joining offshore pipeline with the onshore system
- Construction of a 1.6km (1 mi.) onshore gravel pad as a staging area to pre-weld pipe sections
- Construction of an onshore pipeline and road

Estimating the total tonnage requirements is highly speculative as the proportion of onshore and offshore pipelines is not known, the fill requirements depend on the routing of the pipeline, and the trenching methods are not selected. As a result, a standard figure was used for planning purposes based on material requirements of 227MT per 1.6km (250 tons per mi.) of pipeline, whether offshore and onshore. The major components of this tonnage are pipe and fuel. This estimate is based on interviews with trucking operators and construction companies. Table 4.11 summarizes the requirements on a year-by-year basis.

4.2.4 Offshore Loading and Storage

Alternatives to transporting oil by pipeline to TAPS could conceivably be considered depending on the location of the finds and the capacity of the TAPS. Such alternatives are: (1) the construction of an offshore treatment and storage facility for field production, loading into a fleet of icebreaker tankers and Aleutian transshipment terminal for VLCC; and (2) the construction of a pipeline southward to a new loading terminal on the west coast of Alaska. However, as suggested by MMS, the pipeline scheme indicated in Section 4.2.3 is anticipated to be the most likely and is used as a base for assessing the effects of the June 1984 lease offering.

4.2.5 Onshore Support Facilities

4.2.5.1 Types of Facility

Several types of onshore support facilities are needed in the exploration and development phases. These requirements were described in Technical Report Number 79, the Chukchi Sea Petroleum Technology Assessment, and are reiterated in Figure 4.3.

There are three potential base locations in the study area: on the east side, Bullen, located on Mikkelssen Bay 64.4km (40 mi.) east of Prudhoe Bay; on the west side, Camp Lonely, located 160.9km (100 mi.) southeast of Barrow; and in the middle sector, Oliktok, located 64.4km (40 mi.) west of Prudhoe Bay.

It is difficult to assess the location of temporary shore facilities at the present time, as the location of the gravel supply sources and the artificial islands has not been determined.

4.2.5.2 Material Requirements

Material requirements consist of modules for the basic shore base facility(ies), material handling equipment such as conveyors mounted on sunken barges to form temporary shore facilities (sand and gravel), construction material for the roads, airport, airstrip and heliport facilities, construction material and sunken barges for the basic port facilities.

The requirements resulting in major transportation flows are the modules which can be estimated according to the methodology applied in the Base Case forecasts. Sand and gravel requirements are assumed to be on the order of 4,000,000 cubic meters (5,200,000 cubic yards) per terminal. Construction material requirements can be obtained by multiplying the above estimate by the percent of terminal construction completed in any given year according to the MMS lease offering schedule. Table 4.11 summarizes anticipated requirements related to onshore support facilities.

FIGURE 4.3
ONSHORE SUPPORT FACILITY REQUIREMENTS
JUNE 1984 DIAPIR FIELD LEASE OFFERING

Facility	Purpose
Basic Shore Based Facility	Servicing of exploration, development and long term production; location of company headquarters and employee housing (oil, construction, transport, other services), procurement of storage and fabrication areas for materials, equipment, and ample supplies of spare parts.
Temporary Shore Facility	Handling of peak construction activities associated with artificial islands and pipeline construction.
Airport, Airstrip and Heliport Facilities	Servicing of exploration and development activities.
Basic Port Facility	Servicing and sheltering of vessels, tugs, barges, construction vessels (dredges, pipe laying equipment), work boats, ice breakers, etc.; located near or at shore base facility.
Construction of Appropriate Roads	Servicing of the harbor and support base complex.
Additional Shore Base Support and Port Facilities	Might be required at a location different from the basic exploratory location to be closer to the actual offshore production fields; additional support linked to production could necessitate an enlargement of the initial basic harbor and support base complex.

Source: Dames and Moore. Chukchi Sea Petroleum Technology Assessment, OCS Lease Sale #85. Alaska OCS Socio-economic Studies Program. Technical Report No. 79, 1982.

TABLE 4.11
QUANTITY REQUIREMENTS FOR ONSHORE BASE AND TERMINAL FACILITIES

YEAR	WELLS			NUMBER OF SHORE TERMINALS[a]	PLANT AND CONSTRUCTION MODULE REQUIREMENTS (1000T)	CONSTRUCTION MATERIALS, SAND AND GRAVEL REQUIREMENTS (m^3)
	EXPLORATION	DEVELOPMENT	PRODUCTION			
1984	-	-	-	-	-	-
1985	4	-	-	0.3	7.0	1,200,000
1986	3	1	-	0.7	7.0	2,800,000
1987	6	2	-	-	13.0	-
1988	8	2	-	-	16.0	-
1987	7	3	-	-	16.0	-
1990	2	4	-	0.3	10.0	1,200,000
1991	-	-	16	0.3	17.0	1,200,000
1992	-	-	46	0.3	50.0	1,200,000
1993	-	-	53	0.4	57.0	1,600,000
1994	-	-	18	0.3	20.0	1,200,000
1995	-	-	15	0.3	16.0	1,200,000
1996	-	-	16	0.3	17.0	1,200,000
1997	-	-	15	0.3	16.0	1,200,000
1998	-	-	-	-	-	-

[a] 0.5 onshore terminal at 50/50 share with Canada for environmental controls.

Source: Louis Berger and Associates, Inc.

4.3 OCS-Related Population and Employment

As a result of the activities described above, both population and employment will increase in Anchorage, Fairbanks and Southcentral Alaska. These increases were forecast for MMS by ISER using the Man in the Arctic (MAP) model (see Table 4.12). North Slope workers for these activities are all expected to commute from other locations in Alaska.

Population and employment increases for Anchorage and Fairbanks as a result of the Diapir Field activities are estimated between 3 and 4 percent. The increase is even smaller for Southcentral Alaska. The effects of this change are expected to be negligible in these two urban areas since these increases are the same magnitude as annual forecast changes in population and employment (see Table 3.1) in the Base Case.

The additional North Slope workers due to the lease offering are all expected to maintain residences elsewhere in Alaska or out of State as shown in Table 4.13. This means that no population increases are expected on the North Slope except for workers in OCS-related camp or facility sites. The total number of workers projected for the North Slope will, however, add a substantial increment to the forecast oil-related employment. It represents a 13 to 28 percent increase from 1985 to 1988, and except for 1991 and 1993, represents over 50 percent increase after 1990.

TABLE 4.12

FORECAST POPULATION AND EMPLOYMENT CHANGES

RELATED TO THE DIAPIR FIELD LEASE OFFERING OF JUNE 1984

YEAR	ANCHORAGE				FAIRBANKS				SOUTH CENTRAL ALASKA*			
	TOTAL POPULATION	INCREASE EMPLOYMENT	PERCENT CHANGE		TOTAL POPULATION	INCREASE EMPLOYMENT	PERCENT CHANGE		TOTAL POPULATION	INCREASE EMPLOYMENT	PERCENT CHANGE	
			POPULATION	EMPLOYMENT			POPULATION	EMPLOYMENT			POPULATION	EMPLOYMENT
1985	1256	688	1	1	334	173	-	1	245	114	-	1
1986	1265	691	1	1	280	145	-	-	205	94	-	-
1987	2006	1093	1	1	467	241	1	1	331	150	-	1
1988	2229	1211	1	1	542	279	1	1	376	168	1	1
1989	4092	2218	2	2	1017	523	1	2	721	317	1	1
1990	6698	3621	3	3	1764	905	2	3	1298	564	2	2
1991	3348	1805	1	1	818	418	1	1	634	272	1	1
1992	6144	3330	2	3	1716	875	2	3	1332	564	2	2
1993	5284	2833	2	2	1368	696	2	2	1120	469	2	2
1994	8688	4646	3	3	2272	1153	3	3	1858	768	2	3
1995	6818	3636	3	3	1777	900	2	3	1534	626	2	2
1996	8375	4455	3	3	2179	1100	3	3	1921	775	2	3
1997	9874	5238	4	4	2565	1292	3	4	2274	906	3	3
1998	8754	4632	3	3	2225	1118	3	3	2009	791	3	3
1999	8389	4427	3	3	2132	1069	3	3	1951	759	2	3
2000	8510	4479	3	3	2175	1088	3	3	2011	773	2	3
2005	9099	4776	3	3	2395	1194	3	3	2229	847	3	3
2010	8278	4334	3	3	2189	1089	2	3	2072	779	3	3

* Excluding Anchorage, primarily Kenai Peninsula residents.

Note: Figures include North Slope workers living in each location, workers in petroleum support activities and workers in retail trade, services & government.

Source: Appendix I, Diapir Field Lease Offering (June 1984) Draft Environmental Impact Statement, U.S. Dept. of Interior, Sept. 1983

TABLE 4.13

NORTH SLOPE EMPLOYMENT

RELATED TO THE DIAPIR FIELD LEASE OFFERING

YEAR	LIVING IN ANCHORAGE	LIVING IN FAIRBANKS	LIVING IN SOUTH CENTRAL	OUT OF STATE	TOTAL	NORTH SLOPE EMPLOYMENT-%
1985	229	101	82	332	744	17
1986	177	78	63	299	617	13
1987	271	119	96	539	1025	24
1988	295	130	105	599	1129	28
1999	541	238	192	1010	1981	49
1990	934	410	332	1308	2984	75
1991	438	192	156	299	1085	31
1992	882	387	314	766	2249	64
1993	699	307	248	351	1605	46
1994	1109	487	394	883	2873	82
1985	861	378	306	391	1936	55
1986	1033	454	367	380	2234	64
1987	1187	521	422	409	2539	72
1988	1003	441	357	352	2153	62
1999	937	411	333	338	2019	58
2000	933	410	332	337	2012	58
2005	1003	441	357	352	2153	62
2010	896	394	319	301	1910	55

Source: Appendix I, Diapir Field Lease Offering (June 1984) Draft Environmental Impact Statement, U.S. Dept. of Interior, Minerals Management Service, Sept. 1983

4.4 OCS Related Transportation Demand

The forecast of OCS demand for supplies presented in Section 4.2 in relation to expected OCS events is split among modes in this Section.

A summary of material requirements relating to anticipated June 1984 Diapir Field lease offering activities is presented in Table 4.14. The most extensive requirements are linked to the movement of sand and gravel which is anticipated to total nearly 63.5 million metric tons (70 million tons) over the 1985-1987 exploration and development period. Nearly 22.7 million metric tons (25 million tons) or 35 percent of all movements will originate at onshore borrow sources: 10 million tons will be used for island construction, and 12,700MT (14,000 tons) for the construction of harbor and support facilities. The remaining 40.8 million metric tons (45 million tons) or 25 million cubic meters (32.7 million cubic yards) will be obtained from offshore sites.

Other major movements will be caissons (446,000MT or 492,000 tons), fuel (256,000MT or 282,000 tons), plant and building modules (238,000MT or 262,000 tons), connecting pipelines (192,800MT or 212,500 tons), drilling mud (153,000MT or 169,000 tons) and drill pipe and casings (102,500MT or 113,000 tons).

4.4.1 Pipeline Demand

As a result of the oil production expected under the medium case scenario used here, three trunk pipelines will be needed to connect offshore production areas with TAPS. One trunk line would extend east from Prudhoe Bay; the second line would be to the west and extend as far as Pt. Barrow. A third would service the area west of Pt. Barrow (MMS, 1983). The pipelines required to serve these areas are discussed in Section 4.5.1.

4.4.2 Marine System

The total demand requirements allocated to the water mode evaluated in this section are based on the following assumptions (see Table 4.15). Sealift traffic by barge and tug is shown in Table 4.16.

TABLE 4.14

SUMMARY TABLE OF ADDITIONAL MATERIAL REQUIREMENTS TO THE NORTH SLOPE -JUNE 1984 DIAPIR FIELD LEASE OFFERING

(1000 Tons)

	WELL DRILLING SUPPLIES					SAND AND GRAVEL				PIPELINE RELATED TONNAGE				
						ISLAND SAND & GRAVEL		TERMINAL SAND AND GRAVEL FROM ON-SHORE SOURCES	TOTAL SAND & GRAVEL					
YEAR	PIPES	MUD	FUEL	DRILL WATER	WELL DRILL CUTTINGS	ON-SHORE SOURCE	OFF-SHORE SOURCE			400 BASIC MILES	250 mi. OPTION	EXPLOR. & PROD. RIGS(#)	PLANT & BUILDING MODULES	CAISSON TRANSPORT
1984	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1985	2.9	4.4	7.3	14.6	7.4	1,600	6,100	1,200	8,900	25	25	3	7	80
1986	2.2	3.3	5.5	10.9	5.6	1,600	6,100	2,800	10,500	37.5	25	3	7	80
1987	4.4	6.6	10.9	21.9	11.1	1,600	6,100	-	7,700	25	12.5	6	13	80
1988	5.8	8.7	14.6	29.2	14.8	1,600	6,100	-	7,700	25	-	7	16	80
1989	5.1	7.7	12.8	25.5	13.0	1,970	9,850	-	11,820	25	-	7	16	103
1990	1.5	2.2	3.6	7.3	3.7	370	3,750	1,200	5,320	12.5	-	4	10	23
1991	7.7	11.6	19.3	38.5	29.6	370	3,750	1,200	5,320	-	-	2	17	23
1992	22.2	33.2	55.4	110.8	85.1	370	3,750	1,200	5,320	-	-	6	50	23
1993	25.5	38.3	63.8	127.6	98.1	-	-	1,260	1,600	-	-	6	57	-
1994	13.5	20.2	33.7	67.4	51.8	-	-	1,200	1,200	-	-	4	20	-
1995	7.2	10.8	18.1	36.1	27.8	-	-	1,200	1,200	-	-	2	16	-
1996	7.7	11.6	19.3	38.5	29.6	-	-	1,200	1,200	-	-	2	17	-
1997	7.2	10.8	18.1	36.1	27.8	-	-	1,200	1,200	-	-	2	16	-
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	112.9	169.4	282.3	564.6	405.4	9,480	45,500	14,000	68,980	150	62.5	7	262	492

Source: Louis Berger and Associates

TABLE 4.15

MARINE TRANSPORTATION PRIMARY DEMAND

JUNE 1984 DIAPIR FIELD LEASE OFFERING

(1000 tons)

	ARCTIC SEA LIFT					BARGING ON BEAUFORT SEA						
	SEATTLE TO SUPPORT BASE			SEATTLE TO TEMPORARY BASES		SUPPORT BASES TO ISLANDS DRILLING SUPPLIES				TEMPORARY BASES TO ISLANDS		OFFSHORE BORROW SITES TO ISLANDS
	DRILLING SUPPLIES		PLANT & BUILDING	CAISSONS FOR ISLAND CONSTRUCTION	PIPELINE FOR 250 MILE WEST BRANCH					CAISSON	ONSHORE	
YEAR	PIPES	MUD	MODULES	NORTH SLOPE	OPTION, WAINWRIGHT	PIPES	MUD	FUEL	WATER	TRANSPORT	SAND & GRAVEL	SAND & GRAVEL
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	.3	.4	7	80	25	.4	.7	1.1	2.2	80	800	3,000
1986	.2	.3	7	80	25	.3	.5	.8	1.6	80	800	3,000
1987	.4	.7	13	80	12.5	.7	1.0	1.6	3.3	80	800	3,000
1988	.6	.9	16	80	-	.9	1.3	2.2	4.4	80	800	3,000
1989	.5	.8	16	103	-	.8	1.2	1.9	3.8	103	985	5,000
1990	.2	.2	10	23	-	.2	.3	.5	1.1	23	185	1,900
1991	.8	1.2	17	23	-	1.2	1.7	2.9	5.8	23	185	1,900
1992	2.2	3.3	50	23	-	3.3	5.0	8.3	16.6	23	185	1,900
1993	2.6	3.8	57	-	-	3.8	5.7	9.6	19.1	-	-	-
1994	1.4	2.0	20	-	-	2.0	3.0	5.1	10.1	-	-	-
1995	.7	1.1	16	-	-	1.1	1.6	2.7	5.4	-	-	-
1996	.8	1.2	17	-	-	1.2	1.7	2.9	5.8	-	-	-
1997	.7	1.1	16	-	-	1.1	1.6	2.7	5.4	-	-	-
1998	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	11.3	16.9	262	492	62.5	16.9	25.4	42.3	84.7	492	4,740	22,700

Source: Louis Berger and Associates, Inc.

TABLE 4.16

SEALIFT TRAFFIC - JUNE 1984 DIAPIR FIELD LEASE OFFERING (1000 tons)

Year	Tonnage	# Barges[a]	# Tugs[b]
1985	112.7	23	12
1986	112.5	23	12
1987	106.6	22	11
1988	97.5	20	10
1989	120.3	25	13
1990	33.4	7	4
1991	42.0	9	5
1992	78.5	16	8
1993	63.4	13	7
1994	23.4	5	3
1995	17.8	4	2
1996	19.0	4	2
1997	17.8	4	2

[a]A figure of 4,820 tons per barge is assumed based on the five year average tons per barge experienced during the years 1979-1983.

[b]Based on historical experience, it is assumed that one tug carries two barges.

Source: Louis Berger and Associates, Inc.

4.4.2.1 Drilling Supplies

According to historical records, 10 percent of all dry drilling supplies are sealifted to one of the North Slope support bases (Table 4.15). The rest of the dry goods are trucked along the Haul Road. Fuel and drill water are processed in the Arctic and therefore do not need to be transported north. When the Beaufort Sea is frozen, those liquid supplies can be trucked to the drill site. During the 50 to 70 day navigation season, or 15 percent of the time, barges can be used for that purpose and also carry pipe, casings and drill mud.

4.4.2.2 Drill Cuttings

The nearly 1,800MT (2000 tons) of drill cuttings are not anticipated to create any demand on marine transportation as they would be disposed of primarily on site under conditions prescribed by the EPA's pollutant discharge permit.

4.4.2.3 Sand and Gravel

Onshore sand and gravel used for island constructionare assumed to be either trucked all the way to the island site in the winter on ice roads, or trucked to a temporary shore base and then shuttle barged to island sites during the navigation season.

Offshore sand and gravel can either be piped from the borrow source to the island, if the borrow source is located within a mile or two of the island, or barged to the site. It is assumed that 50 percent of total fill requirements use the latter method and therefore have an impact on fleet requirements. These are discussed in Table 4.10. Onshore sand and gravel to be used in establishing terminals and temporary as well as basic support bases are assumed to be trucked and therefore not to use the marine mode.

4.4.2.4 Pipeline

Pipeline tonnage related to the potential 400km (250 mi.) extension from the western fields to the TAPS would be sealifted to the study area; a potential unloading base could be Wainwright. Other pipe would be trucked north via the Haul Road.

4.4.2.5 Exploration and Production Rigs

Interviews with oil company officials have indicated that there would not be any basic movement of rigs north as existing North Slope rigs would simply be reallocated to new fields once exploration or production finishes at other locations.

4.4.2.6 Plant and Building Modules, Caissons

Plant and building modules are anticipated to be sealifted from Seattle to a basic support base such as Camp Lonely, Oliktok or Bullen. Caissons for artificial islands will also be sealifted and then floated to temporary locations where tugs will tow them to the island sites.

4.4.3 Aviation System

As discussed in Chapter 3, there are two general categories of potential demand for air services as a result of the proposed lease offering: (1) direct demand for shipment of high priority material and commuting workers and (2) increases in air travel demand due to indirectly related population changes. Demand for Anchorage, Fairbanks, Barrow and Deadhorse airports is discussed below.

4.4.3.1 Anchorage and Fairbanks Airports

The incremental demand at these two airports due to the lease offering is given in Table 4.17. Direct passenger demand is based on 26.7 trips per North Slope employee per year. Southcentral residents and out of state residents are assumed to pass through the Anchorage airport on their way to the North Slope. Indirect passenger demand was calculated on the basis of two trips per person of increased population due to the lease offering.

TABLE 4.17

INCREMENTAL AVIATION DEMAND AT ANCHORAGE AND FAIRBANKS
RELATED TO DIAPIR FIELD LEASE OFFERING (JUNE 1984)

	ANCHORAGE PASSENGER TRIPS(000)				OPERATIONS/YR.		FAIRBANKS PASSENGER TRIPS(000)				OPERATIONS/YR.	
YEAR	DIRECT [a]	INDIRECT [b]	TOTAL	CARGO DIRECT [c] (tons)	TOTAL	PERCENT	DIRECT [d]	INDIRECT [e]	TOTAL	CARGO DIRECT [c] (tons)	TOTAL	PERCENT
1985	18	3	21	400	920	0.2	3	1	4	300	180	0.1
1986	15	2	17	400	760	0.1	2	-	2	200	120	0.1
1987	25	5	30	600	1020	0.2	3	1	4	400	200	0.1
1988	28	5	33	700	1460	0.3	4	1	5	400	240	0.1
1989	49	9	58	1200	2560	0.4	6	2	8	800	400	0.2
1990	72	15	87	1800	3840	0.7	11	4	15	1200	680	0.3
1991	25	7	32	1800	1440	0.2	5	2	7	600	320	0.1
1992	55	15	70	1900	3180	0.5	11	3	14	1400	720	0.3
1993	36	14	50	1700	2340	0.4	8	3	11	1200	560	0.2
1994	67	20	87	2200	3920	0.6	13	5	18	1400	680	0.3
1995	44	17	61	1400	2720	0.4	10	4	14	900	580	0.2
1996	50	21	71	1600	3160	0.5	12	4	16	1000	880	0.2
1997	56	24	80	1700	3540	0.5	14	5	19	1200	800	0.3
1998	48	22	70	1300	3060	0.4	12	4	16	900	660	0.2
1999	45	21	66	1200	2860	0.4	11	4	15	800	600	0.2
2000	45	21	66	1200	2860	0.4	11	4	15	800	600	0.2
2005	48	22	70	1300	3060	0.4	12	5	17	900	660	0.2
2010	42	20	62	1100	2700	0.3	11	4	15	800	600	0.2

[a] 27 person trips per year for Anchorage, Southcentral and out of state residents.

[b] 2 trips per person of added population per year for Anchorage and Southcentral residents.

[c] 1 ton per North Slope employee plus 2% of dry drilling supplies, split 40% Fairbanks - 60% Anchorage, rounded to nearest 100.

[d] 27 person trips per year for Fairbanks residents.

[e] 2 trips per person of added population for Fairbanks.

Source: Louis Berger and Associates, Inc.

Air cargo demand for OCS support was calculated based on historic relationships of cargo shipments to North Slope employment and total supply shipments. Total operations were then estimated on the basis of 50 passengers or 9MT (10 tons) per operation, which have been the approximate average load factors for North Slope flights in the past. The resulting increase in the number of aircraft operations for either airport is substantially less than 1 percent over the entire forecast period.

4.4.3.2 Deadhorse Airport

The forecast increment of aviation demand for Deadhorse Airport is given in Table 4.18. This table shows the aircraft operations, enplaned passengers and cargo that would occur under the OCS development assumptions described in Section 4.2.

The aviation demand is based on the figures described previously in Table 4.17. All direct trips from either Anchorage or Fairbanks are assumed to go to Deadhorse Airport.

Due to the ability of oil companies to schedule the flights efficiently with a high average load factor, the impact on Deadhorse Airport is more in the passenger and cargo count than in aircraft operations. The maximum increase in operations is expected to be 11 percent compared to a maximum increase in enplaned passengers of 87 percent, and 83 percent peak increase in air cargo. It should be noted, however, that the absolute number of both passengers and cargo is not extraordinarily large.

4.4.3.3 Barrow Airport

Since there are no new employees or residents forecasted for the Barrow area as a result of the lease offering, the demand on the Barrow airport is expected to increase only slightly. This increase will be due to the administrative center role of Barrow and to the fact that if there are additional workers and oil-related firms on the North Slope, some trips will be made to Barrow for liaison purposes. These trips will probably use existing scheduled aircraft for the most part and are not expected to increase aircraft operations significantly, if at all. Therefore, Barrow airport demand will be essentially identical to the Base Case forecast (Table 3.17).

TABLE 4.18

INCREMENTAL AVIATION DEMAND AT DEADHORSE AIRPORT RELATED TO DIAPIR FIELD LEASE OFFERING (JUNE 1984)

	AIRCRAFT OPERATIONS				ENPLANED PASSENGERS (000)				AIR (TONS)			
YEAR	BASE CASE	OCS	TOTAL	% CHANGE[a]	BASE CASE	OCS	TOTAL	% CHANGE[a]	BASE CASE	OCS	TOTAL	% CHANGE[a]
1985	41,700	940	42,640	2	120	21	141	18	6320	700	7020	11
1986	45,400	780	46,180	2	131	17	148	13	6700	600	7300	9
1987	39,800	1100	40,900	3	115	28	143	25	6100	1000	7100	16
1988	37,100	1480	38,580	4	107	32	139	30	5740	1100	6840	19
1989	37,100	3720	40,820	10	107	55	162	51	5080	2000	7080	39
1990	37,100	3760	40,860	10	107	83	190	78	4860	3000	7860	61
1991	32,400	1400	33,800	4	93	30	123	32	5380	1400	6780	26
1992	32,400	3180	35,580	10	93	66	159	71	6060	3300	9360	54
1993	32,400	2220	34,620	7	93	44	137	47	5900	2900	8800	49
1994	32,400	3720	36,120	11	93	80	173	86	5840	3600	9440	62
1995	32,400	2460	34,860	8	93	54	147	58	5840	2300	8140	40
1996	32,400	2840	35,240	9	93	62	155	67	4560	2600	7160	56
1997	32,400	3180	35,580	10	93	70	163	35	3500	2900	6400	83
1998	32,400	2680	35,080	8	93	60	153	65	3500	2200	5700	63
1999	32,400	2460	34,860	8	93	56	149	60	3500	2000	5500	57
2000	32,400	2460	34,860	8	93	56	149	60	3500	2000	5500	57
2005	30,100	2680	32,780	9	87	59	146	68	3250	2200	5450	68
2010	27,800	2140	29,940	8	80	53	133	66	3000	1900	4900	63

[a]% Change is traffic in OCS Diapir Field Lease Offering Compared to Base Case

Source: Louis Berger and Associates, Inc.

4.4.4 Highway System

There are two components of the highway system that will experience the effects of the Diapir Field lease offering. There is the primary highway network that will be used for long distance trucking from Anchorage or other Southcentral ports to the North Slope. Then there is the local road system on the North Slope which will be affected primarily by sand and gravel movements. Each of these is treated below.

4.4.4.1 Long Distance Truck Traffic

The principal long distance truck traffic associated with the lease offering has three components: a camp support component, an OCS exploration and development supply component, and a pipeline component. The camp support traffic consists of the supplies necessary to maintain the support bases on the North Slope, and the consumable items needed to support the workers working there. The existing traffic related to this camp support activity was estimated at 62 vehicles per day or .013 daily truck trips per worker. This was forecast in the Base Case to change in relation to the number of oil-related workers on the North Slope.

The same approach is used to forecast camp support traffic in Table 4.19. For each additional employee on the North Slope due to the OCS activity, .013 truck trips on the Dalton Highway are forecast to support him or her. One fourth of these trips are assumed to come directly from the Lower 48 states, one fourth from Fairbanks and half directly from Anchorage along the Parks Highway.

OCS exploration and development traffic consists of 85 percent of the dry drilling supply tonnage (pipe and drilling mud) destined for the North Slope. Some of this tonnage (25 percent) is carried by rail to Fairbanks and trucked north, and the rest is trucked from Seward or Anchorage directly to the North Slope.

TABLE 4.19

INCREMENTAL TRUCK TRAFFIC TO THE NORTH SLOPE
RELATED TO THE DIAPIR FIELD LEASE OFFERING (JUNE 1984)
(AADT)

YEAR	CAMP SUPPORT BASE CASE	CAMP SUPPORT OCS	CAMP SUPPORT TOTAL	% INCREASE[a]	OCS EXPLORATION & DEVELOPMENT BASE CASE	OCS EXPLORATION & DEVELOPMENT OCS	OCS EXPLORATION & DEVELOPMENT TOTAL	% INCREASE[a]	PIPELINE TRAFFIC	TOTAL OCS RELATED TRAFFIC
1985	71	10	81	14	38	3	41	8	-	13
1986	62	8	70	13	37	3	40	8	-	11
1987	58	13	71	22	36	5	41	14	-	18
1988	58	15	73	26	23	7	30	30	-	22
1999	58	26	84	45	30	6	36	20	-	32
1990	51	39	90	76	47	2	49	5	6	47
1991	51	14	65	27	53	9	62	17	12	35
1992	51	29	80	57	50	27	77	54	6	62
1993	51	21	72	41	49	31	80	63	6	58
1994	51	37	88	72	49	17	66	35	12	66
1995	51	25	76	49	22	9	31	41	6	40
1996	51	29	80	57	-	9	9	-	-	38
1997	51	33	84	65	-	9	9	-	-	42
1998	51	28	79	55	-	-	-	-	-	28
1999	51	26	77	51	-	-	-	-	-	26
2000	51	26	77	51	-	-	-	-	-	26
2005	47	28	75	60	-	-	-	-	-	28
2010	43	25	68	58	-	-	-	-	-	25

[a] % Increase is OCS support traffic for Diapir Field Lease Offering Compared to Base Case traffic.

Source: Louis Berger and Associates, Inc.

The increase in North Slope oil-related employment forecast as a result of the lease offering is substantial and this is reflected in a major increase in required camp support traffic as shown in Table 4.19. This traffic will increase by 8 to 26 trucks per day in the first five years and then by 25 to 30 trucks per day in later years. This represents an increase averaging over 50 percent of Base Case traffic.

Similarly, during the projected period of drilling (1985 to 1997), there is a substantial increase in truck traffic related to drilling supplies, especially during production drilling when it reaches 63 percent of Base Case traffic at its peak.

Pipe segments will need to be shipped to the North Slope to build the trunk pipelines required to connect production wells to the TAPS. These requirements were described in Section 4.2.3.

Most pipeline required for the expected Diapir Field activities will be transported by truck up the Haul Road to the North Slope, as it has been in the past. This will result in a large number of truck loads in the period of 1990 to 1995 but only a minor increase in AADT on the highway system. This is shown in Table 4.19.

All three components of OCS-related truck traffic would effect traffic levels on the two primary highways feeding the North Slope, the Dalton and Parks Highways. These effects are shown in Tables 4.20, 4.21 and 4.22.

On the Parks Highway and the Alaska Highway the forecast OCS traffic amounts to less than 3 percent of the forecast traffic volume on the lowest traffic link in the highest impact year. On the Haul Road (Dalton Highway), the traffic impact is much greater, especially north of the Yukon River Bridge. OCS traffic will add 30 to 40 percent to Base Case traffic in many years. This effect is much less on those sections of the Haul Road near Fairbanks but is still substantial.

TABLE 4.20

INCREMENTAL TRAFFIC ON THE DALTON HIGHWAY RELATED TO THE DIAPIR FIELD LEASE OFFERING (JUNE 1984) (AADT)

YEAR	OCS TRAFFIC	FOX TO LIVENGOOD		LIVENGOOD TO ELLIOTT HIGHWAY		NORTH OF YUKON BRIDGE TO PRUDHOE BAY	
		BASE CASE	TOTAL	BASE CASE	TOTAL	BASE CASE	TOTAL
1985	13	651	664	465	478	150	163
1986	11	702	713	507	518	157	168
1987	18	758	776	536	554	149	167
1988	22	818	840	574	596	134	156
1999	32	884	916	619	651	143	175
1990	47	894	941	656	703	152	199
1991	35	941	976	699	734	164	199
1992	62	991	1053	741	803	163	225
1993	58	1044	1102	785	843	164	222
1994	66	1099	1165	832	898	167	233
1995	40	1156	1196	877	917	143	183
1996	38	1206	1244	920	958	124	162
1997	42	1258	1300	965	1007	126	168
1998	28	1312	1340	1010	1038	126	154
1999	26	1368	1394	1063	1089	133	159
2000	26	1428	1454	1115	1141	136	162
2005	28	1771	1799	1413	1441	150	178
2010	25	1955	1980	1552	1577	169	194

Source: Table 3.19 and Table 4.18 .

TABLE 4.21

INCREMENTAL TRAFFIC ON THE PARKS HIGHWAY
RELATED TO THE DIAPIR FIELD LEASE OFFERING (JUNE 1984)

YEAR	OCS TRAFFIC [a]	NEAR WASILLA		NEAR NENANA		NEAR ESTER	
		BASE CASE	TOTAL	BASE CASE	TOTAL	BASE CASE	TOTAL
1985	7	8134	8141	1464	1471	1250	1257
1986	6	8866	8872	1583	1589	1298	1304
1987	10	9663	9673	1711	1721	1344	1354
1988	12	10533	10545	1849	1861	1393	1405
1989	17	11481	11498	1999	2016	1443	1460
1990	26	12514	12540	2162	2188	1493	1519
1991	22	13640	13662	2330	2352	1549	1571
1992	39	14868	14907	2512	2551	1605	1644
1993	37	16207	16244	2708	2745	1662	1699
1994	40	17665	17705	2920	2960	1722	1762
1995	25	19255	19280	3094	3119	1785	1810
1996	22	20988	21010	3307	3329	1842	1864
1997	23	22877	22900	3536	3559	1904	1927
1998	14	24936	24950	3780	3794	1967	1981
1999	13	27180	27193	4040	4053	2032	2045
2000	13	29626	29639	4327	4340	2104	2117
2005	14	34214	34228	6105	6119	2481	2495
2010	12	36317	36329	6740	6752	2932	2944

[a] 50% of camp support traffic and 75% of other traffic.

Source: Louis Berger and Associates, Inc., 1983

TABLE 4.22

INCREMENTAL TRAFFIC ON THE ALASKA HIGHWAY
RELATED TO THE DIAPIR FIELD LEASE OFFERING (JUNE 1984)
(AADT)

Year	OCS TRAFFIC[a]	NEAR CANADIAN BORDER		SOUTH OF JUNCTION		NORTH OF DELTA JUNCTION	
		BASE CASE	TOTAL	BASE CASE	TOTAL	BASE CASE	TOTAL
1985	3	257	260	318	321	700	703
1986	2	275	277	330	332	721	723
1987	3	294	297	343	346	743	746
1988	4	315	319	356	360	765	769
1989	7	337	344	369	376	788	795
1990	10	360	370	383	393	811	821
1991	4	378	382	396	400	835	839
1992	7	397	404	410	417	860	867
1993	5	417	422	424	429	886	891
1994	9	438	447	438	447	912	921
1995	6	460	466	452	458	941	947
1996	7	483	490	464	471	962	969
1997	8	507	515	475	483	983	991
1998	7	533	540	486	493	1004	1011
1999	7	559	566	498	505	1027	1034
2000	7	586	593	509	516	1048	1055
2005	7	749	756	571	578	1168	1175
2010	6	827	833	640	646	1304	1310

[a]25% of camp support traffic.

Source: Louis Berger and Associates, Inc., 1983

4.4.4.2 Local Roads

OCS development in the Diapir Field will generate increased use of existing roads (including ice roads), as well as the development of new roads.

Increased Use of Existing Local Roads. Local roads in the Kuparuk and Prudhoe Bay areas will be affected by increased use of existing roads for (1) the local hauling of sand and gravel for artificial island construction; (2) the hauling of various materials and equipment in the region via the Parks and Dalton Highways; and (3) the transport of various materials arriving in the region via the sealift and summer barge shipments.

The extent of increased traffic which will be generated through increasing sand gravel hauling can be exemplified through a brief description of the recent Mukluk Island project. Mukluk Island was built with 92,000 cubic meters (1.2 million cubic yards) of gravel. SOHIO Construction Company hauled onshore gravel by truck to Thetis Island, a designated staging area (Alaska Economic Report, 1983). Gravel was subsequently transferred onto barges which transported gravel directly to the project site. In order that Thetis Island could be used as a staging area for the project, an ice road was built from onshore gravel sources to Thetis Island during the winter of 1982-1983. Eight 34.4 cubic meter (45 cubic yard) trucks were used to haul onshore gravel to Thetis Island.

As stated earlier, it is anticipated that 17 or 18 gravel or caisson islands will be constructed in the exploration phase and four similar islands will be developed in the production phase. Further, it is assumed that half of the exploration and production islands will be developed using onshore sand and gravel sources. Table 4.14 indicates that approximately 8.6 million metric tons (9.5 million tons) of sand and gravel will need to be hauled on local roads (including ice roads) for artificial islands. Using the Mukluk project as an example, it is estimated that each island project will generate the use of roughly 10 to 20 units of heavy equipment, e.g., 34.4 cubic meter (45 cubic yard) trucks and Caterpillar D-8 bulldozers, plus 10 to 20 units of lighter vehicles, for the duration of each island construction project.

Overall, increased local vehicular traffic for sand and gravel hauling represents an estimated 25 percent increase in local traffic. This estimate is based on the assumption that increased traffic is generally proportional to the anticipated increased volume of sand and gravel requirements for artificial island construction (25 percent). A significant portion of the increased truck traffic will be off-road surface freight movements; however, the principal point of origin for these trucks will be Prudhoe Bay or Kuparuk.

Long distance truck traffic coming to and from the North Slope will affect local roads in terms of increased deliveries of materials necessary for camp support, OCS exploration and development, and pipeline operation and maintenance. As these truck deliveries arrive on the North Slope, it is also reasonable to assume that some of these materials will be stored in local distribution centers in Deadhorse before being transported to specific work sites or support facilities on the North Slope. Consequently, an additional amount of truck traffic will be generated through the local transshipment of materials arriving via long distance truck deliveries.

In general, it is estimated that long distance truck traffic on local roads and related local transshipment will account for a 40 to 50 percent increase in local road traffic. This assumption is based upon truck traffic projections for the Parks and Dalton Highways (Tables 4.20 and 4.21). These projections suggest that long distance truck traffic will increase by 8 to 26 trucks per day from 1985 to 1990 and by 25 to 30 trucks in subsequent years (Section 4.4.3.1). Consequently, the effect of this significant traffic increase will vary during the next 25 years with the most apparent effects occurring during the production phase of OCS development.

Local road traffic will also increase through the local truck delivery of various materials via the sealift and summer barge shipments. Trucks will be used to deliver unloaded barged cargo which will be delivered to various docks and temporary shoreline staging areas along the North Slope. As indicated in Section 4.5.2.1, OCS development will generate a 29 percent increase in sealift tonnage. The increase in local road traffic will almost be proportionate to the increase in sealift tonnage. However, it is recognized that some barge shipments to various temporary shoreline staging areas will not generate any truck traffic on local roads. Consequently, a 25 percent increase in local road traffic is expected as a result of local truck deliveries from the sealift and summer barge shipments.

4.4.5 Rail System Demand

Part of the freight destined for the North Slope as a result of the Diapir Field lease offering will travel from Anchorage, Seward or Whittier to Fairbanks on the Alaska Railroad, to be reshipped on the Haul Road. This cargo is assumed to be split between truck and rail modes in proportions similar to those experienced in the past, as mentioned under highway demand in Section 4.4.3.

The three components of this cargo are camp support freight, drilling supplies and pipeline materials. It is assumed that 50 percent of camp support, 25 percent of drilling supplies and 90 percent of pipeline materials are shipped by rail. This amounts to 231,000MT (255,000 tons) in the peak year of 1994 as shown in Table 4.23. This peak amounts to a 4 percent increase in total forecast traffic on the railroad.

4.5 Impact Analysis

The following sections describe the effects on each transportation mode of the OCS events and related transportation demand described above. Impacts on infrastructure become significant if a capacity threshold is reached as a result of the increased traffic, or if additional cargo handling or passenger terminal facilities would be needed. Impacts on carriers are significant if their volume increases substantially, or their revenues increase noticeably more than their marginal costs.

A threshold of 5 percent or greater is used to distinguish a significant impact, either positive or negative, on traffic volumes, cargo handling requirements or carrier revenues. This figure is the lowest level normally perceived as an unusual change by the carriers. It also relates indirectly to the concept of a 95 percent confidence level in that 5% (100-95%) is regarded as a common threshold for significant condidence in statistical analysis of data, and has been used by Louis Berger and Associates on a number of impact studies.

TABLE 4.23

FORECAST INCREASE IN TRAFFIC ON THE ALASKA RAILROAD
DUE TO THE DIAPIR LEASE OFFERING OF JUNE 1984
(000 tons)

YEAR	CAMP SUPPORT	DRILLING SUPPLIES	PIPELINE MATERIALS	TOTAL OCS TRAFFIC	BASE CASE TRAFFIC	TOTAL TRAFFIC	% CHANGE
1985	26	8	-	34	6997	7031	-
1986	20	8	-	28	7285	7313	-
1987	33	13	-	46	6901	6947	1
1988	38	19	-	57	6676	6733	1
1989	66	16	-	82	6590	6672	1
1990	100	5	58	163	6604	6767	2
1991	36	24	115	175	6707	6882	3
1992	74	72	58	204	6861	7065	3
1993	54	83	58	195	7017	7212	3
1994	95	45	115	255	7139	7194	4
1995	64	24	58	146	7270	7416	2
1996	74	24	-	98	7390	7488	1
1997	84	24	-	108	7531	7639	1
1998	72	-	-	72	7685	7757	1
1999	66	-	-	66	7856	7922	1
2000	66	-	-	66	8050	8116	1
2005	72	-	-	72	9075	9147	1
2010	64	-	-	64	9824	9888	1

Source: Louis Berger and Associates, Inc.

4.5.1 Pipeline Construction

In order to serve the demand for oil transportation described in Section 4.4.1, three trunk pipelines connecting with TAPS have been identified by MMS (see Figure 4.1). The locations have been laid out in a strictly hypotheticial manner, since industry will have a strong influence on the actual location consistent with Federal, state and Borough regulatory constraints.

One trunk line would extend east from Prudhoe Bay; the second line would be to the west and extend as far as Point Barrow. These would tie into TAPS at Pump Station No. 1. A third pipeline would service the area west of Point Barrow. Technology is available to run the first two trunk lines either offshore or onshore. Offshore pipelines were adopted for this scenario. The rationale for this selection differs slightly for the two lines, essentially reflecting the perceived social and biological drawbacks to onshore pipelines and the roads associated with these lines.

Possible landfall sites for the trunk pipeline from the east include that used for the Endicott production pipeline and an area around Bullen Point where there may be onshore support facilities. In this impact analysis, the offshore trunk pipeline is assumed either to join or to parallel the Sag Delta-Duck Island pipeline.

For the pipeline from the west between Prudhoe Bay and Point Barrow, it is assumed, as it was for sale 71, that the landfall site for an offshore pipeline would be to the east of Harrison Bay and the Colville River delta. An alternative assumption would be that the site be located near the hypothetical support base near Camp Lonely and from there tie into the Kuparuk pipeline.

The third pipeline assumed for the proposed lease offering supports the area west of Point Barrow. Due to the physical constraints around Point Barrow, the pipeline from this area would be onshore and would require a service road. The pipeline would cross the North Slope between Point Belcher and TAPS Pump Station No. 3. In general, the route would be south of the 152.4m (500 ft.) contour line (south of the lake district) and north of the Colville River. More precise routing would probably reflect the location of oil production in the National Petroleum

Reserve-Alaska. This route probably would not be developed independently from production in the Barrow Arch. The effects of pipeline construction on the marine, road and rail modes have already been discussed.

4.5.2 Marine System

4.5.2.1 Infrastructure

The affect of OCS development on marine infrastructure in Alaska is indicated for the two North Slope docking facilities of Prudhoe Bay and Oliktok, for Camp Lonely, for Barrow (indirect demand), and for the Southcentral ports of Anchorage, Whittier, Seward and Valdez.

Prudhoe Bay and Oliktok. Conclusions regarding development needs at Prudhoe Bay and Oliktok are highly dependent upon the general location of exploration and development activities relating to the June 1984 lease offering. As noted in Table 4.24, it appears that, if development were to occur on the western side of the lease offering, capacity at Oliktok, which was nearly adequate in the Base Case, will have to be increased with a new dock to handle modules. A new dock will definitely be needed at Camp Lonely if that location would improve logistics. On the other hand, if development were to occur on the eastern side of the lease offering, the Base Case excess capacity at Prudhoe Bay would suffice, unless development occurs so far east as to justify the choice of Bullen as a basic support site and harbor facility. Since there is no port infrastructure at Bullen, a dock will have to be built.

Camp Lonely, Bullen, Wainwright. Camp Lonely, Bullen and Wainwright are appropriate to fulfill the physical requirements necessary to create a basic support and harbor complex. As stipulated earlier, if the logistics of OCS development are such that Oliktok or Prudhoe Bay are adequately and centrally located, then only one new dock at Oliktok would be necessary. However, Oliktok appears to be located too far to the east to support western development and Prudhoe Bay, too far to the west for eastern development. Also without any deletions in the proposed lease offering, development would be likely to occur across the board, resulting in the need for two basic support and harbor complexes at such locations as Camp Lonely and Bullen.

TABLE 4.24

ANALYSIS OF POTENTIAL CAPACITY SHORTFALLS AT PRUDHOE BAY AND OLIKTOK DOCKS

(1000's of tons)

YEAR	BASE CASE THROUGH PUT[a]		OCS SEALIFT TO SUPPORT BASE	AT PRUDHOE BAY IF EASTERN DEVELOPMENT	AT OLIKTOK IF WESTERN DEVELOPMENT
	Prudhoe Bay	Oliktok			
1983	94	35	-	-	-
1984	105	49	8	-	-
1985	67	31	8	-	-
1986	69	35	14	-	-
1987	70	55	18	-	13
1988	77	45	18	-	3
1989	59	60	10	-	10
1990	64	60	19	-	19
1991	98	60	56	-	56
1992	132	60	63	12	63
1993	125	60	23	-	23
1996	89	60	18	-	18
1995	89	60	19	-	19
1996	28	25	18	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-

[a] Based on demand and threshold capacity (60,000 tons at Oliktok)

Source: Louis Berger and Associates, Inc., 1983

The infrastructural impact on Wainwright of the June 1984 lease offering is not significant as drilling supplies destined for NPR-A exploration have already crossed the northern and southern beaches, and the additional tonnages of 23,00MT (25,000 tons) of pipe in 1985 and 1986, and 11,000MT (12,000 tons) in 1987 would not be sufficient to justify the construction of a dock.

Other Locations on the Arctic Coast. Other locations could be identified on the Arctic coast to serve as temporary bases to allow for the handling of caissons and gravel. The caissons will be floated and separated from their supporting barges and towed to the island sites. No special infrastructure is required as this operation can and should occur offshore in a relatively calm area.

The handling of gravel will require the creation of some basic infrastructure. This could be a gravel causeway extending far enough into the sea to offer an adequate depth at Mean Low Water (MLW) to load a 1,400MT (1,500 ton) barge (2.7m or 9 ft. draft). The operation requires such a high capacity that two conveyors of 2,700MT (3,000 tons) per hour capacity each would be needed. Enough storage space must be provided to handle a total of 363,000MT (400,000 tons) in one 50-to-70 day shipping season, assuming that there would be a need for two such temporary terminals. Assuming that all tonnage must be stored and available at the beginning of the shipping season, a stacking height of 10m (30 ft.) and an angle of repose of 40 degrees, an estimated 100,000 square meters (120,000 square yards) or 10 hectares (25 acres) of storage will be needed.

The Base Case identified a need for two gravel loading causeways or facilities. If it were possible to use those facilities in this case, the effect will be mitigated. One such location (Thetis Island) already exists.

Barrow. The June 1984 lease offering forecasts are only slightly higher than the Base Case forecasts and similarly would not justify the construction of docking facilities at Barrow, although the smaller scale beach improvement project described in the Base Case might be even more worthwhile to consider.

Southcentral Ports. It was observed in the Base Case that only three locations would experience capacity problems, and that none of those situations will be affected by increased activity in the North Slope. That conclusion was reached by the Corps of Engineers in its 1981 report "Southcentral Region of Alaska Deep Draft Navigation Study." The analysis performed in the context of this impact assessment and the marginal material requirements calculated are such that, considering the anticipated reduction of development activities at Prudhoe Bay and Kuparuk, there does not appear to be any potential constraining impact on Southcentral ports resulting from the proposed June 1984 lease offering development.

4.5.2.2 Carriers

This Section presents the likely impact of the June 1984 lease offering activities on the sealift carriers as well as on Arctic carriers working in the Beaufort Sea. This impact is shown in terms of percent increase in the fleet requirements as well as in terms of actual numbers of barges and trips required to accommodate Base Case marine demand.

Sealift. The impact of the OCS lease offering development is expected to result in an average 29 percent increase in sealift tonnage going to a variety of North Slope locations such as Prudhoe Bay, Oliktok, Camp Lonely, Wainwright, Bullen and temporary offshore off-loading stations for prefabricated caissons destined for artificial islands (see Table 4.25).

Total sealift over the planning period is estimated at 2,606,000 MT (2,873,000 tons) in the Base Case and 3,354,000 MT (3,697,000 tons) with the June 1984 lease offering development. Hence, between 1984 and 1996, the additional leae offering fleet requirement would be 100 tugs and 170 barges, or a yearly average of 8 tugs and 13 barges (see Table 4.26).

Marine Operators in the Beaufort Sea. Commodities requiring marine transportation in the Beaufort Sea were identified as dry and liquid drilling supplies and sand and gravel. The companies already involved in the trade in the context of the 1979 joint Federal-State Beaufort lease offering and the 1982 Diapir Field lease offering are likely to expand their operations. Those companies are principally Arctic Slope/Wright Schuchart Construction Co., Arctic Marine Freighters and Kodiak Marine Transport.

TABLE 4.25

IMPACT OF JUNE 1984 DIAPIR FIELD LEASE OFFERING
ON SEALIFT TONNAGE TO THE NORTH SLOPE

	BASE CASE SEALIFT (1000 TONS)						JUNE 1984 LEASE OFFERING (1000 TONS)			
YEAR	PRUDHOE BAY[c]	OLIKTOK[c]	CAMP LONELY[a]	WAINWRIGHT[b]	TEMPORARY ARCTIC STATIONS[c]	TOTAL	CAMP LONELY AND BULLEN[c]	TEMPORARY ARCTIC STATIONS[a]	WAINWRIGHT[e]	TOTAL
1983	94	35	2	2	-	133	-	-	-	-
1984	105	49	3	3	-	160	8	-	-	8
1985	67	31	4	4	70	176	8	80	25	113
1986	69	35	4	4	70	178	14	80	25	119
1987	70	55	16	16	70	227	18	80	12.5	111
1988	77	45	17	17	70	226	18	80	-	98
1989	59	60	29	29	70	247	10	103	-	113
1990	64	60	36	36	70	266	19	23	-	42
1991	98	60	29	29	70	286	56	23	-	79
1992	132	60	29	29	70	320	63	-	-	63
1993	125	60	29	29	-	243	23	-	-	23
1994	89	60	15	15	-	179	18	-	-	18
1995	89	60	15	15	-	179	19	-	-	19
1996	28	25	-	-	-	53	18	-	-	18
1997	-	-	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-
TOTAL						2,873				824

[a]Only drilling supplies to NPR-A fields.

[b]Prefabricated concrete caissons for island construction in existing Diapir Field lease offering areas.

[c]90 percent modules, 10 percent drilling supplies.

[d]Caissons for island construction.

[e]Pipeline supply for potential western extension of TAPS to supply fields west of Barrow.

Source: Louis Berger and Associates, Inc.

TABLE 4.26

**BASE CASE AND OCS LEASE OFFERING
SEALIFT TRAFFIC
(1000 tons)**

	BASE CASE			OCS LEASE OFFERING		
Year	Tonnage	# Tugs[a]	# Barges[b]	Tonnage	# Tugs[a]	# Barges[b]
1983	133	14	23			
1984	160	17	33	8	2	1
1985	106	11	22	113	12	23
1986	112	12	23	119	13	25
1987	157	17	33	111	12	23
1988	155	16	32	98	10	20
1989	177	19	37	113	12	23
1990	196	21	41	42	5	9
1991	216	23	45	79	8	16
1992	250	26	52	63	7	13
1993	243	25	50	23	3	5
1994	179	19	37	18	2	4
1995	179	19	37	19	2	4
1996	53	16	11	18	2	4

[a]Based on historical experience it is assumed that one tug carries two barges.

[b]A figure of 4,820 tons per barge is assumed based on the five year average tons per barge experienced during the years 1979 to 1983.

Source: Louis Berger and Associates, Inc.

The marginal increases in summer barge shipments of drilling supplies to offshore locations were estimated to be 15,000MT (17,000 tons), 23,400MT (25,800 tons), 38,000MT (42,000 tons) and 77,000MT (85,000 tons) for pipe and casings, mud, fuel and drill water, respectively. This compares to Base Case volumes of 73,000MT (81,000 tons), 111,000MT (122,000 tons), 184,000 (203,000 tons) and 369,000MT (407,000 tons), respectively, to supply the two existing Diapir Field areas. The marginal OCS impact corresponds to a 21 percent increase in this type of traffic during the 50-to-70 day shipping season. Assuming that 1,360MT (1,500 ton) multipurpose barges (tanker barges with cargo on deck) are used to supply the wells, the total additional drilling supplies use one more tug and barge a year during the 1985 to 1997 period, instead of the five tugs and barges required in the Base Case.

There will be a 26 percent increase in the volume of sand and gravel transported from onshore staging areas to island locations. The same increase will occur in trucking requirements from onshore borrow sources to staging/transshipment areas. The transportation of sand and gravel dredged from offshore borrow sources is anticipated to increase by 76 percent as a result of this lease offering. Table 4.27 presents those results based on the assumption that only half of the requirements will be transported by barge, while the other half would be trucked to the island site in the winter from onshore sources, or would be piped to the site from offshore borrow sources located in the immediate vicinity of the proposed island locations.

The proportional impact on the fleet is similar or slightly higher as the haul distances are expected by oil company representatives to be slightly longer, increasing the ton-mile figure more than the tonnage figure.

Fleet requirements for movements from staging areas to islands assume the use of 1,360MT (1,500 ton) hopper barges and a 16 hour round trip from the staging area to the island, assuming a 96.6km (60 mi.) average distance from the staging area to the island (distance of 64.4km or 40 mi.) between the staging area of Thetis Island and Mukluk Island, requiring a 12 hour round trip for tow) (SOHIO, 1983). Based on these assumptions, the nearly 4.5 million metric tons (5 million tons) of sand and gravel required over an eight year period in the June

TABLE 4.27

IMPACT OF JUNE 1984 LEASE OFFERING

DEVELOPMENT ON SAND AND GRAVEL MOVEMENTS

IN THE BEAUFORT SEA

	TRANSPORTATION OF FILL REQUIREMENTS (million tons)[a]			
	ONSHORE SOURCES		OFFSHORE SOURCES	
YEAR	BASE CASE	OCS 87	BASE CASE	OCS '87
1983	1.26	-	.77	-
1984	1.51	-	.77	-
1985	2.34	.80	2.73	3.00
1986	3.89	.80	2.21	3.00
1987	3.64	.80	2.77	3.00
1988	3.50	.80	2.97	3.00
1985	-	.98	-	5.00
1990	-	.18	3.57	1.90
1991	2.00	.18	6.20	1.90
1992	-	.18	7.63	1.90
1993	-	-	-	-
1994	-	-	-	-
	18.14	4.74	29.82	22.70
	74%	26%	24%	76%

[a]All transportation requirements are assumed to be one-half of total requirement.

Source: Louis Berger and Associates, Inc.

1984 lease offering case would require that six barges and six tugs be added to the fleet.

Fleet requirements for movements from offshore borrow sources to artificial islands assume the use of 1,360MT (1,500 ton) hopper barges, 8 hours for the round trip between the offshore borrow area and the island (average haul distance of 32km or 20 mi.). Using these assumptions, 21 million metric tons (23 million tons) of sand and gravel would be required over an eight year period in the OCS case and would require that 11 barges and 11 tugs be added to the fleet.

4.5.3 Aviation System Effects

The increase in demand for aviation services described in Section 4.4.2 was only found to be significant for flights to Deadhorse. Anchorage, Fairbanks and Barrow are not expected to have a detectable change in air service due to the Diapir Field lease offering of June 1984.

4.5.3.1 Infrastructure

The Deadhorse Airport will experience an increase in the number of cargo and passenger flights of between 780 and 3760 per year. Since the number of operations without the lease offering will be declining in the future at Deadhorse, the net effect will be to only partially offset the expected decline, rather than actually increase the number of operations. Only in 1986 are the operations expected to be slightly greater than present levels (45,000 per year), a major decrease in operations is expected during the 1990's despite the Diapir Field activities.

The same cannot be said for passenger traffic, which will rise to levels much higher than present levels, if the Diapir Field events take place. This would jump passenger traffic at least 20 percent over present levels through the year 2000 and reach a peak of 55 percent over this in 1990. This means that some provision is needed for increased passenger facilities at Deadhorse to handle this traffic.

Present passenger terminals for Wien and Alaska Airlines will need to be expanded to handle this additional traffic unless a third carrier also builds a terminal at Deadhorse. The DOT/PF is also planning an airport land use study which could include possible consolidation of terminal facilities. These plans would be significantly affected by the forecast development of the Diapir Field.

Air cargo is expected to decline sharply under the Base Case and the expected levels due to the Diapir Field events will only offset the decline to some extent in most years. During the 1990's, however, the air cargo related to drilling production wells could be significant (50 percent more than current levels). This will not have much effect on handling facilities but more storage space will probably be needed (see discussion below).

4.5.3.2 Carriers

The scheduled air carriers and air taxis operating out of or into Deadhorse airport will experience the major increase in traffic forecast for the North Slope. Alaska Airlines and Wien Air Alaska, which serve Deadhorse from Anchorage and Fairbanks will increase their passenger and air cargo loads. They may also experience more competition as other scheduled carriers could start service to Deadhorse. This competition is expected to keep tariffs down to a minimum on these flights.

The air taxis operating out of Deadhorse will probably experience increased demand in proportion to the passenger traffic increases at Deadhorse. Helicopter operations on the North Slope will continue to be primarily based from Deadhorse Airport given the availability of already established carrier service areas in the vicinity of the airport. However, industry may request scheduled carriers from Deadhorse Airport to provide helicopter support services at new exploratory sites or support bases, e.g., Camp Lonely, for extended periods to time, e.g., over 30 days. Should these requests materialize, carriers will need to file for permanent or temporary extensions of operating authority with the Alaska Transportation Commission.

It is anticipated that three to four carriers, with servicing capability at Deadhorse, will provide the majority of helicopter services for OCS development. Services provided by the carriers will generally include personnel transport, project reconnaisance flights, material sling loads, emergency medical evacuation, small parts transport, and other various types of logistical support. These services will generally be provided under long term air service contracts, e.g., one year minimum with renewal options, which are of financial benefit to both industry and the air carriers, principally based in Anchorage and Fairbanks. However, special industry sling loads requiring helicopters with a greater cargo weight capacity, e.g., Vertols, will likely use helicopters and crews outside of Alaska.

4.5.4 Highway Effects

There are two types of highway effects anticipated for this OCS activity: infrastructure construction and maintenance. These are divided into principal highway system and local roads. Impacts on carriers are also discussed.

4.5.4.1 Principal Highway System Construction and Maintenance

The traffic increases forecast on the principal highway system in Section 4.4.4 were significant only for the Dalton Highway. The traffic levels involved are well below capacity so no new construction is required.

Road maintenance on the Dalton Highway, however, will be significantly affected, since the large trucks involved are very stressful for highway pavement and base course. The maintenance budget might decrease with lower traffic levels without the lease offering, but would increase or remain the same under the higher forecast traffic expected with the lease offering.

4.5.4.2. Local Road Construction and Maintenance

The construction of new roads will result through the development of new support facilities, e.g., Camp Lonely, Bullen, or Wainwright, onshore pipelines and the widening of existing roads to accommodate increased traffic volumes. For example, if Camp Lonely were to be renovated and expanded to serve as a new support base for OCS development in the western portion of the

Diapir Field, an independent road network will need to be constructed in this area. The network would provide access to new onshore gravel sources, potential offshore pipeline, surface water supplies and other support facilities. Similarly, new gravel roads might also be constructed near the Bullen Point area which might serve as a landfall site for the truck pipeline east of Prudhoe Bay. Local roads will be built and maintained by private industry.

A service road will be needed for the onshore pipeline crossing NPR-A to the coast. Based on the present position of the North Slope Borough with respect to the Haul Road, this road is expected to be strictly a low-level industrial road with no public access. If built, this road would be a significant addition to the road network in the North Slope Borough.

In Section 4.4.4.2, it was estimated that OCS development will generate a 90 to 100 percent increase in traffic on existing local roads in the Kuparuk and Prudhoe Bay areas. In order to maintain the efficiency of local truck traffic movements, it is expected that industry will widen or improve selected portions of the existing local road network.

4.5.4.3 Carriers

The relaxation of ICC regulation and depressed economic conditions outside of Alaska have increased competition for truckload shipments to the North Slope. Growing opportunities for potential truck business are expected to generally increase the amount of carriers who will market and serve the North Slope. Given the trend for common carriers to lease rather than own trucks (Section 2.3.2), it is expected that future trucking to the North Slope will not be dominated by a small group of carriers. Rather, it is expected that carriers used by industry will tend to specialize certain types of shipments, e.g., drilling muds via one or two carriers providing reliable, efficient and cost-competitive service. Consequently, numerous carriers based in Anchorage, Fairbanks and Seattle are expected to support OCS activities on the North Slope.

The long distance trucking carriers will experience a small but significant increase in business as a result of the proposed Diapir Field lease offering. The present underbidding by smaller carriers is expected to decrease as the weaker firms go out of business, and the traffic increases somewhat. The present over capacity in the trucking industry in Alaska is expected to continue into the future with only a small increase due to North Slope demand resulting from the lease offering.

Due to present contracting methods, 2 to 3 firms will be awarded the majority of the traffic, and these firms will benefit more than others in the business. The competition for these contracts will be stiff and consequently, tariffs are expected to remain close to marginal costs. The rate structure will tend to stabilize, however, as a result of increased traffic. This will benefit the major carriers.

4.5.5 Railroad Effects

The maximum increase in annual tonnage rail shipments due to the lease offering is expected to be 4 percent. This level of increase can easily be absorbed by the present infrastructure, equipment and operations. Therefore, no noticeable effect is expected for the Alaska Railroad except for an increase in revenues which would be greater than 4 percent, due to the higher than overall tariffs per ton changed on this type of freight.

5. SUMMARY OF EFFECTS

5.1 Transportation System Effects

The most significant effects of the proposed Diapir Field lease offering on Alaska's transportation system will relate to (1) sand and gravel movements on the North Slope and offshore, (2) pipeline construction, (3) sealift of modular structures, (4) Deadhorse airport passenger movements and (5) Dalton Highway truck traffic. The effects on the primary highway network, Fairbanks and Anchorage International Airports and Southcentral ports are expected to be insignificant. The Alaska Railroad and Barrow Airport will experience small but positive effects on their operations.

5.1.1 Sand and Gravel Movements

The sand and gravel movements needed in the construction of gravel islands and caisson-retained islands will be significantly greater with the June 1984 lease offering than without it, particularly if commerical quantities of oil are discovered as anticipated (see Sections 4.2.1.2, 4.2.2.2 and 4.4.2.3). Sixty-three and one half million metric tons (70 million tons) of sand and gravel will be needed, of which 35 percent will come from onshore sources and 65 percent from offshore dredging. Gravel causeways and ice roads will be constructed for the onshore gravel movements, and barges will be used to move dredged material offshore and also carry some of the onshore gravel to offshore sites. These requirements are estimated to increase the barge fleet operation in the Beaufort by six tugs and six barges during the ten year island construction period. Truck operators would experience a 25 percent increase in their operations for onshore gravel movements.

5.1.2 Pipelines

Three trunk pipelines are expected to be built to connect production areas to the TAPS at Prudhoe Bay. This amounts to 1,050km (650 mi.) of pipeline which would be a major addition to the transportation infrastructure on the North Slope (see

Sections 4.2.3, 4.4.2.4 and 4.5.1). The construction of these pipelines will in itself have significant effects on road and marine traffic to the North Slope. If there is an accompanying access road along the onshore pipelines, this could also change the nature of the North Slope transportation system.

5.1.3 Marine

The sealift operation is expected to experience an average 29 percent increase in tonnage between 1984 and 1996 for modular structures, caissons and drilling supplies. This change is significant, but can be accommodated by the operator with some effort. Since the unit costs of operation are not affected very much by the number of barges, the effect on tariffs is expected to be minimal (see Sections 3.4.6, 4.4.2 and 4.5.2).

5.1.4 Aviation

Passenger traffic at Deadhorse Airport is expected to increase by 20 to 50 percent over a year period as a result of the lease offering. While aircraft operations as a whole will not be significantly affected (except possibly for helicopter operations) passenger facilities will be strained at their present levels and some additional facilities will probably be needed. Carriers serving Deadhorse will experience an increase in demand and service levels to the North Slope will increase as a result of this additional traffic, creating a positive impact for North Slope residents (see Sections 4.4.3 and 4.5.3).

Finally, Dalton Highway traffic will be significantly higher with the proposed lease offering than without it, reaching a peak of 40 percent over present levels. This will not require new infrastructure, but will necessitate higher road maintenance expenditures by the state (see Sections 4.4.4 and 4.5.4).

5.2 Community Effects

Transportation developments associated with the proposed June 1984 Diapir lease offering are expected to have little effect on existing North Slope communities (other than Prudhoe Bay/Deadhorse). Marine support will continue to be provided primarily across existing docks at Prudhoe Bay and Oliktok, or through new support bases at Camp Lonely or Bullen, which are abandoned DEW Line stations with no associated permanent population. If a pipeline were built to serve the area west of Barrow, some supplies would be offloaded across the beech at Wainwright as happened during NPR-A exploration activity in this area; however, this would not require construction of any new infrastructure, and the effect on the community would be minimal. Non-OCS associated marine shipments to Barrow will increase to a level such that some improvement of the beach is warranted. This would improve marine service to the community.

Deadhorse Airport is the only aviation facility in the region to be significantly affected by OCS-generated traffic. Increased service to this facility could result in improved aviation service to Barrow if carriers decide to serve that community in conjunction with scheduled service to Deadhorse.

All of the three trunk pipelines proposed to support this lease offering are routed to avoid existing communities (see Figure 4.1) and are not expected to have any direct impact on these communities. New road development will be confined to temporary extensions of the existing local road system for sand and gravel hauling (built and maintained by industry) and possible service roads to access the proposed trunk pipelines. Use of these roads is assumed to be limited to industry, in light of present North Slope Borough policies, and none would connect to existing communities.

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