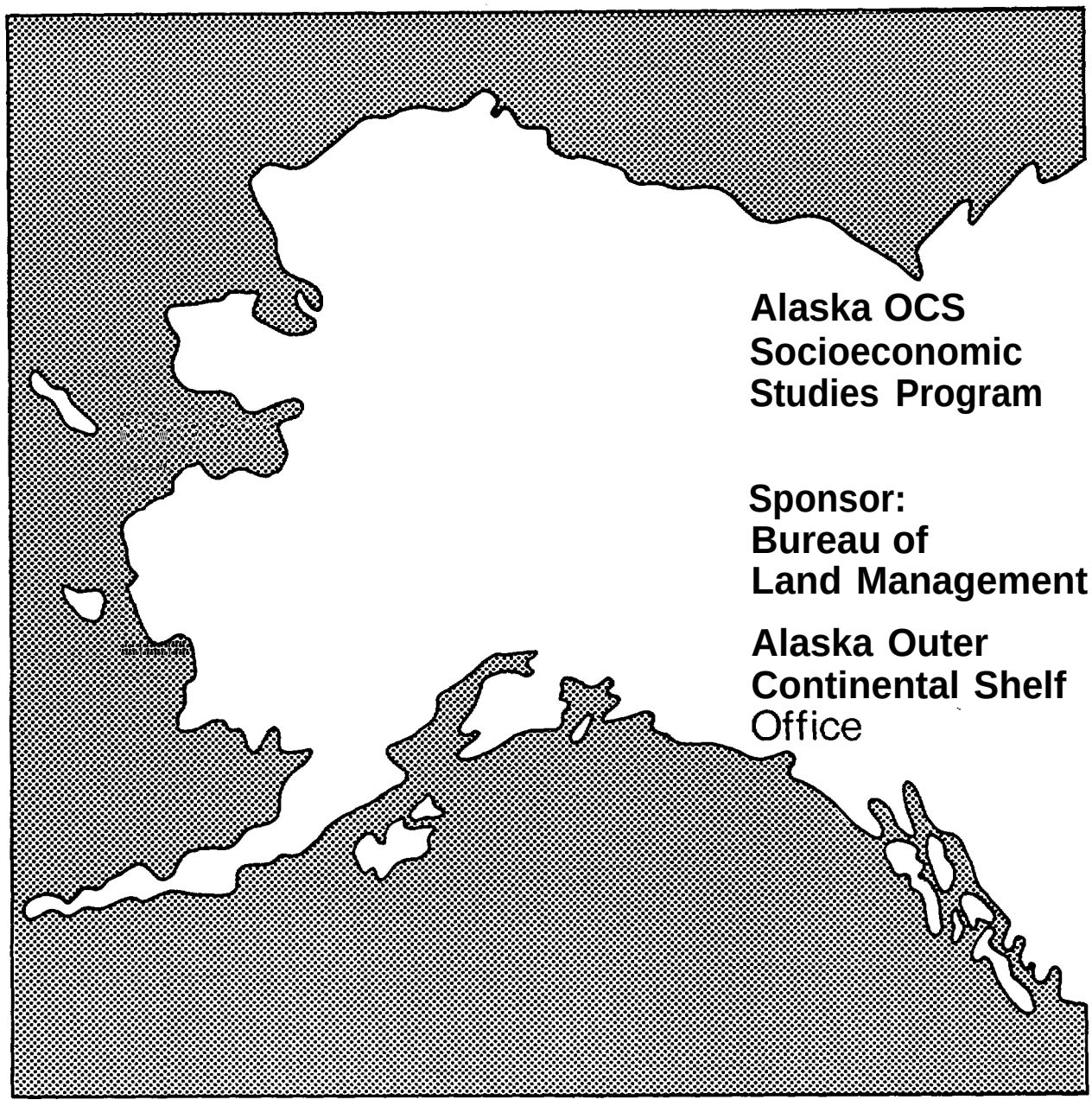
Technical Report Number 4



Alaska OCS Socioeconomic Studies Program

Sponsor: Bureau of Land Management

Alaska Outer Continental Shelf Office

Prudhoe Bay Case Study

The United States Department of the Interior was designated by the Outer Continental Shelf (OCS) Lands Act of 1953 to carry out the majority of the Act's provisions for administering the mineral leasing and development of off-shore areas of the United States under federal jurisdiction. Within the Department, the Bureau of Land Management (BLM) has the responsibility to meet requirements of the National Environmental Policy Act of 1969 (NEPA) as well as other legislation and regulations dealing with the effects of off-shore development. In Alaska, unique cultural differences and climatic conditions create a need for developing additional socioeconomic and environmental information to improve OCS decision making at all governmental levels. In fulfillment of its federal responsibilities and with an awareness of these additional information needs, the BLM has initiated several investigative programs, one of which is the Alaska OCS Socioeconomic Studies Program.

The Alaska OCS Socioeconomic Studies Program is a multi-year research effort which attempts to predict and evaluate the effects of Alaska OCS Petroleum Development upon the physical, social, and economic environments within the state. The analysis addresses the differing effects among various geographic units: the State of Alaska as a whole, the several regions within which oil and gas development is likely to take place, and within these regions, the local communities.

The overall research method is multidisciplinary in nature and is based on the preparation of three research components. In the first research component, the internal nature, structure, and essential processes of these various geographic units and interactions among' them are documented. In the second research component, alternative sets of assumptions regarding the location, nature, and timing of future OCS petroleum development events and related activities are prepared. In the third research component, future oil and gas development events are translated into quantities and forces acting on the various geographic units. The predicted consequences of these events are evaluated in relation to present goals, values, and expectations.

In general, program products are sequentially arranged in accordance with BLM's proposed OCS lease sale schedule, so that information is timely to decision making. In addition to making reports available through the National Technical Information Service, the BLM is providing an information service through the Alaska OCS Office. Inquiries for information should be directed to: Program Director, Socioeconomic Studies Program, Alaska OCS Office, P. O. Box 1159, Anchorage, Alaska 99510.

TECHNICAL REPORT NO. 4 CONTRACT NO. AA550-CT6-61

ALASKA OCS SOCIOECONOMIC STUDIES PROGRAM

PRUDHOE BAY CASE STUDY

PREPARED FOR

BUREAU OF LAND MANAGEMENT

ALASKA OUTER CONTINENTAL SHELF OFFICE

February 1978

DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE
NATIONAL TECHNICAL INFORMATION SERVICE
5285 PORT ROYAL ROAD
SPRINGFIELD, VIRGINIA 22161

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of the Interior, Bureau of Land Management, in the interest of information exchange. The U.S. Government assumes no liability for its content or use thereof.

ALASKA OCS SOCIOECONOMIC STUDIES PROGRAM
PRUDHOE BAY CASE STUDY

Prepared by
Crittenden, Cassetta, Cannon/Hellmuth, Obata & Kassabaum, Inc.

February 1978

REPORT DOCUMENTATI ONPAGE

1. Report No.	2.	3. Recipient's Accession No.
Technical Report No. 4		

4. Title and Subtitle	5. Report Date
PRUDHOE BAY CASE STUDY	February 1978
	6.

7. Author(s)	8. Performing Organization Report No.
Crittenden, Cassetta, Cannon/ Hellmuth, Obata & Kassabaum, Inc. (CCC/HOK)	

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
CCC/HOK, under contract to Peat, Marwick, Mitchell & Co. 601 West Fifth Street Anchorage, Alaska 99501	11. Contract or Grant No. AA550-CT6-61
	13. Type of Report
12. Sponsoring Organization Name and Address Alaska Outer Continental Shelf Office Bureau of Land Management P. O. Box 1159 Anchorage, Alaska 99510	14.

15. Supplementary Notes

16. Abstract

The Prudhoe Bay Case Study is the fourth technical report to be issued as part of the Alaska OCS Socioeconomic Studies Program.

The Prudhoe Bay Case Study explores the concept of enclave development in remote areas. The first portion of the study documents the present status of the working and living relationships at Prudhoe Bay, an industrial enclave built to tap the largest known oil and gas reserve in North America. The working and living conditions at Prudhoe Bay are highlighted by comparing facilities, services and characteristics of the work force of the operating oil companies who administer and operate the facilities at Prudhoe Bay, with the service companies, firms that are under contract to the oil companies to perform specified functions.

The second portion of the study gleans from the experience gained in constructing and operating facilities at Prudhoe Bay lessons that might be applied in the event that enclave development occurs elsewhere in the State.

17. Originator's Key Words	18. Availability Statement
Alaska, OCS Development, Prudhoe Bay, Enclave	

19. U. S. Security Classif. of the Report	20. U, S. Security Classif.	This Page	21. No. of Pages	22. Price
Unclassified	Unclassified			

TABLE OF CONTENTS

LIST OF FIGURES. VII

LISTOFTABLES. VIII

I. INTRODUCTION. 1

Purpose oftheStudy. 1
Background. 1
Methodology of the Study 3
Principal Findings. 4

II. BACKGROUND OF PRUDHOE DEVELOPMENT 7

Physical Environment of the North Slope 7
Background of Physical Facilities Development 11
Early Oil Exploration Activity on the North Slope 14

III. DEVELOPMENT OF THE PRUDHOE BAY FIELD. 17

Concentrated Exploration/Early Development: 1969-1974. . . 17
Development Phase: 1974-1977 22

IV. BASECAMP PHYSICAL ENVIRONMENT 27

Description of the Camp 27
Operating Oil Companies 28
Service Companies. 29
Comparison of Basecamp Physical Facilities
and Living Environments. 30

V. SOCIAL PROFILE OF BASECAMP. 60

Origin of Workers/Work Schedule 61
Size of Work Force. 64
Native Employment. 64
Percentage of Females in Work Force 66
Union Affiliation. 69

VI. RELATIONSHIP BETWEEN PRUDHOE BAY AND NORTH SLOPE BOROUGH. . 75

Services Provided to Prudhoe Bay by North Slope Borough . . 75
Taxation Benefits Provided to North Slope Borough
byPrudhoeBay. 77

VII. ISSUES ASSOCIATED WITH NEW ENCLAVE DEVELOPMENT IN ALASKA. . 83

Potential for Uplands or Beaufort Discovery 83
Potential for New Enclave Development With
Beaufort or Uplands Find 85
Issues Related to New Enclave Development 87

REFERENCES. 94

LIST OF FIGURES

1. Existing Prudhoe Bay Facilities IX

2. Atlantic Richfield Company Operations Center. 36

3. British Petroleum Alaska, Inc. Operating Center. 37

LIST OF TABLES

1.	Physical Facilities.	39
2.	Utilities Service.	42-43
3.	Fire Protection Services	46-47
4.	Police/Security Services	50
5.	Medical Services	52
6.	Recreational Facilities.	57
7.	Commercial Amenities	59
8.	Origin of Workers.	63
9.	Size of Work Force	65
10.	Native Employment.	67
11.	Female Employment.	70
12.	Union Affiliation.	72-74
13.	General Revenues by Source	79
14.	Ten Largest Property Taxpayers in the Borough - 1976 As Assessed by North Slope Borough.	80
15.	Ten Largest Property Taxpayers in the Borough - 1976 As Assessed by State of Alaska.	81

I. INTRODUCTION

Purpose of the Study

This report is a case study of Prudhoe Bay, an industrial enclave built to service the largest known oil and gas reserve on the North American continent. Although a great deal of information has been written about the trans-Alaska pipeline, remarkably little has been written on Prudhoe Bay itself. This report represents the first time a detailed case study of Prudhoe Bay has been prepared.

Prudhoe Bay is the subject of a case study for two reasons. The first is to describe the facilities and workers located at Prudhoe in the fall of 1977 when oil production began. The second is to identify factors that might be replicated with enclave development in other remote areas of the State. While this case study is not intended to be a formal and detailed assessment of impacts arising from Prudhoe Bay, it does identify impacts on the provision of services on a regional scale, on the local unit of government and on the State. These are the kinds of impacts that may appear in the event that additional enclave development occurs elsewhere in Alaska.

Background

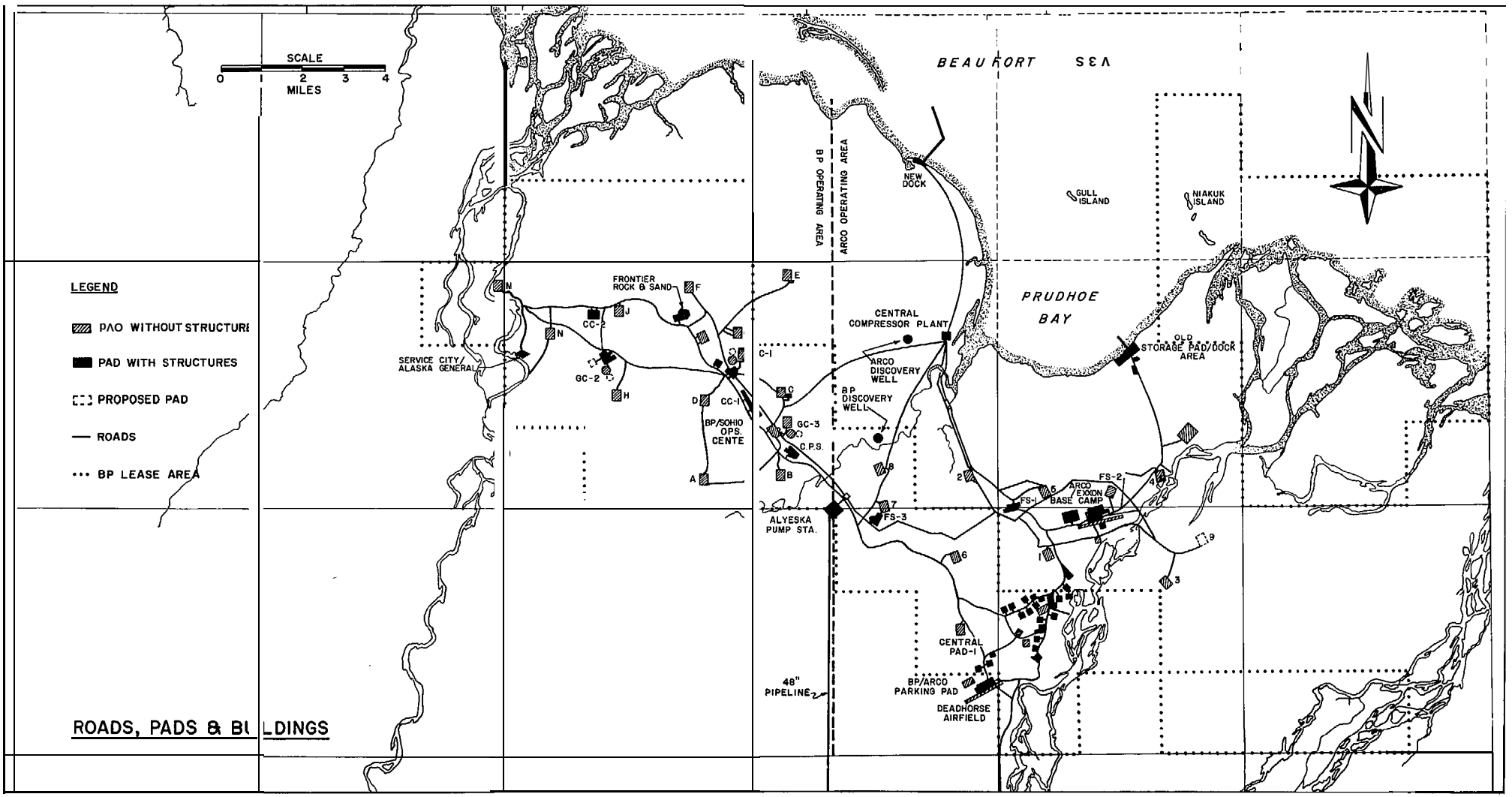
The Prudhoe Bay industrial enclave is located 13 to 16 kilometers (8 to 10 miles) inland from Prudhoe Bay near the mouth of the Sagavanirktok River,

about 208 kilometers (110 miles) southeast of Barrow. The enclave encompasses a 995-square kilometer (384-square mile) area containing oil production facilities, operations facilities, support services, and living quarters for persons who work the oil fields of the North Slope and Prudhoe Bay.

The enclave is geographically isolated from other communities on the North Slope, and does not depend upon them or the North Slope Borough for the provision of services. All essential services including utilities, medical services, fire protection, housing and commercial amenities are provided within the enclave. With the exception of the services of a State Trooper located at the Deadhorse Airport, police and security services are also provided by the oil companies.

Prudhoe Bay is solely a work camp organized for on-shore oil operations on the North Slope. As such it does not contain social and governmental institutions that are associated with typical communities. Prudhoe is nonetheless the largest settlement on the North Slope. As documented by the North Slope Borough Planning Department, the 1976 population of the Prudhoe enclave was 5,531 persons as contrasted with 2,218 persons at Barrow, the largest indigenous community on the North Slope (Herb Bartel, Director of Planning, North Slope Borough, 1977).

The occupants of Prudhoe Bay include the operating oil companies and the service companies that support them. Sixteen oil companies own the leases that comprise the Prudhoe Bay field. To avoid the duplication of effort that would occur if each of the oil companies constructed its own facilities, the oil companies and the State of Alaska are parties to a Unit



(figure 1)

(Source: BP Alaska, Inc.)

Existing Prudhoe Bay Facilities

Agreement. Under the terms of this agreement, the two largest lease holders, ARCO and BP Alaska, administer the field as “oil operators.” Firms performing certain specified services for the operating oil companies are known as service companies. Each of the operating oil companies as well as each service company maintains individual and self-contained facilities for their workers.

This case study describes the facilities and occupants of Prudhoe Bay in fall 1977. The term “enclave” is used to describe all of the facilities and services located within the geographic limits of the Prudhoe field. The term "basecamp" is generally used in reference to the permanent facilities of the oil operators at their operations centers and the permanent facilities of the service companies at the Prudhoe/Deadhorse Industrial Subdivision. The term “work camp” is generally used in reference to the living and working facilities temporarily established at the site of drilling operations. In some cases, these terms have been used interchangeably.

Methodology of the Study

The methodology of the Prudhoe Bay study was limited to generally available secondary data sources supplemented by the review and corroboration of information by a field visit to Prudhoe, and by discussions with representatives of the State, the North Slope Borough, the oil companies and selected service companies operating at Prudhoe Bay.

A thorough review of secondary data sources revealed that only a small number of data sources on Prudhoe Bay existed, and that of these sources,

only a very few contained information pertinent to this study. In addition, data related to employee characteristics was generally not available because the information was considered to be proprietary, or was available only in disaggregate form in individual employee or union files. The absence of firm data has resulted in some cases on a reliance on informed opinion and speculation by industry representatives and representatives of governmental agencies.

Principal Findings

From the perspective of the oil companies, the State and the North Slope Borough, the development of a self-sufficient industrial enclave at Prudhoe was an efficient way to explore for and develop oil and gas resources on the North Slope. The use of the Unit Agreement, by which the leaseholders with the largest interest operated the field for the sixteen parties of interest, has proved effective in maximizing the recovery of reserves while minimizing environmental impacts.

The development of the Prudhoe enclave took place in the context of enormous logistical difficulties imposed by the extreme climate and fragile terrain of the North Slope, the absence of an adequate transportation network for the movement of supplies and equipment, legal challenges to development, and difficult timing requirements related to the start of oil production.

As of late 1977 the Prudhoe enclave is the largest settlement on the North Slope of Alaska. Occupants of the Prudhoe field consist of oil operators and service companies engaged in performance of certain tasks associated

with oil exploration and production, and services related to the residential support of the field. A clear distinction exists between the physical facilities and work force of the oil operators and the service companies. The operating oil companies have more elaborate facilities, provide more services, and have a more permanent work force than do the service companies.

The living quarters provided by the oil operators of Prudhoe Bay represent a significant advance in Arctic construction from the standpoint of technological innovation and amenities provided. Similarly, the techniques of oil operations represent technological advances in the application of off-shore drilling to on-shore oil operations to minimize environmental impacts on the Slope.

The size of the Prudhoe field and its distance from nearby settlement resulted in the development of the extensive settlement at Prudhoe. In the opinion of oil industry spokesmen, it is highly unlikely that a field of similar magnitude will be found in Alaska. It is also unlikely that an enclave the size of Prudhoe will be developed elsewhere in Alaska. Nonetheless, there are certain conditions identified in the course of the case study that may be replicated with enclave development in other remote areas of the State. These include:

- Disruption of services by providers from outside the immediate region. Transportation services appear to be especially susceptible to change during the construction phase of enclave development. Transport resources committed to the oil companies may not be available for local use. After construction is completed, changes in service patterns may become permanent.

- Fiscal impacts. The property taxes levied on the facilities at an enclave may increase manyfold the revenues available to the local unit of jurisdiction. If what occurred at Prudhoe Bay proves typical of enclave development elsewhere in the State, the local unit of government will likely negotiate with the oil companies to provide the enclave with as few services as possible.

- Administrative responsibilities. Oil operations as well as enclave development impose additional administrative requirements on State and local units of government. With respect to enclave development, these are particularly related to planning, land use and regulatory controls. Regulatory measures developed in connection with the Prudhoe enclave should provide useful information for regulating future enclave development.

- Employment impacts. The introduction of a major settlement in a remote area that has been dependent on patterns of local employment will likely have an impact on local wage rates and local patterns of employment.

These and other impacts will be investigated in more detail as part of the impact analysis component of the Alaska OCS Socioeconomic Studies Program.

II. BACKGROUND OF PRUDHOE DEVELOPMENT

The enclave at Prudhoe was developed to provide oil exploration and production facilities, operation facilities, support services, and living quarters for the oil fields of the North Slope and Prudhoe Bay. The enclave that was developed is similar to work camps associated with oil operations in other parts of the world. However, in the case of Prudhoe, development also had to respond to a unique set of requirements associated with oil operations on the North Slope of Alaska.

The purpose of this chapter is to provide an overview of environmental and building constraints attendant upon development of the enclave at Prudhoe Bay. The overview first describes elements of the North Slope physical environment that impact on oil operations and facility construction; secondly describes the history of facility construction in the North American Arctic; and thirdly describes early oil exploration on the North Slope, culminating in the discovery of oil at Prudhoe Bay.

Physical Environment of the North Slope

CLIMATIC CONDITIONS

The climatic conditions on the North Slope impose severe limitations on oil exploration and production. The Arctic winter, extending for a ten-month period, is characterized by extremely cold temperatures which may drop as low as -48 degrees C to -51 degrees C (-55 degrees F to -60 degrees F). More important than the free air temperatures during the

Arctic winter are the "equivalent chill temperatures" resulting from persistent high winds. It is not unusual during the winter months to experience "equivalent chill temperatures" of -82 degrees C (-115 degrees F), at which temperature exposed skin can freeze within 30 seconds. February is the coldest month on the North Slope.

Average summer temperatures range from -1 degrees C to 7 degrees C (30 to 45 degrees F), but a wind of 20 miles per hour will produce an equivalent chill temperature of -12 degrees C (12 degrees F). Also in summer low clouds, fog, swampy tundra and insects are part of the living and working environment.

The number of daylight hours vary greatly by season. For almost 67 days during the winter months, the sun does not appear over the horizon. Between mid-April and mid-August the amount of light is sufficient to carry on work for 24 hours a day (Selkregg, 1975; BP Alaska, Inc., June 1977).

THE LAND

A major constraint to any type of development in the Arctic is the land itself. Tundra is the term given to the undulating plain which characterizes the topography of the Arctic. Underlying the tundra is permafrost, rock or soil whose temperature has remained below freezing for at least two years. However, in most Arctic areas the ground has been frozen for tens of thousands of years. On the North Slope, permafrost may reach depths of 610 meters (2,000 feet).

Covering the tundra is a fragile vegetation that includes grass, lichen, sedge and moss. During the summer months, this vegetation acts as a barrier that insulates the permafrost below from the warmth of the sun. If the vegetative cover is removed, the permafrost begins to thaw, permitting the soil to erode. Over time, shallow patches of eroded tundra may become deep trenches.

Early construction methods used on the North Slope did not recognize the fragility of the tundra, and early roads were built by bulldozing. The exposed ground quickly thawed and became unstable. All of the buildings, facilities, roads and pipelines constructed at Prudhoe and across the North Slope have had to make provision for the fragility of the Arctic tundra. This has involved seasonal construction and the use of gravel as a natural insulating cover for the construction of roads and drilling pads. It has also involved the elevation of built structures on piles to provide air circulation and prohibit heat loss from thawing the ground below.

TRANSPORTATION

The surface movement of goods in the north can only be accomplished under certain circumstances. No road network exists in the Arctic. The only inter-regional road is the North Slope haul road, built to service the construction of the trans-Alaska pipeline, which extends from Fairbanks to Prudhoe Bay.

With the exception of traffic on the haul road, the absence of roads restricts the transportation of supplies to the winter months when the soil is frozen. During the summer, land vehicles driven across the tundra

damage the vegetative cover, and cause erosion and scarring of the land. The North Slope is thus dependent upon air transport and barge or ship transport for the long distance transportation of most goods.

All passenger traffic and the majority of cargo is transported by air. Within the Prudhoe Bay facility, there are two airports -- a State-owned and operated facility at Deadhorse; and an airstrip at Prudhoe Bay owned and operated by BP and ARCO. Air transport to the North Slope is affected by frequently changing weather conditions; pilots can seldom count on long-range visibility near Prudhoe. Air traffic is also frequently disrupted by whiteouts, a phenomenon that occurs when overcast skies in combination with the snow-covered landscape cause the horizon to disappear (Ellis, 1971).

Marine transportation, which is the most economical means of transporting heavy cargo to the North Slope, is most directly affected by the constraints of the Arctic. The shipping season in the Arctic is very short. The ice-free period extends for an average of six weeks in August and early September, which is the only time barges can reach the North Slope. Marine transport to the Slope thus occurs in annual sea lifts, carefully planned so that barges are positioned to take advantage of the ice break-up when it occurs.

In addition, the waters off the entire Arctic coast are extremely shallow, from .5 to 2.7 meters (1.5 to 9 feet) in Prudhoe Bay. As a result, goods carried on cargo ships and ocean-going barges must be offloaded onto shallow- and medium-draft barges for lightering to the Prudhoe Bay dock facilities.

The combination of the short ice-free period and the absence of deep water ports results in a complex logistical framework for marine transport of goods to the Slope. Nonetheless, the absence of a road network during the major period of Prudhoe development forced reliance on marine transport, and in some cases, major air lifts of supplies to the Slope.

SCHEDULING OF ACTIVITIES

The Arctic winter weather adversely affects worker efficiency and thus the time that must be allocated to complete certain tasks. For example, the lightening of cargo from ocean barges to shore is far more easily accomplished at the onset of the ice-free season than at its conclusion. While it might take one tug only an hour to move a barge a distance of 1.6 kilometers (1 mile) at the beginning of the ice-free season, such an operation may take six tugs an entire day to perform at the end of the season (Alaska Construction & Oil Report, April 1976). Similarly, outdoor maintenance tasks requiring manual dexterity take far longer to accomplish in the sub-zero Arctic environment than they would in more temperate areas (Ellis, 1971).

These factors impacted upon requirements for the living and working environment of the basecamps that were provided at Prudhoe Bay.

Background of Physical Facilities Development

The physical facilities provided by BP and ARCO at Prudhoe Bay represent a significant advance in Arctic construction. From the perspective of technological innovation and the level of amenities provided in the living

environment, these facilities are the most sophisticated construction that has been accomplished to date in the Arctic. A reviewof previous facilities development in the North American Arctic provides perhaps a clearer understanding of the development that occurred at Prudhoe Bay.

The history of physical facilities in the Arctic is exceedingly sparse. Settlement that occurred before the discovery of oil at Prudhoe consisted of Native villages or military installations. Until the late 1960's only minimal attention had been directed to the quality of the living environment; settlements were designed to meet the requirements of functional necessity.

The construction by the Air Force of Distant Early Warning (DEW) System Stations in the 1950's provided the first major coordinated construction in the North American Arctic. The DEW Line Stations, established to provide intermediate radar detection of enemy aircraft, were built across the Arctic coast from Point Lay to the Canadian border and beyond at intervals of approximately 80 kilometers (50 miles). The stations were prefabricated individual structures of plywood panels on piles and skids connected by above-grade walk-through utilidors. Services were provided in individual units. Separate units contained dormitory style living quarters, mess hall, recreation facilities, operations center, and support services.

The first major composite facility built in the Arctic was designed for use by the U.S. Strategic Air Command in the late 1950's at Frobisher Bay

in Canada. The Frobisher Bay facility, now used for student housing, consisted of two buildings. The larger building contained dormitory style sleeping quarters, recreation facilities, food service and an operations center. The second building contained a self-contained utility system, as well as maintenance and repair shops. The buildings were constructed on piles 2.5-3 meters (8-10 feet) off a gravel pad with wood frame and metal siding.

The next refinement of North American Arctic construction is represented by an Aircraft and Warning System (AC&W) facility designed by CCC/HOK and constructed by the Corps of Engineers for the U.S. Air Force at Cape Lisburne in 1967. This facility was the first of several built to replace existing AC&W camps whose construction was similar to the DEW Line stations. The facility consisted of a composite structure and a utility structure, both constructed on steel piles with steel framing and insulated metal-clad enclosure. As required at other remote sites, the Cape Lisburne facility is capable of meeting all of its own operational needs. The structure was unique in that it provided a fully insulated and heated walk-through crawl space for protection and maintenance of utility systems.

More importantly, the facility was unique in that it represented the first example of Arctic construction that considered human needs associated with life in an isolated location of extreme climate. Every attempt was made to maximize human contact and social interaction in the design of the facility. This was a significant departure from the earlier utilidor-connected facilities. The Cape Lisburne plan provides a central two-story circulation court off which the major spaces of social interaction

were reached, such as the Airmen's Club, theater, food service and craft shops . This circulation plan increased the possibility of social contact while at the same time maintaining the privacy of individual sleeping quarters (Ed Crittenden, CCC/HOK, 1977).

Until the development of Prudhoe Bay, facility construction in the North American Arctic had been limited to these military enclaves. The early enclaves were primarily characterized by self-sufficiency with respect to utility systems and living environment, and functionality and austerity with respect to the level of amenities provided. In addition, the early enclaves consisted of individual structures (frequently modules connected by utilidors) in contrast with the far more extensive development and numerous individual structures developed at Prudhoe.

Early Oil Exploration Activity on the North Slope

The existence of oil on the North Slope was documented in the summer of 1886 when Charles Brewer and a friend were at Cape Simpson, about 80 kilometers (50 miles) southeast of Barrow. Brewer, relating the incident in his book Fifty Years Below Zero, recalled that as he and his friend walked inland toward a distant hill and reached the top of a rise, they saw below them a small dark lake. Brewer guessed the liquid was oil. He struck a match and placed it at the edge of the lake. The lake burned with intense heat and with greasy smoke (Ellis, 1971),

The earliest oil exploration activity on the North Slope occurred in the National Petroleum Reserve in Alaska (NPR-A). Known until July 1977 as

Naval Petroleum Reserve No. 4 (NPR-4), this area of approximately 95,830 square kilometers (37,000 square miles) was created by President Harding in 1923. Under Executive Order, the Secretary of the Navy was charged to "explore, protect, conserve, develop, use, and operate. . ." the Reserve.

Actual exploration and drilling activity in NPR-A did not begin until 1944. During the following nine years the Navy and its civilian contractor undertook a large scale exploration program which resulted in the generation of information concerning nine gas or gas and oil fields (U.S. Department of the Navy, 1977).

By the provisions of Public Land Order No. 1621, dated April 18, 1958, all federal land in the Umiat Meridian, except Naval Petroleum Reserve No. 4, was subject to oil and gas leasing. Lands east of the NPR-4 area were opened to leasing by the Department of the Interior in 1958, and the leases were issued in 1959 (North Slope Borough, July 1976).

The exploratory activity at Prudhoe began with lease sales by the State in 1964. In that year, in 1965, and in 1967, the State held lease sales on nearly 485,640 hectares (1.2 million acres) of land east of the National Petroleum Reserve-Alaska. From 1964 until mid-1968, exploratory activities were generally unproductive; oil companies drilled approximately 50 exploratory wells without a major discovery. Then, in July of 1968, the ARCO-Humble discovery well, Prudhoe Bay No. 1 and the Sag River No. 1 confirmation well verified the existence of what has proven to be the largest oil field known to exist on the North American continent (Harry Kugler, Petroleum Geologist, Division of Oil and Gas Conservation,

Department of Natural Resources, 1977).

The development of the Prudhoe field and the basecamp at Prudhoe Bay in response to this discovery is described in the section that follows.

CHAPTER III. DEVELOPMENT OF THE PRUDHOE BAY FIELD

Concentrated Exploration/Early Development: 1969-1974

Announcement of the Prudhoe discovery had two immediate impacts. First, the oil companies exhibited significant renewed interest in the drilling of exploratory wells on existing State and federal leased lands. Second, the attention of both the State and the oil companies became focused on the lease sale of State lands scheduled to take place on September 10, 1969. Also during this period, environmental concern regarding a trans-Alaska pipeline led to a series of studies related to other transportation alternatives such as rail transport connecting with the Alaska Railroad, submarine transport, and tankers through the Northwest Passage.

After the September lease sale, the focus of attention shifted from drilling activity on earlier leased lands, to delineating the extent of the Prudhoe Bay field (Alaska Construction & Oil Report, November 1969). To accomplish this task, a large quantity of equipment and supplies had to be transported to the North Slope. The surface movement of goods to the Slope was precluded by the absence of a road network. The transportation of goods to the Slope was primarily dependent upon an annual sealift of barges originating in the Lower 48.

Since it was already too late in the year to bring barges through the ice pack, supplies were either brought in via the MacKinzie River through Canada or brought in by air. During 1969, the number of take-offs and landings on the North Slope averaged 1,000 per day. Twenty-three rigs and most supplies were airlifted to Prudhoe by Hercules C-130'S, capable of

carrying a 21.8-metric ton (24-ton) payload. The scale of the airlift is illustrated by the fact that to transport one drilling outfit to Prudhoe, a Hercules had to make 72 round-trips between Fairbanks and Prudhoe (Ellis, 1971).

The equipment was primarily used for additional exploratory drilling. Exploratory drilling at Prudhoe was undertaken from pads built on gravel to protect the tundra. The pads, which measured approximately 182.9 meters by 91.4 meters and 1.5 meters thick (600 feet by 300 feet and five feet thick), were built to accommodate the well and its support facilities, including a portable camp for 40-50 men, maintenance shops, drilling equipment and fuel storage facilities. The first pads were constructed during the winter of 1969 when access could be gained to drilling sites across the frozen tundra.

The drilling pads were constructed by service companies operating out of base camps at Prudhoe, who brought self-contained portable camps to the drilling site if warranted by the length of construction activities (Alaska Construction & Oil Report, August 1973). Upon completion of drilling pads, other service companies were engaged by the oil operators to drill the well. It took between 30-90 days to drill an exploratory well, depending upon the depth of the oil reservoir, and drilling crews were located in portable camps at the drilling site. Drilling crews consisted of approximately 20-22 men, supplemented by supervisory personnel from the oil operators and construction managers, together with geologists, mechanics, electricians, and service personnel for the residential quarters (Charles Keffer, North Slope Project Manager, ARCO, 1977).

In addition to the need for drilling equipment on the Slope, there was also an immediate need for permanent facilities. Prior to the 1969-1970 winter drilling season, only ARCO/Exxon and BP Sohio (ARCO and BP), who were the major leaseholders, had developed any permanent facilities. Two service companies already operating on the Slope, Alaska General Construction Co. and Frontier Rock and Sand, Inc., had also established base camp facilities.

After the 1969 lease sale the State Division of Lands began to receive numerous requests from non-petroleum industries for surface leases in proximity to oil operations. The State was concerned about minimizing the potential environmental impact associated with granting these leases, and also concerned about minimizing the use of gravel and water resources, which are in extremely short supply everywhere on the Slope. In response, the State Division of Aviation and the State Division of Lands designated an area adjacent to the Deadhorse Airport for an industrial subdivision which grouped the service companies in a single location. As with the oil operators, individual service companies applying for leases were responsible for providing their own self-contained physical facilities, utilities and services.

The oil companies and service companies both favored the creation of an industrial subdivision. From the perspective of the oil companies, the grouping of service companies permitted them greater flexibility in the design and location of oil field facilities. From the perspective of the service companies, a location next to the Deadhorse Airport placed them near their principal source of supplies. With the exception of Alaska

General Construction and Frontier Rock and Sand, whose leases predated the industrial park, all of the service companies in the Prudhoe enclave developed their facilities in the State designated area.

Also at this time, a series of transportation improvements were developed by ARCO and BP through the use of joint working agreements. These included the airstrip located across from the ARCO base camp, the original dock facility, and adjacent storage pads to accommodate supplies transported by barge during the annual sealift. A gravel causeway and four barges placed at one end served as the unloading dock (Alaska Construction & Oil Report, November 1969). A road between these facilities was also constructed, as well as a number of lateral roads throughout the enclave.

At the beginning of 1970, the oil companies were very optimistic that there were no significant barriers to producing the Prudhoe field. They expected that the proposed trans-Alaska pipeline would be completed and would be carrying oil by 1972. Toward that end, the oil companies focused their efforts in two major areas. First, the oil companies entered into preliminary discussions among themselves and with the State concerning a Unit Agreement to operate the Prudhoe field. Second, they continued with extensive efforts related to the transport of equipment and supplies.

The authority for the Unit Agreement was Section 31.05.110(a) of the Alaska Statutes (Oil and Gas Conservation). This Act and a predecessor Act passed before statehood had been framed to prevent duplicator efforts on the part of several oil companies operating in the same field; to ensure a greater ultimate recovery of oil and gas; and to protect the environment

by avoiding over-drilling and minimizing the number of surface facilities (Alaska Construction & Oil Report, August 1970). Both the oil companies and the State viewed the Unit Agreement as the most efficient means for the recovery of gas and oil. Under the terms of the Unit Agreement the costs of operating the Prudhoe field were apportioned among the sixteen leaseholders, and ARCO and BP were designated as the two field operators.

The second major effort, the transportation of equipment and supplies to Prudhoe, was unparalleled in the Arctic. The 1970 sea lift was the largest marine transport effort since World War II. More than 169,645 metric tons (187 ,000 tons) of cargo were barged to Prudhoe from the Lower 48. The cargo primarily consisted of 270.4 kilometers (168 miles) of pipe for the collection of pipelines, the first phase modules for the ARCO base camp, and the first phase modules for Flow Stations 1 and 2.

By early 1971, the optimism of the oil companies faded as repeated environmental and other legal challenges were instituted against the proposed trans-Alaska pipeline. In response, the oil companies slowed the pace of drilling new development wells and constructing the oil production infrastructure. In fact, in 1971 there was a reverse air lift of oil rigs off the North Slope because of the slowdown (Charles Keffer, North Slope Project Manager, ARCO, 1977).

In July 1972, the North Slope Borough was incorporated. In consequence, the Prudhoe field, lying within its jurisdictional boundaries, became subject to Borough regulations and property taxes. In order to mitigate potential Borough responsibility for providing services to the Prudhoe unit,

discussions were held between the oil companies and the North Slope Borough in 1973. It was agreed by both the Borough and the oil operators that the Prudhoe enclave would remain a private industrial development essentially independent of the Borough's mandated areawide responsibilities. The oil companies would be initially and would continue to be primarily responsible for providing their own services and facilities (Herb Bartel, Planning Director, North Slope Borough, 1977). In late 1973, the sea lift brought the first phase of the BP Operations Center, which was completed in March of the following year.

Development Phase: 1974-1977

The pace of development at Prudhoe continued slowly until January 1974, when the Secretary of the Interior issued the permit authorizing construction of-the pipeline across federal lands. In May 1974, the State authorized construction of the pipeline across State lands.

Once the necessary approvals for the pipeline had been obtained, the pace of development activities rapidly increased. During the development phase, expansion of the residential facilities and construction of roads and utility systems for the basecamp occurred simultaneously with the drilling of development wells and the construction of gathering, separation, and processing facilities for oil and gas production. It was also during this phase that the North Slope haul road, trans-Alaska pipeline and the facilities at Valdez were constructed (Alaska Construction & Oil Report, October 1976; BP Alaska, Inc., June 1977).

As with the exploratory phase, the drilling of development wells first involved the construction of gravel pads, in this case multi-well gravel pads, from which as many as six to eight wells could be drilled. The purpose of these multi-well pads was to minimize environmental damage to the surface of the land. The use of multi-well drilling pads was one of the offshore drilling techniques adapted for use at Prudhoe Bay (Alaska Construction & Oil Report, November 1969 and May 1972).

Generally, each well was drilled to tap 129.5 hectares (320 acres, or one-half square mile) of the oil reservoir; wells that were little more than 30.5 meters (100 feet) apart at the surface were drilled vertically through 610 meters (2,000 feet) of permafrost, and then drilled at an angle for another 1,830 to 3,048 meters (6,000 to 10,000 feet) until the target was reached. The technology of drilling had advanced to the point that it was not unusual to come within 15.2 meters (50 feet) of a target area that could have been as much as 3,658 meters (12,000 feet) from the drill rig. To drill a new well on the gravel pad, the drilling rig was skidded across the pad without being disassembled and set up to begin drilling within 48 hours. It took an average of 30 days to drill a development well. When all wells on one pad had been drilled, the rig was jack-knifed, trucked along the road system and set up on the next pad. Rigs used on the Slope were specially designed so that they could be separated into sections and transported to a new pad in two or more days. This procedure would have taken from ten to twelve days with a conventional rig (BP Alaska, Inc., April 1976)

When completed, each well was equipped with dual safety valves, one on

the surface and the second set below the base of the permafrost. Once in operation, oil would be transported from the wells to gathering centers, by means of flowlines, where the oil would be separated from gas condensate, water and other impurities that were produced with it.

From the gathering station, the crude oil would proceed to the first of a series of eight pump stations that would pump the oil through the trans-Alaska pipeline connecting Prudhoe Bay with the port of Valdez. At Valdez, the crude oil would be pumped into supertankers for shipment to oil refineries in the Lower 48 (Alyeska Pipeline Service Company, October 1977).

The drilling program during this period included plans for 130 development wells. This required a wide range of equipment, supplies, and living facilities for workers associated with the development program. Most of this equipment came to the North Slope by barge during the annual sealift. Included in the 1974 sealift were modules for BP's gathering centers 1 and 2.

On September 29, 1974, the haul road connecting Fairbanks with Prudhoe Bay was completed. With the completion of the road, a surface transportation capacity became available to supplement the sea and air movement of cargo and supplies to the North Slope. The haul road made it possible to transport equipment overland required for the construction of the pipeline, and also to bring supplies and equipment to Prudhoe. The first phase of ARCO's Parsons camp was trucked to Prudhoe via haul road. When erected on site, this facility initially housed 870 persons (Charles Keffer, North Slope Project Manager, ARCO, 1977). During 1975, BP completed two 500-man construction camps in addition to its previously built operations center (Alaska Construction & Oil Report, April 1975).

Despite the new overland access route, the annual sealift remained the major means of transporting cargo to the Slope. The sealift of 1975 was particularly significant. Cargo included the remainder of ARCO's gathering stations 1 and 2, modules for ARCO's gas injection plant, and additions to both the ARCO and BP living modules.

During the summer of 1975, the ice pack off the Arctic Coast did not break up for the first time within memory. Waiting to round Point Barrow was a fleet of 25 tugs, each towing a barge carrying much needed North Slope oil field equipment. Lightening tugs were used to try to maintain an open channel between the ice bound barges and the Prudhoe dock. However, as October progressed, the ice began to freeze faster than the tugs could keep it broken (Alaska Construction & Oil Report, April 1976).

When barges were eventually trapped in ice in December, ARCO management made the decision to build a gravel road to the iced-in modules. Between December 18, 1975 and January 27, 1976, crews working 24-hours a day constructed a road that was 1,524 meters long and 15.2 meters wide (5,000 feet long and 50 feet wide). The road enabled the modules to be offloaded and moved over the road by means of giant crawler transporters. In addition, a 1,524-meter (5,000-foot) extension was added to a second dock about 16 kilometers (10 miles) northwest of the original dock facility (Selkregg, 1975; BP Alaska, Inc., 1976; Alaska Construction & Oil Report, April 1976).

The 1975 sealift, with the attendant difficulties encountered in attempting to free the barges from the ice, brought the remainder of ARCO's gathering stations 1 and 2, as well as modules for ARCO's gas injection plant

(Alaska Construction & Oil Report, April 1976).

The goal at Prudhoe Bay during 1976 was to complete placement of the operations equipment for both ARCO and BP including development wells, gathering stations, and the flow lines connecting the wells and the gathering stations. In addition, both the ARCO and BP basecamps were expanded: ARCO by a 240-man addition and BP by a 124-man addition. BP also added a master operations center (BP Alaska, Inc., June 1977).

In early 1977, the BP central power station and ARCO's compression plant were completed. This year also marked the completion of the pipeline. On June 20, 1977, oil first entered the pipeline at Alyeska pump station No. 1. Since that time, activities at the Prudhoe field have been devoted to the production of oil together with additional exploratory drilling operations.

CHAPTER IV. BASECAMP PHYSICAL ENVIRONMENT

The purpose of this chapter is to provide a description of the industrial facilities and living quarters for workers at Prudhoe Bay in the Fall of 1977 at the time oil production began. The chapter has been structured to separately describe the operating oil companies and the five representative service companies that have been included as a part of the study. The second section compares the facilities, services and amenities provided by the oil companies at their operations centers and basecamps with those provided by the service companies at their Prudhoe facilities.

Description of the Camp

The Prudhoe Bay Unit is a 995-square kilometer (384-square mile) industrial development consisting of oil production facilities, operations facilities, support services, and living quarters for persons who work the oil fields of the North Slope and Prudhoe Bay. The configuration of the camp and the placement of facilities within it do not respond to typical community locational requirements. The development of the Prudhoe enclave is the direct result of the requirements of oil production. Facilities are located to maximize efficient oil operations and to minimize environmental disruption.

Oil production facilities occupy approximately 259-square kilometers (100 square miles) of the Prudhoe Bay Unit. The facilities are connected by a gravel spine road 48.2 kilometers long, 9.1 meters wide, and 1.5 meters thick (30 miles long, 30 feet wide and 5feet thick), running from the northwest to the southeast of the unit, with access roads leading to individual

facilities. Facilities in the camp are strung out along the road and to the north and east (BP Alaska, Inc., June 1977).

Operating Oil Companies

Sixteen oil companies hold an interest in the development of the Prudhoe Bay field. These sixteen companies have entered into a Unit Agreement that provides for the operations of the field by the companies with the largest lease interest: Atlantic Richfield/Exxon and BP Alaska/Sohio. Atlantic Richfield operates the eastern section of the field, and BP Alaska operates the western portion, supported by construction management firms and service companies.

Under the terms of the Unit Agreement, costs and oil produced will be shared by the 16 participating companies according to agreed-upon ratios of participation. Developing the field in this way is encouraged by the State, as well as the oil companies themselves. It avoids the duplication of facilities, airstrips, production pads, access roads, oil flowlines and power plants. It also ensures maximum efficient production.

Both of the oil operators have constructed essentially the same physical facilities including separate development wells connected to their own gathering stations; three gathering stations are located on each side of the field. Both BP and ARCO also have constructed separate operations centers and construction camps centrally located to best serve their respective sides of the field.

In addition to their separate facilities, the oil operators share certain facilities that have been sited to serve both operating areas. These include a central compression plant for reinjecting water and gas separated from the oil at the gathering stations; a central power station; docks; and an airstrip.

Service Companies

Rather than performing all the tasks inherent in the oil exploration and production processes themselves, the oil operators have found it administratively and financially desirable to award other firms contracts to perform a variety of specified services. Each oil operator has selected a construction manager to supervise the work of these services in the field. In the case of ARCO, this is Ralph M. Parsons; in the case of BP, it is Brown and Root. The base camp facilities for the construction management firms are located in proximity to the oil operators on respective sides of the field.

Service companies are also involved in all aspects of the exploration, development and production phases of oil operations, and operate either under direct contracts with the oil operators or with their designated construction managers. Contracts are awarded to service companies *on* a competitive bid basis. In consequence, the size of the workforce maintained by a given service company at Prudhoe varies with the number and duration of contracts on which it has successfully bid.

Most of the service companies are grouped in an area zoned by the North

Slope Borough as an industrial park near the airstrip at Deadhorse. Each service company is responsible for providing and maintaining its own facilities. However, arrangements have been made with the oil operators to provide fire protection services and emergency medical and health services. Each service company is essentially autonomous from all others, and all of the service companies are independent of the oil company facilities.

The facilities provided by the service companies are generally smaller than those of the operating oil companies, and all provide more modest sleeping quarters (two persons to a room, rather than one) and a lower level of amenities than do the oil operators.

Although a large number of service companies are under contract to the operating oil companies, a representative sample of service companies has been included in this study for comparative purposes that are described below.

NABORS ALASKA DRILLING, INC.

Nabors Alaska Drilling, Inc., has been involved with oil wells drilling on the North Slope since 1963. The company is under contract to the oil companies within the Prudhoe Bay Unit and other oil companies on the Slope to provide drilling services for exploratory and production wells.

KODIAK OIL FIELD HAULERS, INC.

Kodiak Oil Field Haulers, Inc., a subsidiary of Nabors Alaska Drilling, Inc., provides truck hauling and equipment maintenance services to the oil companies and other subcontractors within the Prudhoe Bay Unit. The

company hauls water and gasoline as well as all forms of heavy equipment on the Slope and within the Prudhoe Bay Unit.

FRONTIER ROCK & SAND, INC.

Frontier Rock & Sand provides oil field services at the Prudhoe Bay Unit and on the North Slope related to gravel moving, road construction, pad construction, pile driving and the drilling of conductor holes for wells.

FRONTIER EQUIPMENT COMPANY

Frontier Equipment Company provides oil field services at the Prudhoe Bay Unit and on the North Slope related to heavy equipment services and leasing. The Frontier Companies have been on the North Slope since 1964 providing services for wildcat drilling operations.

NANA OIL FIELD SERVICES, Inc.

NANA Oil Field Services Company, a subsidiary of the NANA Regional Corporation, provides a broad range of services to oil operators and other subcontractors at Prudhoe Bay. These include fuel and water hauling services; transporting of workers to different locations within the field; catering services for one of the drilling rigs; and tours of Prudhoe Bay during the summer months. NANA Oil Field Services is also the Chevron dealer at Prudhoe Bay, and as such sells aviation fuel, diesel fuel and regular gasoline in addition to its fuel hauling services.

NANA Environmental Systems, Inc., a second subsidiary of the NANA Regional Corporation, is in the process of developing a central utility at Deadhorse under contract to the North Slope Borough. The central

utility will include a water utility (with reservoir and filtering plant) and a solid waste facility. The water will be sold to service companies at Deadhorse and in the Prudhoe field; the solid waste facility will be used by oil operators and service companies alike.

Comparison of Basecamp Physical Facilities and Living Environments

The harshness of the Arctic environment, the isolation of Prudhoe Bay, and the length of the typical work day make the provision of pleasant, comfortable and safe living quarters mandatory. While the basecamps have attributes in common, characteristics of the living quarters supplied by the operating oil companies and the service companies differ in a number of significant ways, including configuration of the physical facilities, provision of utilities, and the level of amenities and services provided for employees.

PHYSICAL FACILITIES

The basecamps of the two operating oil companies are physically independent of each other, although they do share certain facilities and utilities. Most of the service companies are clustered in proximity to one another in an industrial area adjacent to the Deadhorse Airport. Most service company camps are operated independently of one another and the oil companies. Table 1, Physical Facilities, summarizes the capacity of the ARCO, BP and service company basecamps.

Operating Oil Companies

The accommodations provided by ARCO and BP are of a significantly higher

quality than those provided by the service companies. Both the ARCO and BP operations centers provide office space, living quarters, and dining, recreation and medical facilities for company employees and certain contract personnel. The ARCO and BP operations centers have a 440- and 264-bed capacity, respectively (BP Alaska, Inc., June 1977).

The two operations centers have elements in common:

- The operations centers are modular. They were constructed out-of-state and then barged to Prudhoe Bay to minimize expensive on-site labor. In the case ofBP, the units were fabricated in Texas; the units for ARCO were fabricated in Seattle.

- Both took advantage of newly developed crawler type tractor units used for the movement of rockets at Cape Kennedy to move the completed modules from construction site to barge and from barge to permanent site at Prudhoe.

- Each center is constructed on pilings to permit the flow of air beneath the structure. This gap between the structure and the tundra prevents the permafrost from melting from the warmth emitted by the building.

- The interiors of the operations centers have been designed to offset the isolation of working and living on the North Slope. They incorporate a feeling of brightness and openness that belies the harshness of the environment outside.

- The design of the centers attempts to foster social interaction among workers through the careful design of circulation corridors and the provision of extensive recreation facilities.

- Workers at ARCO and BP centers are provided individual bedrooms, as contrasted with the double room occupancy of the service companies.

However, while sharing these characteristics, the configuration of the two operations centers differ.

ARCO

The configuration of the ARCO operations center, as shown in Figure 2, is an l-i-shaped design; the center consists of eight two-story living and administration modules laid side by side. The modules were designed to "plug-in" to a large central corridor facility containing the security/ reception area, dining facilities, an auditorium used to show daily movies, lounging areas, exercise room, gymnasium, saunas, commissary, and medical services. The ARCO facility is a steel frame structure completely enclosed by prefabricated insulated metal clad panels (CCC/HOK, 1977; Field Visit, 1977).

BP

The sleeping quarters of the BP operations center are contained in two three-story wings, placed side by side with approximately 15.2 meters (50 feet) between them. Each wing consists of several modules joined together on site. The modules were built on steel and concrete bases of

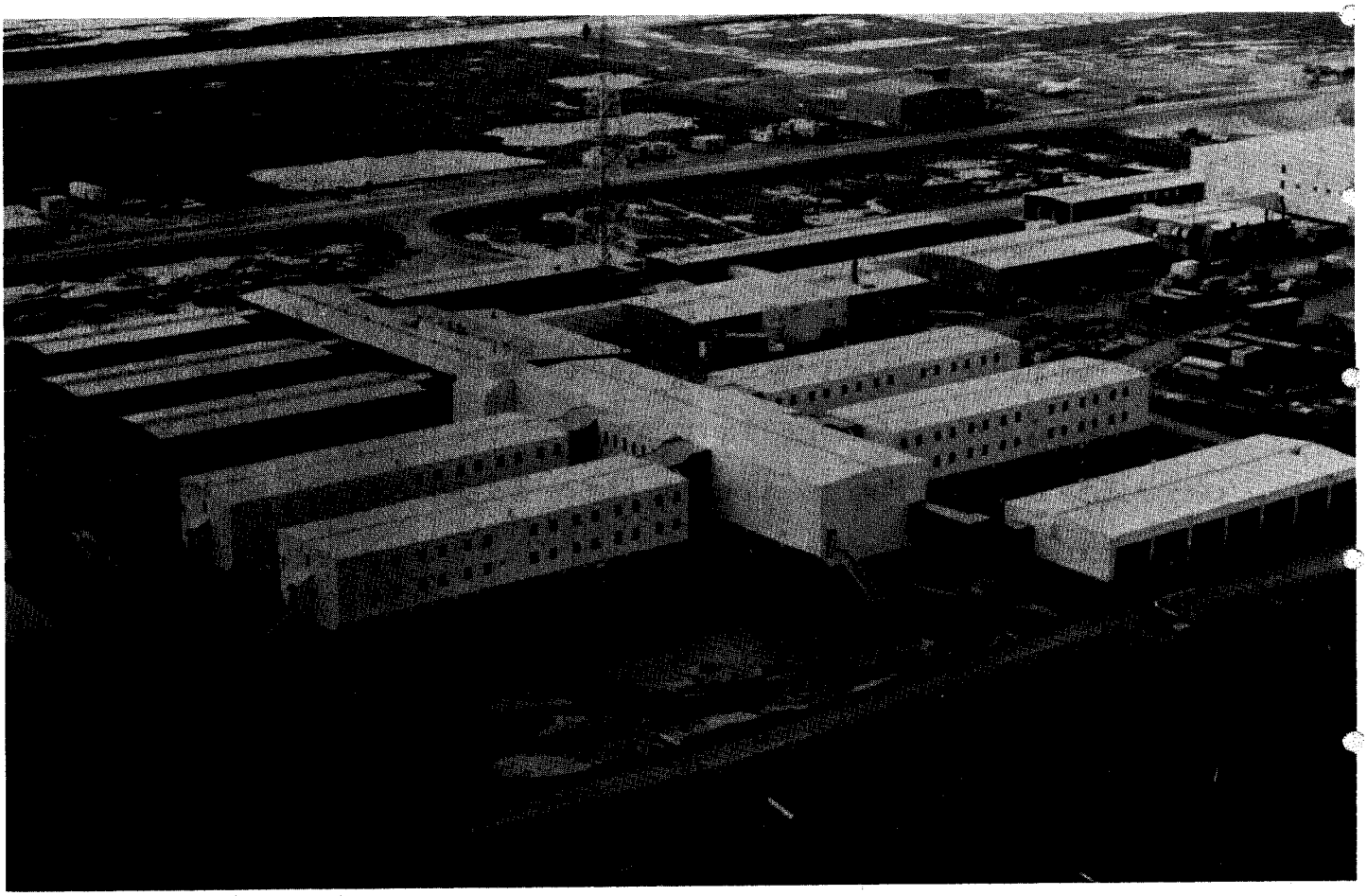
conventional fir wood frame construction. Instead of connecting the wings by means of a central core, as was done in the ARCO center, the area between the two wings has been enclosed. Spanning the distance between the two wings is a truss system supporting a transparent roof, which allows the maximum amount of light to enter. The end walls of the enclosed space, at the second and third-story levels, are of glass, forming huge windows that can be opened during the summer. Figure 3 shows exterior and interior views of the BP operations center.

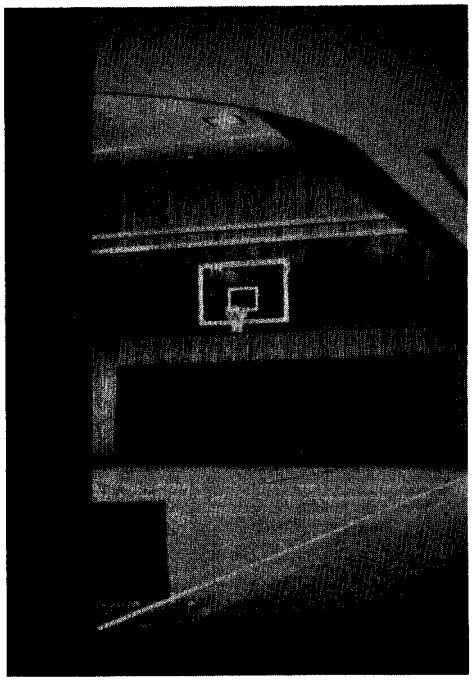
The enclosed area on the first floor contains the swimming pool, the recreation and dining area, an indoor landscaped area and a lounge. The second floor contains the basketball court and overlooks the landscaping, swimming pool and dining area below. Other facilities found within the enclosed area are a theater, saunas, lounge-reading areas and medical facilities.

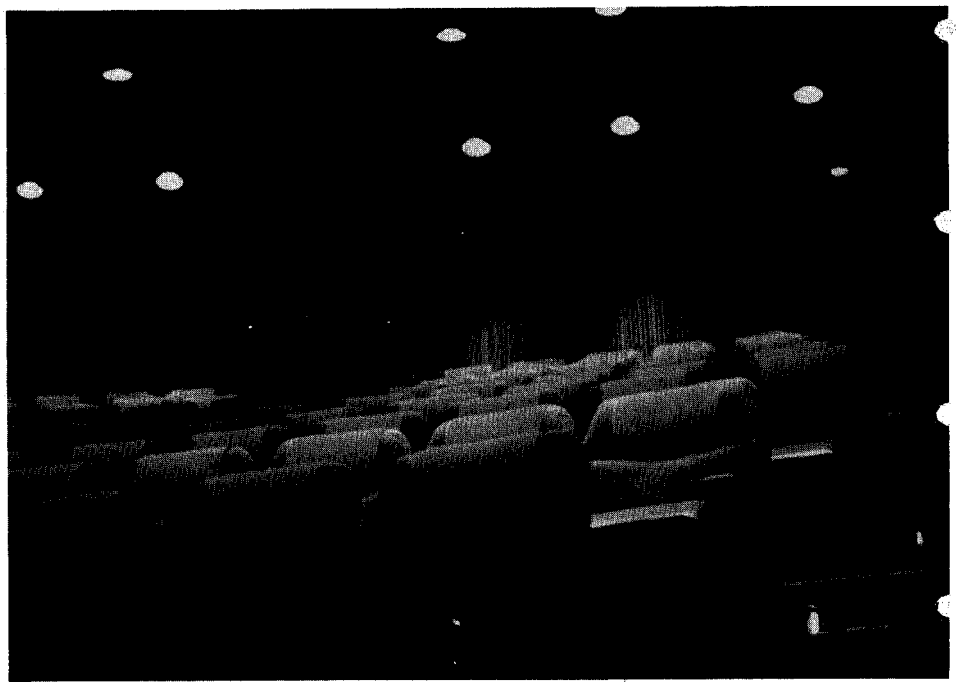
Another important element of the BP operations center, in addition to the feeling of openness created by the transparent roof and glass walls, is the use of bright colors and super graphics throughout the facility. Neither ARCO nor the service companies has this design feature (BP Alaska, Inc., 1974) .

Service Companies

Service companies provide functional accommodations for their temporary employees that are designed to meet minimum union and code standards. Workers trade off long working hours, fairly spartan living quarters and





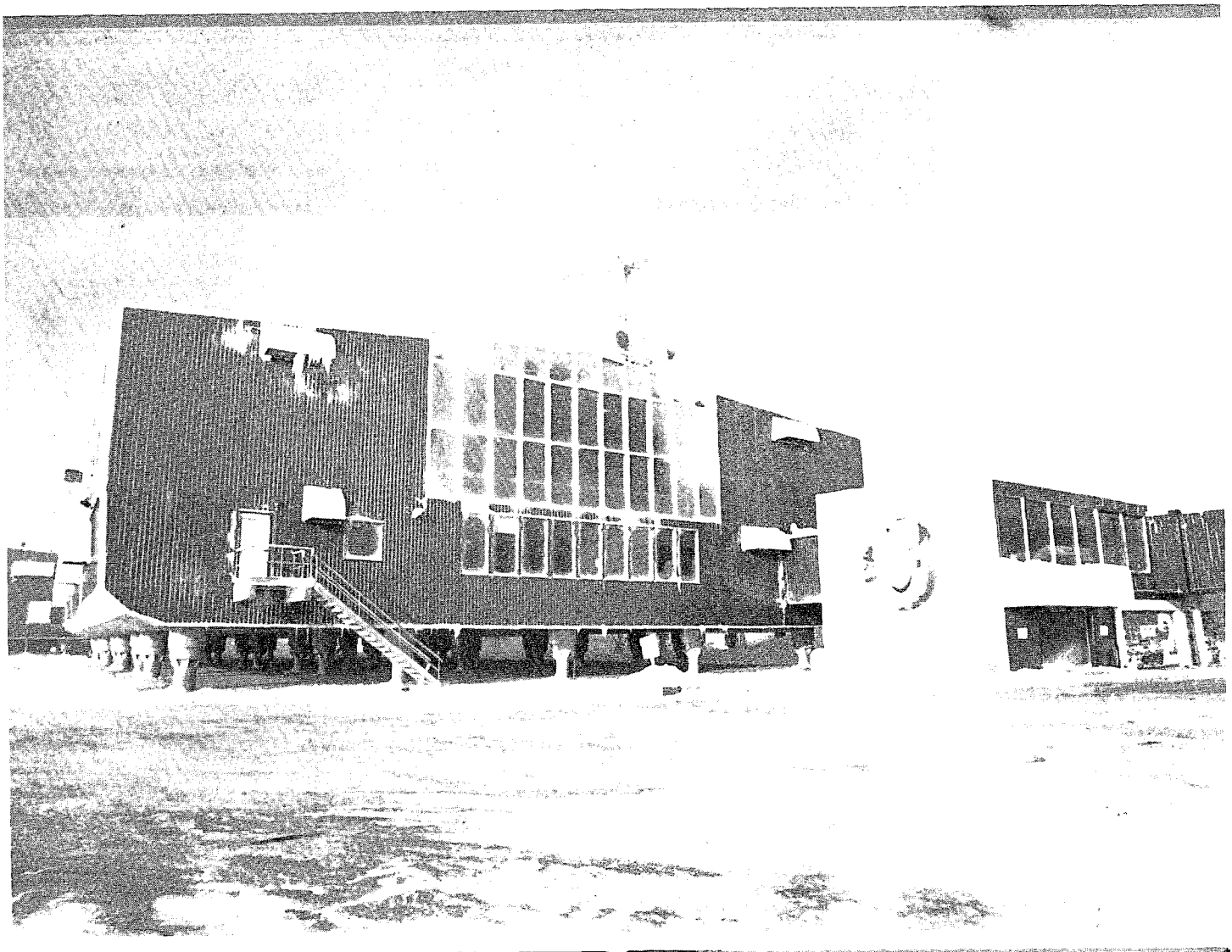


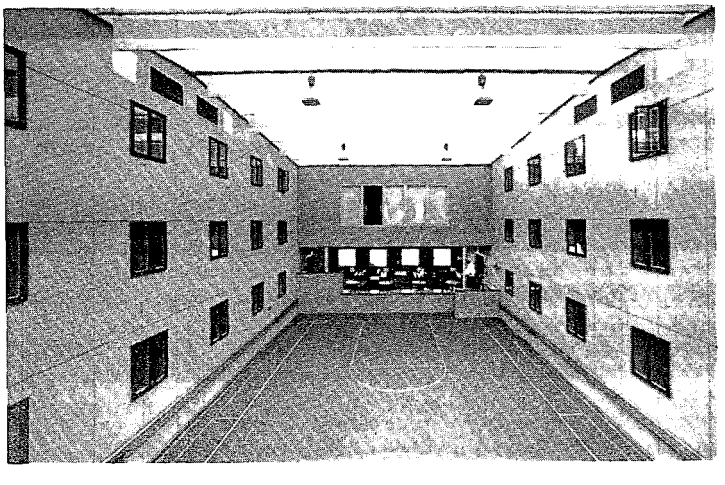
Atlantic Richfield Company Operations Center

(top) Aerial view of ARCO basecamp.
(bottom left) Indoor gymnasium.
(bottom right) Motion picture theatre/auditorium.

(Source: CCC/HOK)

(figure 2)





British Petroleum Alaska, Inc. Operations Center

(top) South Approach to BP basecamp.
(bottom left) Indoor glassed-in garden.
(bottom right) Bedroom suites overlooking enclosed recreation court.

(Source: BP Alaska, Inc.)

(figure 3)

a minimal array of recreational facilities for high salaries. (Robert Scott, Frontier Equipment Company, 1977).

A typical service company basecamp facility consists of a one-story Atco trailer placed on piles to protect the tundra. Trailers are connected by a system of covered pedestrian corridors.

The size of service company basecamps vary from 40 to 50 persons, a capacity typical of portable drilling rigs, to the 240-bed NANA Oil Field Services, Inc., hotel-basecamp located at Deadhorse Airport. Most basecamp facilities include two-person bedrooms-with a centrally located communal toilet-shower facility. Women sleep two to a room and have separate bathroom facilities. In most instances, women use the shower facilities either before or after the men use them. (Field Visit, 1977).

The array of amenities that make the operations centers pleasant environments are largely absent from the service company basecamps. For example, corridors in the basecamps are long, narrow and dark. In addition, a number of camps carpet only their bedrooms with indoor/outdoor carpeting, covering the floors in the corridors and other facilities with linoleum. (Charles Cox, Alaska General Construction Co., 1977).

UTILITIES SERVICE

Contrary to what might be expected from a typical community, not even the provision of utilities is integrated at Prudhoe Bay. For the most part, the provision of utilities is the independent responsibility of each

TABLE 1

PHYSICAL FACILITIES

Operating Oil Companies	Physical Facilities
Atlantic Richfield Company	ARCO basecamp has a 440-bed capacity with individual rooms. Parson's camp has a 1750-bed capacity with shared rooms.
BP Alaska, Inc.	Operations Center has a 264-bed capacity with individual rooms. Construction Camps 1 and 2 each have a 500-bed capacity with shared rooms.
Service Companies	
Nabors Alaska Drilling, Inc.	Drilling crews are housed in 40 to 50 man portable camps at the rig site, 2 men per room.
Kodiak Oil Field Haulers, Inc.	Company maintains a permanent basecamp near Deadhorse, with 108-bunk capacity, 2 men per room.
Frontier Rock & Sand, Inc.	Company maintains a permanent 120-man camp at Deadhorse. Camp is currently shut down pending award of another contract.
Frontier Equipment Company	Permanent basecamp with 156-man capacity (2 men per room) is located on western side of Prudhoe Bay unit. In addition, 25 workers from the Frontier basecamp and 30 people from the company are currently being housed at the ARCO/Parson's camp.
Alaska General Construction Co.	Service City basecamp, located 43.5 kilometers (27 miles) west of Deadhorse, has a 150-man capacity (2 men per room). This basecamp, the oldest in the Prudhoe Bay Unit, has its own private 1,676-meter (5500-foot) gravel airstrip that can handle Hercules aircraft.
NANA Oil Field Services, Inc.	Maintains a 240-man camp at Deadhorse, which is used by their crews as well as providing room rentals to oil and other companies on the Slope.

firm operating there. However, there is a difference in the degree of independence with which the oil companies and service companies provide their own utilities (Cf. Table 2, Utilities Service).

Operating Oil Companies

- Water/Sewage

  ARCO and BP have each developed independent water sources. ARCO has a permit to draw water from the Sagavanirktok River by means of pipelines to its operations center. BP draws water from an 11.4 million liter (3 million gallon) reservoir it constructed at Big Lake adjacent to the operations center. To prevent freezing of the water during the winter, BP uses styrofoam floats and circulates heated water through the reservoir. As a supplement to this water source, BP has an 11.4 million liter reserve capacity from three 3.8-million liter (one million-gallon) storage tanks. ARCO and BP each maintain their own sewage treatment package plant (David Maze, Administration, BP Alaska, Inc; Don Jones, Employee Relations, ARCO, 1977).

- Electricity/Gas

  Under the terms of the Prudhoe Bay Unit Operating Agreement, the provision of electricity and gas utilities are shared by ARCO and BP. BP has constructed the central power station and the electrical transmission lines to all operations facilities. ARCO has the responsibility of conditioning the natural gas that is then used for electrical generation and heating systems for field facilities and for Alyeska's first four pump stations (Prudhoe Bay Unit Agreement, April 17, 1977).

Service Companies

No central utility existed at the Deadhorse industrial subdivision at the time it was created in 1969. As a stipulation of their lease, service companies locating at Deadhorse were required by both the State Division of Lands and the Division of Aviation to provide all their own utilities. (Pat Dobey, Department of Natural Resources, Division of Minerals and Energy Management, 1977).

All service company camps in the industrial subdivision individually provided their own electricity and heat with generators powered by diesel fuel that was purchased from ARCO's topping plant. In 1974, an electric utility was formed as a subsidiary of Atwood Enterprises, Inc. The following year, the utility became Arctic Utilities, Inc. (AUI), a subsidiary of NANA Development Corporation. AUI presently provides power to Deadhorse Airport and to approximately one-half of the service companies in the industrial subdivision. (Tom Dow, General Manager, NANA Oil field Services, Inc., 1977).

All service company camps maintain their own package sewage treatment plants and either supply their own water requirements through permits to pump water out of nearby lakes and rivers, or purchase their water from water-hauling companies such as Muk-Luk or Kodiak Oil Field Haulers. (Mike Krupa, Business Manager, Kodiak Oil Field Haulers, Inc., 1977). Each camp maintains its own purification system for potable water.

Because of problems with solid waste disposal, package treatment plant failures, and water supply in Deadhorse industrial subdivision, the oil-field operators, service companies, and the State in 1976 asked the North

TABLE 2

UTILITIES SERVICE

Operating Oil Companies	Utilities Service
Atlantic Richfield Company	ARCO's electrical supply comes from BP's Central Power Station *via* 69 kv lines which traverse the field. Both ARCO basecamp and Parson's camp maintain separate sewage treatment facilities. The water supply for the camp is pumped from the Sag River, about 1.6 kilometers (1 mile) to the east. In addition, an emergency reservoir is maintained with a 7.6 million liter (2 million gallon) capacity.
BP Alaska, Inc.	BP's Central Power Station provides electricity to all oil operations facilities at Prudhoe and has a generating capacity of 134 megawatts. BP's water supply includes a 11.4 million liter (3 million gallon) capacity earthwork reservoir across from the Central Operations Center and five 3.8 million liter (1 million gallon) tanks which together serve the COC and construction camps 1 and 2. A sewage treatment facility handles COC and construction camp 1, with construction camp 2 maintaining a separate facility.
Service Companies	
Nabors Alaska Drilling, Inc.	Drilling rigs and portable camps all supply their own electricity through 400 kw portable generators; provide their own water supply and sewage treatment plants. Diesel fuel is purchased from ARCO topping plant.
Kodiak Oil Field Haulers, Inc.	Camp provides its own electricity, using two 300 kw generators. Camp also provides its own water and sewage treatment facilities.
Frontier Rock & Sand, Inc. Frontier Equipment Company	Frontier companies provide their own electricity using generators, their own sewage treatment facilities, separate water supply and water tanks.

TABLE 2
UTILITIES SERVICE

Service Companies	Utilities Service
Alaska General Construction Co.	Camp provides its own electricity using three 500 kw generators, its own separate water supply, and sewage treatment facilities. Water and gasoline are delivered to the camp by Mukluk or Kodiak Oil Field Haulers. Diesel fuel is purchased from ARCO topping plant.
NANA Oil Field Services, Inc.	NANA has its own electrical supply that includes one 500 kw generator, two 350 kw generators, and two 250 kw generators that also supply power to half of the Deadhorse area. The camp has its own sewage, treatment facility and water supply, and is also involved in hauling water to other subcontractors.

Slope Borough to create a utility service area and construct a central utility for the subdivision.

During 1976, the Borough began construction on the $18 million central utility, $2.25 million of which will be covered by a grant from the State. The central utility will provide solid waste incineration, sewage treatment, water purification and a water storage reservoir available on a contractual basis to facilities within the Prudhoe enclave. It is anticipated that the solid waste incineration facility, scheduled for completion in the summer of 1978, will be used by both oil companies and service companies. Solid waste incineration facilities are not presently available within the Prudhoe unit. Only the service companies are expected to use the services of the sewage treatment facility, water purification plant, and water storage reservoirs inasmuch as these services are already separately provided by the oil companies (Herb Bartel, Director of Planning, North Slope Borough, 1977).

FIRE PROTECTION SERVICES

The isolation of Prudhoe Bay, the harsh environment, the handling of highly flammable materials, and the scarcity of water make it particularly vulnerable to fire. Fire prevention equipment and procedures have been emphasized at Prudhoe, and the field is well equipped with some of the most modern fire fighting equipment. In addition to incorporating fire protection features into the design of their respective facilities and purchasing a variety of fire fighting equipment, the two oil operating companies and many of the service companies have entered into mutual aid, fire fighting

contingency plans. The fire safety record of the camp is extremely good, and the department is not often required for fire emergencies (Field Visit, Fall 1977). (Cf. Table 3, Fire Protection Services.)

Operating Oil Companies

The operating oil companies have trained staff and the most extensive equipment at Prudhoe Bay. In addition, ARCO, BP and Alyeska Pipeline Company participate in a mutual help agreement in the event of oil spills or fire in the field. The design of the operations centers and related facilities incorporate many fire protection features, including the size of enclosed spaces, their relationship to one another, placement of fire doors, and selection of materials.

ARCO. Fire protection is provided by a staff of 20 who maintain a facility adjacent to the ARCO operations center, including four firefighting vehicles. All ARCO facilities have integral sprinkler systems, halons (a gas manufactured by DuPont that is effective in fire fighting), and other equipment.

BP. Fire protection at BP is provided by its four- to six-person staff that maintains the firefighting facility including four fire-fighting vehicles. BP facilities all have extensive fire protection systems, including integral sprinkler systems, back-up sprinkler systems and halons. The swimming pool located in the operations center also functions as an indoor firefighting reservoir.

TABLE 3

FIRE PROTECTION SERVICES

Operating Oil Companies	Fire Protection Services
Atlantic Richfield Company	Fire protection is provided by an ARCO fire-fighting staff which maintains a fire fighting facility next to the ARCO basecamp, including four fire fighting vehicles. All ARCO facilities maintain sprinkler systems, halons and other fire protection equipment. ARCO/BP/Alyeska participate in a mutual help agreement and contingency plan for oil spills and fire in the field.
BP Alaska, Inc.	Company maintains fire-fighting facility and a 4t06 full time staff at its operations center, including four fire fighting vehicles. BP facilities all have extensive fire protection systems, including back-up sprinklers, halons and fire doors. Company also participates in ARCO/ BP/Alyeska joint field fire agreement.
Service Companies	
Nabors Alaska Drilling, Inc.	Camp has its own fire protection system including halons, sprinklers and extinguishers.
Kodiak Oil Field Haulers, Inc.	Each camp has its own fire protection system in the form of sprinkling systems and halons. Company is also part of a contingency plan for fire fighting within the Prudhoe Bay Unit. In case of fire, they would make available their 13 water trucks.
Frontier Rock & Sand, Inc.	Camp provides its own fire protection system, including sprinkler systems and halons. Water trucks are available for larger fires. Company is also part of contingency plan for fighting fire in Prudhoe Bay Unit. Camp relies on BP and ARCO assistance in fighting major fires.

TABLE 3
FIRE PROTECTION SERVICES

Service Companies	Fire Protection Services
Frontier Equipment Company	Camp provides its own fire protection services including sprinkler systems, halons and water trucks. Company is part of contingency plan for fire fighting within Prudhoe Bay Unit.
Alaska General Construction Co.	Camp maintains its own fire protection system. Because of camp's isolation from the rest of the field, it is not part of any fire contingency plan for the Prudhoe Bay Unit.
NANA Oil Field Services, Inc.	Camp maintains its own sprinkler systems and hand extinguishers. Because of camp's isolation, it is not part of a fire contingency plan for the Prudhoe Bay Unit. However, company makes available their water trucks when required for fire fighting within the Unit.

Service Companies

The service companies have less elaborate fire protection systems than do the oil companies. Each camp has a sprinkler system and halons. Most service companies, except those that are quite isolated, participate in the contingency plan for firefighting within the Prudhoe Unit.

POLICE/SECURITY SERVICES

A State Trooper housed at ARCO-Parsons' camp provides the only public safety assistance in the Prudhoe-Deadhorse area. The North Slope Borough assumed areawide responsibility for public safety in July of 1976; however, the Borough contends that this areawide service does not include the Prudhoe-Deadhorse area (Herb Bartel, Director of Planning, North Slope Borough, 1977) .

Both oilfield operators retain security systems at all operations facilities because of the major investment involved and the sensitivity of their industrial operations. The security force is very much in evidence throughout the entire enclave. The security personnel to employee ratio at Prudhoe is approximately 1:40, a ratio far higher than that typically found in urban areas. Frequently the police to citizen ratio is approximately 1:1,000 (Field Visit, Fall 1977).

O'Neill Security Systems and NANA Oil Field Services security forces perform the following functions for the oil companies at Prudhoe:

- They restrict access to oil operations facilities through a

pass system and maintain daily recores of the flow of goods and people in and out of each facility.

- Although security personnel are unarmed, they are used to control minor disturbances and are also available to help the State Trooper carry out his responsibilities whenever the situation warrants it.

- Security guards also enforce the no firearms and alcohol policies of the operating oil companies.

- As watchmen, they also perform fire prevent activities (Don Jones, Employee Relations, ARCO, 1977). (Cf. Table 4, Police/Security Services.)

None of the service companies maintains a security force, and none feels it necessary to do so. Service company facilities fall under the jurisdiction of the State Trooper located in the ARCO-Parsons camp.

MEDICAL SERVICES

While information does exist about the medical facilities provided by the operating oil companies and the service companies, no published data on the incidence and nature of medical problems at Prudhoe Bay are available. The discussion of medical services that follows is therefore based upon discussions with representatives of oil companies and service companies, and the field visit to Prudhoe Bay. The discussion is divided

TABLE 4

POLICE/SECURITY SERVICES

Operating Oil Companies	Police/Security Services
Atlantic Richfield Company	Company contracts with private firm (O'Neill) to provide security services. In addition, it relies on the State Trooper located at the Parsons camp for field problems beyond the capabilities of O'Neill 's services. Security guards do not carry firearms.
BP Alaska, Inc.	Security systems are provided through a contract with NANA Security Systems, a subsidiary of NANA Oil Field Services, Inc. The security force is used for restricting access to BP facilities, work force control and fire watch. Company also relies on State Trooper stationed at ARCO's Parson's camp. Security guards do not carry firearms.
Service Companies	
Nabors Alaska Drilling, Inc. Kodiak Oil Field Haulers, Inc. Frontier Rock & Sand, Inc./ Frontier Equipment Company Alaska General Construction Co. NANA *Oil* Field Services, Inc.	Companies do not maintain security forces and do not feel it necessary to do so. Camps fall under jurisdiction of State Trooper located in ARCO Parsons camp.

between health services and mental health services, and is summarized in Table 5, Medical Services.

Health Services

The ARCO operations center has the most extensive medical facility at Prudhoe Bay. ARCO's medical center consists of two beds for overnight care, treatment rooms, a diagnosis room, and equipment for complete cardiac care. BP's health facilities are limited to a dispensary and treatment room. These facilities are staffed by paramedics (David Maze, Administration, BP Alaska, Inc., 1977).

Staffing at the ARCO facility includes a full-time doctor and three to four paramedics. Under an arrangement between ARCO and BP and the service companies, the ARCO-employed physician serves all personnel at the Prudhoe Unit. Patients with serious injuries or illness are evacuated by jet to medical facilities in Anchorage (Don Jones, Employee Relations, ARCO, 1977).

The physician assistant in charge of the ARCO medical facility estimates that the average daily case load is 50 patients; upper respiratory infections account for approximately 75% of the medical complaints. The physician assistant also indicated that heart attacks were fairly common, and attributed the high incidence of this problem to the high stress factor in the work, and also to the fact that some employees are not in good shape when they report for work (Field Visit, Fall 1977).

Diet is an important consideration in the camp due to the high energy requirements of the work. It is the general policy of the oil companies

TABLE 5

MEDICAL SERVICES

Operating Oil Companies	Medical Services
Atlantic Richfield Company	A first aid room is provided at ARCO's basecamps. Major medical facilities are located in ARCO-Parsons complex which includes a dispensary and overnight medical facilities. Staffing includes 3--4 paramedics and a full time doctor. Patients with serious injuries and illnesses are evacuated by jet to Anchorage.
BP Alaska, Inc.	The BP operations center contains a medical center and treatment room staffed by paramedics. BP relies on doctor located at ARCO basecamp for more serious illnesses. Patients with severe injuries or serious illness are evacuated by jet to Anchorage.
Service Companies	
Nabors Alaska Drilling, Inc. Kodiak Oil Field Haulers, Inc. Frontier Rock &Sand, Inc./ Frontier Equipment Company NANA Oil Field Services, Inc.	First aid room provided; however, camp relies on medical services from ARCO or BP, depending upon contract in force when injury or illness occurs.
Alaska General Construction Co.	A first aid room is located within the camp, but camp relies on BP for more serious medical problems.

to make a maximum of 5,000 calories and two pounds of meat available per man per day. Meals typically include two kinds of meat, canned and fresh fruit, fresh frozen vegetables, milk, orange juice, coffee and tea, fresh pastries and desserts. Coffee and fresh donuts are available 24 hours a day. At breakfast, trays of sandwiches, desserts, fruits and drinks are available so that sack lunches can be prepared.

For field employees this diet is required by the demands of the work, For office workers and those with more sedentary occupations, there are frequently problems with weight (Field Visit, Fall 1977).

The service companies have first aid rooms where treatment can be given to minor injuries or illness. For more serious problems, a service company will rely on facilities and staff at ARCO and BP, depending on the firm with which it has a contract. Employees with serious medical problems are transported by jet to Anchorage hospitals (Irene Barti, Office Manager, Alaska General Construction Co., 1977).

Mental Health

Neither the operating oil companies nor the service companies have professional staff or facilities specifically designated for the treatment of mental health problems. Oil company representatives indicated that mental illness had never represented a significant problem at Prudhoe. However, they also indicated that workers regularly report to the dispensary for psychiatric treatment (Field Visit, Fall 1977).

Oil company representatives also pointed out that the prohibitions against

alcohol and firearms at Prudhoe were imposed for reasons of both public safety and mental health (David Maze, Administration, BP Alaska, Inc., 1977; Don Jones, Employee Relations, ARCO, 1977). However, the camp occasionally has an alcohol problem with various workers. A bulletin board at the ARCO operations center has a notice of a weekly meeting of Alcoholics Anonymous (Field Visit, Fall 1977).

RECREATIONAL FACILITIES

Differences in the level of amenities supplied the permanent employees of the operating oil companies, as compared with the temporary workers employed by the service companies, is clearly shown by their respective recreational facilities.

Operating Oil Companies

The quality and diversity of recreational facilities and opportunities the oil companies provide their employees are quite extensive.

ARCO. The ARCO operations center has a number of active and passive recreational facilities. The center has a gymnasium laid out as a basketball court, a jogging track, a well-equipped gym room with universal gym equipment, exercise bicycles, and weights, and a billiard room. ARGO has also hired a trainer to advise employees who are interested in body building or in losing weight. The gymnasium and its facilities are used extensively.

More passive recreational pursuits are also available. These include a large, comfortable lounge with television and a small library of 300-400

popular volumes and trade journals, and a well-designed theater with seating for approximately 200 persons. The theater is used both as a meeting space and as a space for viewing films. Movies are shown three times a day, once for each shift, and are changed daily.

BP. From the standpoint of variety, quality and setting, the BP operations center provides the most elaborate recreational facilities found on the North Slope. Most of the active recreational facilities are in the enclosed temperature-controlled three-story area between the bedroom wings of the camp. Within this area is found a 40-foot long swimming pool that also serves as an emergency water reservoir for firefighting; a basketball court; and a recreation area that is covered with astroturf and is used for jogging and other forms of exercise. The recreation area also has an enclosed garden featuring a pine tree and a cluster of birches surrounded by flowers and plants.

The BP operations center also has a six-person sauna; a theater; a recreation room with a variety of table games; and reading rooms. By 1978, the center is scheduled to have the capability of broadcasting video-taped television programs within a limited radius of the camp. The operations center has a system that broadcasts audio programs on three channels to the public areas and to each bedroom. Movies are a constant form of entertainment at the camp. They are changed daily and typically shown three times, once for each shift (BP Alaska, Inc., 1974).

The BP operations center periodically holds a flea market where employees sell crafts produced in their off-hours.

Service Companies

The recreational facilities provided employees of the service companies are far less extensive than those found at the ARCO and BP operations centers. None of the service companies has a gymnasium, an exercise room or a swimming pool. (Cf. Table 6, Recreational Facil ities.)

Typical of the range of the recreational facilities offered by individual service companies are a recreation room with pool tables, ping pong and other table games. Some service companies are in range of ARCO's television broadcast signal and receive television programming. All camps show movies on a daily basis.

COMMERCIAL AMENITIES

Because most of the everyday needs of employees including food, recreation, visual entertainment and free laundry facilities are provided by the oil companies and service companies, the variety of items available in oil company and service company commissaries are very similar. In general, they include the types of items one would expect to find in a small corner drugstore.

Among the items for purchase in commissaries are magazines, candy, cigarettes, toiletries and general sundries. Newspapers from major Alaskan cities and some West *Coast* cities are also available. Typically, these papers are at least two days late. Major news magazines are also available, but these are typically weeks out of date. The major source of news in the camp comes from TV programs, which are taped in Anchorage and shipped

TABLE 6

RECREATIONAL FACILITIES

Operating Oil Companies	Recreational Facilities
Atlantic Richfield Company	Gymnasium, exercise room with universal gym equipment, exercise bicycles and weights, running track, basketball court, sauna, billiard room. Trainer available to advise employees interested in weight loss or in body building. Lounge has color television and areas in which to play parlor games. Small library has popular volumes. New movies are shown daily in theater.
BP Alaska, Inc.	Within the operations center, a 12-meter (40-foot) swimming pool, 6-person sauna, theater, basketball court, open recreation area for exercising, recreation room and reading rooms are provided. The operations center also periodically holds a flea market where BP employees sell crafts produced in their off-hours. BP's two construction camps contain small rooms for showing movies, reading rooms and recreation rooms which include pool tables, ping pong, fooz ball and shuffleboard.
Service Companies	
Nabors Alaska Drilling, Inc. Kodiak Oil Field Haulers, Inc. Frontier Rock & Sand, Inc./ Frontier Equipment Company NANA Oil Field Services, Inc. Alaska General Construction Co.	Each service company provides a recreation room including shuffleboard, pool, fooz ball, and ping pong and a reading room. Movies are also available on a daily basis.

to Prudhoe one day late. Bulletin boards provide the major source of intra-camp communications, with announcements of recreational events, advertisements, meeting announcements (such as Alcoholics Anonymous) and personal messages (Field Visit, Fall 1977).

Although the items carried in the various commissaries are nearly identical, a more extensive selection of items is found at NANA's hotel-basecamp, where tourist trinkets are sold to summer tourists visiting the Prudhoe facilities (Tom Dow, General Manager, NANA Oil Field Services, Inc., 1977).

TABLE 7

COMMERCIAL AMENITIES

Operating Oil Companies	Commercial Amenities
Atlantic Richfield Company	ARCO's main basecamp and Parsons camp maintain large commissaries selling cigarettes, candy, magazines, film, toiletries and other sundries.
BP Alaska, Inc.	Commissaries are maintained in both camps and the operations center, selling magazines, candy, cigarettes, toiletries and other sundries.
Service Companies	
Nabors Alaska Drilling, Inc.	None available.
Kodiak Oil Field Haulers, Inc. Frontier Rock & Sand, Inc./ Frontier Equipment Company Alaska General Construction Co.	Commissaries provided at each work camp, selling general sundries.
NANA Oil Field Services, Inc.	Commissary providing sundries, together with a gift shop selling tourist trinkets during the summer.

V. SOCIAL PROFILE OF BASECAMP

The purpose of this chapter is to provide an overview description of the work force at Prudhoe Bay over the course of major exploration and development activities. For the most part, specific information on the work force was maintained only in individual employee or union files, and was considered proprietary information. Because of this lack of published data, the description has been limited to information obtained through discussions with representatives of the oil operators and service companies and the field visit to Prudhoe Bay.

In compiling this information, certain basic distinctions were noted between employees of the oil companies and service companies which help to frame the chapter's discussion. These differences are primarily related to where workers are from, their length of stay at Prudhoe, and their professional or skills classification.

Generally oil company employees are permanent; many have been at Prudhoe for as long as two years. They do not belong to unions, and more likely than not, they fall into professional or managerial job classifications. Although the companies indicate that most of their employees have been hired in Alaska, some were formerly with the companies in other parts of the United States or in other oil producing areas of the world. Oil company work schedules largely preclude out of State residence. Some women and some Natives are employed by the oil operators at Prudhoe, but no firm data exist on their numbers or the percentage of the total work force that they represent.

By way of contrast, service company employees are typically temporary workers hired out of union halls in Anchorage or Fairbanks. The service companies depend upon the unions to enforce the "Alaska hire" provisions in dispatchment, but recognize that specialized workers are sometimes hired out of State. The work force of a typical service company experiences wide annual fluctuations; employment is dependent upon successful bidding for service contracts. There is also wide seasonal fluctuation. Service company employment typically increases by as much as 500% during the winter construction season.

This chapter's discussion has been organized around five categories related to work force characteristics: origin of workers and work schedules, size of the work force, Native employment, percentage of females in the work force, and union affiliation. In each category, data on the characteristics of oil company employees are contrasted with data on those of the five representative service companies included as a part of this study.

Origin of Workers/Work Schedule

For operating oil companies and service companies alike, no hard data are available on the origin of their employees. ARCO estimates that more than 90 percent of its employees are Alaska residents, most of whom were recruited from Anchorage, Fairbanks, Barrow or the Kenai Peninsula. BP estimates that 100 percent of its employees are Alaska residents. Whether these workers lived in Alaska the year preceding their employment by the oil firms is not documented (Kenneth Haigler, Manager, Employee Relations, ARCO, 1977; David Maze, Administration, BP Alaska, 1977).

Although the hiring process can be discussed, the general lack of information together with the differences in the kinds of skills required by various *service* companies make it difficult to generalize about origins of these workers. Typically, the locals of Alaska unions looked outside the state to fill job openings requiring skills not represented in the local union membership. For example, an average of 73% of Kodiak Oil Field Haulers, Inc., employees were hired out-of-state. Skills necessitating out-of-state hiring by the service companies surveyed included operating engineers, culinary help and teamster positions. In contrast, Alaska General Construction estimates that 90% of its labor force is from Alaska (Mike Krupa, Kodiak Oil Field Haulers, Inc., 1977; Irene Barti, Alaska General Construction, 1977). Table 8, Origin of Workers, shows the variance among selected service companies.

The work schedules of the operating oil companies are generally one week on, one week off. In the case of ARCO there are four basic rotation schedules for employees relating to the importance of their jobs. Supervisory personnel are scheduled for one week on and one week off. Other personnel are on a 3/1, 4/2 or 9/1 rotation, with housekeeping or other menial occupations in the 9/1 rotation category. In all cases, the one-week period off makes it highly likely that employees will reside in Alaska (Field Visit, Fall 1977; David Maze, Administration, BP Alaska, 1977).

The work schedules of the service companies vary in terms of the number of weeks on at Prudhoe. A schedule of nine to ten weeks on is typical. Regardless of the number of weeks on, most service companies have two weeks off, a schedule that allows workers to live outside the state.

TABLE 8

ORIGIN OF WORKERS

Operating Oil Companies	Origin of Workers
Atlantic Richfield Company	No hard data available. Over 90% Alaska residence (Anchorage, Fairbanks, Barrow, Kenai Peninsula). Work schedule: 12 hour shifts; 1/1, 3/1, 4/2, 9/1 rotations.
BP Alaska, Inc.	No hard data available. Alaska hire. 100% Alaska residence. Work schedule: 12 hour shifts; 1 week on/1 week off.
Service Companies	
Nabors Alaska Drilling, Inc.	No hard data available. Alaska hire. Assume Alaska residence owing to work schedule: 12 hour shifts; 2 weeks on/ 1 week off.
Kodiak Oil Field Haulers, Inc.	No hard data available. Alaska hire. Company estimates following residence: 76% of teamsters out of State; 66% of operating engineers out of State; 72% of culinary help out of State; 73% average out of State residence. Work schedule: 12 hour shifts; 4 weeks on/2 weeks off.
Frontier Rock & Sand, Inc. Frontier Equipment Company	No hard data available. Alaska hire; Anchorage and Fairbanks. Work schedule permits out of State residence: 11½ hour shift + unpaid ½ hour lunch break; 10 weeks on/2 weeks off.
Alaska General Construction	No hard data available. 90% Alaska hire. 15% North Slope hire. 75% Anchorage area hire, including Kenai Peninsula. Work schedule permits out of State residence: 10-12 hour shifts; 9 weeks on/2 weeks off.
NANA Oil Field Services, Inc.	No hard data available. Alaska hire. Work schedule permits out of State residence: 12 hour shifts (being changed to 10 hour shifts); 4 weeks on/2 weeks off.

Twelve-hour shifts are typical for both operating oil companies and for service companies alike.

Size of Work Force

Published records on the size of the work force do not exist. ARCO estimates that its payroll at Prudhoe Bay was fewer than 100 workers during the 1968-1974 period. Approximately 600 permanent workers worked at the ARCO facilities in late 1977, and the company projects that this number will grow to 1,000 by 1983. BP employed fewer than 100 workers between 1968-1974. At the present, the company estimates it has 400 permanent employees at Prudhoe (Don Jones, Employee Relations, ARCO, 1977; David Maze, Administration, BP Alaska, Inc., 1977).

Because of the variety of factors that have been discussed earlier, the size of the labor force of the service companies varies greatly from season to season and year *to* year. Table 9, Size of Work Force, shows the fluctuation in the number of workers. For example, Nabors Alaska Drilling, Inc., estimates that between summer and winter its labor force can grow from 30 to 150 workers. Between summer and winter, Kodiak Oil Field Haulers, Inc., grows from 40 to 200 workers (Mike Krupa, Kodiak Oil Field Haulers, Inc., 1977).

Native Employment

No hard data are available on the percentage of Natives who have been hired by the operating oil companies or the service companies. ARCO estimates

TABLE 9

SIZE OF WORK FORCE

Operating Oil Companies	Size of Work Force
Atlantic Richfield Company	No hard data available. 1968-1974 less than 100 workers. Estimated 600 workers Fall 1977, expected to grow to 1,000 by 1983.
BP Alaska, Inc.	No hard data available. 1968-1974 less than 100 workers. Estimated 400 permanent BP employees Fall 1977.
Service Companies	
Nabors Alaska Drilling, Inc.	No hard data available. Summer employment: est. 30 workers Winter exploratory drilling: est. 150 workers.
Kodiak Oil Field Haulers, Inc.	No hard data available. Summer employment: est. 40 workers Winter heavy construction: est. 200 workers.
Frontier Rock & Sand, Inc. Frontier Equipment Company	No hard data available. Varies from skeleton force of 20 workers to high of 350 workers for each company. Employment based on construction season and bidding success.
Alaska General Construction Co,	No hard data available. Existing work force: 200 workers. Fluctuates between construction seasons.
NANA Oil Field Services	No hard data available. 10-15 person work force in winter, including 5 catering services workers for drill rig. 20 during summer, including tour guides for Prudhoe camp.

that it employs twelve Natives from Barrow. BP estimates that it currently employs fifteen Natives from the North Slope (Don Jones, Employee Relations, ARCO, 1977; David Maze, Administration, BP Alaska, Inc., 1977).

As shown in Table 10, Native Employment, the experience of the service companies in employing Natives has been varied. Several firms have used all-Native crews. Nabors Alaska Drilling, Inc., found that no Native remained with the firm a requisite length of time to be classified as a driller. Alaska General Construction Co., a joint venture with the Arctic Slope Regional Corporation, also has several all-Native crews. Overall, about 15% of the firm's workforce is Native. The company uses its airplanes for flights to Barrow, Nome, Wainwright and Nuiqsut to transport Natives back and forth to work sites (Irene Barti, Alaska General Construction Co., 1977).

NANA Development Corporation, which is Native-owned, has several operating arms which provide services at Prudhoe Bay. NANA Oil Field Services and Arctic Utilities, Inc., both employ Natives, but not exclusively (Tom Dow, NANA Oil Field Services, Inc., 1977).

Percentage of Females in Work Force

While both the oil operators and certain service companies state that they have employed women in a variety of jobs, no published records on the employment of women are available.

Both oil operating companies employ women as clerical personnel and as operators. On the basis of observation during the field visit, it is

TABLE 10

NATIVE EMPLOYMENT

Operating Oil Companies	Native Employment
Atlantic Richfield Company	No hard data available. Company estimates 12 Natives hired from Barrow.
BP Alaska, Inc.	No hard data available. Company estimates 15 Natives currently employed.
Service Companies	
Nabors Alaska Drilling, Inc.	No hard data available. Company indicates that some drilling crews have been 100% Native. No Native has stayed with the company long enough to be classified as a driller.
Kodiak Oil Field Haulers, Inc.	No hard data available. Company indicates that some Natives are employed and are typically hired in Anchorage office.
Frontier Rock & Sand, Inc. Frontier Equipment Company	No hard data available. Company indicates that Natives have been hired from the Slope, particularly from Barrow. Duration of Native employment is said to be erratic and tied to Native hunting and fishing seasons.
Alaska General Construction Co.	No hard data available. Company indicates that Natives represent 15% of work force. Company Twin Otter makes daily flights to Barrow, Nome, Wainwright and Nuiqsut to transport Native workers. Company runs several all-Native crews. Alaska General is a Native-owned corporation.
NANA Oil Field Services, Inc.	2 of the 15 NANA employees are Native. NANA Field Services, Inc., is a Native-owned corporation.

estimated that approximately 5% of the oil company employees are women.

The interaction between male and female employees was also noted during the field visit. For example, it was observed that women chose to sit apart from the men in the dining room. The explanation given was that competition for female attention can become very intense and the cause of fights. As a result, women typically do not publicly display interest in a specific individual. At the same time, it was pointed out that the presence of women was a positive force both in its impact on morale and in making male employees more concerned about their appearance.

The oil companies provide separate facilities for women employees, but this is not always true of the service company camps. Regardless of whether separate facilities are provided, a definite lack of formality was noted during one field visit. For example, a woman employee was observed cleaning male bathroom facilities when the bathroom was heavily in use. During this time, she made no attempt to leave the bathroom or restrict her movements to certain areas while the men were there. Neither she nor they appeared concerned (Field Visit, Fall 1977).

Several of the service companies employ women. Kodiak Oil Field Haulers, Inc. , estimates that approximately 50% of basecamp employees are women, most of whom perform domestic jobs such as cleaning and catering. Other firms such as Frontier Rock and Sand, Inc., and Frontier Equipment Company have occasionally hired women as a result of union dispatchment (Mike Krupa, Kodiak Oil Field Haulers, Inc., 1977; Bob Scott, Frontier Rock and Sand, Inc., 1977}.

Table 11, Female Employment, summarizes what information is available.

Union Affiliation

The most significant difference between the operating oil companies and the service companies regarding union affiliation is that the employees of the oil companies are primarily non-union, while most employees of the service companies belong to and are hired through unions. The union affiliation of workers means that they may be hired out-of-state if their skills are not available within Alaska. Service companies depend upon unions to abide by "Alaska hire" provisions in union dispatchment, and do not themselves monitor the origins of workers who have been dispatched.

The "Alaska hire" legislation grew out of a realization that the proposed construction of the pipeline and related facilities would create a large number of jobs at a time when high unemployment was a statewide problem. In response, the State Legislature enacted a bill entitled "Local Hire Under State Leases," AS 38.40.010, on July 7, 1972. The intent of this "Alaska hire" provision was to ensure that as many Alaska residents as possible would receive the employment opportunities that would be provided by exploration of resources at Prudhoe Bay and elsewhere in the state. Under the terms of the Legislation, Alaska residents, when qualified and available, were to be given preference by employers (State of Alaska, Local Hire Under State Leases).

State labor officials later estimated that the "Hire Law" applied to about 12,000 jobs in Alaska, about 6% of the State's total employment

TABLE 11

FEMALE EMPLOYMENT

Operating Oil Companies	Female Employment
Atlantic Richfield Company	No hard data available. Women are employed in ARCO camp in clerical positions and as operators.
BP Alaska, Inc.	No hard data available. Women are employed in BP camp in clerical positions and as operators.
Service Companies	
Nabors Alaska Drilling, Inc.	No hard data available. No women employees.
Kodiak Oil Field Haulers, Inc.	No hard data available. Estimated 50% of base camp employees are women involved in cleaning, catering and other domestic jobs.
Frontier Rock & Sand, Inc. Frontier Equipment Company	No hard data available. Limited number of women employees at Prudhoe for either company. Company estimates that Frontier Rock & Sand has periodically had women employees through union dispatchment.
Alaska General Construction Co.	No hard data available. No women employees.'
NANA Oil Field Services, Inc.	No hard data available. One (1) woman office worker from Kotzebue.

(Anchorage Daily News, November 1, 1977, p. 1).

Since union affiliation was a prerequisite for most of the construction jobs, the local hire law affected union dispatchment procedures. However, during the early days of recruiting workers for the pipeline, both the unions and the State Department of Labor, which was charged with administering the law, had difficulty in enforcing its provisions.

By the completion of the pipeline, the law had been fairly well accepted by the oil operators and unions alike. As part of the utilization agreement signed in 1977, ARCO and BP voluntarily agreed to apply the provisions of the law to their on-going contracts. The unions, in scheduling lay-offs as the pipeline neared completion, first laid off out-of-state workers.

The legality of the local hire law has been challenged and resolution of this issue is now pending before the U.S. Supreme Court (Anchorage Daily News, November 1, 1977, p. 1).

Table 12 presents a summary of union affiliations.

TABLE 12

UNION AFFILIATION

Operating Oil Companies	Union Affiliation
Atlantic Richfield Company	Non-Union
BP Alaska, Inc.	Non-Union
Service Companies	
Nabors Alaska Drilling, Inc.	No hard data available. Alaska Roughnecks & Drillers Association, Anchorage (affiliated with Teamsters). International Brotherhood of Teamsters, Chauffeurs, Warehousemen & Helpers of America, Anchorage, Local 959.
Kodiak Oil Field Haulers, Inc.	No hard data available. International Union of Operating Engineers (AFL-CIO), Seattle Local 302. Motel, Restaurant and Construction Camp Employees Union (AFL-CIO) Anchorage Local 878, Anchorage Local 883, Fairbanks Local 879. Other Alaska Locals: Juneau Local 60 Juneau Local 869 Ketchikan Local 867 Sitka Local 873i International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America, Anchorage Local 959.
Frontier Rock & Sand, Inc.	No hard data available International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America, Anchorage Local 959. International Association of Structural and Ornamental Ironworkers (AFL-CIO) Anchorage Local 751. Pile Drivers Union, Anchorage Local 2520.

Service Companies	Union Affiliation
Frontier Rock & Sand, Inc. (Continued)	International Union of Operating Engineers (AFL-cIO;, Seattle Local 302. Carpenters Union (AFL-CIO), Anchorage Local 1281, Fairbanks Local 1243. Other Alaska Locals: Kodiak Local 2162 Ketchikan Local 1501 Haines Local 466 Sitka Local 466 Juneau Local 2247 Wrangall Local 2362 Laborers & Hod Carriers Union (AFL-CIO) Anchorage Local 341, Fairbanks Local 942.
Frontier Equipment Company	Non-Union
Alaska General Construction Co.	No hard data available. International Brotherhood of Teamsters, Chauffeurs, Warehousemen and Helpers of America, Anchorage Local 959. International Association of Structural and Ornamental Ironworkers (AFL-CIO) Anchorage Local 751. Pile Drivers Union Anchorage Local 2520. International Union of Operating Engineers (AFL-CIO), Seattle Local 302. Hotel, Motel, Restaurant and Construction Camp Employees Union (AFL-CIO) Anchorage Local 878, Local 883, Fairbanks Local 879. Other Alaska Locals: Juneau Local 60, Local 869 Ketchikan Local 867 Sitka Local 873. Laborers &Hod Carriers Union (AFL-CIO) Anchorage Local 341, Fairbanks Local 942.

Service Companies	Union Affiliation
NANA Oil Field Services, Inc.	International Union of Operating Engineers, Seattle Local 302. Hotel, Motel, Restaurant and Construction Camp Employees Union (AFL-CIO), Anchorage Local 878, Local 883, Fairbanks Local 879. Other Alaska Locals: Juneau Local 60, Local 869 Ketchikan Local 867 Sitka Local 873.

VI. RELATIONSHIP BETWEEN PRUDHOE BAY AND NORTH SLOPE BOROUGH

The Prudhoe Bay enclave is not a political unit of government. It is a private industrial development, primarily located on State-owned land within the jurisdictional boundaries of the North Slope Borough (NSB), that is engaged in the production of oil. As such, Prudhoe is a taxpayer of the Borough, subject to its areawide powers and theoretically dependent upon it for the provision of certain services.

This section briefly discusses two aspects of the relationship between Prudhoe and the NSB: the services rendered to Prudhoe by the NSB and the property taxes paid by the enclave to the Borough since its incorporation. The intent is to generally indicate the level of revenues available to the Borough as a result of oil development at Prudhoe in comparison with the Borough services that have been provided. The discussion is somewhat biased in that it does not consider the additional costs imposed upon the Borough as a result of development within its boundaries. Some of these additional impacts are briefly described in the next chapter.

Services Provided to Prudhoe Bay by North Slope Borough

The North Slope Borough was incorporated on July 1, 1972. As a first class Borough, it assumed mandatory areawide powers of assessment and taxation; and planning and zoning. The Borough gained responsibility for an even broader range of services in April of 1974 when the towns and villages of the North Slope voted to transfer an extensive array of services, as defined in Alaska Statutes 29.38.030, to the Borough. The intent of this

transfer was to recognize the primary role of the Borough in service delivery, and to avoid the duplication of services. The list of services for which the Borough gained areawide responsibility included streets and sidewalks; sewers and sewage treatment; water course and flood control; telephone systems; light, power and heating facilities; water; transportation systems; libraries; airports and aviation facilities; garbage and solid waste collection and disposal; housing and urban renewal, rehabilitation and development; preservation, maintenance and protection of historic sites. The Borough assumed police power on July 1, 1976 (Dupere and Associates, 1976).

Despite this wide range of responsibilities, the North Slope Borough has never been required to provide these services to the Prudhoe enclave. This is essentially the result of an understanding between the oil companies and the NSB soon after the Borough's incorporation in 1972. At that time, the oil operators agreed that Prudhoe would remain as a private industrial complex rather than become dependent upon the Borough for the provision of essential services (Herb Bartel, Director of Planning, North Slope Borough, 1977).

In consequence, Prudhoe has remained largely independent of the North Slope Borough for services, which it has provided on its own. This arrangement has not posed a serious problem for the oil operators, who have made major investments in permanent self-contained facilities to last the life of the field. It has, however, presented difficulties for the service companies whose basecamp facilities do not represent the same level of investment and amenity due to the more indeterminate nature of their tenure at Prudhoe. The primary area of concern on the part of the

individual service companies has been utilities service, sewage treatment, and solid waste disposal. The latter is a concern of the oil companies as well.

Until 1976, the North Slope Borough received property taxes from the Prudhoe development but supplied the firms there with no services. During 1976, the Borough, at the urging of the oil companies, the service companies and the State, created a service area and began construction on a 12 million dollar central utility. When completed, the utility will provide solid waste incineration, sewage treatment and water purification. The oil operators and service companies alike will make use of the solid waste treatment plant. Sewage treatment and water purification will also be available as needed to individual service companies, but will not be used by the oil operators.

Construction on the Borough central utility was halted in 1977 when the oil companies filed a legal suit against the Borough for levying an additional tax on oil company properties to support debt service on bonds to construct the central utility. The Borough has appealed its case to the State Supreme Court after the 1977 lower court ruling in favor of oil companies. While a decision from the State Supreme Court is pending, the total cost for completion of the central utility has risen to 18 million dollars (Tom Dow, General Manager, NANA Oil Field Services, Inc., 1977).

Taxation Benefits Provided to North Slope Borough by Prudhoe Bay

Since the Prudhoe Bay facilities lie within the boundaries of the North

Slope Borough, they are subject to taxing authority of the Borough. The Borough's operating budget is financed primarily by means of the property tax. The property taxes levied on the facilities at Prudhoe Bay account for approximately 90% of the Borough's budget (George Ahmaogak, North Slope Borough Assessing Department, 1977).

The impact of development at Prudhoe Bay on the general revenues of the Borough is shown in Table 13. The increase in general property taxes from 1973 to 1977 is a function primarily of continual development of facilities at the Prudhoe Bay field but also of population growth within the Borough. Between 1973 and 1977 the general property taxes increased from $418,000 to $18.2 million. Of the $18.2 million, $15.7 million were paid by Prudhoe Bay property owners (George Ahmaogak, North Slope Borough Assessing Department, 1977). Table 14 lists the ten largest property taxpayers in the North Slope Borough.

Although the Borough is the primary beneficiary of property taxes from Prudhoe Bay, the State, as shown *in* Table 15, also levies property taxes on certain oil related properties.

It is clear that the Borough would have received roughly the same revenues from Prudhoe Bay property taxes whether or not Prudhoe had developed as an independent industrial enclave or a permanent community. In the absence of any substantial settlements in proximity to the Prudhoe Bay field, the oil companies had no option but to develop their facilities in the context of an independent enclave. If community infrastructure had been available nearby, they might have chosen otherwise. Moreover, at the time oil

TABLE 13

GENERAL[1] REVENUES BY SOURCE
NORTH SLOPE BOROUGH
Since Incorporation July 1, 1972
(In $000 to nearest $1,000

Fiscal Year	General[2] Property Taxes	Sales[3]	State	Federal	Miscellaneous Revenues	Total
1973	$ 418	$ 37	$ 69	$ 27		$ 551
1974	3,548	1,040	1,376	31	$ 168	6,163
1975	5,501	1,181	2,295	1,767	975	11,719
1976	6,608	-o-	4,153	1,209	3,127	15,097
1977	18,221	-o-	5,026	500	908	24,655

1/ Term means all cash receipts except enterprise funds.

2/ Property taxes include penalties, interest and charges.

3/ Sales taxes include penalties and interest.

Source: Official Statement by Eben Hopson, Sr., Mayor, North Slope Borough of Notice of Sale of General Obligation Bonds, 1976.

TABLE 14

TEN LARGEST PROPERTY TAXPAYERS IN THE BOROUGH - 1976
AS ASSESSED BY
NORTH SLOPE BOROUGH

	Assessed Value	Tax Levy 10.3
Alyeska Pipeline Service Company	$83,849,600	$ 863,650.88
Atlantic Richfield Company	49,655,420	511,450.83
SOHIO Petroleum Company	37,139,100	382,532.73
Puget Sound Tug & Barge Company	10,978,480	113,078.34
British Petroleum	7,947,680	81,861.10
Alaska-General/General Construction Co.	7,046,250	72,576.38
Frontier Equipment Company	6,301,470	64,905.14
Dye Construction Company, Inc.	5,945,010	61,233.60
Alaska Constructors, Inc.	4,533,420	46,694.23
NANA Oil Field Services	3,134,230	32,282.57
TOTAL	$216,530,660	$2,230,265.80

SOURCE : Borough Assessor
North Slope Borough

TABLE 15

TEN LARGEST PROPERTY TAXPAYERS IN THE BOROUGH - 1976
AS ASSESSED BY
STATE OF ALASKA

	Assessed Value	Tax Levy 10.3
Alyeska Pipeline Service Company	$ 728,923,000	7,507,906.90
Atlantic Richfield Company	371,084,710	3,822,172.51
SOHIO Petroleum Company	344,472,460	3,548,066.34
Parker Drilling Company	11,321,730	116,613.82
Mobil Oil Corporation	10,324,660	106,344.00
Nabors Alaska Drilling, Inc.	8,714,590	89,760.28
Dowell Division of the Dow Chemical Co.	5,307,140	54,663.54
Kodiak Oil Field Haulers, Inc.	5,105,820	52,589.95
Rowan Drilling, U.S.	3,910,460	40,277.74
Geophysical Services, Inc.	3,670,820	37,809.44
TOTAL	$1,492,835,390	$15,376,204.52

The State assesses certain oil related properties defined in Alaska Statutes 43.56. The Borough millage rate is levied directly by the Borough. The companies concerned use the locally paid taxes as credit from the State for its levy.

The levy on the State assessed property is mandatory. The companies pay the Borough levy and then use the paid tax bills as credit against the State levy of 20 mills.

SOURCE : Borough Assessor, North Slope Borough

development activities began at Prudhoe, the North Slope Borough was not yet in existence. However, from the perspective of the North Slope Borough, the type of community that developed at Prudhoe had a significant impact on Borough expenditures. Although Borough revenues would not have been affected by the type of development that occurred at Prudhoe, expenditures for services would have significantly increased if Prudhoe had been developed as a typical community rather than as an independent enclave.

VII. ISSUES ASSOCIATED WITH NEW ENCLAVE DEVELOPMENT IN ALASKA

The size and character of the Prudhoe enclave is directly related to the size of the Prudhoe field. The likelihood that an oil field of similar proportions will be found in Alaska is perhaps one in a thousand; nor is it likely that an industrial enclave the size of prudhoe will again be developed (Bill Pyle, Dames & Moore, 1977). Nonetheless, there are certain issues associated with enclave development at Prudhoe that would apply to enclave development elsewhere in the State regardless of the size of the find.

The purpose of this chapter is, first, to consider the potential for new enclave development on the North Slope in connection with a major uplands find or a find in the Beaufort; and, secondly, to consider issues related to new enclave development in Alaska suggested by the Prudhoe experience.

Potential for Uplands or Beaufort Discovery

UPLANDS

Discussions with industry representatives and a review of the literature indicate that a major new uplands find between the Brooks Range and the Beaufort Sea is not considered likely in the near term. This is primarily based on exploration activities to date, and the fact that a find of less than 100 million barrels would be economically infeasible to develop (Alaska Industry, September 1977)

At present, the only potentially producible onshore discovery is located six miles west of the Prudhoe Bay unit, where ARCO discovered oil in the

Kuparuk River Sandstone Formation in 1971 (Alaska Journal of Commerce, September 26, 1977). ARCO is presently drilling more wells on its Kuparuk leases to determine the quantity of oil and gas within the reservoir as the basis for future development (Alaska Industry, August 1977).

Other uplands drilling operations will be limited for the next two years to exploratory drilling in NPR-A by Husky Oil, and a few exploratory wells to be drilled on Arctic Slope Regional Corporation land by Chevron and Texaco. Exxon is also engaged in exploratory drilling 38 miles east of Prudhoe Bay at Point Thompson (Don Jones, Employee Relations, ARCO, 1977).

Major exploration activity on the North Slope is currently constrained by land status limitations associated with pending d-2 proposals. Four separate parks and wilderness areas covered by pending proposals span the entire southern boundary of the upper Arctic. Much of this land has potential for oil and gas discovery, but is excluded from exploration activities. Similarly, pending land selections by the Arctic Slope Regional Corporation, which also have oil and gas potential, must be resolved before major new acreages can be made available for exploration activities.

Other factors affecting new uplands development include a decision on the final pipeline tariff and pricing of the Prudhoe Bay oil. This may affect the economic feasibility of future development on the North Slope. In addition, major discoveries in either the Gulf or Lower Cook Inlet would cause interest in development to shift from the Slope, also making uplands development less likely to occur.

BEAUFORT SEA

With respect to the Beaufort, USGS estimates reserves from the Beaufort Sea Lease Area to the 200 meter isobath at from 0 to 7.6 billion barrels of oil and 19.3 trillion cubic feet of gas (USGS Working Paper 76-830, July 1976). The low estimate of "zero" is used because USGS considers it a good possibility that only uneconomically recoverable resources will be found in the Beaufort Sea. More recent analysis by Dames & Moore projects that the size of the Beaufort field will most likely be in the neighborhood of 1.5 billion barrels (Bill Pyle, Dames & Moore, November 1977). This can be contrasted with the size of the Prudhoe field to gain a sense of comparative requirements. The Prudhoe field has estimated proven recoverable reserves of 9.2 billion barrels of crude oil, 8.5 trillion cubic feet of solution gas, and 16.9 trillion cubic feet of gas-cap gas (BP Alaska, Inc., 1977).

Potential for New Enclave Development With Beaufort or Uplands Find

There appears to be agreement among oil industry representatives and representatives of State agencies that a major discovery on the Slope would at a minimum require some production facilities at the discovery site. The major question concerns whether or not the gathering, separation and processing facilities at Prudhoe would be used, or new facilities for these functions developed in a new and independent enclave.

There are several variables that will determine the answer to this question. They include the size of the find, its distance from the Prudhoe enclave, and the excess capacity of the Prudhoe gathering and processing facilities available at the time of production.

With regard to projected uplands development, it is currently assumed that ARC()'S Kuparuk development will require a separate basecamp and separate support facilities. This is not so much a function of the size of the find, which is not yet fully known, or its distance from Prudhoe, as it is the type of new production facilities that will be required. Quite different from development wells at Prudhoe that operate from oil reservoir pressures, the Kuparuk development wells will require pumps to extract the oil from the low pressure Kuparuk Sandstone Formation. A pipeline will connect the Kuparuk wells to ARCO's flow station #1, where Kuparuk oil will be processed before entering Alyeska Pump Station #1 (Don Jones, Employee Relations, ARCO, 1977).

According to one oil industry spokesman, Exxon's oil discovery 28 miles east of Prudhoe, if economically producible, may also require an enclave development. However, no other additional enclaves are anticipated for onshore activities at this time (Don Jones, Employee Relations, ARCO, 1977).

With respect to OCS activity in the Beaufort Sea, there is a wide diversity of opinion about the use of the Prudhoe facilities. Any decision related to the future use of Prudhoe will depend upon whether crude oil from the new discovery is processed at the site of the find or processed at Prudhoe before entering Alyeska Pump Station #1. The size and configuration of any enclave for OCS will be related to this issue, which is in turn dependent upon the size and location of the find, the capacity of Prudhoe facilities at the time of production, and the capacity of the pipeline at the time of production.

Issues Related to New Enclave Development

The development of a self-sufficient enclave at Prudhoe Bay was the product of a number of factors, some of which were unique to the Prudhoe experience, other of which are likely to prevail with new discoveries elsewhere in the State.

Some of the factors unique to Prudhoe include the size of the field, the remoteness of its North Slope location, the extreme climate and fragile terrain, and the lack of a regional transportation network or adequate outside transportation access for the movement of supplies and equipment. The most significant factor influencing development of an independent enclave appears to be the availability of nearby community infrastructure. At Prudhoe, the lack of nearby community infrastructure was compounded by the remoteness of its North Slope location.

The discussion that follows attempts to identify issues raised by the Prudhoe experience that may be applicable to enclave development in other remote areas of the State first on a general level, and then from the separate perspectives of the oil companies, the State and the North Slope Borough.

GENERAL EXPERIENCE

Some of the most significant changes associated with enclave development are related to the changes in the level and distribution of regional services. Transportation systems appear especially susceptible to disruption and change as a result of enclave development in remote locations.

For example, during the height of construction activity at Prudhoe all available charter aircraft were under contract to the oil companies, which limited the availability of these aircraft for passenger traffic and goods movement in the borough. Scheduled airlines also changed levels of service to local communities to accommodate the requirements at Prudhoe. Direct flights between Fairbanks and Kaktovik, which existed prior to development at Prudhoe, have been replaced by direct flights to Prudhoe. During the early part of the pilots strike against Wien Air Alaska, flights continued to Prudhoe, but not to Barrow. The residual impact of enclave development at Prudhoe was to permanently change patterns and levels of service to villages in the borough in favor of service to the Prudhoe enclave. Existing transportation patterns in other remote areas may be similarly susceptible to change as a result of new enclave development.

Enclave development may also influence the services provided by the public and private sectors. For example, the State and local jurisdictions may have to expand existing services and add new ones in order to monitor and control enclave development. As a result of the Prudhoe enclave, the North Slope Borough and the State were both required to develop new regulatory measures and controls and participate in planning activities related to projected development.

Prevailing local wage rates and employment within a region may change as a secondary effect of the wages paid local workers employed at an enclave. This can have a concomitant effect on the cost of various local goods and services, and hence affect their availability.

In sum, the introduction of a significant new development in a remote area of the State will change regional patterns of service delivery, increase the need for new services, and introduce changes in the economy of local communities. These changes will be analyzed in greater depth as part of the impact analysis component of the Alaska OCS Socioeconomic Studies Program.

The discussion that follows summarizes issues related to developing the industrial enclave at Prudhoe which may have relevance to new enclave development in other remote areas of the State from the separate perspective of the oil companies, the State and the North Slope Borough.

OIL COMPANY EXPERIENCE AT PRUDHOE

From the perspective of the oil operators, a major consideration in developing Prudhoe as a self-contained enclave was the isolation of the Prudhoe oil field from major population centers or even from small settlements. The absence of existing infrastructure and community services made it necessary to develop Prudhoe Bay as an independent enclave.

The primary determinant of the physical configuration of the Prudhoe enclave was the attempt to optimize field design. The decision to locate most of the service companies within an industrial area adjacent to the Deadhorse Airport met the different but complementary needs of the oil operators and governmental agencies. The centralization of service company facilities provided greater flexibility in field design, minimized environmental disruption, and conserved on gravel and water use, both of which are scarce resources in the Arctic. Also from the perspective of

the oil operators at Prudhoe, the discovery of oil reserves of economically feasible size may require the development of new enclaves. The size and degree of independence of new enclaves will be a function of the size and location of newly discovered oil reserves, and the proximity of existing settlement and infrastructure. The configuration of physical facilities will be influenced by oil economics, characteristics of the field, and Borough and State regulations. It is the current assessment of -the oil industry that undiscovered oil reserves are likely to be smaller than those at Prudhoe, and, therefore, it is also likely that future enclaves will be less extensive than the Prudhoe Development (David Maze, Administration, BP Alaska, Inc., 1977; Don Jones, Employee Relations, ARCO, 1977; Charles Keffer, North Slope Project Manager, ARCO, 1977).

While enclave development will probably accompany any future major discoveries on the North Slope, oil companies do not unequivocally favor enclave development if other options exist. Especially as related to OCS development in the Gulf of Alaska, oil companies would prefer to locate marine supply bases as well as development and production facilities in sufficient proximity to populated areas to use existing infrastructures to meet their own needs.

As a second alternative, oil companies would also be willing to locate their facilities on large parcels of land that had been developed by private interests for the purpose of attracting OCS development. If fully serviced, the OCS base would not need to be adjacent to existing urban centers.

As a last alternative, the oil industry would develop an independent enclave. This was the approach the industry had to adopt on the North Slope (David Maze, Administration, BP Alaska, Inc., 1977).

Which of these three options is feasible depends, in part at least, upon State and local jurisdictions and regulations, as discussed below.

STATE EXPERIENCE AT PRUDHOE

In many respects, the events that resulted in the development of Prudhoe Bay moved more rapidly than governmental agencies could monitor or control them. State agencies had to adopt a reactive stance in response to the Prudhoe Bay oil discovery. The magnitude and complexity of oil operations and the timing requirements involved with the development the field gave rise to a wide range of regulations, some redundant and other conflicting, promulgated in an attempt to control development.

At Prudhoe Bay, the desire of the oil companies to optimize field design had to be reconciled with the State's environmental concerns. For example, State agencies were interested in reducing the amount of gravel extracted for use in the construction of roads and drilling pads. In response, the State was able to control the number of drilling pads by restricting the oil industry to using offshore, directional drilling techniques at Prudhoe. Various State agencies have also monitored the oil industry's development of water sources and water use.

The State's ability to respond was also strained by requests from both oil companies and service companies for surface leases. The creation

of the Deadhorse Industrial Park was an attempt to respond to the needs of the oil companies and service companies as well as to environmental concerns.

The experience at Prudhoe Bay has provided the catalyst for revising State policies on surface and subsurface leasing of State lands. These are primarily related to pre-leasing evaluations of potential social and economic impacts associated with oil and gas development, and also to lease stipulations that will be included to mitigate potential impacts. The experience at Prudhoe has also led to changes in the State's permit processes. There is nonetheless still a complexity of regulations and overlapping functional and jurisdictional responsibilities on the part of various agencies and units of government that has yet to be reconciled.

The Unit Agreement between the State of Alaska and the sixteen parties of interest in the Prudhoe field reflects the common goal of the State and the oil companies to maximize the recovery of oil and minimize environmental disruption. Similar agreements will in all likelihood be executed between the State and the parties of interest in future economically producible finds. This is partially directed by the provisions of the legislation, and partially directed by the mutual common interests served.

EXPERIENCE OF NORTH SLOPE BOROUGH AT PRUDHOE

Because initial development at Prudhoe Bay preceeded the incorporation of the North Slope Borough by severa? years, the Borough did not directly influence the location of oil development facilities at Prudhoe.

Since its creation, the primary effect of Prudhoe Bay on the North Slope Borough has been fiscal. With the exception of the financing of the central utility within the industrial park at Deadhorse, a matter currently under litigation, the Borough has levied property taxes at Prudhoe without having to provide any services there. The revenues from the Prudhoe Bay property taxes have increased from $418,000 in 1973 to $18.2 million in 1977, which represents a forty-five fold increase in Borough revenues with essentially no demands on services.

Setting aside requirements for providing direct Borough services to Prudhoe, the Borough has nonetheless been forced to provide additional services within its jurisdictional boundaries as a result of the Prudhoe enclave. These services were primarily related to planning, land use, and regulatory controls.

In terms of future enclave development within its boundaries, it is likely that the Borough will continue to lobby for enclave development rather than the establishment of permanent, traditional communities. Because of its concern over subsistence and environmental issues, the Borough will see to it that enclave development will be as compact as possible. In the future, in addition to its zoning powers, the Borough will use its powers under the Coastal Zone Management Program to regulate the siting of energy-related facilities. It is similarly likely that other local units of government will favor enclave development that provides them with tax revenues without a requirement for the provision of services.

BIBLIOGRAPHY

Alaska construction & Oil. Record slope haul heading north, August 1969: p. 6

----- Hello Operator? Give me Prudhoe. 6-0930. September 1969: p. 83-85, 87, 88.

----- September 11! September 1969: p. 66, 67, 78, 80-82.

----- Oilmen finalize plans for winter on Slope. November 1969: p. 58, 60, 62, 64.

----- Oilmen tap the village work force. November 1969: p. 80, 84, 85.

----- Prudhoe development to be unitized from tart. August 1970: p. 61.

----- North Slope construction: Predictions are difficult in 1970. April 1970: p. 48, 50, 52.

----- Prudhoe Oilfield Development, Environmental impact statement, May 1972: p. 36.

----- North Slope roundup, Activities lower but no time for boredom. August 1973: p. 40-42.

----- Prudhoe Bay preparing for production as pipeline becomes reality. April 1975: p. 78, 80, 82.

----- Special pipeline report. September 1975: p. 60.

----- Special report: 1975 Prudhoe sea lift completed despite Arctic winter. April 1976: p. 54-57.

----- Clark-Lima cranes help in ARCO North Slope project. May 1976: p. 42, 43.

----- Chronology of pipeline events. October 1976: p. 50, 51.

----- Chronology of pipeline events. September 1977: p. 14.

Alaska. Department of Labor, Title 38. Public Lands: Local hire under State leases. Wage and Hour Division pamphlet No. 500.

Alaska. Department of Natural Resources, Division of Lands. Regulations and statutes pertaining to oil and gas leasing of Alaska lands as contained in the Alaska Administrative Code and the Alaska Statutes. September 1974.

Alaska. Department of Natural Resources, Division of Minerals and Energy Management. Prudhoe Bay Unit Agreement, April 1977: p. 50 plus Appendix.

Alaska. Office of the Governor, Division of Policy Planning and Development. Draft environmental assessment: Proposed Beaufort Sea nearshore petroleum leasing. Anchorage, April 4, 1975: p. 492.

Alaska Industry. 1968 oil discovery led to pipeline project. September 1977: p. 12, 14.

Alaska Journal of Commerce. ARCO will drill the Kuparuk. Anchorage, September 26, 1977.

Alyeska Pipeline Service Company. Alyeska Reports. October 1977.

Anchorage Daily News. High court to make decision on Alaska's local hire law. November 1, 1977: p. 1.

Atlantic Richfield Company, BP Alaska, Inc., et al. Prudhoe Bay Operating Agreement. April 17, 1977: 2 vol.

Bradner, Tim. Will the boom break Fairbanks? Alaska Construction & Oil. July 1969: p. 23-28.

----- The politics of Alaska oil. Alaska Construction & Oil. November 1969: p. 20-22, 33, 34.

----- The politics of Alaska oil. Part two. Alaska Construction & Oil. February 1970: p. 24-27, 30.

BP Alaska, Inc. Operations Center, 1974.

----- Prudhoe Bay Operations. April 1976.

----- Producing Prudhoe Bay. June 1977.

Business Week. A desperate gamble to supply Prudhoe. October 13, 1975: p. 34, 36.

CCC/HOK. Atlantic Richfield Company/Exxon - Prudhoe Bay Operations Center Expansion, Phase I. 1976.

Ellis, William S. Will oil and tundra mix? Alaska's North Slope hangs in the balance. National Geographic, 1971: p. 485-517.

General Information and Economic Factors, prepared by Dupere & Associates, Inc., for the North Slope Borough. Barrow, June 1975: p. 49.

General Information and Economic Factors, prepared by Dupere & Associates, Inc., for the North Slope Borough. Barrow, July 1976: p. 44.

McKinney, Virginia. Arctic Oil: The search for more. Alaska Construction & Oil. August 1977: p. 29, 30, 43, 44.

Morrison-Knudsen Company, Inc. "Gas plant work in frigid gloom of North Slope," the Em-Kayan Magazine. Boise, Idaho. February 1976.

NANA Development Corporation. Statement of Qualifications 1976. Anchorage: p. 30.

North Slope Borough, Official Statement, prepared by Dupere and Assoicates, Inc. Barrow, June 1975: p.21.

----- Official Statement, prepared by Dupere and Associates, Inc. Barrow, July 1976: p.39.

Ott, Jack. Preparing to run the trans-Alaska pipeline. The Sohioan, June 1977: p.20-22.

Reprint of Alaska Administrative Code. Title II, Natural Resources, Part 3, Oil and Gas; Chapter 22, Oil and Gas. September 1973.

Selkregg, Lidia, ed. Alaska regional profiles: Arctic region. Anchorage, University of Alaska, Arctic Environmental Information and Data Center, 1975.

Simasko, D.L. Oil industry in Alaska. Changeable as the weather! A history of the role of the independent. Alaska Construction & Oil. December 1970: p. 78, 79.

U.S. Dept. of the Navy. Draft environmental impact statement: continuing exploration and evaluation of naval petroleum reserve no. 4, Alaska. Washington, Naval Petroleum and Oil Shale Reserves Office, 1977.

University of Alaska. Institute of Social and Economic Research. "Petroleum development in Alaska: a look at the past, present and future potentials." Review of Business and Economic Conditions. Fairbanks, March 1977: p. 15.

PRUDHOE BAY STUDY CONTACTS

Ahmaogak, George	Assessing Department, North Slope Borough, Barrow.
Bartel, Herbert	Director of Planning, North Slope Borough, Barrow.
Barti, Irene	Office Manager, Alaska General Construction Co., Anchorage
Copeland, William	North Central Division Manager, State of Alaska, Department of Natural Resources, Division of Oil and Gas Conservation, Anchorage.
Cox, Charles	Operations Manager, Alaska General Construction Co., Anchorage.
Crittenden, Edwin	CCC/HOK, Anchorage.
Dobey, Patrick	Petroleum Manager, State of Alaska, Department of Natural Resources, Division of Minerals and Energy Conservation, Anchorage.
Dorris, David	Planning Analyst, Joint Federal-State Land Use Planning Commission, Anchorage.
Dow, Thomas	Chief of Operations, NANA Development Corporation and Subsidiaries, Anchorage.
Featherstone, A.A.	Project Engineer, North Slope Project, BP Alaska, Inc. Anchorage.
Fison, Susan	Director, Community Information Center, Fairbanks North Star Borough, Fairbanks.
Haigler, Kenneth	Manager, Employee Relations, Atlantic Richfield Company, Anchorage.
Jones, Donald	Assistant Manager, Employee Relations, Atlantic Richfield Company, Anchorage.
Keffer, Charles	North Slope Project Manager, ARCO-Parsons Prudhoe Facilities Project Group, Atlantic Richfield Company, Anchorage.
Krupa, Michael	Personnel Manager, Nabors Alaska Drilling, Inc., Kodiak Oilfield Haulers, Inc., Anchorage.
Kugler, Harry	Petroleum Engineer, State of Alaska, Department of Natural Resources, Division of Oil and Gas Development, Anchorage.

Mayo, Patricia	Office of Economic Opportunity, Department of Health, Education and Welfare, Anchorage.
Maze, David	Administration, BP Alaska, Inc.
Pyle, William	Dames & Moore, Anchorage.
Scott, Robert	President, Frontier Rock and Sand, Inc., Anchorage.
Singletary, Mark	Regional Lawyer, Atlantic Richfield Company, Anchorage.
Smythe, G. R.	Partner, Alaska Consultants, Inc., Anchorage,
Sterret, Thomas	Leasing Manager, State of Alaska, Department of Natural Resources, Division of Minerals and Energy Management, Anchorage.
Taylor, James	President, Nabors Alaska Drilling, Inc., Kodiak Oilfield Haulers, Inc., Anchorage.
Trimble, Niall	Economist, State of Alaska, Department of Community and Regional Affairs, Juneau.
, Walker, Michael	Regional Planner, OCS Office, Bureau of Land Management, Department of the Interior, Anchorage.