OUTER CONTINENTAL SHELF OIL AND GAS INFORMATION PROGRAM

Update 1, May 1982 Outer Continental Shelf and Onshore Oil and Gas Activities and Impacts in the Arctic: A Summary Report, October 1981

U.S. Geological Survey Open-File Report 82-19
(Update to Open-File Report 81-621)

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Update 1, May 1982 Outer Continental Shelf and Onshore Oil and Gas Activities and Impacts in the Arctic: A Summary Report, October 1981

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Prepared for the U.S. Department of the Interior,
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Note to Readers

On January 19, 1982, Secretary of the Interior James G. Watt issued Secretarial Order No. 3071 establishing a Minerals Management Board and a Minerals Management Service (MMS) that would be under the supervision of the Under Secretary. On May 10, 1982, Secretary Watt signed an amendment to Secretarial Order No. 3071. In accordance with the amended order, the Minerals Management Board will continue to be chaired by the Under Secretary, with other members of the Board being the Assistant Secretaries for Energy and Minerals, Land and Water Resources, Indian Affairs, and Policy, Budget, and Administration. The Board will supervise and oversee MMS operations.

The Minerals Management Service will implement new policy and guidance procedures developed by the Minerals Management Board and will be responsible for exercising the following:

- All functions carried out previously by the former Conservation Division of the U.S. Geological Survey (USGS);

- Outer Continental Shelf Program support activities, including functions of the Office of OCS Program Coordination; all functions related to the management of offshore energy and minerals administered by the Bureau of Land Management (BLM); all functions that support the OCS program in the Geologic Division and the Office of the Assistant Director for Resource Programs of the U.S. Geological Survey; oil spill trajectory analysis functions of the Office of Earth Science Applications, U.S. Geological Survey; all functions of the Office of Policy Analysis relating to scheduling the sale of leases of OCS lands; and all functions relating to the OCS program transferred from the Department of Energy.

Until further notice, the Minerals Management Service will continue to use administrative support services provided by the U.S. Geological Survey and the Bureau of Land Management, and the Office of OCS Information will continue to use the USGS open-file report numbering system for summary reports and indexes. References to the U.S. Geological Survey and the Bureau of Land Management remain in this document. Future Office of OCS Information publications will report changes in organization as they occur.

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INTRODUCTION

In October 1981, the Office of Outer Continental Shelf Information (OCSI) of the U.S. Geological Survey (USGS) published the initial summary report for the Arctic subregion of Alaska, the **Arctic Summary Report, October 1981** (Jackson and others, USGS Open-File Report 81-621). This report is the first update to the initial report. Updates are published approximately every 6 months in order to provide additional and revised information. A revised summary report is published only when a new Outer Continental Shelf (OCS) lease sale is held or if a commercial discovery is announced on the OCS in that region.

In January 1982, Department of the Interior (DOI) Secretary James Watt issued Secretarial Order No. 3071 that changed the name of the U.S. Geological Survey's Conservation Division to Mineral Management Service (MMS) and placed the Minerals Management Service under the supervision of a Minerals Management Board headed by Under Secretary Donald Hodel. Because the Outer Continental Shelf Information Program had been a part of the Conservation Division, it, too, became part of the Minerals Management Service. This reorganization will not change the Outer Continental Shelf Information Program functions or its reports.

On May 10, 1982, Secretary Watt signed an amendment to Secretarial Order No. 3071. As a result, the Minerals Management Service will be responsible for all OCS Program support activities, including functions of the Office of OCS Program Coordination; all functions related to the management of offshore energy and minerals previously administered by the Bureau of Land Management (BLM); all functions that support the OCS Program in the Geologic Division and the Office of the Assistant Director for Resource Programs of the U.S. Geological Survey; oil spill trajectory analysis functions of the Office of Earth Science Applications of the U.S. Geological Survey; all functions of the Office of Policy Analysis relating to the scheduling of the sale of leases of OCS lands; and all functions relating to the OCS Program transferred from the Department of Energy.

The initial Arctic Summary Report provided a description of the Arctic environment, resource and reserve estimates, a history of oil- and gas-related activity in the subregion, a discussion of existing and proposed hydrocarbon transportation strategies, and a description of existing and proposed oil and gas facilities and their impacts. Appendixes provided detailed descriptions of the geologic setting, a discussion of the methods used to provide oil and gas resource estimates, a history of the people of the northern Alaska Arctic, a description of the Intergovernmental Planning Program (IPP) of the Bureau of Land Management, and a list of OCS-related studies with abstracts.

The initial Arctic Summary Report differed from other summary reports in the series. At the request of State and local planners, the report covered all onshore and offshore oil- and gas-related activity in the subregion. However, this update and subsequent summary reports will focus on OCS-related activities. Other offshore and onshore oil- and gas-related activities will be summarized because it is difficult to discuss OCS oil and gas transportation strategies or cumulative impacts without reference to the other oil and gas development projects in the Arctic.

This report, Update 1, May 1982, discusses Arctic oil and gas activities since October 1981 and their possible impacts. It is intended to supplement the initial Arctic Summary Report. Copies of the initial summary report (USGS Open-File Report 81-621) and copies of other reports in the series may be obtained from the Office of Outer Continental Shelf Information, Minerals Management Service, National Center--MS 640, Reston, VA 22091. The telephone number of the Office of OCS Information is (703) 860-7166.

Alaska Index

In addition to the summary reports, indexes of information have been prepared by the Office of Outer Continental Shelf Information in conjunction with the Bureau of Land Management (BLM) to further supplement the information being made available to State and local governments for reference, planning, and decisionmaking purposes. An Alaska Index (Dorrier, 1981, USGS Open-File Report 81-20) was released in January 1981. This index was updated in March 1982 (Collignon, 1982, USGS Open-File Report 82-18). These indexes provide detailed information on the oil and gas leasing process, the leasing schedule and sale history, ongoing programs and State and local involvement in the OCS leasing program. Indexes are also available from the OCS Information Program at the above address.

Leasing Schedule

On October 6, 1981, a three-judge Court of Appeals in Washington, D.C., unanimously ruled on the **State of California** v. **Andrus** (80-1894) suit, stating that the June 1980 leasing schedule did not meet all of the requirements of the OCS Land Act, as amended. The ruling stated that the June 1980 leasing schedule failed to (1) identify offshore California Lease Sales 78 and 80 "with greater specificity," (2) "consider the need" enumerated in sections 18 (a)(2)(B) and (G) to share benefits and risks of the plan among all OCS regions, (3) consider the relative environmental sensitivity of different OCS areas, and (4) "strike a proper balance" required in section 18(a)(3) between environmental factors and economic factors. The court also stated that the proposed leasing schedule would be submitted by DOI Secretary Watt to Congress for approval, would be prepared in accordance with the ruling, and that until the proposed leasing schedule is approved, the June 1980 schedule must be followed.

On January 19, 1982, the appeals court approved a timetable for submission of the proposed leasing schedule. Under this timetable, the Department of the Interior was to announce a tentative proposed final leasing schedule on or about March 15, 1982, which would be based on consideration of all factors in sections 18(a)2 and (a)3 of the amended OCS Lands Act. The Department of the Interior was to show that new data had been considered as well as the analysis method of incorporating the new data in the development of the proposed leasing schedule.

A final supplement to the final environmental impact statement was published in March 1982. Notice of its availability was published in the Federal Register, vol. 47, no. 45, March 8, 1982. On March 15, 1982, a news release was issued by the Office of the Secretary of the Department of the Interior announcing a tentative proposed 5-year OCS oil and gas leasing program (DOI, 1982b). A proposed final program was submitted to the President and Congress on May 7, 1982. It is anticipated that the final program will be approved in July.

Sixteen lease sales in the Alaska region are proposed in the proposed final 5-year OCS leasing schedule. Two sales--Lease Sale 71 in the Diapir Field (Beaufort Sea) and Lease Sale 57 in the Norton Basin--are scheduled to be held in 1982. One sale is scheduled for 1983: Lease Sale 70 in the St. George Basin. The Department of the Interior will consult with the Alaska Land Use Council following issuance of the proposed notice of sale for Lease Sale 70. Four sales are scheduled for 1984: Lease Sale 83 in Navarin Basin, Lease Sale 87 in Diapir Field (Beaufort Sea), Lease Sale 88 in the Gulf of Alaska and Lower Cook Inlet, and Lease Sale 89 in St. George Basin. In 1985, three lease sales are scheduled: Lease Sale 85 in Barrow Arch (Chukchi Sea), Lease Sale 92 in the North Aleutian Basin, and Lease Sale 100 in Norton Basin. Four lease sales are proposed for 1986: Lease Sale 107 in the Navarin Basin,

Lease Sale 97 in the Diapir Field (Beaufort Sea), Lease Sale 99 in Kodiak, and Lease Sale 101 in the St. George Basin. Two lease sales are scheduled for 1987: Lease Sale 109 in the Barrow Arch (Chukchi Sea) and Lease Sale 86 in Shumagin. Figure 1 shows the lease sales scheduled for the Alaska region in the May 1982 proposed final 5-year OCS leasing program. Figure 2 shows the locations of the scheduled sales.

On April 1, 1982, the Department of the Interior announced the reoffering of approximately 3.2 million acres (1,294,720 hectares) on the Outer Continental Shelf. This lease sale is identified as Reoffering Sale RS-2, and it is tentatively scheduled for July 1982. In this lease sale, 564 tracts offshore the South and Mid-Atlantic States, California, and Alaska will be offered. The 140 tracts that will be offered in Alaska are in the Cook Inlet and Shelikof Strait; they are tracts that were offered but not leased in Lease Sale 60.

Oil- and Gas-Related Activities in the Arctic

Arctic oil and gas exploration began in Alaska with USGS's surface work in 1901. (A map of the Arctic subregion is presented in figure 3.) In 1904, oil seeps were found on what is now the National Petroleum Reserve in Alaska (NPRA). The U.S. Navy, in conjunction with civilian drilling contractors, conducted an extensive geological mapping and exploratory drilling program on the Reserve from 1944 until 1953. During 1949 and 1950, the Navy drilled several test wells south of Barrow in order to develop a natural gas fuel supply for the Navy's Barrow Camp. These wells were the first development wells in the U.S. Arctic.

In 1964, the State of Alaska began leasing land on the North Slope that was believed to have a high hydrocarbon potential. In 1968, the Prudhoe Bay oil field was discovered east of the NPRA, and development of the field began in the same year. Construction of the Trans-Alaska Pipeline System (TAPS) began in 1974 and was completed in 1977. A total of approximately 2 billion barrels (317,800,000 m3) of oil had been moved to market at the end of 1981. Kuparuk, a second, smaller field also on State land, began production in December 1981.

The first Federal OCS lease sale in the subregion, the Joint Federal/State Beaufort Sea Lease Sale, was held on December 11, 1979. Exploratory drilling is under way on both Federal and State tracts, and oil has been discovered on State tracts. A second Federal sale, Lease Sale 71, is scheduled for September 1982.

The first NPRA lease sale was held on January 27, 1982, and a second NPRA sale was held on May 26, 1982. Exploration is expected to begin in the fall of 1982.

The words "block," "lease," "tract," and "OCS serial number" have discrete definitions and applications. **Block** is used to refer to a geographical area as portrayed on OCS official protraction diagrams or leasing maps. A block in the Alaska Region generally contains 5,693 acres (2,304 hectares). All blocks have identifying numbers. **Lease** is used to mean a contract authorizing exploration for and development and production of minerals on the submerged lands covered by such a contract. A **tract** is the description of a single leasing unit for administrative purposes; it is a convenient way of numbering a unit that may contain a single block or portions of several blocks. The block numbers and OCS official protraction diagram numbers comprise the legal description of a tract in the lease contract. The lease contract is also assigned an **OCS serial number.** The Minerals Management Service uses these numbers to identify blocks after a sale has occurred. Tract numbers are generally used by trade publications to identify blocks. In this report, tract numbers are used, followed by OCS lease numbers in parentheses.

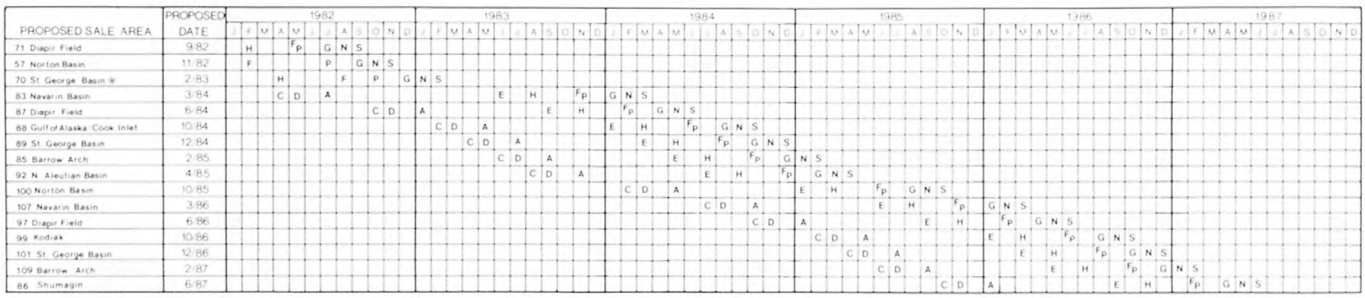


FIGURE 1.--May 1982 proposed final 5-year OCS leasing schedule. (Adapted from DOI, 1982c, by Rogers, Golden & Halpern, 1982.)

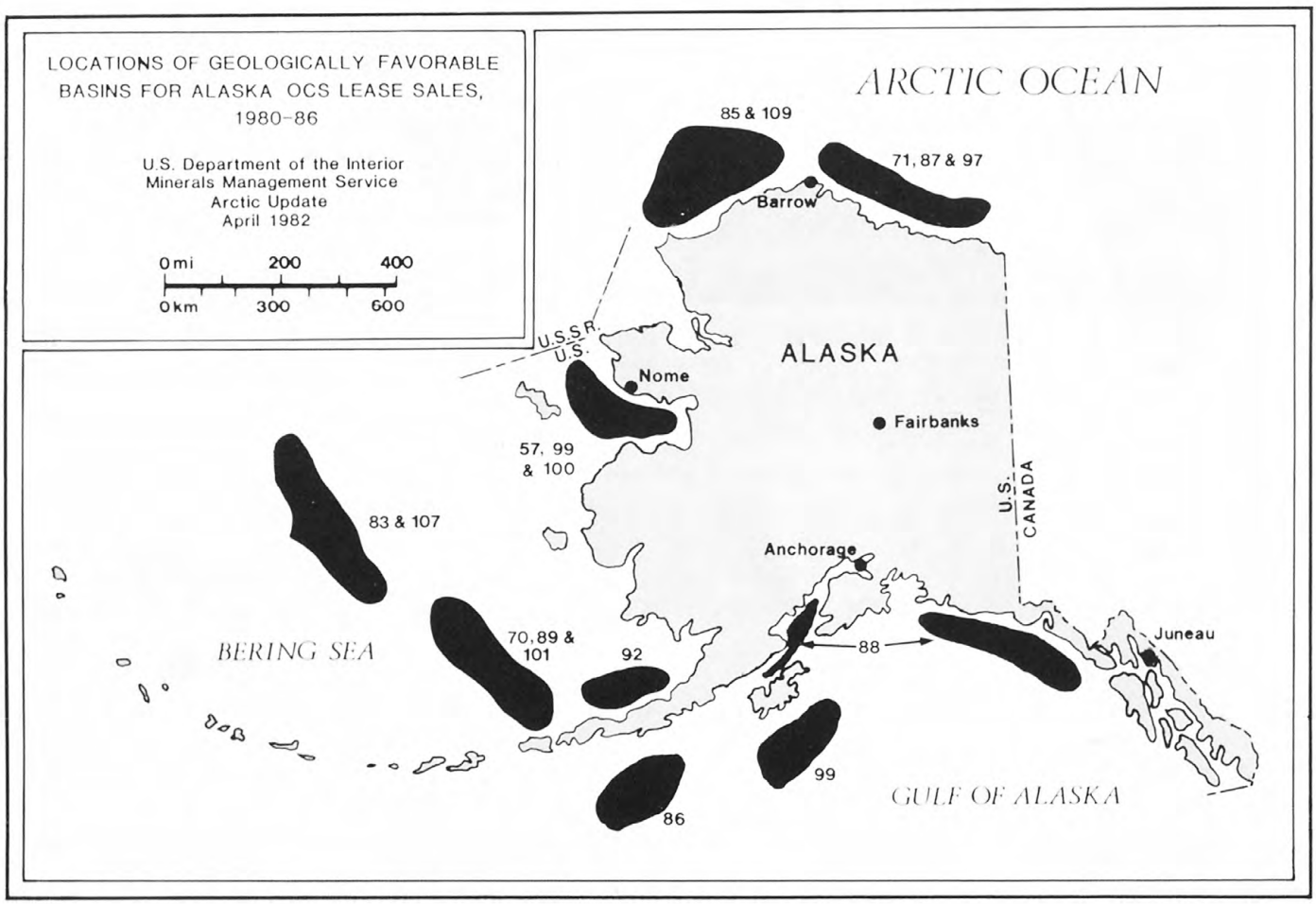


FIGURE 2.--General areas of proposed lease sales in the May 1982 proposed final 5-year OCS leasing program. (Adapted from DOI, 1982c, by Rogers, Golden & Halpern, 1982.)

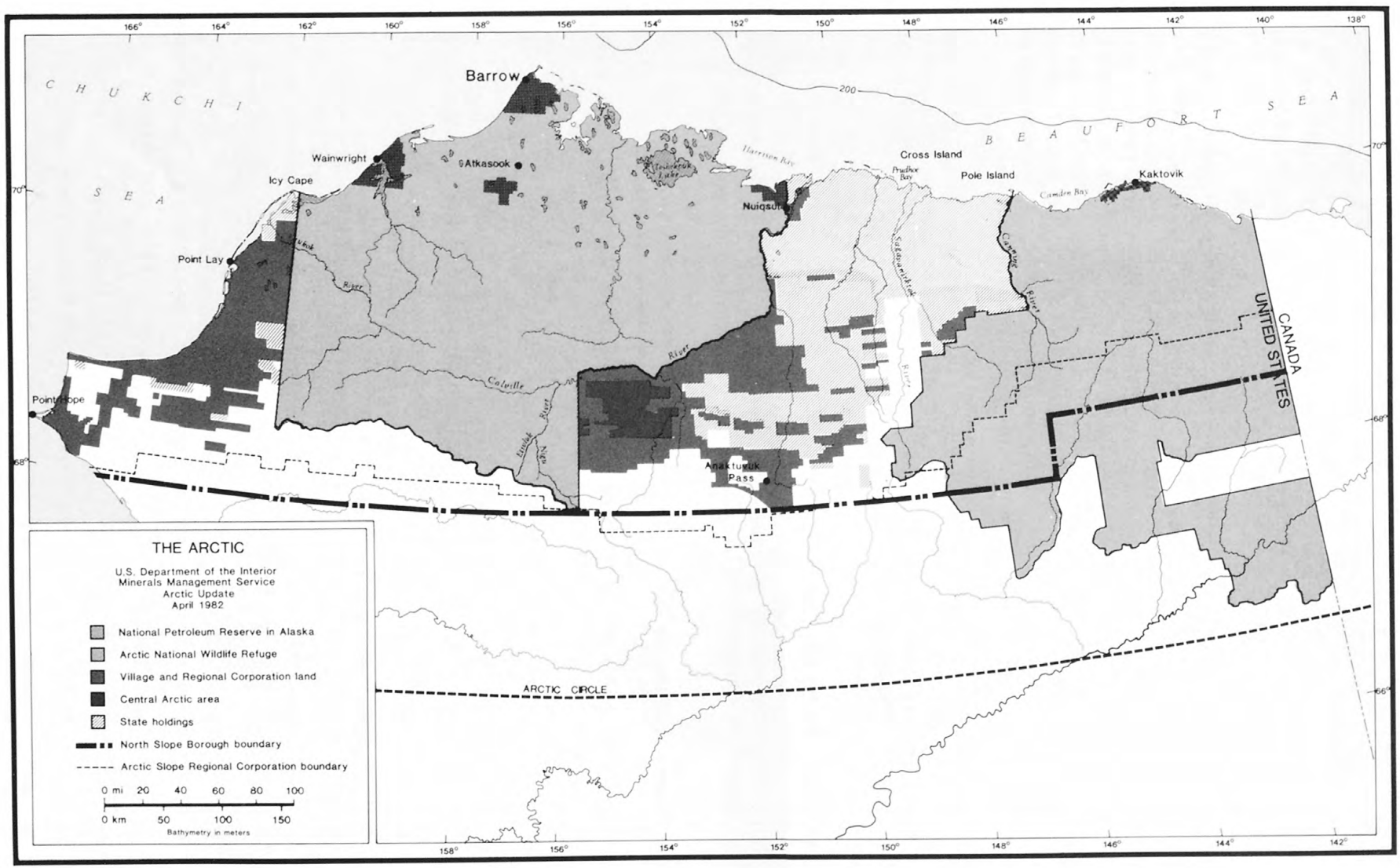


FIGURE 3.--The U.S. Arctic. (Adapted from Jackson and others, 1981, by Rogers, Golden & Halpern, 1982.)

The Department of the Interior is currently planning geologic and geophysical exploration for the coastal portion of the Arctic National Wildlife Refuge (ANWR). The Fish and Wildlife Service has been designated as lead agency. An environmental impact statement that will evaluate guidelines (regulations) for geologic and geophysical exploration and the potential impacts of surface geological and geophysical exploration is expected in the summer of 1982.

The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) called for the evaluation of Federal onshore land for potential oil and gas leasing. One Favorable Petroleum Geologic Province (FPGP) has been designated in the Arctic subregion--the Cape Lisburne Province. This land will be leased competitively, although no date for a lease sale has been set at this time. Some additional Arctic land will be leased noncompetitively at a drawing tentatively scheduled for July 31, 1985. ANILCA also requires the Secretary of the Interior to carry out a study of Federal land in the central Arctic. A report summarizing the first year of the study was sent to Congress in January, 1982. A summary of oil- and gas-related activities on Federal lands in the Arctic is presented in table 1.

The State has six lease sales planned for the Arctic subregion. The most recent lease sale was held on May 26, 1982. Another sale is scheduled for September 1982, and one for each year thereafter until 1986, when two sales are also planned. A summary of oil- and gas-related activities on State lands in the Arctic is presented in table 2.

OIL AND GAS RESOURCES OF THE ARCTIC

A description of the geology of the Arctic was provided in the initial Arctic Summary Report (USGS Open-File Report 81-621).

Resource and Reserve Estimates

New risked recoverable resource estimates for Beaufort Sea leased lands have been issued since the publication of the October 1981 report. The new estimates indicate that there are 205.3 million barrels (32,622,000 m3) of oil and 157.4 billion cubic feet (4,454,420,000 m3) of gas on the 24 federally managed offshore tracts leased in the Joint Federal/State Lease Sale (MMS, 1982b). Unrisked resource (conditional) estimates of undiscovered recoverable oil and gas resources were prepared by the U.S. Geological Survey for Lease Sale 71 (BLM, 1981a). These estimates are presented in the discussion of Lease Sale 71, on page 13.

MAGNITUDE AND TIMING OF DEVELOPMENT

Federal OCS Activity

One OCS lease sale, the Joint Federal/State Beaufort Sea Lease Sale, has been held in the Arctic subregion. Six Federal sales are planned for the area. The first of these, Lease Sale 71, in Diapir Field (Beaufort Sea), is scheduled for September 21, 1982. A second Diapir Field sale, Lease Sale 87, is proposed for June 1984. Lease Sale 85, Barrow Arch, in the Chukchi Sea, is proposed for February 1985. Another Diapir Field sale, Lease Sale 97, is scheduled to be held in June 1986. A second Barrow Arch sale, Lease Sale 109, is proposed to be held in February 1987. The first lease sale to be held in Hope Basin (Kotzebue Sound), Lease Sale 86, is scheduled for 1987.

TABLE 1.—Oil and gas activities on Federal lands in the Arctic

	Pre-sale	Lease sale	Exploration
OCS	Seismic reflection profiles, total magnetic field measurements, refraction lines, gravity data; USGS and U.S. Coast Guard, 1969 through 1970's	Joint Federal/State Beaufort Sea Lease Sale, December 11, 1979	Two gravel islands constructed; one gravel island planned; two exploratory wells.
		Lease Sale 71, September 1982	None to date
NPRA	Geologic mapping; USGS; 1923-26	Lease Sale 821, January 27, 1982	No private exploration to date; all exploration has been under Federal Government sponsorship, including development of Barrow gas fields
	Seismic reflection profiles, aeromagnetic flight lines, seismic refraction profiles, gravity data,	Lease Sale 822, May 26, 1982	
	Seismic lines, geophysical and geochemical surveys, gravity data, test wells, USGS and U.S. Navy, 1953 to present		
ANWR	Geological and geophysical surface exploration by industry planned to begin early 1983	None planned	None to date
Other Federal Land	One FPGP designated in Cape Lisburne Province	None planned	None to date
	Central Arctic area-First year of study completed	None planned	None to date

On February 10, 1982, the proposed Alaska Region OCS Operating Orders were published in the Federal Register by the Minerals Management Service. The proposed orders incorporate provisions of the Gulf of Alaska Operating Orders and the Arctic Operating Orders, and will also include the Bering Sea. The Alaska Operating Orders will supersede the Arctic Operating Orders and will apply to land leased in the Joint Sale as well as land leased in future Federal OCS sales. The final operating orders are expected to be published in June 1982.

The Environmental Protection Agency (EPA) is proposing general National Pollutant Discharge Elimination System (NPDES) permits for oil and gas activity on the Alaska Outer Continental Shelf. General permits will apply to large areas, while individual permits, currently in use, are required for each discharge system. Operators will be allowed to

TABLE 2.—Oil and gas activities on State lands in the Arctic

Lease Sale[1]	Location	Exploration	Discovery announced	Development	Production
Lease Sale 13 December 9, 1964	Prudhoe Bay offshore and uplands	Prudhoe	January 1968	1968 to present	1977 to present: 1.5 million bpd
Lease Sale 14 July 14, 1965	Prudhoe Bay offshore and uplands	Kuparuk	Early 1970's	Under way	December 1981 to present: 80,000 bpd
Lease Sale 18 January 24, 1967	Prudhoe Bay offshore and uplands	Lisburne West Mikkelsen Point Thomson	Early 1970's None to date 1972		
Lease Sale 23 September 10, 1969	North Slope offshore and uplands	Duck Island Sag Delta Milne Point Gwydyr Bay	October 1980 April 1981 April 1981 April 1981	Sag Delta/Duck Island development anticipated	
Joint Federal/ State Beaufort Sea Lease Sale December 11, 1979	Beaufort Sea	Sag Delta Challenge Island	1980-81	Sag Delta/Duck Island development anticipated	
Lease Sale 31 September 16, 1980	Prudhoe Bay uplands	None to date			
Lease Sale 36 May 26, 1982	Beaufort Sea	None to date			
Lease Sale 34 September 28, 1982	Prudhoe Bay uplands				
Lease Sale 39 May 1983	Beaufort Sea				
Lease Sale 43 May 1984	Beaufort Sea				
Lease Sale 47 May 1985	Kuparuk Uplands				
Lease Sale 48 January 1986	Kuparuk Uplands				
Lease Sale 50 September 1986	Camden Bay				

bpd = barrels per day. For metric equivalent, multiply by .1589.

[1]Acreage from these sales overlaps.

SOURCES: Alaska Oil and Gas Conservation Commission, 1981; Keiser, 1981, oral commun.; Rogers, 1982, oral commun.

discharge pollutants after notifying the Environmental Protection Agency of their agreement to meet general permit requirements. General NPDES permits for Alaska will be developed by EPA Region 10 in Seattle, Washington. An NPDES permit for the Beaufort Sea is expected late in 1982. This permit will apply only to tracts leased in the Joint Federal/State Sale (Sikorski, 1982, oral commun.).

JOINT FEDERAL/STATE BEAUFORT SEA LEASE SALE. The Joint Federal/State Beaufort Sea Lease Sale (BF) was held on December 11, 1979. It was jointly conducted by the Department of the Interior and the State of Alaska as the result of an agreement between the Department of the Interior and the State concerning jurisdiction over submerged lands on the OCS. As a result of the sale, 24 Federal leases were issued; 4 of these are for undisputed Federal land and 20 are for disputed acreage that is being federally managed. The State issued 62 leases; 58 of them were for undisputed State acreage, and 4 of them are disputed but managed by the State. Exploratory drilling and other downhole activities were restricted to the period between November 1 and March 31 on all federally managed tracts and on all State tracts inside the barrier islands for 2 years. Table 3 shows companies, tract numbers, OCS lease numbers, and block numbers for federally managed tracts and tract numbers, State plane coordinates, and block numbers for State-managed tracts leased in the Joint Sale. A more detailed history of the Joint Sale can be found in the initial summary report.

Jurisdiction over the disputed tracts will not be resolved until a decision is issued by the U.S. Supreme Court. A special master appointed to hear the case and make a recommended ruling on the points of contention will not make recommendations to the Supreme Court before the summer of 1982. Monitoring efforts at Dinkum Sands are expected to be completed this spring, and this evidence will be presented to the special master at that time.

One other lawsuit resulting from the Joint Sale remains in litigation. This suit was filed in January 1981 by the Inupiat Community of the Arctic Slope, the Ukpegvik Inupiat Corporation (Barrow's village corporation), and certain individuals in the U.S. District Court in Anchorage. This lawsuit alleges that the Inupiat people have full title, ownership, and dominion over the entire North Slope, including offshore areas beyond 3 geographic miles (5.5 km). It charges the United States with infringement of tribal sovereignty, trespassing, breach of trust, responsibility, and abridgment of Native American religious freedom.

On May 7, 1982, the Alaska Supreme Court issued a decision in the suit that was filed in December 1979 by the North Slope Borough, the village of Kaktovik, and various environmental organizations. It concerned the validity of the Beaufort Sale beyond the barrier island. The Court found that there was not sufficient information to determine how Alaska's Commissioner of Natural Resources made the consistency determination. The necessary corrective measures were detailed in a remand order that was issued on May 20, 1982. The Court's decision upheld the validity of the sale against the other challenges (Thie, 1982, oral commun.).

To date, 13 exploratory wells have been drilled on land leased in the Joint Sale. Three exploratory wells were drilled in the 1980-81 drilling season on State land. During the 1981-82 drilling season, 10 additional wells were drilled; 2 of these were on a Federal tract.

During the 1981-82 drilling season, Exxon built an unnamed gravel island on federally managed Tract 37 (OCS-Y 0191). The island is 480 feet (146 m) in diameter and 11 feet (3.4 m) above mean high water. Exxon has drilled two wells on this gravel island. The first well

TABLE 3.—Joint Federal/State Beaufort Sea Lease Sale statistics

Block number*	Tract number	OCS lease number	Well or plan name	Owner	Operator	Season drilled
			Federally managed tracts			
471	2	Y 0175	Shell Seal Prospect	Amoco	Shell	83-84[g]
470	23	Y 0179	Shell Seal Prospect	Amoco	Shell	83-84[g]
472	24	Y 0180	Shell Seal Prospect	Amoco	Shell	83-84[g]
516	25	Y 0181	Shell Seal Prospect	Murphy & Shell	Shell	83-84[g]
564	35	Y 0189		Union & Exxon	Exxon	
609	36	Y 0190		Exxon, Union, & ARCO	Exxon	
610	37	Y 0191	OCS-Y 0191 no.1 & no.2	Exxon, Union, & ARCO	Exxon	81-82
655	38	Y 0192		Exxon, Union, & ARCO	Exxon	
699	39	Y 0193		Exxon, Union, & ARCO	Exxon	
744	41	Y 0195	Shell Tern Prospect	ARCO, Shell, & Murphy[h]	Shell	82-83[g]
745	42	Y 0196	Shell Tern Prospect	Shell & Murphy	Shell	82-83[g]
788	43	Y 0197	Shell Tern Prospect	ARCO & Exxon	Shell	82-83[g]

Block number	Tract number	State plane coordinates[e]	Well or plan name	Owner	Operator	Season drilled
			State-managed tracts			
515	47	Sec. 4, 13n-14e	Shell Seal Prospect	Amerada Hess	Shell	83-84[g]
521	54	Sec. 2, 13n-16e	Cross Island No. 1	Tenneco	Tenneco	83-84[g]
565	62	Sec. 23, 13n-16e	No Name Island No. 1	Amoco	Amoco	81-82
652	75	Sec. 36, 12n-16e	Sag Delta No. 7	Marathon & Amerada Hess	Sohio	80-81, 81-82[f]
698	76	Sec. 27, 12n-16e	Sag Delta No. 8	Sohio & Native Corps.[b]	Sohio	80-81
698	76	Sec. 36, 12n-16e	Sag Delta No. 9	Sohio & Native Corps.	Sohio	81-82
698	76	Sec. 36, 12n-16e	Sag Delta No. 10	Sohio & Native Corps.	Sohio	81-82
657	79	Sec. 30, 12n-19e	Jeanette Island No. 1	Mobil, Phillips, & Chevron	Chevron	81-82
753[a], 796	96[a], 109	Sec. 11, 10n-22e	Alaska Island No. 1	Exxon, Sohio, & Native Corps[c]	Sohio	80-81
751, 752, 795, 796	95, 108, 109	Sec. 8, 10n-22e	Challenge Island	BP, Sohio, Mobil, Phillips, Chevron, & Exxon[d]	Sohio	81-82
798	111	Sec. 17, 10n-23e	Alaska State F No. 1	Exxon	Exxon	81-82
799-800	114	Sec. 23, 10n-23e	Alaska State D No. 1	Exxon	Exxon	81-82

*The block numbers given here are those given in BLM's Bid Re-Cap. However, many tracts are composed of two or more blocks.
[a]Bottom hole location.
[b]The Native Corporations leasing Tract 76 are Nana, Koniag, Sealaska, and Cook Inlet. Each Native Corporation holds 1 percent of the lease.
[c]Tract 109 is owned by Exxon. Tract 96 is owned by Sohio, Nana Regional Corp., Konig, Inc., and Sealaska Corp.
[d]Tract 95 is leased by BP, Sohio, Nana Regional Corp., Koniag, Inc., and Sealaska Corp. Tract 108 is leased by Mobil, Phillips, and Chevron. Tract 109 is leased by Exxon.
[e]Surface location.
[f]Reentry.
[g]Planned.
[h]ARCO was high bidder and sole leasee but has assigned part of the lease to Shell and Murphy.

SOURCES: Lowry, 1982, and B. O'Brien, 1982 (Federal information); Alaska Oil and Gas Conservation Commission, 1981-82 (State information).

was spudded on November 1, 1981, and it was temporarily plugged and abandoned on March 31, 1982. The second well was spudded on December 27, 1981, and it was temporarily plugged and abandoned on March 7, 1982. Tract 37 (OCS-Y 0191) received the highest bid in the Joint Sale--over $143 million.

Shell filed the second exploration plan for federally managed land. This plan, known as Shell Tern Prospect, was submitted on September 25, 1981, and approved October 23, 1981. A gravel island is being constructed on Tract 41 (OCS-Y 0195). Shell will drill from the island during the 1982-83 season. The plan also covered Tract 42 (OCS-Y 0196) and Tract 43 (OCS-Y 0197).

The third exploration plan for federally managed land, known as Shell Seal Prospect, was submitted on October 29, 1981, and approved on December 1, 1981. This plan covers Tract 2 (OCS-Y 0175), Tract 23 (OCS-Y 0179), Tract 24 (OCS-Y 0180), Tract 25 (OCS-Y 0181), and several State leases. A gravel island is being built on Tract 47, (a State tract) and drilling will occur during the 1983-84 season.

Three exploratory wells were drilled on State-managed leases during the 1980-81 drilling season. Two of these were drilled directionally by Sohio from artificial islands on tracts acquired in previous State lease sales. These wells, known as Sag Delta No. 7 and No. 8, were drilled on Tracts 75 (Sec. 31, 12n-17e) and 76 (Sec. 23, 12n-17e), respectively. Sag Delta No. 7 yielded 4,400 barrels (699 m3) of oil per day from a depth of 12,100 feet (3,688 m). Sohio also drilled from Challenge Island. This well was abandoned because of downhole problems after being drilled to 13,587 feet (4,141 m) at the convergence of Tracts of 108, 109, and 95 (Sec. 8, 10n-22e). The well found 50 feet (15 m) of hydrocarbon-bearing rock.

Eight wells were drilled on State-managed tracts during the 1981-82 drilling season. Sohio has drilled one well from Alaska Island on Tract 109 (Sec. 11 10n-22e). The well deviates to the north under Tract 96 and will test the same geologic structure that Sohio tested last year from Challenge Island. Exxon has drilled two wells: one was drilled from North Star Island on Tract 111 (Sec. 17, 10n-22e), and the other from Flaxman Island on Tract 114 (Sec. 23, 10n-23e). Both wells are expected to be completed and tested during the current season. Sohio is drilling two wells on Tract 76 (Sec. 36, 12n-16e) from Endeavor Island: Sag Delta No. 9 and Sag Delta No. 10. Sohio has also reentered Sag Delta No. 7 on Tract 75 and has tested the well for Marathon Oil Company and Amerada Hess Corporation. This well flowed oil from two zones. A test of the Cretaceous upper Kuparuk sand flowed 1,604 barrels (255 m3) of oil per day. A test of the Upper Triassic Sag River sands flowed 347 (55 m3) of oil per day. The well was temporarily plugged and abandoned in March 1982. A spokesperson for Marathon said that additional drilling will be necessary to determine the extent of the reserves (Oil & Gas Journal, 1982d). Amoco drilled Tract 62 (Sec. 23, 13n-16e) from No Name Island and Chevron drilled Tract 79 (Sec. 30, 12n-19e) from Jeanette Island.

On May 14, 1982, Secretary of the Interior James Watt announced that the Department of the Interior has extended the exploratory drilling season from 5 months to 10 months on Federal tracts in the Beaufort Sea. Oil companies may now drill exploratory wells between November 1 and August 31. The September and October restriction is designed to protect the bowhead whales during their fall migration. The Department of the Interior's decision to lengthen the drilling season follows a biological opinion issued in April 1982 by the National Marine Fisheries Service (NMFS) in which NMFS determined that the longer drilling season would be prudent (Energy Daily, 1982b).

The State of Alaska also announced an extended drilling season on May 14, 1982. However, the State's seasonal drilling restrictions are somewhat more complex than those

announced by the Department of the Interior. There are two tiers in the State's restriction. Tier 1 is currently in effect. The second tier (which permits exploratory drilling and other downhole activities on State tracts in the Beaufort Sea throughout the year, except during bowhead whale migration) will become effective when companies can demonstrate oil spill cleanup capabilities in broken-ice conditions to the satisfaction of Alaska's Department of Environmental Conservation. In tier 1, there are restrictions pertaining to the area inside the barrier islands and restrictions pertaining to the area outside the barrier islands. Inside the barrier islands, the State will allow exploration and other downhole activities above the threshold level (level where hydrocarbons are expected to be encountered) year-round; exploration will be permitted below the threshold level between November 1 and March 1, except at the mouths of major rivers where drilling will cease April 30; no drilling will be allowed during bowhead whale migration; and testing will be allowed year-round if casing has been set. Outside of the barrier islands, exploration and other downhole activities will be allowed year-round above the threshold level, except during whale migration; exploratory drilling will be allowed below the threshold level between November 1 and May 15; testing will be allowed year-round if casing has been set, except during whale migration (Boston, 1982, oral commun.; P. O'Brien, 1982, oral commun.).

The State of Alaska is currently determining if the Federal drilling restrictions meet State consistency requirements. A decision is expected by June 15, 1982. The North Slope Borough has filed a notice that they intend to bring suit against the Department of Interior for extending the drilling season (Curran, 1982, oral commun.).

Shell's two wells are the only exploratory wells that are definitely planned for Joint Sale tracts at this time, although Amoco may drill a second well from No Name Island and Tenneco may drill from Cross Island during the 1982-83 season. This slowdown is not unexpected. The exploratory wells drilled in the Beaufort Sea to date have been in protected shallow water. Wells in deeper water require more planning and are more expensive. In addition, the geology of the offshore area is more complex than had been expected (Energy Daily, 1982a).

On May 5, 1982, Sohio announced plans to develop the Sag River/Duck Island area. Production is planned to begin in 1988, and daily production is anticipated to be between 75,000 and 150,000 barrels (11,917-23,835 m3) of oil per day. In addition to Sohio, Exxon, Union Oil Company, ARCO, Amoco Production Company, NANA Regional Corporation, Sealaska Corporation, Cook Inlet Regional Corporation, and Koniag Corporation are lease holders in the area. The area to be developed contains tracts leased in various State sales as well as State tracts leased in the Joint Beaufort Sale. Preliminary plans call for the construction of four gravel islands. Three of these islands will be used for drilling and production with each island supporting up to 80 wells. The fourth island will be used to house water intake facilities (Huxley, 1982, oral commun.).

LEASE SALE 71. The second Federal Beaufort Sea sale, Lease Sale 71 (Diapir Field), is proposed for September 21, 1982. In April 1980, the Department of the Interior selected 424 blocks comprising over 1.9 million acres (768,740 hectares) for environmental study (BLM, 1980). A description of early pre-sale activities was given in the initial Arctic Summary Report.

In preparation for the sale, approximately 995 line miles of high-resolution seismic data for OCS oil and gas exploration were collected by Western Geophysical Company under contract to the U.S. Geological Survey. The information is now available from the National Oceanic and Atmospheric Administration EDIS/NGSDC, Code D621, 325 Broadway, Boulder, CO 80303. The data were used to identify potentially hazardous geologic structures and

other constraints to oil and gas exploration and development in the sale area (Oil & Gas Journal, 1981a).

The draft environmental impact statement (DEIS) for Lease Sale 71 was released on December 22, 1981, by the Department of the Interior. The DEIS describes 372 blocks totaling approximately 1.8 million acres (728,280 hectares) in the Diapir Basin, located 3 to 37 miles (4.8-60 km) offshore in water depths that range from 16 to 131 feet (4.9-40 m).

The unrisked resource (conditional) estimates of undiscovered recoverable oil and gas estimates made by the U.S. Geological Survey indicate that 2.38 billion barrels (378,182,000 m3) of oil and 1.78 trillion cubic feet (50,374,000,000 m3) of natural gas are located in the Lease Sale 71 area. These estimates assume discovery of hydrocarbons (BLM, 1981a).

Six alternatives to the proposed lease sale were considered in the DEIS. Four alternatives suggest modifying the proposed sale area by deleting various blocks. One alternative is the deletion of 33 blocks in the north/northeast portion of the sale area. This alternative is designed to lessen ice hazards in the flaw lead zone. The Cape Halkett alternative proposes deletion of 49 blocks in the western portion of the sale area to protect areas important for Barrow subsistence activities and the habitats of bowhead whales and seals. Modification of the sale area near the Colville River Delta, which calls for the deletion of 47 blocks, is an alternative designed to protect subsistence and biological resources. A fourth alternative is the deletion of 37 blocks near Simpson Lagoon to protect subsistence and biological resources, primarily seals and caribou. No-sale and delay-the-sale alternatives are also discussed in the draft environmental impact statement. A major concern in the DEIS is the effect of oil spills, operational construction, and drilling discharges on fish resources, waterfowl, and marine mammals and their habitats and the physical environment. In addition to the series of alternatives, proposed stipulations are published in the report. These stipulations are also designed to mitigate impacts. Among them are the following:

- measures to protect sites, structures, or objects of historical or cultural significance;
- an orientation program for all personnel involved in exploration or development that will promote an understanding of and appreciation for local values, customs, and lifestyles;
- pipeline requirements to ensure proper transportation of hydrocarbon products;
- prohibition of exploratory drilling from September 1 through October 31 to protect bowhead whales from the potential effects of oil spills; and
- prohibition of the discharge of drilling muds under the ice (BLM, 1981a).

Reporting the social impacts of Lease Sale 71, the draft environmental impact statement concluded that changes in the population of the North Slope would be unlikely as a result of the proposed sale. The DEIS also states that disturbances to sociocultural systems are likely but that the proposed stipulations could reduce some of the potential social impacts if adopted and enforced (BLM, 1981a).

Public hearings on the DEIS were held during the first week of February 1982 in Barrow, Nuiqsut, Kaktovik, Fairbanks, and Anchorage. The issues raised at the public hearings included discussions on the following: stipulations regarding seasonal drilling, the

need for a 10-year lease term, alternative deletions proposed in the DEIS, the adequacy of oil spill cleanup technology, oil spill risk and analysis information, the adequacy of available technology to deal with ice forces, Inupiat claims to offshore areas, impacts on subsistence activities and Native livelihood, concerns about gravel, and the cumulative effects of hydrocarbon development on the North Slope (B. O'Brien, 1982, oral commun.).

The final environmental impact statement was released on May 24, 1982. It was submitted to the Environmental Protection Agency and made public for 30 days before the Secretary of the Interior was to make a decision on conducting the lease sale (DOI, 1981).

Additional Federal Lands

A number of oil- and gas-related activities are planned for Federal land in the Arctic. These activities are not related to OCS lease sales. However, it is difficult to discuss transportation strategies for OCS oil and gas and cumulative impacts without reference to all projects planned for the Arctic. Therefore, summaries of other Federal oil- and gas-related projects are presented below.

NATIONAL PETROLEUM RESERVE IN ALASKA (NPRA). The National Petroleum Reserve in Alaska, a 37,000-square-mile (96,000-km2) reserve, is situated on the North Slope between the Brooks Range and the Arctic Ocean. A history of NPRA's legislative mandates and oil and gas exploration, as well as the issues in NPRA leasing, were presented in the initial Arctic Summary Report.

The first of the two initial sales of NPRA land, Lease Sale 821, occurred on January 27, 1982, after being postponed from December 16, 1981, because of confusion over antitrust information requirements. Bids were received on 29 tracts or 49 percent of the tracts that were offered. The Department of the Interior rejected four bids as insufficient. The accepted bids totaled $57,146,483 and they covered 653,436 acres (264,380 hectares). The second sale, Sale 822, was held on May 26, 1982. This sale offered approximately 3.5 million acres (1,416,100 hectares). Oil companies bid $9.7 million on 12 tracts; 212 tracts were offered in the lease sale. A third NPRA sale is scheduled for July 1983.

The final environmental assessment (EA) for NPRA presented a discussion of the reserve's hypothetical technical development. The area selected by the Bureau of Land Management for lease could have an average oil equivalent in place of 3 billion barrels (476,700,000 m3), according to USGS estimates. With a 55 percent recovery rate, the total recoverable oil in the sale area will be 1.7 billion barrels (270,130,000 m3) with an average production of 111,600 barrels (17,733 m3) per day. The EA indicates that exploratory drilling will begin in the fall of 1982 and that 22 exploratory wells will be drilled. It predicts the discovery of two oil fields and at least one gas field. If commercial discoveries are made during 1983-86, field development can be anticipated in the late 1980's and early 1990's. The assumed transportation scheme involves lateral east to west oriented trunk pipelines to TAPS and ANGTS (BLM, NPRA Program Staff, Alaska Office, 1981). More information concerning NPRA can be obtained from Jerry Wickstrom, BLM, Alaska State Office, 701 C Street, Anchorage, AK 99513 (telephone: (907) 271-3632).

ARCTIC NATIONAL WILDLIFE REFUGE (ANWR). The Arctic National Wildlife Refuge occupies 18 million acres (7,282,800 hectares) in northeastern Alaska. As a result of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA), a part of ANWR has been designated a wilderness area. The oil and gas potential of the coastal plain can be assessed.

The Department of the Interior granted the U.S. Geological Survey lead agency responsibility to establish guidelines for oil and gas exploration in ANWR. A lawsuit, **Trustees for Alaska** v. **Watt,** was filed on May 1, 1981, and on December 4, 1981, the U.S. District Court in Anchorage ruled in favor of Trustees for Alaska, giving responsibility to the Fish and Wildlife Service. The guidelines are to include prohibitions, restrictions, and conditions on exploratory activities to ensure that exploration does not adversely affect fish, wildlife, or the environment. The agency is also responsible for writing an environmental impact statement (EIS) for surface geological and seismic exploration on the coastal plain. Initial guidelines will be published with the final EIS in July 1982.

The Fish and Wildlife Service is also conducting a baseline study within the coastal plain as required by ANILCA. The Fish and Wildlife Service, in consultation with the Native Village and Regional Corporations, the North Slope Borough, and the State, is examining fish and wildlife populations and habitats in the coastal plain study area. Special emphasis will be put on the study of caribou, wolves, wolverines, bears, waterfowl, and musk oxen. The Fish and Wildlife Service is also analyzing potential effects of exploration and development activities on culture, lifestyle, and subsistence activities of the affected natives (Haugh, 1981, oral commun.). For more information concerning ANWR, contact Dr. Gerry Garner, Fish and Wildlife Service, Federal Building, 101 12th Avenue, Fairbanks, AK 99701 (telephone: (907) 456-0250).

FAVORABLE PETROLEUM GEOLOGICAL PROVINCES. As described in the initial summary report, section 1008 of the Alaska National Interest Lands Conservation Act directed the Department of the Interior to evaluate all available onshore Federal land in Alaska, excluding the North Slope, for potential oil and gas leasing. The call for expression of interest, published in the Federal Register on April 30, 1981, resulted in the selection of 12 priority areas.

Leasing on these lands will be noncompetitive unless the Minerals Management Service, in a statewide evaluation, determines the area to be a Favorable Petroleum Geologic Province (FPGP). FPGP's must be leased competitively while most other public land in Alaska outside NRPA can be leased over-the-counter. Three FPGP's in Alaska have been designated to date. One of these, Cape Lisburne Province in the Arctic subregion, includes a portion of the North Slope Borough west of NPRA and east of Point Hope.

Land that is not designated as an FPGP will be leased at drawings. The Bureau of Land Management has scheduled 12 drawings on about 40 million acres (16,184,000 hectares) of Federal land. The only North Slope Borough land that is included in these drawings is Naatak, which includes some acreage in the Cape Lisburne area and some land south of the borough boundary. This drawing, scheduled for July 31, 1985, will offer perhaps as much as 1 million acres (404,600 hectares) for lease.

CENTRAL ARCTIC AREA. The Alaska National Interest Lands Conservation Act of 1980 also requires the Secretary of the Interior to carry out a study on Federal land in the Central Arctic area of Alaska. The Act allows 8 years to complete the study. A report summarizing the first year's activity of the study was submitted to Congress by Secretary James Watt in January 1982. The objectives of the study are to estimate oil and gas resource potential, to review and evaluate alternative transportation routes, to determine wilderness characteristics and wildlife resources, and to analyze impacts of oil and gas development on the Bureau of Land Management lands in the region (DOI, 1982a). Copies of this report are available from the Bureau of Land Management, Office of Public Affairs, 18th and C Streets NW., Washington, DC 20240.

Originally, the Central Arctic area covered approximately 4.5 million acres (1,820,700 hectares). However, on February 19, 1982, the State of Alaska selected approximately 3.5 million acres (1,416,100 hectares). The Central Arctic study will continue, but the anticipated completion date is now 1984 (Barkow, 1982, oral commun.).

State Activity

The first North Slope State lease sale in Alaska was held on December 9, 1964. The Prudhoe Bay reservoir was part of the land leased in that sale. Since the first sale, the State has held six lease sales in the subregion, including the Joint Federal/State sale in 1979. Figure 4 presents hydrocarbon projects on State land in the Arctic. The most recent sale in the subregion, Lease Sale 36, was held on May 26, 1982. It offered 56,200 acres (22,739 hectares) of land, including submerged land north of Prudhoe Bay adjacent to the Midway Islands and submerged land and upland in the Flaxman Island - Canning River area. Thirteen tracts received bids. Currently, the State is planning to hold six additional sales. Lease Sale 34 is scheduled for September 28, 1982, and it will offer approximately 1,500,000 acres (606,900 hectares) of land in the Prudhoe uplands. Lease Sale 39, scheduled for May 1983, and Lease Sale 43, scheduled for May 1984, will both offer acreage in the Beaufort Sea. Lease Sales 47 and 48 will offer areas in the Kuparuk uplands area. Lease Sale 47 is scheduled for May 1985 and Lease Sale 48 is scheduled for January 1986. The most recent addition to the State's leasing schedule is Lease Sale 50 in Camden Bay, scheduled for 1986. This sale area covers State lands lying offshore of the Arctic National Wildlife Refuge.

PRUDHOE BAY. The Prudhoe Bay field is continuing to be developed by ARCO and Sohio. In 1981, 110 new wells were drilled, and approximately the same number are planned for 1982. During 1981, an average of 1.5 million barrels (238,350 m3) of oil were produced daily and 1.6 billion cubic feet (45,280,000 m3) of gas were reinjected into the formation daily (Knepler, 1982, oral commun.).

KUPARUK. The Kuparuk field is located 40 miles (64.3 km) to the west of Prudhoe Bay. ARCO Alaska, Incorporated, brought Kuparuk on stream on December 13, 1981, with production of 50,000 barrels (7,945 m3) per day of crude oil from 24 wells. ARCO holds all the oil and gas leases in the 20-square-mile (52-km2) area providing this initial production. There are plans to unitize the field. In January 1982, peak flow from Kuparuk was 80,000 barrels (12,712 m3) per day from 40 wells. Plans called for a second production stage that would yield approximately 80,000 barrels (12,712 m3) per day in 1983. However, lagging crude oil prices have caused ARCO Alaska to revise its timetable for the development of Kuparuk. The second production stage is now planned for late 1984 or early 1985. Kuparuk production now averages 90,000 barrels (14,301 m3) per day. About 40 development wells will be drilled this year (Oil & Gas Journal, 1982e).

The Kuparuk reservoir is relatively shallow with a depth of 6,000 to 8,000 feet (1,829-2,438 m), and has no gas cap associated with it. As a result, ARCO plans a waterflood demonstration project early in 1983, leading to a full field waterflood involving 340 injection wells by 1986. Kuparuk is estimated to hold 4 to 5 billion barrels (635,600,000-794,500,000 m3) of oil; total recoverable oil with successful waterflood is estimated at 1.2 to 1.5 billion barrels (190,680,000-238,350,000 m3). When fully developed, Kuparuk may have as many as 800 producing and water injection wells (Oil & Gas Journal, 1981e). Along with Kuparuk's oil, 35 million cubic feet (990,500 m3) of natural gas per day will be produced. A portion of the gas will be used as fuel for the field, and about 25 million cubic feet (707,500 m3) of gas per day will be injected until gas sales take place (Pacific Oil World, 1982).

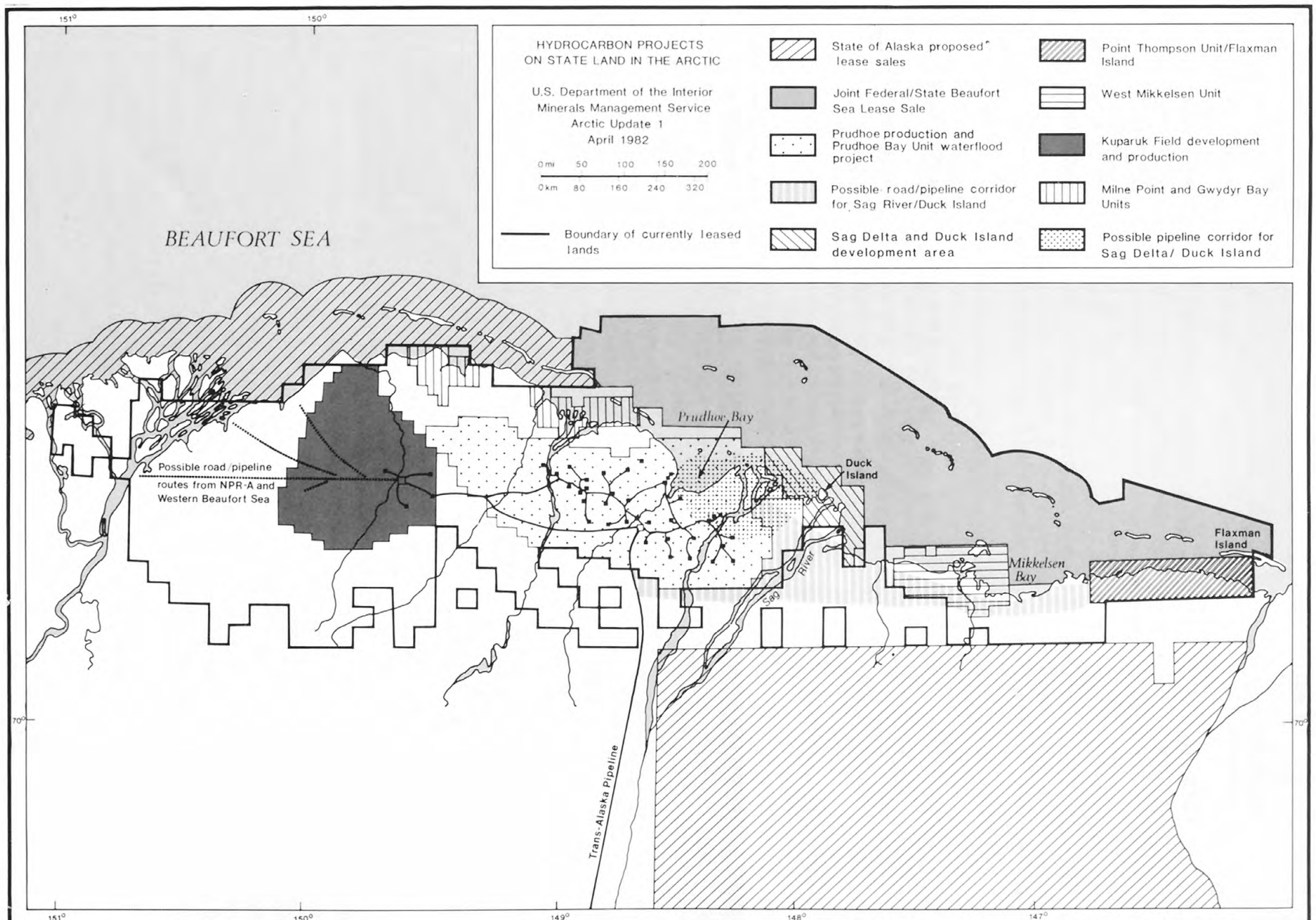


FIGURE 4.--Hydrocarbon projects on State land in the Arctic. (Redrafted from BLM, 1981a, by Rogers, Golden & Halpern, 1982.)

The 26-mile (42-km) Kuparuk pipeline connects with the TAPS at Pump Station 1 in Prudhoe Bay. This pipeline has a capacity of 175,000 barrels (27,807 m3) per day. Oil from Kuparuk field increased the throughput capacity of TAPS to 1.6 million barrels (254,240 m3) per day. A second Kuparuk line is planned for early 1984 (Oil & Gas Journal, 1981e).

ADDITIONAL STATE LAND. Development of additional State leases seems likely in the very near future. State land will be used in the Sag River/Duck Island area development described above. Conoco, Incorporated, has suspended drilling of the Gwydyr Bay Unit for evaluation, and development is pending (Merriman, 1982, oral commun.). Conoco has also submitted a second development plan for Milne Point to the State's Division of Minerals and Energy Management. While the first plan called for two development wells to delineate the reservoir, this plan calls for two additional development wells. Production from the Milne Point Unit may begin as early as 1985 (Hedlund, 1982, oral commun.).

ARCO Alaska Inc. is assessing the commercial potential of an 18 to 40 billion barrel (2,860,200-6,356,000 m3) heavy-oil formation overlying pay zones in the Kuparuk field. The current program entails coring, testing, and data gathering from two development wells and one wildcat well in the Kuparuk field area. Information gleaned from the three wells could lead to a multi-million-dollar pilot production program to test the feasibility of heavy oil recovery (Oil & Gas Journal, 1982c).

OIL AND GAS TRANSPORTATION STRATEGIES

The initial Arctic Summary Report (USGS Open-File Report 81-621) summarized the role of the Intergovernmental Planning Program (IPP) in planning for and regulating oil and gas transportation. It also examined existing and proposed transportation systems for Alaska oil and gas. This report presents recent IPP activities and new information concerning the Trans-Alaska Pipeline System (TAPS), the Northern Tier Pipeline (NTP), the Alaska Natural Gas Transportation System (ANGTS), other future pipeline routes, and tanker and submarine transport.

OCS Transportation Planning

The Department of the Interior's Bureau of Land Management has the lead role in the transportation planning process for oil and gas discovered on the OCS. This planning process is coordinated through BLM's Intergovernmental Planning Program for OCS Oil and Gas Leasing, Transportation and Related Facilities. Each of BLM's six offshore leasing areas has an advisory committee called the Regional Technical Working Group (RTWG). Each working group meets approximately four times a year to offer advice to the Bureau of Land Management on technical aspects of leasing, transport of oil and gas to shore, and BLM's environmental studies program.

The Alaska RTWG has held three meetings since the publication of the initial summary report in October 1981. A meeting was held November 18, 1981, in Anchorage, Alaska. During the meeting, the results of Lease Sale 60 were reported, the ranking of proposed environmental studies was discussed, as well as mitigating measures for proposed Lease Sale 70 in St. George Basin. The group also discussed the preparation of a regional transportation management plan for the Beaufort Sea.

A second meeting was held in Anchorage on February 4, 1982. Topics discussed at the meeting included: the new 5-year leasing schedule, the establishment of the Minerals

Management Service, the environmental and socioeconomic studies program, and the proposed mitigation measures for Lease Sale 71 in the Beaufort Sea. In addition, Claude Sellars, Supervisor of Engineering and Development for Shell Oil Company, discussed pipeline technology in the Arctic.

A third meeting of the RTWG was held in Anchorage on April 6, 1982. At the meeting, the new and old leasing processes were compared, a report on the State's transportation plan was presented, and the future of the IPP was discussed. The next RTWG meeting is scheduled for August 4, 1982, in Anchorage.

The current members of the Alaska Regional Technical Working Group Committee are listed in table 4. The U.S. Coast Guard is now represented by Captain Karl Wassenburg. The Honorable Alan Beardsley, the Mayor of the City of Kodiak, has resigned from the committee.

Existing and Proposed Transportation Systems

Currently, there is only one means of transporting Alaska crude oil from the North Slope. The Trans-Alaska Pipeline System carries oil from the North Slope to Valdez, and from there it is tankered to the conterminous States. There are a number of proposed strategies to transport gas from Prudhoe Bay, as well as a number of proposed new oil pipelines. All of these are discussed in the following sections. A history of existing and proposed transportation systems was presented in the initial Arctic Summary Report.

TRANS-ALASKA PIPELINE SYSTEM (TAPS). Construction of TAPS began in 1974, and the system started transporting oil from the North Slope in 1977. Current throughput from Prudhoe to Valdez is 1.6 million barrels (254,240 m3) of oil per day. By 1981, 2 billion barrels (317,800,000 m3) of Prudhoe Bay crude oil had moved through TAPS.

In February 1978, a saboteur detonated an explosive that breached the pipeline, causing a discharge of oil. Alyeska Pipeline Service Company which owns and operates TAPS, repaired the pipeline, contained the leak, and removed the oil at a cost of $1,169,000. Alyeska brought suit against the Federal Government to recover the costs of cleaning up oil discharged from the pipeline into navigable waters. The plaintiffs argued that under the Water Pollution Control Act, the owners should be able to recover cleanup costs. The defendant contended, however, that the governing statute in the case was the Trans-Alaska Pipeline Authorization Act, not the Water Pollution Control Act. Under the Pipeline Act, cleanup costs cannot be recovered. On May 6, 1981, the U.S. Court of Claims, in a summary judgment, decided in favor of the United States (**Alyeska Pipeline Service Co. et al.** v. **United States**, 1981).

In recent congressional action, senators have introduced a bill making it a crime to damage or to attempt to damage the Trans-Alaska Pipeline System. An identical bill was passed by the Senate in July 1977, but the bill failed to be passed by the House. The bill makes sabotage of the pipeline a Federal felony punishable by up to a $15,000 fine, up to 15 years in prison, or both.

On December 13, 1981, TAPS began carrying 50,000 barrels (7,945 m3) of oil per day from Kuparuk, in addition to oil from Prudhoe Bay. The 26-mile (42-km) Kuparuk line, with a capacity of 175,000 barrels (27,807 m3) per day, ties into TAPS Pump Station 1 at Prudhoe Bay. Kuparuk pushed TAPS beyond its average throughput of 1.5 million barrels (238,350 m3) per day. Recent tests involving a drag-reduction additive put current use at about 1.8

TABLE 4.—Alaska Regional Technical Working Group Committee

Member	Affiliation
Ms. Ester Wunnicke (co-chairperson)	Bureau of Land Management
Mr. Bill Van Dyke (co-chairperson)	State of Alaska
Mr. Ron Morris	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
Mr. Gerald Reid	Fish and Wildlife Service
Mr. Rod Smith	Minerals Management Service
Mr. Jim Sweeney	Environmental Protection Agency
Capt. Karl Wassenberg	U.S. Coast Guard
Ms. Kit Duke (recommended)	State/Federal Transportation Planning Organization
Mr. Dave Benton (recommended)	Friends of the Earth
Ms. Kay Diebels (recommended)	Private citizen
Mr. Lee Gefvert (recommended)	Alaska Oil and Gas Association
Mr. Gil Jemmott	Alaska Oil and Gas Association
Mr. Mel Monsen, Jr. (recommended)	United Fishermen of Alaska, Bering Sea Fishermen Association

For further information concerning the Alaska Regional Technical Working Group Committee membership, contact Gordy Euhler, Bureau of Land Management, 620 East 10th Avenue, P.O. Box 1159, Anchorage, AK 99510 (telephone (907) 276-2955).

million barrels (286,020 m3) per day. A second Kuparuk pipeline to tie into TAPS and move additional Kuparuk oil is planned for early 1984. ARCO does not anticipate additional Alaska production straining TAPS' 2 million barrels (317,800 m3) per day design capacity before Prudhoe and Kuparuk begin their decline (Oil & Gas Journal, 1981e).

Amendments have been introduced to Congress to deregulate the price of oil transported by TAPS. The original bills excluded TAPS from the otherwise comprehensive rate deregulation proposals for oil pipelines. The industry supported amendments that would deregulate TAPS, and the amendments will be considered along with the original bills in congressional hearings. The Senate hearings are scheduled to begin May 21, 1982, and the hearings in the House of Representatives may begin as early as May 1, 1982 (Federal Energy Regulatory Commission, 1981).

On December 7, 1981, the Department of the Interior informed Alyeska that it would extend all of Alyeska's construction camp permits through December 1982. However, the Department of the Interior requested that Alyeska remove the facilities and restore the sites during the spring and summer of 1982, if Northwest Alaskan Pipeline Company has not purchased those facilities by that time. The Department of the Interior also requested that Alyeska give priority to clearing those camps to which the Northwest Alaskan Pipeline Company has applied for permission to use. Alyeska will retain one camp, Chandalar, for storage of materials.

Phase II hearings on TAPS began on February 24, 1982, before the Federal Energy Regulatory Commission (FERC). The issues that are being explored include the following: possible mismanagement of the construction project, appropriate rate base methodology, appropriate depreciation charges, removal costs involving dismantling and restoration expenditures and investments, and other issues not disposed of in the Phase I proceedings. These issues include the submission of a detailed study to support the inclusion of an appropriate working capital allowance in the rate base, reduction in the rate base to account for accrued dismantling and restoration expenses, and the disposition of the escrow fund upon resolution by the courts of the constitutionality of the Alaska income tax legislation of July 8, 1978. The Phase II hearings are expected to be concluded in November 1982. Judge Kane's decision in this case is subject to Commission review.

In his February 1980 decision on Phase I of the TAPS proceeding, Judge Kane recommended lowering the rates for transporting crude oil through TAPS. This decision is yet to be affirmed by the Commission (Federal Energy Regulatory Commission, 1982). However, British Petroleum Pipelines Inc., one of the companies that owns TAPS, offered the State $35 million in exchange for an agreement from the State to drop its argument for more money. On May 19, 1982, the Alaska Legislature rejected the out-of-court settlement (Anchorage Daily News, 1982a). On May 27, 1982, the antitrust division of the Justice Department filed a request with FERC for an expedited decision on the rates charged by TAPS. The Justice Department said failure to rule promptly on the rates would perpetuate uncertainty that could discourage future development of additional North Slope and Beaufort Sea oil reserves (Anchorage Daily News, 1982b).

In April 1982, Alyeska Pipeline Service Company completed a pipeline stabilization project at Atigun Pass. The settlement of unstable soils in the area had produced stress on the pipeline. Large tractors with side booms raised the pipeline while bedding and concrete slurry were placed beneath it. Drainage grading of slopes and settlement rod placement to help correct the stabilization problems at Atigun Pass were started in April, 1981 (BLM, 1982).

The Haul Road. Before construction of the Trans-Alaska Pipeline began, a road was built to transport equipment and supplies. It was also designed to be used during pipeline operation. The Haul Road, now known officially as Dalton Highway, was completed in 1975 and runs along a 424-mile (682-km) route from Livengood to Deadhorse. In anticipation of the Haul Road being used for gas-line construction, Federal and State authorities have signed agreements defining agency responsibility for managing land and water resources. The agreement clarifies issues that have been consistently controversial. According to the agreement, the State will authorize "driveway" permits where auxiliary roads attach to the Haul Road (BLM, 1981b). These driveway permits allow the State to determine where access roads will connect to Dalton Highway. However, the Bureau of Land Management retains the right to approve access roads.

During 1982, ARCO Alaska, Inc., is planning to move a record volume of supplies to Prudhoe Bay on the Haul Road. At least 70 tons (63 metric tons) of line pipe, piling, and construction material will be shipped to Seward on the Kenai Peninsula; then it will travel by rail to Fairbanks and by truck to Prudhoe Bay. Most of the line pipe will be used in ARCO's development of Kuparuk field, but some will be used in ARCO's development projects in the eastern half of the Prudhoe Bay field. Previous pipe shipments to the North Slope have been by barge during the annual summer sea lift (Pacific Oil World, 1982).

NORTHERN TIER PIPELINE (NTP). The Northern Tier Pipeline is a proposed 1,500-mile (2,414-km) oil pipeline, designed to carry North Slope oil from Port Angeles, Washington, to Clearbrook, Minnesota. The proposed pipeline has a capacity of 900,000 barrels (143,010 m3) of oil per day. In April 1982, Governor John Spellman rejected the NTP proposal. A description of NTP can be found in the initial Arctic Summary Report.

Idaho, Montana, North Dakota, and Minnesota approved permits for the pipeline's construction in their States. A report released in September 1981 by administrative law Judge John von Reis, a member of the Washington Facility Site Evaluation Council (WFSEC), suggested that the Evaluation Council reject the proposal. In his report, based on 18 months of hearings, von Reis questioned the safety of the 22-mile (35-km) submarine portion of the project; he also stated there was a potential for fires and explosions at Port Angeles and said there was no apparent need for the project, particularly in Washington State (Northern Tier Pipeline, Progress Report, 1981a). A final environmental impact statement prepared for the Evaluation Council by CH2M Hill and released in September 1981 differs on several major points with von Reis' recommendation. The environmental impact statement indicates that: a tanker explosion would not cause major damage in Port Angeles; a major underwater pipeline rupture is unlikely; and the company chose the best pipeline route (Anchorage Daily News, 1981). However, in October 1981, the Evaluation Council tentatively denied permit approval for the oil superport at Port Angeles and the pipeline across the State. Public hearings and reviews of the Council's tentative decision followed.

In November 13, 1981, the Army Corps of Engineers recommended issuance of permits to the Northern Tier Pipeline Company, despite the urgings of three Federal agencies to deny the permits. The Fish and Wildlife Service, the National Marine Fisheries Service, and the Environmental Protection Agency said that NTP poses substantial risks to the marine environment of Puget Sound. Shellfish and migrating salmon and waterfowl would be adversely affected by a spill, including fish stocks that are the subject of treaties with Canada (Environment Reporter, 1981). The Corps recommended issuance of the permits, concluding that the project was in the national interest. Permit conditions would include the protection of environmental resources, Indian treaty rights, wetlands, and would specify proper project design (Northern Tier Pipeline, Progress Report, 1981b).

On January 27, 1982, the Washington State Energy Site Evaluation Council voted, in a 19-to-6 decision, against recommending the Northern Tier Pipeline project to the Governor. Governor Spellman had until April 9 to make a final decision.

Governor Spellman rejected the proposal on April 8, 1982, because of environmental concerns. He stated that the proposed pipeline constituted a threat to Puget Sound and posed a danger in the event of fire or explosion at Port Angeles during offloading of oil. However, the Governor left open the possibility of a different route across the State. Since 1976, when the application was filed with Washington State, Northern Tier has spent $50 million on design, promotion, and lobbying (Wall Street Journal, 1982a).

The Northern Tier Pipeline Company announced that they are examining various alternatives, including various legal options to force the issuing of the permit or the filing of a revised application to meet the Governor's objections to the underwater route. On April 21, 1982, Representative Arlan Strangeland of Minnesota introduced legislation that would permit Federal preemption if 120 days of good faith negotiations did not bring agreement. On April 26, 1982, the State of Washington filed suit in Federal District Court in Seattle, in which it asked that the Army Corps of Engineers' permits for the submarine pipeline be held invalid on the grounds that they were issued without regard to the State's coastal zone management laws and that they were in violation of other rights of the State (New York Times, 1982).

Governor Spellman met with Northern Tier officials on May 4, 1982, and discussed possible alterations in the pipeline route. However, on May 10, 1982, the pipeline consortium filed suit in the Federal district court in Seattle against Governor Spellman, charging that in the decision to deny Northern Tier, the State permit violated the United States Constitution on three counts.

ALASKA NATURAL GAS TRANSPORTATION SYSTEM (ANGTS). In 1976, Congress approved the Alaska Natural Gas Transportation Act (Public Law 94-586) that outlined procedures to expedite the construction of a natural gas pipeline from Prudhoe Bay to the conterminous United States. Construction has begun on the Canadian, western, and eastern portions of ANGTS. The history of ANGTS was presented in the Arctic Summary Report (USGS Open File Report 81-621, p. 61).

First flow of Canadian gas through the ANGTS western leg pipeline began on October 1, 1981. The 160-mile (257-km) portion of the pipeline extends from Kingsgate, British Columbia, to Stanfield, Oregon. The Pacific Gas Transmission Company, which operates the pipeline, has a contract with Pan-Alberta Gas Limited for 240 million cubic feet (6,792,000 m3) of gas per day (Oil & Gas Journal, 1981b). Operation began even though some work on the facilities was not finished at that time. Work is scheduled to be completed in spring of 1982 (Office of the Federal Inspector, 1982).

Pipeline construction on the U.S. portion of the eastern leg halted for the winter on December 5, 1981. At that time, construction of 635 miles (1,022 km) (77 percent) of the pipeline was completed. The remaining 188 miles (303 km) of pipeline is scheduled to be installed during 1982. This construction work is approximately on schedule (Office of the Federal Inspector, 1982).

Construction of the Canadian portion of Phase I of the eastern leg proceeded on schedule from October through December 1981. At that time, construction of 268 miles (431 km) of the total 397 miles (639 km) of pipeline was finished. Work on the remaining 129

miles (208 km) of pipeline, the three compressor stations, and the meter station is scheduled to be completed in 1982 (Office of the Federal Inspector, 1982).

Construction has not begun on the 731-mile (1,176-km) Alaska segment of the pipeline. In fall 1981, after the cost of the entire project was reestimated to be $40 billion, gas pipeline firms, Prudhoe Bay producers, and banking institutions began lobbying for waivers of the Alaska Natural Gas Transportation Act that were necessary in order to finance the project. On October 7, 1981, President Reagan submitted to Congress his proposed waiver package. These waivers

- allowed the Federal Energy Regulatory Commission (FERC) the option of approving the billing of natural gas consumers in 48 States before the system is complete;
- lifted the ban on producer-ownership, so that Exxon, ARCO, and Sohio can own 30 percent of the system;
- made the $6 billion gas conditioning plant part of the transportation system and, therefore, part of the financing plan; and
- provided government guarantees that the regulatory framework will not change and that revenues will not be reduced.

A number of objections were directed to the waiver that permits gas customers to be billed for parts of the system before receiving any gas. During congressional debate on the measure, the pipeline builders said it would cost the consumer an average of $1.50 a month, but critics maintain that the cost would go much higher. Opposition rose with speculation that consumers would be paying for a pipeline that might never be completed or for transported gas too expensive to be marketed. Despite consumer protest, the amendments were passed by Congress and signed into law on December 15, 1981.

On January 28, 1982, 5 States, 24 members of Congress, and several consumer groups filed suit challenging the amendments and the approved waiver package. The suit was filed in U.S. District Court of Appeals in Washington, D.C., and alleges that the House of Representatives had not followed proper legislative procedures in approving the bill. The plaintiff's petition argues that Congress acted illegally in voting for the waivers because there were no public hearings before committees and that the Federal Energy Regulatory Commission (FERC) violated Federal law in issuing the waivers without notice or opportunity for hearing or comment (Washington Post, 1982). The suit also charged that the House voted twice on the bill, even though enabling legislation permitted only one vote (Oil & Gas Journal, 1982b). The legal petition was filed under a provision of the original pipeline law that designates the Court of Appeals to hear legal challenges involving the project. On February 5, 1982, the Foothills Pipeline Company, the sponsor of the Canadian segment of ANGTS, filed as an intervenor to protect its interest in ANGTS. On April 20, 1982, the Court of Appeals rejected all of these challenges.

However, there is another challenge to the waiver package. On March 3, 1982, Representative Douglas Applegate of Ohio introduced a bill (HR5697) to repeal the congressional decision. He contends that the Alaska Natural Gas Transportation Act (Public Law 94-586) contains an "express guarantee" that consumers would not pay for the pipeline until gas flowed through it. The bill has been referred to committees.

Before financial institutions make a decision about commitment of funds, the Federal Energy Regulatory Commission will devise and approve a final tariff for the pipeline during final certificate proceedings. Three provisions that will be included with the certificate will be critical to the pipeline's financing process. These are (1) the equity share percentage of the project financing that can be acquired by producers; (2) the dates when the costs of the segments can be passed through to consumers; and (3) the government guarantees that will establish the parameters for profit making (Noroil, 1981). Decontrol of natural gas is another issue affecting ANGTS. Current administration policy favors a more rapid decontrol of gas, allowing gas prices to rise gradually over the next 3 years. Without a change in the law, gas prices will rise suddenly in January 1985 when all new gas will be decontrolled and will have no price ceiling. The high cost of producing and transporting Alaska gas may not find a market if it cannot be "rolled" into less expensive, price-controlled "lower 48" supplies. Although sponsors of ANGTS say they would not be harmed significantly by decontrol, analysts feel that the extra gas brought on-line by decontrol might eliminate the need for the Alaska pipeline.

In March 1982, the State of Alaska released a report prepared by Kidder, Peabody & Company of New York City. This report recommends that the State help finance ANGTS on a debt-guarantee basis only. Equity or debt participation in the project was not recommended on the grounds that such involvement would constitute a conflict of interest because the State will also serve as regulator of the pipeline (Inside Energy, 1982). A decision by the State on the debt guarantee is not expected until 1983 (Engineering New Record, 1982).

On March 16, 1982, FERC Commissioner Anthony Sousa held a conference on the central issues concerning ANGTS. At the conference it was revealed that the scheduled completion date for ANGTS has been set back to November 1, 1987, rather than November 1, 1986, as previously scheduled. Officials representing ANGTS told the Commissioner that they expect to have a financing plan assembled by June 1982 and will submit a proposed tariff to FERC 1 month later. They want the Federal Energy Regulatory Commission to issue a final Federal certificate by December 1982.

After a meeting of pipeline sponsors in Salt Lake City, Utah, on April 30, 1982, it was announced that 1989 was the new target date for the line's completion. The inability to obtain financing for the pipeline at this time was cited as the reason for the delay (Wall Street Journal, 1982b). ARCO is reported to be looking at alternative methods to bring the gas to market, including converting it to methanol or liquefying it for shipment to Japan (Engineering News Record, 1982).

On May 23, 1982, the American Natural Resources Company withdrew from the ANGTS project. The company wanted to remain in the pipeline project at its current level of investment of $29 million, but other group members wanted additional capital.

FUTURE PIPELINE TRANSPORTATION ROUTES. If commercial deposits of oil are discovered on the OCS, TAPS could increase its throughput to 2 million barrels (317,800 m3) per day. If a number of sizeable discoveries are made, a new pipeline might be called for. It is assumed that gas would be transported through the proposed ANGTS. The State of Alaska favors sequential development of OCS and North Slope oil and gas discoveries. This strategy would ensure that duplicate pipelines would not be needed. However, several reports have been published during the past 6 months that discuss the construction of new pipelines. These reports are discussed in the following sections.

National Petroleum Council's Arctic Report. In December 1981, the National Petroleum Council (NPC) released a report entitled **U.S. Arctic Oil & Gas.** This report presented discussions of all aspects of hydrocarbon-related development of offshore areas of the United States north of the Aleutian Islands and the land north of the Brooks Range. Because it was not possible to assume what capacity would be available within TAPS or any of the proposed gas pipelines, the discussion of future transportation routes in the report assumed that additional pipelines and/or terminals would have to be built or the existing terminal expanded.

Because of the wide range of transportation choices available, National Petroleum Council used a representative scenario approach to study transportation systems. All cost data were given in January 1, 1981, dollars and do not take future inflation into account.

The transportation routes developed for the study are shown in figure 5. Where possible, several alternative pipeline routes were selected. The cost of a 42-inch (107-cm) land pipeline to handle 1 million barrels (158,900 m3) of oil per day was estimated to be about $12 million per mile. This figure includes the cost of new haul roads and pump stations. The cost is dependent on the terrain. Fifty percent of the pipeline was assumed to be above ground and 50 percent buried. NPC's report projected construction schedules of 3 or 4 years for land pipeline projects, with a minimum of 4 years if a haul road must be constructed first. These completion times assume that all permits have been obtained and no subsequent permitting delays are encountered.

The capital costs of a land pipeline that would be able to transport 1 billion cubic feet (28,300,000 m3) per day of gas are estimated to amount to $10 million per mile by the National Petroleum Council. Pipelining gas from NPRA to Valdez would require $11 billion capital expenditure. Liquefaction facilities for 1 billion standard cubic feet (28,300,000 m3) of gas range from $1.6 billion for a plant in southern Alaska to $2.5 billion for a facility on the North Slope. Operating costs range from $30 to $60 million per year. Methanol production from the same quantity of gas on the North Slope would require about $6 billion in capital and $200 million per year in operating costs.

Marine pipelines and new terminals were also discussed in NPC's report. Marine pipelines were considered in the St. George, Bristol, Norton, Hope, Chukchi, and Beaufort Basins. Although conditions and pipelaying methods vary between the northern and southern basins, the total pipelaying costs are about the same. Estimates indicate that installation of a 36-inch (91-cm) diameter pipeline to carry either 1 million barrels (158,900 m3) of oil or 1 billion cubic feet (28,300,000 m3) of gas per day would cost a minimum of $5 million per mile of pipeline. Adverse weather and regulatory delays would raise this figure, and actual costs could be 50 to 100 percent higher.

The National Petroleum Council estimated the total capital cost for a 500,000-barrel (79,450 m3) per day terminal at $1.5 billion. A 1-million-barrel (158,900-m3) per day terminal was estimated at $1.9 billion. However, capital costs would be significantly higher for sites where the net offshore construction season is less than 100 days. Operating and maintenance costs for a 500,000-barrel (79,450 m3) and a 1-million-barrel (158,900-m3) per day terminal are estimated at more than $31 million and $33 million per year, respectively.

Marine terminals, submarine, and surface tanker transport systems in the Beaufort Sea area were not considered in this report because most of the basins now proposed to be leased by the Department of the Interior are in relatively shallow water. For oil transport in the Navarin, Norton, Hope, and Chukchi Basins, 250,000-ton (226,775-metric-ton) icebreaker tankers could be used. The cost of one such vessel is estimated to range from $190 to $380

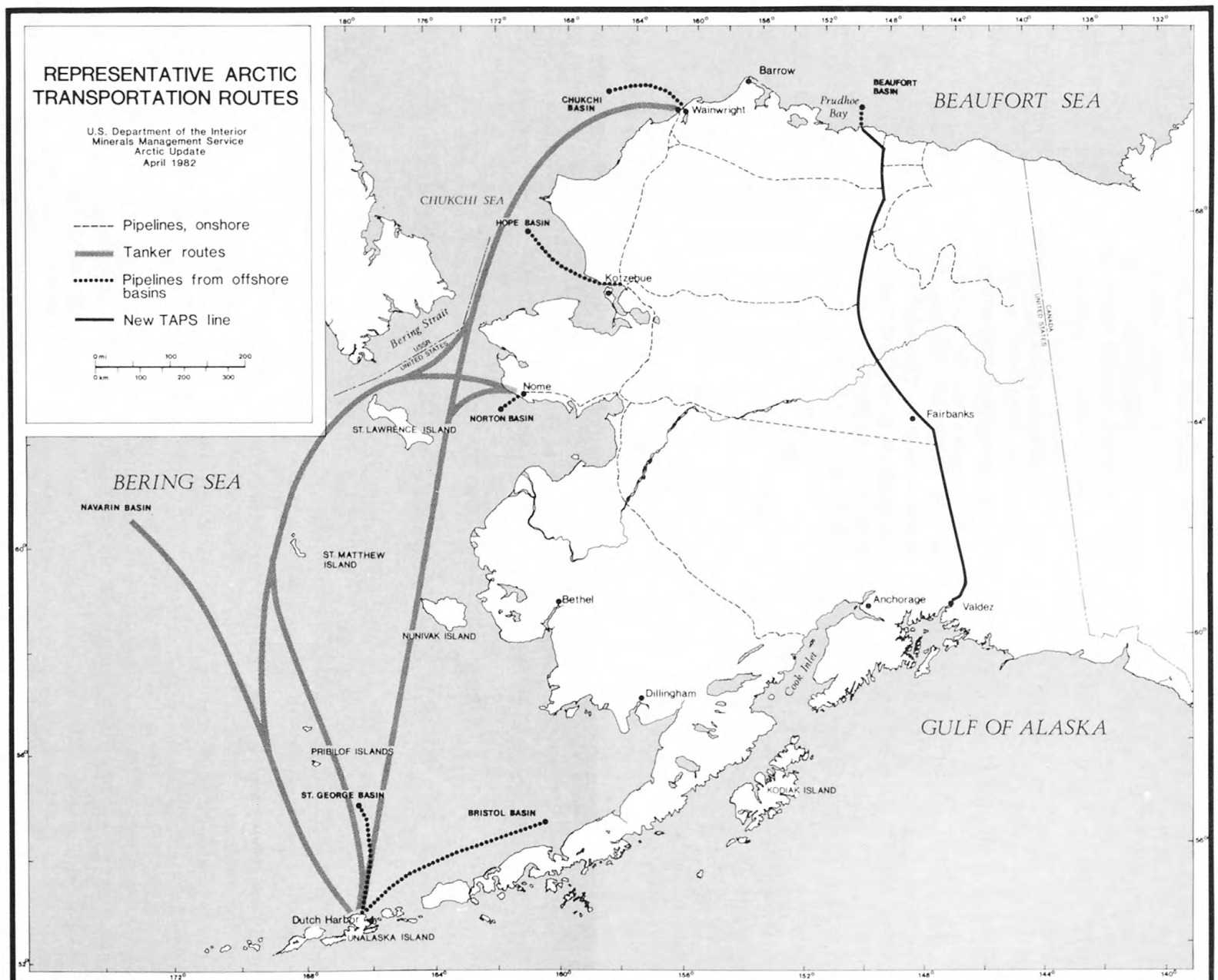


FIGURE 5.--Representative Arctic transportation routes. (Redrafted from National Petroleum Council, 1981, by Rogers, Golden & Halpern, 1982.)

million. Three to thirteen of these vessels would be required to transport up to 1 million barrels (158,900 m3) of oil per day. For gas transport from the same basins, liquefied natural gas (LNG) icebreaker tankers of 4.95 million cubic feet (140,000 m3) each, were considered. Cost estimates for this type of vessel range from $300 to $510 million. Six to ten of these vessels would be needed to transport 1 billion cubic feet (28,300,000 m3) of LNG per day.

The report stressed that the sites selected for terminals, support bases, and pipelines were only representative. These representative locations were deemed adequate for studying overall operational considerations, approximate costs, and environmental concerns.

Dow-Shell Report. In a report to the State of Alaska, the Dow-Shell Group, a consortium of nine companies, evaluated the economic feasibility of developing a petrochemical industry in Alaska. The study covered a gas pipeline from Prudhoe Bay, as well as an extraction plant, a separation facility, and a petrochemical complex for ethylene production. A more complete review of the Dow-Shell Report is presented in the facilities and impacts section of this report (p. 33).

Doyon Report. Doyon, Limited, a Native regional corporation, has proposed a natural gas liquids (NGL) pipeline project from Prudhoe to the Kenai Peninsula as an alternative to the Dow-Shell proposal. The proposed Doyon pipeline would tap the Alaska Natural Gas Transportation System (ANGTS) pipeline for gas liquids, and the Trans-Alaska Pipeline System for crude oil, and transport the mixture to refineries on the Kenai Peninsula. The Doyon report is described in more detail in the facilities and impacts section (p. 34).

Commonwealth North Report. A report issued by Commonwealth North examines natural gas transportation alternatives and recommends an all-Alaska pipeline if plans for the construction of ANGTS became delayed or postponed. The report proposes a high-pressure pipeline, transporting both dry gas and gas liquids, from Prudhoe to a tankering port in southern Alaska. Further description of the Commonwealth North report and the all-Alaska pipeline is found in the facilities and impacts section (p. 35).

TANKER TRANSPORT. Traditionally, the U.S. Government and the petroleum industry have regarded pipelines as the safest and most practical method of transporting oil and gas from the Arctic to southern markets. However, the high cost of pipeline construction as well as the desire to maximize the hydrocarbon resources of the Arctic have kindled new interest in tanker transport.

Canadian petroleum companies are planning to open shipping lanes through the Arctic as an alternative to pipelines. Dome Petroleum is considering using the Arctic Ocean year-round for tankering oil and LNG to southern markets. The proposed route is through the Northwest Passage to eastern Canada. Although the route is longer and more difficult than traveling to the west, the oil would be transported directly to markets on the east coast. Dome plans to begin construction of oil tankers to transport Canadian Beaufort Sea oil by 1984 (Dome Petroleum Ltd., Esso Resources Canada Ltd., and Gulf Canada Resources Inc., 1981). However, Dome Petroleum does plan to move cargo tankers through Alaska waters to carry freight to the northern oil fields from the Canadian west coast (Hoos, 1982, oral commun.).

In November 1981, the Canadian Government gave tentative approval to an Arctic LNG tanker transportation project. This Arctic Pilot Project is estimated to cost $1.3 billion and is designed to move LNG from the Arctic Islands to markets in Canada and the United States through the Northwest Passage. The Canadian National Energy Board was

satisfied the project could be conducted safely if recommendations were followed. These recommendations included a year-round reporting system on ice conditions and an improved method to provide navigators with adequate warning of collision hazards. Petro-Canada, Canada's national oil company, heads the group planning the project and anticipates the shipment of 260 million cubic feet (7,358,000 m3) of gas during a 20-year period beginning in 1985. The project is opposed by the Province of Ontario, Native organizations, and the government of Greenland. A final decision by the Canadian government is expected in the summer of 1982 (Oil & Gas Journal, 1981d).

PROPOSED EXPORT TO JAPAN. In October 1981, the Reagan administration began consideration of a proposal to permit exports of Alaska North Slope crude oil to Japan. A report by the White House study group cited a series of advantages of exporting Alaska oil including improving the efficiency of the U.S. economy by lowering transportation costs; increasing tax revenues for State and Federal governments; and improving trade relations with Japan. The report says that if Alaska crude oil were exported, producers could net $30 million per year more, and the U.S. and Alaska governments would collect nearly $800 million more in taxes (Oil & Gas Journal, 1981c).

Many members of Congress opposed the plan citing the vulnerability of the United States to supply disruptions, the threat to national security, and the loss of maritime jobs. These congressmen stated that the U.S. balance of trade is not a factor because exported oil would be replaced by imported oil at the same price. The American Petroleum Refiners Association (APRA) also opposed the export of crude oil because many West Coast refiners have retrofitted for North Slope crude (Oil & Gas Journal, 1981c).

Removal of the export ban would further hinder plans for both the Northern Tier Pipeline and the trans-Panamanian pipeline. The trans-Panamanian pipeline estimates higher wellhead prices in its plan because of lowered transportation costs, but the proposals to export to Japan anticipated even higher wellhead prices (Oil & Gas Journal, 1981c).

FUTURE TRANSPORTATION PLANNING. The level of hydrocarbon-related activity in the Arctic subregion indicates that there will be a high interest in various oil and gas transportation strategies for the forseeable future. Transportation of gas from Prudhoe Bay will continue to be an issue of national concern until a system is in place to transport gas to markets. There is a high probability of additional commercial discoveries of oil and gas in the subregion. These hydrocarbons will also have to be transported for processing, refining, and distribution. Because of the number of factors that must be considered in transportation planning, it is desirable to begin the process as early as possible.

FACILITIES AND IMPACTS

The support facilities at Prudhoe Bay for onshore and offshore activities resulting from State leasing have been used to support exploratory activity on tracts leased in the Joint Federal/State Beaufort Sea Lease Sale. Future exploratory activity resulting from the Joint Sale will probably also be concentrated in the Prudhoe area. Impacts of OCS-related activity will occur in the social, physical, and biological environment. Existing and proposed facilities and future impacts of oil and gas activities were discussed in detail on pages 69-81 of the initial Arctic Summary Report (USGS Open-File Report 81-621).

Existing and Proposed Facilities

PRUDHOE BAY. The facilities at Prudhoe Bay are contained in approximately a 250-square-mile (647-km2) area. ARCO operates the eastern portion of the unit, and Sohio operates the western part of the field. The facilities currently in place at Prudhoe include production structures, base camps, gravel roads, two gravel docks, two airstrips, a power station, and a small field refinery. A description of the facilities at Prudhoe is included in the initial Arctic Summary Report.

Two new major facilities are proposed for Prudhoe. A sales gas conditioning facility, to prepare gas for delivery through ANGTS, should be completed in the mid- to late-1980's. A waterflood project, designed to increase the quantity of oil recoverable from the Prudhoe field, is expected to be operational in 1982.

Sales Gas Conditioning Facility. A sales gas conditioning facility (SGCF) is being planned to condition natural gas from the Prudhoe Bay Field prior to transportation through ANGTS. The facility will condition gas by removing carbon dioxide and heavy hydrocarbons, and by compressing and chilling the gas. A description of the location of the gas conditioning facility and preliminary engineering work is presented in the initial Arctic Summary Report.

As a result of waivers approved by Congress in December 1981, the gas conditioning facility was included in the transportation system and is therefore part of the financing plan. The Office of the Federal Inspector (OFI), responsible for coordinating Federal and State activity concerning ANGTS, also became responsible for overseeing the design and construction of the plant. The regulatory requirements for the plant will be similar to those for the pipeline.

The Federal Energy Regulatory Commission (FERC) was required to issue a Certificate of Public Convenience and Necessity, which covered both ANGTS and the gas conditioning facility. On December 31, 1981, the Northwest Alaskan Pipeline Company filed a supplement to its application, which contained a description of the design of the gas conditioning facility and the sponsor's cost estimate of $4 billion, in June 1981 dollars. FERC, in an order dated January 4, 1982, amended its 1977 conditional certificate to include the gas conditioning plant. The Federal Energy Regulatory Commission described the action as an interim step in the proceedings, not as a final approval of ANGTS (Office of the Federal Inspector, 1982).

The design work on the gas conditioning facility is being done by the Ralph M. Parsons Company in Pasadena, California. The facility and the quarters for 300 operations personnel will occupy approximately 200 acres (81 hectares). The plant will condition 2.7 billion cubic feet (76,410,000 m3) per day of raw gas and will have a nominal output of 2 billion cubic feet (56,600,000 m3) per day. It will be built adjacent to an existing compressor plant in the Prudhoe Bay field near a barge causeway and dock head.

In March 1982, the Environmental Protection Agency (EPA) granted air quality and water discharge permits for the construction and operation of the gas conditioning facility. The permits enable Northwest Alaskan Pipeline Company, the operating partner for the Alaska segment of ANGTS, to request proposals for gas turbines, generator and compressor units, and water-treatment equipment (Oil & Gas Journal, 1982c).

The current project schedule calls for the first sealift of construction material and equipment to arrive at Prudhoe during the summer of 1983. Prior to the first sealift, the

temporary camp facilities for 1,200 workers, will require laying 1.8 million cubic yards (1,376,100 m3) of gravel during the summer of 1982 and an equal amount in 1983. To keep this schedule, sponsors must make commitments for the procurement of equipment and materials during the second quarter of 1982 (Office of the Federal Inspector, 1982). The sealifts will continue for several years.

Two facility materials fabrication sites on the West Coast will be selected from four possible sites. Los Angeles and San Diego, California; Everett, Washington; and Portland, Oregon, are being considered. Modules, constructed at the fabrication sites, will be barged to Prudhoe starting in August or September of 1983. Between 15 and 22 barges, each approximately 100 feet (30 m) by 400 feet (120 m), will be needed for each annual sealift. Presently, there are no barges of the size required to transport the modules.

Once the barges reach Prudhoe, adequate docking facilities will be needed. Currently, the docks at Prudhoe can accommodate four to five barges at one time. To accept the sealifts for the gas conditioning facility, the docks will have to be expanded by 1983 to accommodate 10 barges simultaneously. Applications for expansion have not yet been sent to the State of Alaska, which must approve the expansion (Office of the Federal Inspector, 1981).

Waterflood Project. The waterflood project at Prudhoe Bay calls for 2.2 million barrels (349,580 m3) of sea water and 1 million barrels (158,900 m3) of produced water per day to be injected into the formation to retrieve an additional 1 billion barrels (158,900,000 m3) of oil from the field. The waterflood project consists of several facilities: an offshore sea water intake facility, a pipeline and supporting gravel causeway, and two onshore injection plants. A description of the facilities planned for the waterflood project is in the initial Arctic Summary Report.

The gravel causeway, designed to support the pipeline from the sea water intake facility to onshore facilities, has been completed. An estimated 1,300,000 cubic yards (999,050 m3) of gravel were needed to construct the causeway that covers approximately 52 acres (21 hectares) of sea bottom. The Alaska Department of Natural Resources required ARCO to monitor the causeway. Envirosphere Incorporated in Bellevue, Washington, is under contract for the monitoring. The causeway was built with a breach to allow fish to migrate, and preliminary results indicate that the fish are using the breach as well as circling around the outer end of the causeway. Benthic infauna communities are developing as they would have without the construction of the causeway. The effect on wetlands has not yet been determined. Results of the causeway monitoring are expected to be published in April 1982. The State of Alaska plans to use the results of the causeway monitoring effort in future causeway permitting.

KUPARUK. The Kuparuk field is approximately 40 miles (64 km) from Prudhoe Bay. Currently, ARCO has one production facility that includes a pipeline and an operations center. Forty wells are supported on five gravel pads and are flowing 80,000 barrels (12,712 m3) per day into the pipeline. The 26-mile (42-km) pipeline transports oil from Kuparuk to TAPS, connecting at Pump Station 1. The three-story operations center was designed to provide living accommodations for 96 workers. ARCO also constructed a water-treatment plant, a power plant, a warehouse, a hanger, and a 200-foot (61-m) communications tower.

The production facility now operating at Kuparuk is the first of three facilities, anticipated to produce a total of 250,000 barrels (39,725 m3) per day during peak development. The second production facility will be constructed southwest of the first facility and will contain similar operations equipment (Sampart, 1982). Doyon Drilling,

Incorporated, (a unit of Doyon Limited) and Nugget Alaska Inc. (a subsidiary of Nugget Drilling Limited, headquartered in Edmonton, Alberta) will drill for ARCO and construct a new rig and housing for workers. The total cost is estimated to be $21 million. The rig design calls for four modules mounted on rubber tires on a single drill pad. The two-story camp will accommodate 60 persons. The rig is scheduled for completion in November 1982, and this production facility is anticipated to produce 80,000 barrels (12,712 m3) per day. The third production facility is estimated to produce 90,000 barrels (14,301 m3) per day by 1986 (Oil & Gas Journal, 1981e).

ARCO also plans a crude-oil gathering system between the field's three central production facilities and approximately 25 drill sites. Santa Fe Engineering Services Company in California will design and engineer the production pipelines as well as the gas lift and waterflood pipeline systems. Installation of the gathering pipeline system for the first three drill sites is expected to be completed in spring of 1982. The pipelines, ranging from 6 to 24 inches (15-61 cm), will be installed on elevated supports (Oil & Gas Journal, 1982a).

Gas production at Kuparuk is estimated at 35 million cubic feet (990,500 m3) per day, with about 25 million cubic feet (707,500 m3) per day reinjected back into the field. The remainder of the gas will be used as fuel. Because there is no gas cap at Kuparuk (unlike Prudhoe Bay), ARCO engineers plan to reinject the gas over the top of the field, creating a gas cap. ARCO will also use water flooding to create pressure on the field. The material for the waterflood project is planned to be transported in the summer of 1982. ARCO expects full field waterflood by 1985, utilizing 340 water-injection wells.

The North Slope Borough is planning to build a service base in the Kuparuk field. Negotiations are currently under way to determine the size and type of facility. Construction could begin as early as the summer of 1982 (Curran, 1982, oral commun.).

BEAUFORT SEA OCS. Existing facilities at Prudhoe Bay have been used to support exploration on tracts leased in the Joint Beaufort Sea Lease Sale. It is expected that any development and production on those tracts will also utilize many of the facilities in place at Prudhoe Bay. Among these are TAPS, airports, service company supply bases, and construction crews. Ten gravel islands have been constructed in the Joint Sale area. Shell has begun construction of another island--Seal--and has plans to construct Goose A. There have also been two ice islands constructed in the Joint Sale area: these are State no. 1 constructed by Union Oil Company, and Research, constructed by Exxon.

Sohio is testing two large steel tripods, called Arctic Dolphins, in the Beaufort Sea as a possible alternative to gravel islands. Use of the Dolphins, rather than gravel islands, would represent considerable cost savings. The steel structures were transported to the test site in September 1981. They measure 40 feet (12 m) square and stand 30 feet (9.1 m) high. The test site is less than 1 mile (1.6 km) northwest of Reindeer Island, a natural barrier island (Alaska Mines & Geology, 1982).

Siting of production facilities for Joint Sale leases cannot be undertaken until a commercial discovery is announced. If there is such a discovery, production islands, causeways, and pipelines will be built.

Proposed Treatment Facilities

The feasibility of the development of a petrochemical industry in Alaska has been the subject of four recent reports. All of these proposed projects considered using NGL from the Arctic. The conclusions of these reports are presented in the following sections.

DOW-SHELL REPORT. In October 1980, the State of Alaska and the Dow-Shell Group signed a memorandum of understanding and intent for the purpose of studying the feasibility of a petrochemical industry in Alaska. The firms in the group included Dow Chemical Company, Shell Chemical Company, Alaska Interior Resources Company, Inc., Alaska Interstate Company, Asahi-Dow, Ltd., E.I. du Pont de Nemours, MAPCO Alaska, Inc., Mitsubishi Chemical Industries, Ltd., and Mitsubishi Corporation. The year-long study was released September 9, 1981, and it was completed at a cost of $5.5 million. The cost of the petrochemical industry project is estimated at $8 to $10 billion and is targeted for the late 1980's or early 1990's (Dow-Shell Group, 1981).

The 10-volume report divided the scope of study into two projects: a natural gas liquids (NGL) project that included extraction, transportation, and separation of NGL; and a petrochemical complex. The NGL project, estimated to cost a total of $3.5 to $4.0 billion in 1981 dollars, anticipated an NGL extraction plant at Prudhoe Bay using a refrigerated lean oil absorption process. The plant, estimated to cost $1 billion, would be upstream of planned Alaska natural gas transportation system (ANGTS) facilities. The pipeline would go from Prudhoe Bay to one of six terminal sites. The gas would flow at ground temperature, and the line would be buried a nominal 3 feet (0.9 m), except where conditions would require otherwise. The pipeline would include five or six pumping stations, depending on which terminal site were chosen. Sites reviewed were: Fairbanks, Point Mackenzie, Fire Island, Wildwood, Seward, and Valdez. Cost estimates for the pipeline range from $1.6 to $2.4 billion, depending on the terminal site. The fractionation plant at the terminal site, estimated at $175 million, would separate the natural gas liquids into ethane and liquid petroleum gases for transport to the lower 48 States and Pacific Rim countries (Dow-Shell Group, 1981).

According to the study, the amount of ethane available in North Slope NGL reserves justifies construction of two world-scale petrochemical complexes, each plant being able to produce 1.5 million pounds (680,400 kilograms) of ethylene per year. To avoid flooding the market with ethylene products, the study suggests dividing the construction of the petrochemical complex into two phases, 5 years apart, at a total cost of $4.5 to $5.0 billion in 1981 dollars (Dow-Shell Group, 1981).

The Dow-Shell Group also analyzed the potential effect of a world-scale petrochemical industry (both the NGL and the petrochemical complex) on Alaska's people, environment, and infrastructure. The study concluded that the project could be developed in an environmentally safe manner. The new industry in Alaska could create 6,800 permanent jobs, of which 80 to 85 percent could be filled by State residents. Although development of a petrochemical complex for NGL could strain the physical resources of the community, the study reports that experience with other small American communities indicates a favorable reaction from community members (Dow-Shell Group, 1981).

Although the Dow-Shell Group concluded that Alaska is attractive for petrochemcial development, its economic feasibility depends on several sets of factors. Suitable conditions for construction and implementation of an NGL project consist of the following: real crude oil values rising above $38.00 per barrel (in 1981 dollars), availability of LPG ships for transportation to U.S. markets, and NGL owners committing resources to ANGTS or the

NGL project. Development of a petrochemical complex in Alaska depends on (1) petrochemical market growth in Pacific Rim countries, (2) availability of ethane at a cost low enough to offset the high cost of manufacturing in Alaska, (3) infrastructure development, and (4) availability of fuel and power (Dow-Shell Group, 1981).

The study also concluded that the timing of NGL and the petrochemical complex in Alaska would be influenced by several factors. If the Alaska Natural Gas Transportation System proceeds on its present schedule, it would probably precede an NGL project. Construction of both projects at the same time would put a strain on the Alaska construction capabilities and economy. Another factor affecting the NGL project is the lagging demand for petrochemicals in Pacific Rim countries that could delay the project. Increases in crude oil values, infrastructure development, and other Alaska projects could also affect timing, according to the report (Dow-Shell Group, 1981).

In July 1981, the Alaska Department of Fish and Game issued an interim evaluation of potential impacts of the proposed Dow-Shell petrochemical development project. The report was prepared in response to the Dow-Shell progress reports, and it identified the Department's concern in regarding potential impacts. The report concludes that insufficient information is available to predict the full magnitude of impacts that a petrochemical industry might have on Alaska fish and wildlife resources. The analysis was inhibited by lack of information on the identity and quantity of effluents, emissions, and wastes.

The Fish and Game report covered impacts from three aspects of the project: gas liquids recovery at Prudhoe Bay, a gas liquids pipeline, and a main petrochemical complex at a tidewater port. The Department of Fish and Game anticipates that major impacts to fish and wildlife will result from the main petrochemical complex and the construction of the pipeline. A petrochemical complex at any of the proposed sites will have the greatest impact on marine fisheries, especially shellfish and salmon, resulting in direct mortality or reduced production through loss of food or disruption of life stages. The major long-term impacts resulting from construction of the pipeline are anticipated to be on fish and wildlife populations, and wildlife habitats. Impacts will result from construction in watercourses, from gravel removal and work pad construction, and from increased access to sensitive wildlife areas. The report states that the proposed petrochemical complex would have the lowest potential for adversely impacting wildlife at the Fire Island and the Point MacKenzie sites. The sites having the highest potential impact are Seward and Valdez. The Fish and Game report concludes that a final assessment of impacts from a petrochemical project would require more detailed chemical, physical, biological, and toxicological data (Alaska Department of Fish and Game, 1981).

EXXON REPORT. In September 1981, the Exxon Chemical Company concluded that an Alaska petrochemical venture would not be economically attractive at this time. Exxon reported that after nearly a year of intensive engineering studies, cost estimates for a petrochemical industry were substantially higher than anticipated. As a result, the appraisals did not indicate attractive prospects for a petrochemical project for at least a number of years. Exxon plans to update these studies if factors become more favorable (Exxon Chemical Company, 1981).

DOYON REPORT. In October 1981, Doyon Limited proposed a $1.3 billion NGL pipeline project designed to transport 112,000 barrels (17,797 m3) of NGL per day and 50,000 barrels (7,945 m3) of crude oil per day to the Kenai Peninsula. The Doyon proposal is billed as an alternative to the Dow-Shell Group proposal to build an NGL pipeline from the North Slope to an unspecified port in Alaska. Doyon was originally a member of the Dow-Shell Group, but Doyon withdrew from the group because of differences over the amount of

recoverable gas liquids within the State and the amount of gas liquids available for transportation.

The proposal calls for tapping into the ANGTS at Delta Junction for gas liquids. To carry NGL between Delta Junction and Glenhallen, 143 miles (230 km) of 16-inch (41-cm) diameter pipeline is proposed. This uninsulated pipeline would be buried, except for a 1/2-mile (0.8-km) section placed aboveground to cross the Denali Fault. At Glennhallen, the Doyon pipeline would be expanded to 20 inches (51 cm) in diameter to accept crude oil from the Trans Alaska Pipeline System. Both products would be mixed in the pipeline and would be moved 255 miles (410 km) via the Glenn Highway route and Turnagain Arm to Nikishka to refineries for separation. This section of the pipeline will also be uninsulated and buried and will operate at ambient ground temperature (Doyon Limited, 1981).

At Nikishka, the crude oil and NGL would be separated and the NGL fractionated into ethane and liquid propane gas (LPG). Ethane would be fed to a proposed ethylene plant on the Kenai Peninsula and LPG would be refrigerated and stored for export to the lower 48 States. The crude oil would be refined by Chevron and Tisoro. The production decline in Cook Inlet has forced refineries on the peninsula to look for new sources of crude oil (Doyon Limited, 1981).

There are three major differences between the Doyon proposal and the Dow-Shell proposal. Doyon anticipates transporting 112,000 barrels (17,797 m3) per day, while the Dow-Shell proposal has designed transportation for 210,000 barrels (33,369 m3) per day. Because the Dow-Shell proposed pipeline originates on the North Slope, the anticipated length of the pipeline would be 450 miles (724 km) longer than the Doyon pipeline, if the Dow-Shell line went to Kenai. And, as stated above, the Doyon line will transport crude oil in addition to gas liquids (Doyon Limited, 1981).

COMMONWEALTH NORTH REPORT. Commonwealth North is a nonprofit corporation that studies issues facing the State of Alaska and the Nation. The Board of Directors is chaired by two former Alaska Governors, Governor William A. Egan and Governor Walter J. Hickel. In November 1981, Commonwealth North issued a report evaluating alternatives for natural gas transportation between the North Slope and markets in the lower 48 States. The report recommends that if ANGTS fails to be financed or becomes delayed because of litigation, the State of Alaska should take a leadership role in the building of a high-pressure gas line from Prudhoe Bay to a tidewater port and should provide equity investment or loan guarantees to an all-Alaska pipeline project.

Commonwealth North estimates a potential of 210,000 barrels (33,369 m3) per day of quality gas liquids requiring transportation. The report states that even with congressional waivers, the ANGTS line may not be financed and may require the participation of the State of Alaska or Federal loan guarantees. Furthermore, North Slope gas moving through ANGTS may not reach U.S. markets and may be exported to Japan and Pacific Rim countries; therefore, Commonwealth North urges an all-Alaska pipeline to ensure adequate gas supplies in American markets (Commonwealth North, 1981).

The natural gas project proposed by Commonwealth North has two parts: a liquification plant and tankering port and a high-pressure pipeline to move dry gas and gas liquids. The pipeline would parallel TAPS. The costs of the proposed ANGTS pipeline and the all-Alaska pipeline are estimated by producers to be roughly the same. However, proponents of the all-Alaska line state that their alternative has a distinct financing advantage. The all-Alaska pipeline alternative is comprised of four parts, all of which can

be financed separately: the pipeline, a liquification facility at a tidewater port, tankers, and a revaporization plant (Commonwealth North, 1981).

Future Impacts of Oil and Gas Activities

Both offshore and onshore oil- and gas-related activity in the Arctic will produce impacts on the physical and biological environment as well as on the Inupiat. These impacts were discussed at length in the initial summary report. Only new developments and the results of new studies are presented in this update.

IMPACTS ON THE ENVIRONMENT. The sand and gravel requirements of oil and gas exploration and development are extensive, and the removal of sand and gravel affects the biological as well as the physical environment. The impacts associated with the removal of gravel from inland locations are greater than those associated with offshore gravel removal, and impacts associated with gravel removal from areas beyond the barrier islands are minimal. As a result, the U.S. Army Corps of Engineers granted four permits to remove gravel from the Beaufort Sea, beyond the barrier island, during the past 6 months. This gravel was used for the water-injection project at Prudhoe.

The Department of the Interior is developing a leasing program for sand and gravel extraction offshore in the Beaufort Sea. The program was announced in January 1982 by Secretary of the Interior James Watt. The sand and gravel leasing is the first phase of a case-by-case approach to nonenergy mineral exploration on the OCS throughout the Nation. The Minerals Management Service and the Bureau of Land Management will describe the location of the deposits and outline the terms and royalty rates for the leases. Lease sale preparation will require steps similar to those taken for offshore oil and gas leasing, including planning and environmental assessment. The sand and gravel leasing program will have the support of the State of Alaska (Oil & Gas Journal, 1982b).

There is still a great deal of controversy concerning impacts to the biological environment from oil- and gas-related activities. Much of this controversy centers around endangered species, particularly the bowhead whale. Several studies have been recently completed or are currently under way to determine the size and health of the bowhead whale population. Late in 1981, the Bureau of Land Management released Technical Paper No. 9, which evaluates the potential effects of oil- and gas-related activity on marine mammals. The report concludes that the most likely effects of oil and gas exploration and development on marine animals will be behavioral changes induced by noise and disturbance. Additional behavioral changes could be induced by oil spills (Cowles and others, 1981). The Bureau of Land Management will release a study concerned with tissue structural studies of endangered whales in the Beaufort Sea this spring. Sohio also is conducting a bowhead whale study and expects to publish a report by the summer of 1982. There is considerable disagreement concerning the size of the bowhead population. Currently, the Alaska Whaling Commission is investigating the possibility of using satellite photography to count bowhead whales.

In April 1982, the National Marine Fisheries Service (NMFS) issued two biological opinions concerning the bowhead whale. The first of these concerned the Beaufort Sea area and contained NMFS's recommendations on seasonal drilling restrictions. The second biological opinion covers the entire Arctic region. The biological opinion concerning the Beaufort proposed shortening the period when oil- and gas-related activities should be prohibited on Federal tracts to 2 months each year. This opinion was based on the multi-

million-dollar whale studies conducted during the past 2 years by the Department of the Interior and the National Marine Fisheries Service (DOI, 1982d).

Impacts to nonendangered species are also the subject of controversy. Portions of the calving grounds of all three Arctic caribou herds has either been leased or is scheduled for lease. Although the population of the central Arctic herd is increasing, it is being displaced. An unpublished study conducted by ARCO indicates that the herd may suffer irreversible damage if oil- and gas-related activity continues to spread across the North Slope.

The impacts resulting from both catastrophic and chronic oil spills are also disputed. Those who support oil and gas development maintain that projected oil spill probabilities in the Arctic are too high. In an attempt to determine the actual incidence of oil spills on the North Slope, Blair E. Wondzell, the Alaska Oil and Gas Commission, compiled data from major oil companies, the North Region Office of the Department of Environmental Conservation, and their own files. This information was originally published in the December 1981 Bulletin of the Alaska Oil and Gas Conservation Commission. Oil industry spill data on the North Slope includes spills attributable to industry operations, including support operations, but it does not include spills by towns and villages, the Naval Research Lab at Barrow, or by Alyeska. The results of the Oil and Gas Commission's efforts are charted in figure 6.

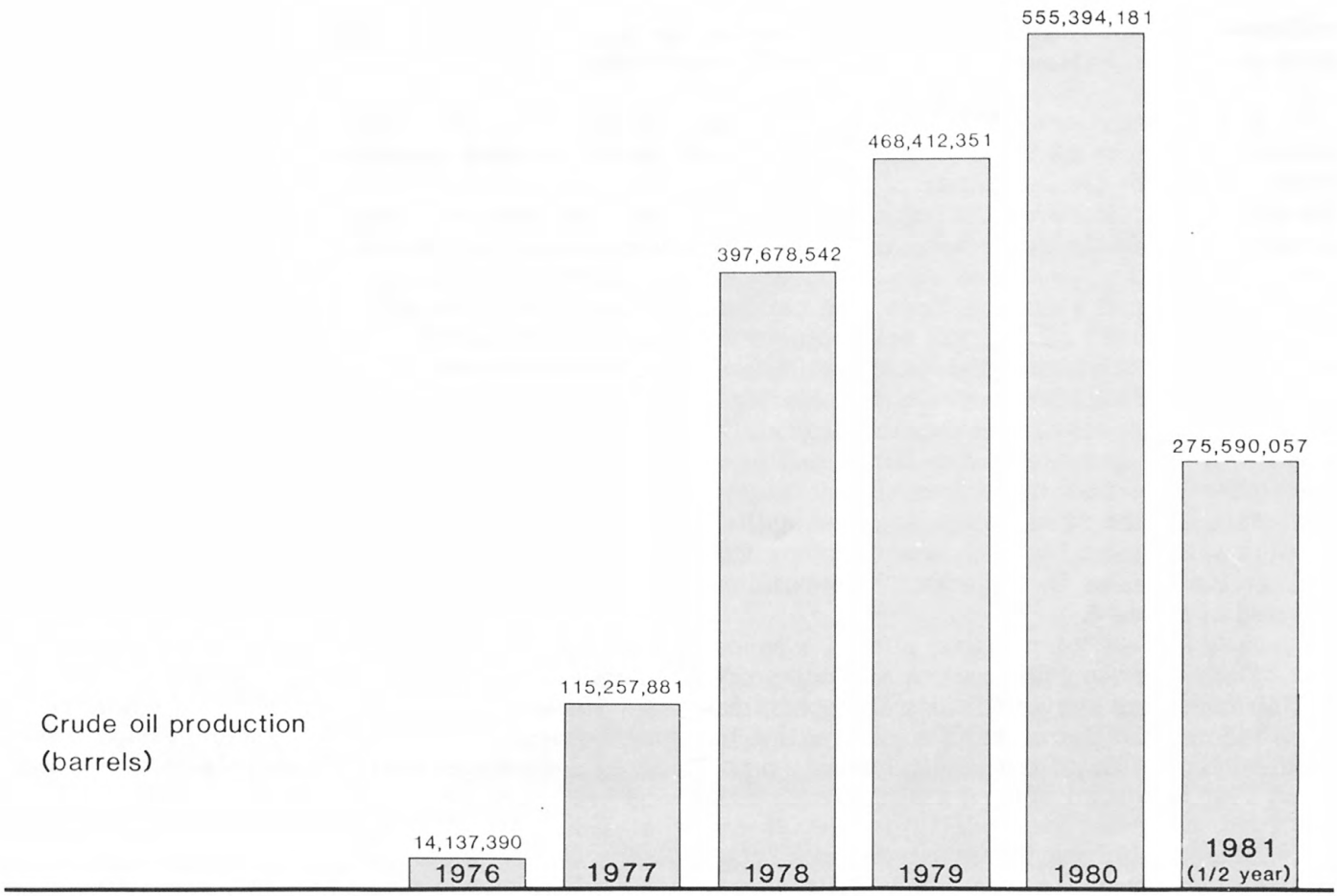
Data prior to 1976 are not available. The Department of Environmental Conservation in Fairbanks has individual oil spill reports for years 1964 and 1975, but the data have not been tabulated. Therefore, the information in figure 6 represents only the production period of the Prudhoe Bay field (and all other north Slope oil industry activity from 1976 to mid year, 1981).

Since 1976, the oil industry's spill record on the North Slope has been good. Annual spillage has decreased from about 1,100 barrels (175 m3) per year to about 400 barrels (64 m3). Volume produced per volume spilled may not have much meaning because the spillage is from the exploratory wells as well as Prudhoe Bay development and production operations; however, the above numbers disclose that approximately 500,000 barrels (79,450 m3) were produced for each barrel spilled.

CUMULATIVE ENVIRONMENTAL IMPACTS. Because of the wide range of ongoing and proposed Federal and State leasing activities, cumulative impacts of oil and gas exploration and development will be significant. The chances of a catastrophic oil spill and the number of small chronic spills of produced water and oil could increase. Reductions in caribou and other terrestrial mammal populations, birds, and certain marine mammal populations, including polar bears and ice-associated seals, are projected to occur with cumulative development. Reductions of bowhead whale populations are more difficult to predict, if these reductions occur, their effects would be extremely serious for the Natives (BLM, 1981a).

CONCLUSION

This report was written to provide State and local officials in Alaska and other interested parties with current planning information about oil- and gas-related activities on the North Slope. Although only one exploratory well has been drilled on the Arctic OCS, the area has a long history of oil- and gas-related activities. The State has leased land on the North Slope since 1963, and the discovery of oil and gas at Prudhoe Bay was announced in 1968. The exploration of tracts leased in the Joint Sale and increased oil- and gas-related



	1976	1977	1978	1979	1980	1981 (1/2 year)
Number of spills	27	49(3)[a]	81(5)[a]	81	123	116
Volume spilled (barrels)[b]	1,103	1,047	390	219	631	259

[a]The number in parentheses indicates the number of additional incidents for which no volume was reported.

[b]Spilled volume includes refined products as well as crude oil.

FIGURE 6.--Prudhoe Bay production and North Slope oil spills. (Alaska Oil and Gas Conservation Commission, 1981.)

activity are expected. The amount and pace of development will be determined by the amount of oil and gas discovered in the Arctic; the outcome of existing and proposed litigation; the type of coastal zone management program implemented by the North Slope Borough; and the types of transportation systems built or adopted.

Impacts resulting from development will be significant. The physical, biological, and social environments of the Arctic will continue to be altered. However, because of the length of time needed for the planning of new oil- and gas-related facilities in the Arctic, it is unlikely that any new facilities, other than those discussed in this report, will be built during the next 6 months.

Another update will be published in approximately 6 months. When a significant event occurs, a new summary report will be issued. The Office of OCS Information staff is available to assist State agencies if additional information or clarification is desired (telephone: (703) 860-7166).

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APPENDIX - OCS-RELATED STUDIES

There are several sources of information on Federal, State, and local oil- and gas-related activities in Alaska. Among them are the Arctic Environmental Information and Data Center (AEIDC), the Alaska Office of the Outer Continental Shelf Environmental Assessment Program (OCSEAP) and National Oceanic and Atmospheric Administration (NOAA), the Bureau of Land Management's Alaska OCS Office, and the U.S. Geological Survey's Public Inquiries Office. Studies available from or for inspection at these locations are discussed in this appendix, as well as Alaska oil- and gas-related studies produced for other Federal, State, and local agencies.

One of the best sources of Federal, State, and local studies concerning Alaska is the Arctic Environmental Information and Data Center. The AEIDC, a research unit of the University of Alaska, was established in 1972 by the Alaska State Legislature. The major objective of the AEIDC is to provide referral to and disseminate resource information about Arctic regions, with emphasis on the Alaska environment.

The Information Services staff of the AEIDC provides information referral, continually develops and maintains specialized information files, and retrieves and distributes information. These services are augmented by computerized data bases. The AEIDC's collection of 8,000 documents includes materials that are unpublished or out-of-print, and materials that are not restricted by copyright can be reproduced for a minimal charge.

The AEIDC publishes **Current Research Profile for Alaska** to document and categorize the scope of scientific research about or being conducted in Alaska. It contains abstracts of research in physical, biological, and related social sciences conducted during a given year. The most recent edition is for 1980.

For more information on AEIDC reports and services, contact:

AEIDC
707 A Street
Anchorage, AK 99501
(907) 279-4523.

The studies listed below were not included in the first Arctic Summary Report.

FEDERAL STUDIES

U.S. Department of the Interior:

Bureau of Land Management

The OCS environmental studies program of the Bureau of Land Management includes a number of BLM-funded studies administered through the National Oceanic and Atmospheric Administration's Outer Continental Shelf Environmental Assessment Program (OCSEAP). The studies funded under OCSEAP address the following subject areas: contaminant distributions; environmental hazards; pollutant transport, weathering, and fate; living resources; and effects of petroleum on marine organisms.

The reporting of these studies consists of annual, quarterly, and final reports as well as synthesis reports prepared prior to each lease sale. OCSEAP final reports, summarized in this section, are contractually required reports containing the investigator's conclusions, hypotheses, and recommendations concerning the specific subject covered in a given study. These reports are not necessarily the last report of the contract, and additional material may be presented in OCSEAP quarterly and annual reports, synthesis reports, other government or institution reports, and the open literature. The National Oceanic and Atmospheric Administration issues bound quarterly and annual reports as well as bound volumes of final reports categorized as physical science studies (volumes 1-3) and biological studies (volumes 1-16). Recent volumes are available from:

Writer/Editor
NOAA/OMPA/OCSEAP Alaska Office
P.O. Box 1808
Juneau, AK 99802
(907) 586-7441.

Requests for earlier volumes will be referred to NOAA's distribution center in Boulder, Colorado, or to the Department of Commerce's National Technical Information Service (NTIS). The address of NTIS is:

NTIS
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650.

Citations of publications resulting from these OCSEAP studies through January 1980 are compiled in **Environmental Assessment of the Alaskan Continental Shelf--Comprehensive Bibliography, 1980.** This report and information on more recent OCSEAP publications may be obtained from the NOAA/OMPA/OCSEAP Office or:

Coordinator,
Environmental Studies Program
P.O. Box 1159
Anchorage, AK 99510
(907) 276-2955.

The Bureau of Land Management also funds some OCS environmental studies separately from OCSEAP. These are primarily marine mammal studies, some of which are summarized below. Other marine mammal studies include a tagging study to test a new radio tag design for use on gray whales and a tissue structural study on bowhead whales. Inquiries on these studies should be made to the BLM Alaska OCS Office. In addition, an ongoing study on oil toxicity and seabirds is being funded out of the BLM Pacific OCS office to determine long-term effects of ingested crude oil on seabird reproduction. For information contact the BLM Pacific OCS Office, Federal Building, Room 200, 1340 West 6th Street, Los Angeles, CA 90017.

The Bureau of Land Management's OCS Socioeconomic Studies Program researches socioeconomic, sociopolitical, and transportation impacts of oil and gas activities and the effects on the man-made and natural physical environment. Studies are conducted prior to each lease sale. Many of the reports resulting from these studies are available from the source listed below as well as from NTIS.

Coordinator,
Socioeconomic Studies Program
P.O. Box 1159
Anchorage, AK 99510
(907) 276-2955.

Studies for the Arctic summarized below include OCSEAP final reports, additional BLM-funded environmental studies, socioeconomic studies under BLM's Socioeconomic Studies Program, and other BLM studies. Although most reports are available through the National Technical Information Service, these studies may also be reviewed at the BLM Alaska OCS Office, 620 East 10th Avenue, Anchorage, Alaska; at the Washington OCS Office of the BLM, 18th and E Streets, NW., Washington, DC; or at the NOAA/OMPA/OCSEAP Alaska Office in Juneau.

Aagaard, Knut, 1981, Current measurements in possible dispersal regions of the Beaufort Sea: prepared for the Outer Continental Shelf Environmental Assessment Program (OCSEAP) by the University of Washington, Department of Oceanography, Seattle, Wash., RU 91, 74 p. Available from NOAA/OMPA, OCSEAP.

This study presents a description of Beaufort Sea shelf circulation and its relationship to adjacent regions. This 5-year project involved running hydrographic sections by helicopter during fall, winter, and spring and making moored current measurements with the objective of determining dispersal mechanisms for pollutants across the shelf. The moored current meters also recorded time series of temperature. Considerable discussion is given to upwelling, strong longshore currents, cross-shelf circulation, wind influence, seasonal variability, and influx from the Bering Sea. The study points out the far-reaching nature of hydrographic connections with adjacent regions such as the Bering Sea and the Canadian Beaufort.

Ainley, D.G., Grau, C.R., Morell, S.H., Roudybush, T.E., and others, 1979, Influence of petroleum on egg formation and embryonic development in seabirds: prepared for OCSEAP, RU 423. Available from NOAA/OMPA/OCSEAP.

This report evaluates the effects of brief sublethal exposure to an oil spill on reproduction of Cassin's Auklet and Western Gulls nesting on the Farallon Islands, California. A single oral dose of bunker C fuel oil or Prudhoe Bay crude oil was administered and the effects noted on egg production, hatching success, fledging success, egg yolk structure, and yolk composition. Laboratory studies were designed to determine effects on yolk qualities and composition and embryonic changes in response to the oil.

Alaska Consultants, 1978, Beaufort Sea petroleum scenarios: man-made environmental impacts: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 19. Available from NTIS (PB 294314/AS).

The objective of this study is twofold: to develop projections of population, employment, and their characteristics for the communities of Barrow, Kaktovik, Nuiqsut, and Wainwright between 1980 and 2000 in annual intervals; and to forecast the changes likely to occur in the man-made physical environment of the North Slope Borough. It focuses specifically on economic and demographic projections for the infrastructure and delivery systems for Barrow, Kaktovik, Nuiqsut, Wainwright, and the North Slope Borough as an entity. The analysis of change was conducted for five

scenarios, one of which assumes no OCS development in the Beaufort Sea and four of which assume increasing levels of such development. The characteristics of the four OCS scenarios were generated by Dames & Moore. The characteristics of the non-OCS scenario together with forecasts of statewide and regional population, employment, and economy for all five scenarios were generated by the Institute of Social and Economic Research.

Alaska Consultants, 1978, Beaufort Sea region man-made environment: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 8. Available from NTIS (PB 281634/AS).

The objective of this study is to understand the current physical, social, economic, and demographic conditions of the Beaufort Sea petroleum development region including both the North Slope Borough as a whole, and the communities of Barrow, Kaktovik, Nuiqsut, and Wainwright. This study is part of Phase I, Task 6 Baseline Studies of the Socioeconomic Studies Program, and it will be supplemented by and synthesized with baseline studies conducted by other program subcontractors. The baseline studies, in turn, will form the basis of impact identification with and without OCS development.

Anderson, J.W., Roesijadi, G., Augenfeld, J.M., Riley, R.G., and others, 1980, Research to determine the accumulation of organic constituents and heavy metals from petroleum-impacted sediments by marine detritivores of the Alaskan OCS: prepared for OCSEAP by Battelle Pacific Northwest Laboratories, Richland, Wash., RU 454. Available from NOAA/OMPA/OCSEAP.

This study investigates the fate of petroleum hydrocarbons in the water column and intertidal zone and their availability to, and effects on, the biota. Investigations included two field habitats to supplement laboratory observations.

Barry, R.G., 1979, Study of climatic effects on fast ice extent and its seasonal decay along the Beaufort-Chukchi coasts: prepared for OCSEAP by the University of Colorado, Institute of Arctic and Alpine Research, RU 244, 60 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

This study attempts to interpret ice characteristics and their time variations from remote sensing data, primarily Landsat satellite imagery, supplemented by aircraft and field observations on the Beaufort and Chukchi coasts. Ice characteristics and behavior during the decay season of 1973-76 were mapped. Concurrent observations were made of coastal weather conditions and regional atmospheric circulation patterns in order to derive a systematic set of weather-ice relationships that can provide a framework for predictive schemes. The study showed that 250-400 thawing degree days (TDD's) were required to remove fast ice and 400-550 TDD's were required to produce open water extending 50 miles (80 km) off Point Barrow by mid-September.

Bendock, Terrence N., 1977, Beaufort Sea estuarine fishery study: prepared for OCSEAP by the Alaska Department of Fish and Game, Fairbanks, Alaska, RU 233. Available from NOAA/OMPA/OCSEAP.

This report presents the results of fish surveys conducted along 102 miles (164 km) of the Beaufort Sea coastline between the Colville and Canning Rivers over a 2-year period beginning in 1975. Tagging and recapture studies were carried out in order to define migration patterns and timing of anadromous fishes, particularly in Prudhoe

Bay. Gravel and water mining activity is seen as the major disruptive force on nearshore fish fauna, as these activities would affect fall spawning and overwintering habitats.

Bureau of Land Management, 1981, Draft environmental impact statement, proposed OCS oil and gas Lease Sale 71, Diapir Field: Washington, D.C., 240 p. and appendixes. Available from the BLM Alaska OCS Office.

This draft environmental impact statement describes the proposed oil and gas lease sale for Diapir Field in the Beaufort Sea, scheduled to be held September 1982. Environmental impacts, particularly oil spills and socioeconomic effects from onshore development, are discussed. Alternatives and mitigating measures that could reduce adverse impacts associated with the proposal also are presented, and their impacts are discussed. This report was prepared after extensive consultation and coordination with other government agencies, industry, and the public.

Braham, H.W., Krogman, B.D., and Carroll, G., 1981, Bowhead whale (Balaena mysticetus) migration, distribution, and abundance in the Bering, Chukchi, and Beaufort Seas: prepared for OCSEAP by the National Marine Mammal Laboratory, Seattle, Wash., RU 69/70, 84 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

This report updates a 1979 final report for OCSEAP by the National Marine Mammal Laboratory, incorporating additional field research conducted under an expanded National Marine Fisheries service program. The main objectives of the study were to determine the general distribution and migration of these whales in spring and autumn and to estimate abundance. Field research was conducted from September 1975 in the Bering, Chukchi, and Beaufort Seas. A literature survey covering the period of June 1975 through March 1978 is also included in the report.

Burns, John J., and Frost, Kathryn J., 1979, The natural history and ecology of the bearded seal, Erignathus barbatus: prepared for OCSEAP by the Alaska Department of Fish and Game, Fairbanks, Alaska, RU 230, 77 p. Available from NOAA/OMPA/OCSEAP.

This report presents a study of the natural history and ecology of bearded seals undertaken from June 1975 through April 1979. A preliminary life table was developed and presented. Based on recent harvests, the contribution of bearded seals to village economies was estimated. Growth parameters, some behavioral characteristics, seasonal movements, and pathology and contaminant burdens were also summarized. Direct and indirect effects of OCS development, excluding major accidents such as spills, were also discussed.

Burns, John J., Fay, Francis H., and Shapiro, Lewis H., 1980, The relationships of marine mammal distributions, densities, and activities to sea ice conditions: prepared for OCSEAP by the Alaska Department of Fish and Game, Fairbanks, Alaska, RU 248-249. Available from NOAA/OMPA/OCSEAP.

The objective of this study was to determine the characteristics, distribution, and extent of the sea ice habitats used by marine mammals, the distribution and relative densities of mammals in those habitats, and the major biological events in the lives of those mammals that are linked to their use of the ice. Potential effects of OCS development on ice-associated marine mammal populations are discussed.

Carey, Andrew G., 1977, Summarization of existing literature and unpublished data on the distribution, abundance, and life histories of benthic organisms (Beaufort Sea): prepared for OCSEAP by Oregon State University, Department of Oceanography, Corvallis, Ore., RU 7, 789 p. Available from NOAA/OMPA/OCSEAP.

This report, completed by the Oregon State University Benthic Ecology Group, summarizes the state of knowledge of the benthic ecology of the Outer Continental Shelf of the Beaufort Sea. In addition to a narrative summary of benthic community structure and composition, the report contains a species list developed from published and unpublished literature, an atlas of distribution charts for selected organisms, and an annotated bibliography.

Carls, Mark G., and Rice, Stanley D., 1980, Toxicity of oil-well drilling muds to Alaskan larval shrimp and crabs: prepared for OCSEAP by the National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Auke Bay Laboratory, Auke Bay, Alaska, RU 72. Available from NOAA/OMPA/OCSEAP.

This study was undertaken in the laboratory to measure the toxicity of drilling muds to crab and shrimp larvae to provide a better basis for assessing potential environmental effects of drilling muds. Several types of tests were conducted on six species of crab and shrimp larvae.

Colony, Roger, 1979, Dynamics of nearshore ice: prepared for OCSEAP by the University of Washington, Polar Science Center, Seattle, Wash., RU 98, 9 p. and appendix. Available from NOAA/OMPA/OCSEAP.

The objective of this project was to determine from drifting buoys the motion of nearshore ice pack from Point Barrow to Cape Lisburne. Four buoys deployed in March of 1978 within 62 miles (100 km) of the coast were seen to move into the central Chukchi Sea during early summer and then to move north and west, probably to be incorporated into the transpolar drift stream. This program expands the geographic coverage of earlier observational studies begun in 1975 and offers some indication of year-to-year variability in ice behavior.

Cowles, Cleveland J., Hansen, Donald J., and Hubbard, Joel D., 1981, Types of potential effects of offshore oil and gas development on marine mammals and endangered species of the northern Bering, Chukchi, and Beaufort Seas: prepared for the Bureau of Land Management, Anchorage, Alaska, Technical Paper No. 9, 23 p. Available from the BLM Alaska OCS Office.

This technical paper summarizes information on types of potential effects on marine mammals, endangered species, and rare plants that may be associated with oil and gas lease sales pending for the northern Bering Sea and Arctic regions. It has been written to comply with regulations that the Council on Environmental Quality issued in 1979, which specified a reduction in the size and complexity of environmental impact statements produced by the Federal Government with no accompanying reduction in the quality of analysis. To ensure compliance, a series of technical papers is being prepared by the Bureau of Land Management Alaska Outer Continental Shelf Office. The reader should review appropriate EIS documents to obtain further information on the extent or likelihood of various site-specific impacts that may be associated with individual lease sales. As necessary, this technical paper may be revised to broaden its scope or update relevant information.

Cox, J.C., Schultz, L.A., Johnson, R.P., and Shelsby, R.A., 1980, The transport and behavior of oil spilled in and under sea ice: prepared for OCSEAP by ARCTEC, Inc., Columbia, Md., RU 568, 116 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

This report is a study of the behavior of oil spilled beneath ice cover in the presence of a current. The study is basically concerned with the vertical migration of oil through ice, the interaction of oil with pressure ridges, and the horizontal transport of oil beneath ice cover. The problem was addressed in terms of oil interaction with smooth ice, small ice roughness features, and large ice roughness features. The project included both an analytical investigation and laboratory studies in ARCTEC's glass-walled ice flume of refined oils having a wide range of viscosity and density because the properties of oil to be found in the Beaufort Sea were unknown.

Crittenden, Cassetta, Cannon/Hellmuth, Obata, and Kassalbaum, Inc., 1978, Beaufort Sea baseline studies: interim report: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 5. Available for review at BLM Alaska OCS Office.

This document provides an interim inventory of selected baseline information on the physical and man-made environment of the Beaufort Sea petroleum development region and eight of its communities. It is organized into four categories: land use, land status, transportation, and utilities.

Crittenden, Cassetta, Cannon/Hellmuth, Obata, and Kassalbaum, Inc., 1978, Prudhoe Bay case study: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 4. Available from NTIS (PB 281544/AS).

This study explores the concept of enclave development in remote areas. It 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 study presents, 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.

Dames & Moore, 1978, Beaufort Sea petroleum development scenarios: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Reports Nos. 6 and 6a (Executive Summary). Available from NTIS (PB 283236).

The objective of this study is to prepare an expanded set of petroleum development scenarios governing potential future OCS oil and gas development events in the Beaufort Sea Lease Sale Basin. These scenarios will take into account potential oil and gas activities in the State and Federal offshore areas as well as relevant onshore areas. These projections are the basis upon which the studies program will evaluate changes resulting from future OCS development in the Beaufort Sea region.

Dames & Moore, 1978, Beaufort Sea petroleum development scenarios: natural physical environment impacts: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 21. Available from NTIS, (PB224571/AS).

The objective of this study is to analyze the impact on the natural physical environment for each petroleum development scenario and for a non-OCS scenario for the Beaufort Sea region communities of Barrow, Kaktovik, Nuiqsut, and Wainwright. The impact upon the environment was assessed as well as the major impacts to it from each scenario. The analysis of change was conducted for five scenarios, one of which assumes no OCS development in the Beaufort Sea and four of which assume increasing levels of such development. The characteristics of the four OCS scenarios were developed by Dames & Moore. The characteristics of the non-OCS scenario together with forecasts of statewide and regional population, employment, and economy for all five scenarios were developed by the Institute of Social and Economic Research.

Dames & Moore, 1978, Beaufort Sea region natural physical environment: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 10. Available from NTIS (PB 284567/AS).

This study provides critical natural physical information, in mapped and narrative form, for the Beaufort Sea Region Baseline Report. This information is to form the basis for the projection of natural physical environmental impacts and resource conflicts attributable to different OCS development scenarios. Baseline information is to be drawn from existing current sources and analyzed by natural physical specialists to highlight areas of particular susceptibility. Conclusions will be used by other Studies Program elements in their analysis of socioeconomic relationships and outcomes.

Dames & Moore, Chukchi Sea petroleum technology assessment **and** Hope Basin petroleum technology assessment: prepared for the Bureau of Land Management. For information on this ongoing study, contact the BLM Alaska OCS Office. Report due spring 1982.

The principal purpose of this two-part study is to determine if technology will be available to explore and develop the Chukchi Sea and to identify the petroleum technology that may be used to develop oil and gas resources of the two sale areas (Lease Sales 85 and 86). This analysis focuses on both the individual field development components (types of platforms, pipelines, etc.) and the overall field development and transportation strategies. An evaluation of the environmental constraints (oceanography, geology, etc.) identifies the most suitable engineering strategies. This study is assessing the economic viability of various development strategies under different reservoir, environmental, locational, and cost assumptions and estimating the manpower required to construct and operate the facilities.

Dames & Moore, Urban and Rural Systems Associates, and Crittenden, Cassetta, Cannon/Hellmuth, Oloata, and Kassalbaum, Inc., 1977, Beaufort Sea Basin petroleum development scenarios for the Federal Outer Continental Shelf: interim report: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 3. Available for review at BLM Alaska OCS Office.

This study is an interim report that describes in detail a set of petroleum development scenarios that are the most economically and technically feasible, based on available estimates of oil and gas resources of the Beaufort Sea region.

Dennis M. Dooley and Associates, 1978, Beaufort Sea petroleum development scenarios: transportation impacts: prepared for the Bureau of Land Management, Socioeconomic

Studies Program, Anchorage, Alaska, Technical Report No. 20. Available from NTIS (PB 291917/AS).

The objective of this study is to analyze the capacity of existing State and regional transportation systems (air, land, and water) and to determine if the increased demand for these services will take place as a result of differing levels of OCS oil and gas development in the Beaufort Sea. It also assesses Prudhoe Bay and its functioning as an enclave on the North Slope, based on conditions projected for each scenario. The analysis of change for both the State and regional transportation system was conducted for five scenarios: one assumes no OCS development in the Beaufort Sea and four assume increasing levels of such development. The characteristics of the four OCS scenarios were developed by Dames & Moore. The characteristics of the non-OCS scenario together with forecasts of statewide and regional population, employment, and economy for all five scenarios were developed by the Institute of Social and Economic Research.

Dixon, James, 1978, A cultural resource study of the Beaufort Sea: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Fairbanks, Alaska. Available from BLM Alaska OCS Office.

This report is a survey of literature pertaining to Pleistocene archeological, paleontological, and geological resources of the Beaufort Sea, including, but not limited to, geologic events and topography; terrestrial and marine faunal and floral distribution; glaciation and extent of ice cover; Pleistocene vertebrate paleontology; and archeology.

Ender, Richard L., 1978, Anchorage impacts of the Beaufort Sea petroleum development scenarios: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 13. Available from NTIS (PB 291 916/AS).

This study analyzes the impacts and changes in local socioeconomic and physical systems in Anchorage as a result of potential petroleum development in the Beaufort Sea region.

English, T. Saunders, and Horner, Rita A., 1977, Beaufort Sea plankton studies: prepared for OCSEAP by the University of Washington, Department of Oceanography, Seattle, Wash., RU 359, 340 p. Available from NOAA/OMPA/OCSEAP.

This project was undertaken in order to determine the seasonal density distribution and environmental requirements of principal species of phytoplankton, zooplankton, and ichthyoplankton, and to determine seasonal indexes of phytoplankton production. Because information concerning plankton of the Beaufort Sea was limited, most of the conclusions in this study are preliminary.

Fraker, M.A., and Richardson, W.J., 1980, Bowhead whales in the Beaufort Sea: A summary of their seasonal disturbance by offshore oil and gas exploration and development: prepared for the Bureau of Land Management by LGL Ecological Research Associates, Inc., Bryan Texas, 86 p. Available from the BLM Alaska OCS office.

This report is a synthesis of available information on the response of bowhead whales to industrial disturbances during offshore oil and gas exploration and development. The report reviews present information on distribution, movements, activities,

and activity patterns of bowhead whales. The nature of acoustic and other stimuli originating from offshore hydrocarbon exploration and development are examined, and the responses of bowhead whales to these stimuli are evaluated. Data on responses of whales to human activities are limited by inherent difficulties of conducting whale behavior studies. Gaps in the knowledge of disturbance sources and effects are discussed in the final chapter. This report covers task 1 of a larger study for BLM on bowhead whales in the Beaufort Sea.

Gill, Robert, Jr., Handell, Colleen, and Peterson, Margaret, 1978, Migration of birds in Alaska marine habitats: prepared for OCSEAP by the Fish and Wildlife Service, Office of Biological Services--Coastal Ecosystems, Anchorage, Alaska, RU 340. Available from NOAA/OMPA/OCSEAP.

This report summarizes existing data on the timing, routes, patterns and magnitudes of bird migrations in Alaska OCS areas and attempts to relate these events to lease area activities. Because of limitations of the available data, emphasis was placed on species that are highly vulnerable to oil contamination, on areas of present or pending OCS mineral mining activities, and on areas that support large populations of breeding, wintering, and transient marine birds.

Griffiths, Robert P., and Morita, Richard Y., 1980, Study of microbial activity and crude oil--microbial interactions in the waters and sediments of Cook Inlet and the Beaufort Sea: prepared for OCSEAP by Oregon State University, Department of Microbiology, Corvallis, Oreg., RU 190. Available from NOAA/OMPA/OCSEAP.

This study collected baseline data on various microbial functions related to the overall productivity of Cook Inlet, Beaufort Sea, and Norton Sound ecosystems. Both long-term and short-term effects of crude oil and the dispersant Corexit 9527 on microbially mediated cycling of carbon, nitrogen, and phosphorus in the sediments and water column also were studied. An effort was made to relate the findings to management decisions concerning the production and transport of crude oil.

Handell, Colleen M., Peterson, Margaret R., Gill, Robert E., Jr., and Lensink, Calvin J., 1980, An annotated bibliography of literature on Alaska water birds: prepared for OCSEAP by the Fish and Wildlife Service, Marine Bird Section, National Fisheries Research Center, Anchorage, Alaska, RU 339. Available from NOAA/OMPA/OCSEAP.

This report is an attempt to compile all substantive references addressing water birds in Alaska. This bibliography contains 1,554 citations and is current for most journal sources through 1979 and most of 1980. The content of each paper is summarized and each citation is indexed by subject, species, and geographic location. The study includes unpublished as well as published materials. General references or papers that include information on Alaska only as part of a larger area or topic have been omitted.

Horner, Rita A., 1981, Beaufort Sea plankton studies: prepared for OCSEAP, Seattle, Wash., RU 359, 188 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

This project was undertaken to provide basic seasonal information on Beaufort Sea phytoplankton and zooplankton, which provide food for all higher trophic levels including fish, birds, and mammals. Samples collected during icebreaker cruises in August and September of 1972, 1973, 1974, 1976, 1977, and 1978 were analyzed to

determine seasonal density distribution and environmental requirements and to determine seasonal indices of phytoplankton production. Archived samples also were identified. Existing literature was presented in a 1977 report by English and Horner.

Hunt, William R., and Naske, Claus M., 1977, Baseline study of historic ice conditions, Chukchi Sea and Bering Strait: prepared for OCSEAP by the University of Alaska, Institute of Water Resources, Fairbanks, Alaska, RU 261/262. Available from NOAA/OMPA/OCSEAP.

This study examined a wide range of sources of information useful for identifying and confirming historic severe ice events. It is a compendium of data obtained from ship logs, memoirs of mariners and explorers, and government agency reports from a number of libraries and archives. The report also includes charts showing sea ice edge.

James Lindsay and Associates, 1978, Socioeconomic impacts of the Beaufort Sea petroleum development scenarios: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Seattle, Washington, Technical Report No. 23. Available from NTIS (PB 294315/AS).

This study combines five essentially concurrent investigations (Technical Reports 18, 19, 20, 21, and 22) of perceived impacts for the Beaufort Sea Petroleum Development Scenarios. It is a synthesis of findings of socioeconomic impacts that are expected to result from this development.

Kaplan, I.R., and Venkatesan, M.I., 1981, Characterization of organic matter in sediments from Gulf of Alaska, Bering and Beaufort Seas: prepared for OCSEAP by the University of California, Institute of Geophysics and Planetary Physics, Los Angeles, Calif., RU 480, 88 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

In this study, Outer Continental Shelf surficial sediments collected from the proposed lease areas of Beaufort Sea, southeastern Bering Sea, Norton Sound, Navarin Basin, Gulf of Alaska, Kodiak Shelf, and Cook Inlet were analyzed to determine the distribution and concentration of high molecular weight hydrocarbons. The objectives of the investigation were to establish baseline hydrocarbon levels, to characterize the distribution and nature of these hydrocarbons, to assess the possible source of the hydrocarbons, and to understand the probable pathways of hydrocarbon transport in the area in case of an oil spill.

Kozo, Thomas L., 1980, Meteorology of the Alaska Arctic coast: prepared for OCSEAP by the University of Washington, Polar Science Center, Seattle, Wash., RU 519, 11 p. and appendixes. Available from NOAA/OMPA/OCSEAP.

This study was undertaken to measure and analyze surface winds, temperature and atmospheric pressures along the Arctic coast for the purpose of determining the wind field responsible for nearshore (water depths to 66 feet (20 m)) surface water movement. The study was carried out in the Simpson Lagoon-Prudhoe Bay area. Measured surface winds were compared with predicted winds from National Weather Service pressure charts.

Kuhn, P.M., Stearns, L.P., Salazar, E.S., and Loupee, B.J., 1977, Radiometric spectral response of oil films: prepared for OCSEAP by the National Oceanic and Atmospheric Administration, Boulder, Colo., RU 399. Available from NOAA/OMPA/OCSEAP.

This study identifies and determines the extent of oil spills on sea water. In the laboratory an infrared radiometer system was used in conjunction with simulated oil spills. Preliminary results of this research indicate that unique infrared signatures may be found for various oil types. The extent of a spill was found to be easily determined by the infrared radiometer system.

Lewellen, Robert, 1977, A study of Beaufort Sea coastal erosion, Northern Alaska: prepared for OCSEAP, Littleton, Colo., RU 407. Available from NOAA/OMPA/OCSEAP.

This study uses a combination of standard mensurational techniques on sequential aerial photographs, syntheses of published and unpublished data, and analyses of bathymetric charts to document Beaufort Sea coastal erosion from Point Barrow to the Canadian border. A knowledge of coastal erosion forms, processes, and rates is required for conducting oil and gas exploration and development activities. Erosion and sedimentation are important because hydrocarbons and toxic materials can be associated with the mineral and organic particles and because geologic hazards can be identified. With site-specific study, adequate design criteria and standards can be developed. The study shows that the nature of the Beaufort coastline is extremely dynamic, with erosion rates of 3 to 6 feet (0.9-1.8 m) per year. Entire spits and islands may disappear in a single storm.

LGL Ecological Research Associates and LGL Ltd. Environmental Research Associates, 1980, Beaufort Sea barrier island-lagoon ecological process studies, Simpson Lagoon: prepared for OCSEAP, RU 467. Available from NOAA/OMPA/OCSEAP.

This report is the result of an integrated ecological study of a barrier island-lagoon system in Alaska's Beaufort Sea begun in mid-1976. The study focused on geological, oceanographic, and ecological processes that supported vertebrate species of primary interest to humans and that were speculated to be vulnerable to petroleum development activities. Physical processes studied included formation mechanisms of coastal landforms, water circulation and exchange patterns, and transport and delivery patterns of materials carried by the water. The geographical location of the study was the Simpson Lagoon-Jones Islands area.

Lissauer, I.M., Welsh, J.P., and Hufford, G.L., 1976, Environmental risk of Beaufort Sea oil spill--a management tool: prepared for OCSEAP by the U.S. Coast Guard Research and Development Center, Groton, Conn., RU 81. Available from NOAA/OMPA/OCSEAP.

This report presents a technique for delineating areas of the coastline that are most susceptible to environmental damage should a spill occur under summer coastal conditions when the area is essentially full of ice. Minimum impact times and probabilities of impact are determined for 15 potential oil spill sites in the Beaufort Sea Continental Shelf, and a generalized equation is given for calculating minimum impact time for a spill to reach the shoreline from any site off the North Alaska coast.

Ljungblad, D.K., 1981, Aerial surveys of endangered whales in the Beaufort Sea, Chukchi Sea, and Northern Bering Sea: prepared for the Bureau of Land Management by the Naval Ocean Systems Center, San Diego, Calif., Technical Document 449, 302 p. Available from the BLM Alaska OCS Office.

This report documents aerial surveys and acoustical recordings of bowhead whales and other marine mammals made from April 17 to November 4, 1980, in the

Beaufort, Chukchi, and Bering Seas. In order to determine whale distribution, the spring and fall migrations past the lease areas were closely monitored. The effect of changing ice conditions on whale migration patterns is discussed in detail. Notes were taken on unusual and distinctively marked whales, and a stranding was investigated. Analysis of acoustic recordings are included in an appendix.

Ljungblad, D.K., Platter-Rieger, M.F., and Shipp, F.S., Jr., 1980, Aerial surveys of bowhead whales, North Slope, Alaska: prepared for the Bureau of Land Management by the Naval Ocean Systems Center, San Diego, Calif., Technical Document 314, 184 p. Available from the BLM Alaska OCS Office.

This study reports the results of aerial surveys for bowhead whales in an area from Point Barrow to Demarcation Bay along the North Slope of Alaska and primarily along the 10-fathom line. In the fall of 1979, 249 bowhead whales were sighted. Behavior analysis and statistical analysis of initial whale headings were made, along with tapes of whale vocalizations. Preliminary estimates were made of whale migration through the survey area during the 11-day peak period. The report includes a short history and annotated bibliography of the bowhead whale.

Lowry, Lloyd F., Burns, John S., and Frost, Kathryn J., 1979, Trophic relationships among ice-inhabiting phocid seals and functionally related marine mammals: prepared for OCSEAP by the Alaska Department of Fish and Game, Fairbanks, Alaska, RU 232, 58 p. Available from NOAA/OMPA/OCSEAP.

This report presents the results of stomach analyses of 203 ringed seals and 20 bearded seals. The specimens were collected primarily in the vicinity of Point Barrow and off Prudhoe Bay at several times of year in order to assess seasonal changes in feeding patterns. Possible effects of OCS development activities on these species are discussed. Accumulation of spilled oil under sea ice, resulting in a decrease in light penetration and inhibition of algal growth, is of particular concern because algae form the basis for all food chains.

Lowry, L.F., Frost, K., and Burns, J.J., 1980, Trophic relationships among ice-inhabiting phocid seals and functionally related marine mammals of the Chukchi Sea: prepared for OCSEAP by the Alaska Department of Fish and Game, Fairbanks, Alaska, RU 232, 58 p. Available from NOAA/OMPA/OCSEAP.

This study investigates trophic relationships of ice-associated marine mammals, primarily phocid seals, of the Chukchi Sea. The information presented is from a 4-year field program that examined stomach contents of more than 800 seals. Care was taken to collect samples at several times of year to assess seasonal changes in feeding patterns. The report recommends that further study is needed on the foods and feeding habits of marine mammals as well as on the biology and hydrocarbon sensitivity of prey species.

Malins, Donald G., 1976, Assessment of available literature on effects of oil pollution on biota in Arctic and subarctic waters: prepared for OCSEAP by the National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Wash., RU 75. Available from NOAA/OMPA/OCSEAP.

The material included in this report comprises section III of a literature review carried out by the Environmental Conservation Division of the National Marine Fisheries Service. Literature is reviewed on toxicity of crude oils and crude oil

components, including heavy metals, and on the composition and toxicity of formation waters, various drilling muds, and their components. The six research papers included in this report encompass the potential sources and levels of trace metals in the marine environment and their potential biological effects in relation to petroleum drilling and transport operations in Arctic and subarctic environments. The biological effects of four metals--cadmium, lead, chromium and nickel--on organisms were studied in detail.

McCain, B.B., Hodgins, H.O., Sparks, A.K., Gronlund, W.D., and Myers, M.S., 1980, Determine the frequency and pathology of marine fish diseases in the Bering Sea, Gulf of Alaska, Norton Sound, and Chukchi Sea: prepared for OCSEAP by the National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, Wash., RU 332, 63 p. Available from NOAA/OMPA/OCSEAP.

The overall objective of this study was to obtain baseline data on the prevalence, distribution, and characteristics of diseases presently existing in fish and invertebrates in the Bering Sea, Gulf of Alaska, Norton Sound, and Chukchi Sea. Approximately 60 species of fish were examined. Of these only nine species were found to have pathological conditions. Of the 35 invertebrate species examined in the Norton/Chukchi Sea area, 10 had detectable abnormalities. The types of conditions detected during the study were generally chronic conditions.

National Oceanic and Atmospheric Administration, Outer Continental Shelf Environmental Assessment Program, 1981, Beaufort Sea Synthesis--Sale 71 (Draft): Juneau, Alaska. Copies can be reviewed at the BLM Alaska OCS office or at NOAA/OMPA/OCSEAP.

This synthesis organizes all available environmental information pertinent to OCS development for the Sale 71 lease area. Section I presents a characterization of Sale 71 environments, including ecological characterization, circulation, and physical characteristics. Section II is comprised of chapters on ecological processes, sensitivities, and issues; pollutant behavior and trajectories; hazards; and gravel sources and gravel management options. Appendixes deal with quasi-open-water spill movement prediction and ice properties and include seasonal ice morphology maps.

Nummedahl, Dag, 1980, Persistence of spilled oil along the Beaufort Sea coast: prepared for OCSEAP by Louisiana State University, Department of Geology, Baton Rouge, La., RU 540. Available from NOAA/OMPA/OCSEAP.

The research project for which this is the final report was initiated in 1977 to assess the retention potential for spilled oil within the Beaufort Sea coastal environments, to characterize the coastal morphology and sediments, and to determine the annual longshore sediment transport rate. The results are presented in the form of 30 maps of the Alaska coast from Point Barrow to Demarcation Point.

Peat, Marwick, Mitchell and Co., 1978, Beaufort Sea region socioeconomic baseline: prepared for the Bureau of Land Management, Anchorage, Alaska, Technical Reports Nos. 11 and 11a (Executive Summary). Available from NTIS (PB 294339/AS).

This study combines four essentially concurrent investigations (Technical Reports 5, 8, 9, and 10) of the Beaufort Sea region, conducted from 1976 to 1978. This report provides a basis upon which to project socioeconomic impacts on the Beaufort Sea petroleum development region, given a variety of Outer Continental Shelf petroleum development scenarios.

Peat, Marwick, Mitchell and Co., 1981, Transportation baseline update and forecast of conditions without the planned Lease Sale, Beaufort Sea (71): prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 65. Available from NTIS.

This report considers the potential impacts of major development projects on the existing northern Alaska transportation systems. The study projects and analyzes future conditions of the various northern Alaska transportation systems in the absence of the Beaufort Sea lease sale.

Robertson, D.E., and Abel, K.H., 1979, Natural distribution and environmental background of three heavy metals in Alaskan shelf estuarine areas: prepared for OCSEAP by Battelle Pacific Northwest Laboratories, Richland, Wash., RU 506. Available from NOAA/OMPA/OCSEAP.

This study presents data that help describe the natural distribution and environmental background of trace metals in Alaska shelf and estuarine areas selected for offshore oil exploration and recovery and provides baseline information against which future environmental disturbances can be assessed. Trace metals were measured on sediment, suspended particulate matter, seawater samples and biological samples of shelf and intertidal marine organisms by means of neutron activation analysis.

Sackinger, W.M., and Nelson, R.D., 1978, Experimental measurements of sea ice failure stresses near grounded structures: prepared for OCSEAP by the University of Alaska, Geophysical Institute, Fairbanks, Alaska, RU 259, 84 p. Available from NOAA/OMPA/OCSEAP.

In situ measurements of the stresses generated in a sea ice sheet as it fails in the vicinity of a static obstacle, and the rate of approach of the ice sheet during this process are presented in this report. Stress measurements were made by means of embedded load cells (stress transducers) near the grounded pressure ridges at Barrow, Alaska, and near a grounded ice accumulation (floe-island) located in the open ocean 108 miles (175 km) northwest of Barrow. Ice motion and/or strain were measured at Barrow by radar surveillance of the ice pack and at the floe-island by inference from satellite photography and navigational data obtained from the helicopter used for logistics. The study indicates that offshore structures subject to multi-year ice floe pressures must be able to withstand ice stresses at least 250 pounds per square inch and possibly much greater.

Science Applications, Inc., 1980, Environmental assessment of the Alaskan Continental Shelf: comprehensive bibliography: prepared for the Outer Continental Shelf Environmental Assessment Program, 177 p., Office of Marine Pollution Assessment. Limited distribution through NOAA/OMPA/OCSEAP.

The Outer Continental Shelf Environmental Assessment Program currently conducts environmental studies on nine lease areas on the Alaska Outer Continental Shelf, ranging from the subarctic northeast Gulf of Alaska to the Arctic Beaufort Sea. This bibliography lists all publications resulting from research funded by OCSEAP from its inception in 1975 through January 1, 1980. These publications cover a range of disciplines, including marine geology and chemistry, physical oceanography, biology of marine organisms, and research on the effects of oil on ecosystems. A geographic (lease areas and regions) and discipline index is included. It is intended that the bibliography will be updated periodically.

Severinghaus, N.C., and Nerini, M.K., 1977, An annotated bibliography of marine mammals of Alaska: prepared for OCSEAP by the National Marine Fisheries Service, Seattle, Wash., RU 67/68/69/70. Available from NOAA/OMPA/OCSEAP.

This annotated bibliography was developed to aid in assessing baseline characteristics of marine mammals in Alaska as part of OCSEAP. It provides a comprehensive review of major published and unpublished literature on distribution and abundance of marine mammals of Alaska with respect to specific species and areas and serves as a resource base to guide researchers, managers, and administrators. The report includes area, species, and subject indexes.

Shaw, D.G., 1981, Hydrocarbons: natural distribution and dynamics of Alaskan OCS: prepared for OCSEAP by the University of Alaska, Institute of Marine Science, Fairbanks, Alaska, RU 275, 33 p. Available from NOAA/OMPA/OCSEAP.

This study provides baseline data on the ambient hydrocarbons of the water, sediment, and biota of Cook Inlet, the Gulf of Alaska, and the Beaufort Sea. An experimental model of the transport of oil to the benthos by absorption and sedimentation with suspended material was developed during the course of the study. In addition, a theoretical model for the transport of oil to the benthos by incorporation into fecal pellets after ingestion by copopods was developed.

Sowles, Arthur L., Hatch, Scott A., and Lensink, Calvin J., 1978, Catalog of Alaskan seabird colonies: prepared for OCSEAP by the Fish and Wildlife Service, Office of Biological Services, RU 338/341/343, 32 p., maps, and appendixes. Available from NOAA/OMPA/OCSEAP.

This catalog is a summary of data on the location, size, and species composition of seabird colonies along the Alaska coast. It is intended to provide the best information available as a basis for land and resource management decisions affecting seabirds and their terrestrial habitats and to identify gaps in present knowledge of seabird populations in order to foster the collection of new information. The information presented was compiled from a number of sources, including published and unpublished literature and communications from amateur ornithologists, professional biologists, and laymen.

University of Alaska, Institute of Social and Economic Research, 1981, Beaufort Sea statewide and regional demographic and economic impacts: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 62. Available from NTIS.

This study is concerned primarily with measuring the economic effects of the proposed Outer Continental Shelf petroleum development in the Beaufort Sea (Sale 71). This study includes a statewide and regional historic baseline analysis and base case projections against which the direct and indirect economic effects of Beaufort Sea OCS petroleum development are measured. The analysis and projections are carried out on a statewide level for selected regions within the State economy. The regions include Anchorage, Southcentral, Fairbanks, and North Slope regions of the Man-in-the-Arctic Program (MAP) models.

University of Alaska, Institute of Social and Economic Research, 1978, Beaufort Sea petroleum development scenarios: economic and demographic impacts: prepared for

the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 18. Available from NTIS (PB285409/AS).

The objective of this study is to develop forecasts of population and employment for each of five scenarios for the Beaufort Sea region, the State of Alaska as a whole, and Anchorage and Fairbanks. One scenario assumes no development of the Outer Continental Shelf in the Beaufort Sea region and requires further explanation by the subcontractor relative to other lease sale areas of the State, and four scenarios assume different levels of petroleum development. Applicable data were generated by Dames & Moore for each OCS scenario and made available to the subcontractor for input to the MAP model. The non-OCS scenario was developed by the subcontractor.

University of Alaska, Institute of Social and Economic Research, 1978, Governance in the Beaufort Sea petroleum development region: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Reports Nos. 16 and 16A (Executive Summary). Available from NTIS (PB294316/AS).

The overall purpose of this project is to determine the effects of oil and gas development in the Arctic on local governance and related institutional change on the North Slope. The focus is on the interaction of the North Slope Borough government with entities engaged in petroleum exploration and development. The project draws general implications for institutional developments in other regions, including prospects for borough information, and tendencies toward particular policy objectives in the issue-area of petroleum and other resource development. These implications are based on an analysis of (1) past effects of Arctic petroleum development on borough information and of the effects of the borough's resource development policies and decision; (2) prospective patterns of oil and gas development, including the OCS; and (3) the borough's posture toward petroleum development planned by Federal and State governments and the regional corporation.

Wordsmiths, 1978, Alyeska-Fairbanks case study: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Fairbanks, Alaska, Technical Report No. 14. Available from NTIS (PB 284570/AS).

This study is a synthesis of existing findings on the socioeconomic changes in Fairbanks induced by the construction of the Trans-Alaska Pipeline. Fairbanks is likely to provide staging manpower and facilities support for OCS development in the Beaufort Sea petroleum development region. The study of the experience of Fairbanks during pipeline construction will provide the program with indications of type and direction of impacts and responses likely to occur in Fairbanks as the result of proposed OCS development.

Worl Associates, 1978, Beaufort Sea petroleum development scenarios: sociocultural systems impacts: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 22. Available from NTIS (PB291918/AS).

The objective of this study is to assess future impacts of each petroleum development scenario and the related impacts to the man-made and natural physical environments. The analysis was conducted for five scenarios: one assumes no OCS development in the Beaufort Sea and four assume increasing levels of such development. The characteristics of the four OCS scenarios were generated by Dames & Moore. The characteristics of the non-OCS scenario together with forecasts of

statewide and regional population, employment, and economy for all five scenarios were generated by the Institute of Social and Economic Research.

Worl Associates, 1978, Beaufort Sea region sociocultural systems: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 9. Available from NTIS (PB284566/AS).

The objective of this study is an understanding of the organization, content, and concerns of current sociocultural conditions of the Beaufort Sea petroleum development region and the communities of Barrow, Kaktovik, Nuiqsut, and Wainwright. This study is part of Phase I, Task 6 Baseline Studies of the Socioeconomic Studies Program and will be supplemented by and synthesized with baseline studies conducted by other Program subcontractors. The baseline studies, in turn, will form the basis of impact identification with and without OCS development.

Worl, Rosita, 1979, Sociocultural assessment of the impact of the 1978 International Whaling Commission quota on the Eskimo communities: prepared for the Bureau of Land Management, Anchorage, Alaska, 81 p. Available from the BLM Alaska OCS office.

This study assesses the sociocultural impacts of the 1978 International Whaling Commission whaling quota on Eskimo society. The study specifically considers the effects on the harvest system, distribution system, and cultural traditions. The study also outlines individual psychological responses that have the potential to stimulate changes in the whaling complex. The report concludes that the quota had far-reaching impacts in northern Eskimo communities on individual and societal levels and on cultural traditions. While some impacts were immediately observable, it was felt that secondary impacts may not be discernible for several years.

Worl, Robert, Worl, Rosita, and Lonner, Thomas, 1981, Beaufort Sea sociocultural systems update analysis: prepared for the Bureau of Land Management, Socioeconomic Studies Program, Anchorage, Alaska, Technical Report No. 64. Available from NTIS.

This report updates previously collected BLM Socioeconomic Studies Program information about contemporary conditions in the sociocultural systems of Barrow and Nuiqsut. It also forecasts trends in the sociocultural systems without OCS development from Lease Sale 71. The authors noted a remarkable tenacity by the Inupiat in the political and institutional sphere to protect selected aspects of their culture. The most notable change was found in the social organization of the North Slope, where the non-Inupiat population is increasing. Even without Lease Sale 71, the Inupiat sociocultural systems will be subjected to economic pressures from onshore developments.

Not all the OCSEAP research projects funded by the Bureau of Land Management have resulted in final reports (abstracted above). Therefore, a comprehensive inventory of OCSEAP investigations funded through fiscal year 1982 is provided below. The citations include the name of the principal investigator(s), funding dates, title of investigation, and, in parentheses, the research unit (RU) number. Results of these investigations are reported periodically in annual and quarterly reports of principal investigators, available from NOAA/OMPA/OCSEAP in Juneau.

OCSEAP Studies in the Beaufort Sea (Joint Sale and Sale 71)

Aagaard, K., 1975-80, Current measurements in possible dispersal regions of the Beaufort Sea (RU 91).

Aagaard, K., 1975-77, STD Mapping of the Beaufort Sea Shelf (RU 151).

Alexander, V., and Cooney, R.T., 1977, Bering Sea ice edge ecosystem study: nutrient cycling and organic matter transfer (RU 427).

Atlas, R.M., 1975-80, Assessment of potential interactions of micro-organisms and pollutants resulting from petroleum development on the OCS in the Beaufort Sea (RU 29).

Barnes, P.W., and Reimnitz, E., 1975-82, Geologic environment of the Beaufort Sea shelf and coastal regions (RU 205).

Barrick, D.E., 1975-76, Development and operation of coastal HF current mapping radar units (RU 205).

Barry, R.G., 1977, Study of climatic effects on fast ice extent and seasonal decay along the Beaufort Sea/Chukchi Sea coast (RU 244).

Belon, A.E., 1977-80, Operation of an Alaskan facility for application of remote sensing data to OCS studies (RU 267).

Bendock, T.N., 1975-77, Beaufort Sea estuarine fishery study (RU 233).

Biswas, N.N., 1981, Compilation of a homogenous earthquake catalogue for the Alaska-Aleutian region (RU 586).

Braham, H.W., and Krogman, B.D., 1977-78, Distribution and abundance of bowhead and beluga whales in the Arctic Ocean (RU 69). Also, bibliography of marine mammals in Alaska (RU 14, 67, 68, 69).

Broad, A.C., 1975-81, Littoral survey of the Beaufort Sea (RU 356).

Burns, J.J., 1981-82, Biological investigation of beluga whales in the coastal waters of Alaska (RU 612).

Burns, J.J., Eley, and Frost, K., 1977-79, The natural history and ecology of the bearded seal and the ringed seal (RU 230).

Burns, J.J., Fay, F.H., and Shapiro, L.H., 1975-78, Relationships of marine mammal distribution, density, and activities to sea ice conditions (RU 248, 249).

Burrell, D.C., 1976, 1978, National distribution of trace heavy metals and environmental background in Alaskan shelf areas (RU 162).

Callaway, R.J., 1976, Transport of pollutants in the vicinity of Prudhoe Bay (RU 335).

Campbell, 1981-82, Weathering of spilled oil under Arctic environmental conditions (Arctic Marine Oilspill Program) (RU 606).

Cannon, P.J., 1978-80, Environment, geology and geomorphology of the barrier island-lagoon system along the Beaufort Sea coastal plain (RU 530).

Carey, A.G., 1975-81, Distribution and abundance, diversity and productivity of the western Beaufort Sea benthos (RU 6).

Carey, A.G., 1975-6, Summarization of existing literature and unpublished data on distribution, abundance, and life histories of benthic organisms of the Beaufort Sea (RU 7).

Carlson, R.F., 1975-76, Seasonality and variability of streamflow important to Alaskan nearshore coastal areas (RU 111).

Chesler, S.N., 1976, Trace hydrocarbon analysis--sea ice and sea ice-water interface: high molecular weight aromatic hydrocarbons (RU 43).

Coon, M.S., and Pritchard, R.S., 1979-80, Transport and behavior of oil spilled in and under sea ice (task I) (RU 567).

Cooney, R.T., 1975-76, Zooplankton and micronekton studies in the Bering-Chukchi/Beaufort Sea (RU 156, 164d).

Divoky, G.J., 1975-81, Distribution, abundance, and feeding ecology of birds associated with Bering Sea and Beaufort Sea pack ice (RU 196).

Drury, W.H., 1978, Site-intensive studies of marine birds at selected localities in the North Bering Sea and Bering Straits (RU 237).

English, T.S. and Horner, R.A., 1976, 1978-81, Beaufort Sea plankton studies.

Fay, F.H., 1977, 1980, Morbidity and mortality of marine animals (RU 194).

Feder, H.M., 1981, Bering Sea-Chukchi Sea benthic study (RU 5).

Fiscus, C.H., and Braham, H.W., 1976, Abundance and seasonal distribution of bowhead and beluga whales (RU 70).

Galt, J.A., 1976-77, Numerical studies of Alaskan region (RU 140, 146, 149).

Hayes, M.O., 1977-78, Coastal morphology sedimentation, and oilspill vulnerability (RU 59).

Hickok, D.M., 1978-80, Administrative support for NODC/OCSEAP representative and Alaskan data processing (RU 370).

Hopkins, D.M., 1975-82, Offshore permafrost studies in Arctic lease areas (RU 204).

Hopkins, D.M., 1978-80, Shoreline history of the Beaufort Sea and Chukchi Sea as an aid to predicting offshore permafrost conditions (RU 473).

Hoskin, C.M., 1975, 1978, Grain size analysis and Bering Sea bottom analysis (RU 291).

Hoskin, C.M., 1978, Grain size analysis of sediments from Alaskan Continental Shelves (RU 290).

Hufford, G.L., 1976, Beaufort shelf surface currents (RU 81).

Hunt, G.L., and Naske, C.M., 1977, Baseline study of historic ice conditions in Bering Strait, Chukchi Sea, and Beaufort Sea (RU 261).

Kaplan, F.R., and Venkatesan, M.I., 1977, Characterization of organic matter in sediments from Gulf of Alaska, Bering, and Beaufort Seas (RU 480).

Kovacs, A., 1979-80, Oil pooling under sea ice (RU 562).

Kozo, T.L., 1977-79, 1982, Meteorology of the Alaskan Arctic coast (RU 519).

Lafleur, P.D., et al., 1976, Environmental assessment of Alaskan waters--trace elements methodology--inorganic elements (RU 47).

Laursen, G., 1976, Development and operation of a remote sensing platform for OCS studies (RU 536).

Law, E., 1976, Establish and service a project marine baseline data base for the Alaska MEA program (RU 362).

Leendertse, J., and Liu, D., 1977-81, Oceanic circulation modelling and oilspill risk analysis (RU 435).

Lensink, C.J., 1976, Review and analysis of literature and unpublished data on marine birds (RU 339).

Lensink, C.J., and Bartonek, J.C., 1976, Feeding ecology and trophic relationships of Alaskan marine birds (RU 341).

Lensink, C.J., and Bartonek, J.C., 1976, Migration of birds in Alaska coastal and marine habitats subject to influence of OCS development (RU 340).

Lensink, C.J., and Bartonek, J.C., 1975-76, Population dynamics of marine birds (RU 342).

Lensink, C.K., and Bartonek, J.C., 1976, Preliminary catalog of seabird colonies (RU 343).

Lensink, C.K., and Bartonek, J.C., 1976, Seasonal distribution and abundance of marine seabirds (RU 337).

Lewellen, R., 1976, A study of Beaufort Sea coastal erosion (RU 407).

Lowry, L.F., Burns, J.J., and Frost, K., 1976-81, Trophic relationships among ice-inhabiting phocid seals (RU 232).

Malins, D.C., 1976, Assessment of available literature on effects of oil pollution on biota in Arctic and subarctic waters (RU 75).

Malins, D.C., Reichart, W.L., and Roubal, W.T., 1976, Identification of major processes in biotransformation of petroleum hydrocarbons and trace metals (RU 74).

Martin, S., 1977-78, Interaction of oil with sea ice (RU 87).

Matthews, B., 1978-82, Characterization of the nearshore hydrodynamics of the Arctic seas (RU 526).

McCain, B.B., 1976, Determine the incidence and pathology of marine fish diseases in the Gulf of Alaska, Bering Sea, and Beaufort Sea (RU 332).

Meyers, H., 1976, Seismicity of the Beaufort Sea, Bering Sea, and Gulf of Alaska (RU 352).

Morita, R.Y. and Griffiths, R.P., 1975-76, 1978-80, Microbial activity and crude oil-microbial interactions in the water and sediments of Lower Cook Inlet, Beaufort Sea, and Norton Sound (RU 190).

Morrow, J.E., 1976, Literature search on density distribution of fishes in the Beaufort Sea.

Morrow, J.E., 1976, Preparation of illustrated keys to skeletal remains and otoliths of forage fishes--Gulf of Alaska, Bering Sea, and Beaufort Sea (RU 285, 318).

Mueller, G. and Schamel, D., 1976, Avifaunal utilization of the offshore island near Prudhoe Bay (RU 215).

Mungall, J., 1978-81, Oceanic processes in a Beaufort Sea barrier island-lagoon system and its surroundings: numerical modelling and current measurements (RU 531).

Neff, J., 1981, Effects of crude and chemically dispersed petroleum spilled under arctic environmental conditions on benthic organisms (Arctic Marine Oilspill Program) (RU 615).

Nummedal, D., 1977-78, Coastline morphology (RU 540).

Osterkamp, T.E., and Harrison, W.D., 1975-82, Subsea permafrost: probing thermal regime and data analysis (RU 253).

Pritchard, R., 1977-78, Dynamics of nearshore ice (Arctic Ice Dynamics Joint Experiment) (RU 98).

Ray, G.C., and Wartzok, D., 1976, Analysis of marine mammal remote sensing data (RU 34).

Rice, S.D., Karinen, J., and Korn, S., 1977-78, Lethal and sublethal effects upon select Alaska marine species (RU 72).

Risebrough, R.W., and Conners, P.G., 1975-81, Shorebird dependency on Arctic littoral habitats (RU 172).

Rogers, J.C., 1975, 1977-81, Seismic studies of offshore permafrost (RU 271).

Rosenberg, D.H., 1976, Alaska OCS coordination (RU 350).

Royer, T.C., 1978, Circulation and water masses in the Gulf of Alaska (RU 289).

Sackinger, W.M., and Nelson, R.D., 1977, Experimental measurements of sea ice forces near grounded structures (RU 259).

Schell, D.M., 1978-81, Nutrient dynamics and trophic system energetics in nearshore Beaufort Sea waters (RU 537).

Schell, D.M., 1979, Nutrient dynamics and trophic system energetics in nearshore Beaufort Sea waters--winter work (RU 537W).

Schneider, and Divoky, G.J., 1976, Identification, documentation and delineation of migratory bird habitat (RU 3-4).

Schultz, L.A., 1979-80, Transport and behavior of oil spilled in and under sea ice (task II and III) (RU 568).

Searby, H.W., and Brower, W.A., 1975-77, Marine climatology of the Gulf of Alaska and the Bering and Beaufort Seas (RU 347, 496).

Sellman, P.V., and Chamberlain, E.J., 1975-82, Delineation and engineering characteristics of permafrost beneath the Beaufort Sea (RU 105).

Shapiro, L.H., and Harrison, W.D., 1977-82, Mechanics of origin of pressure, shear ridges, and hummock fields on fast ice (RU 250, 265).

Shapiro, L.H., and Nelson, R.D., 1977-79, 1982, In situ measurements of the mechanical properties of sea ice (RU 265, 250).

Shaw, D.G., 1975-77, Hydrocarbons: natural distribution and dynamics on the Alaskan OCS (RU 275).

Stringer, W.J., 1977-78, Morphology of Beaufort Sea, Chukchi Sea, and Bering Sea nearshore ice conditions by means of satellite and aerial remote sensing (RU 257, 258).

Truett, J.C., 1977-81, Beaufort Sea barrier island-lagoon ecological modelling effort for process studies (RU 467).

Weeks, W.F., and Kovacs, A., 1977-82, Dynamics of nearshore ice (RU 88).

OCSEAP Studies in the Chukchi Sea (Lease Sale 85)

Aagaard, K., 1981-82, Current measurements in possible dispersal regions of the Beaufort and Chukchi Seas (RU 91).

Atlas, R.M., 1981-82, Assessment of potential interactions of micro-organisms and pollutants resulting from petroleum development (RU 29).

Barnes, P.W., Reimnitz, E., and Drake, D., 1978, 1981-82, Geologic processes and hazards of Beaufort Sea shelf and coastal regions (RU 205).

Barry, R.J., and Jenner, 1977, Study of climatic effects on fast ice extent and its seasonal decay along the Beaufort Sea/Chukchi Sea coast (RU 244).

Barton, L.H., and Jackson, P.B., 1976-77, Forage fish assessment surveys (RU 19).

Belon, A.E., 1977-80, Operation of Alaskan facility for application of remote sensing data to OCS studies (RU 267).

Biswas, N.N., 1981, Compilation of homogenous earthquake catalogue for the Alaska-Aleutian region (RU 586).

Biswas, N.N., and Gedney, L., 1977-78, 1980-81, Evaluation of earthquake activity around Norton and Kotzebue Sounds (RU 483).

Braham, H.W., and Krogman, B.D., 1977-78, Distribution and abundance of bowhead and beluga whales in the Arctic Ocean (RU 68, 69).

Broad, A.C., 1977-78, 1980, Environmental assessment of selected habitats in the Bering Sea and Chukchi littoral system (RU 356).

Burns, J.J., 1981-82, Biological investigation of beluga whales in the coastal waters of Alaska (RU 612).

Burns, J.J., 1981, Investigations of ice-dependent marine mammals in the coastal zone during summer and autumn (RU 613).

Burns, J.J., Fay, F.H., and Shapiro, L.H., 1977-78, Relationships of marine mammal distribution, abundance, and activities to sea ice conditions (RU 248).

Burns, J.J., and Frost, K., 1976, 1978-79, The natural history and ecology of bearded seals and ringed seals (RU 230).

Carey, A.G., 1981, Distribution, composition, and variability of the western Beaufort and northern Chukchi benthos (RU 6).

Coon, M.S., and Pritchard, R.S., 1982, Transport and behavior of oil spilled under sea ice (RU 567).

Cooney, R.T., 1975-76, Zooplankton and micronekton studies in the Bering-Chukchi/Beaufort Seas (RU 156, 164d).

Crane, M.L., 1980, Alaskan OCSEAP data processing facility (RU 497).

Divoky, G.J., 1978-81, Distribution, abundance, and feeding ecology of birds associated with Beaufort, Chukchi, and Bering Sea pack ice (RU 196).

Divoky, G.J., 1977, Identification, documentation, and delineation of coastal migratory bird habitats (RU 3, 4).

Drury, W.H., 1978, Site-intensive studies of marine birds at selected localities in the northern Bering Sea and Straits (RU 237).

English, T.S., 1980, Plankton studies (RU 424).

Fay, F.H., 1981-82, Modern populations, migrations, demography, trophics, and historical status of the Pacific walrus in Alaska (RU 611, 194).

Fay, F.H., 1980, Morbidity and mortality of marine mammals (RU 194).

Feder, H.M., 1981, Bering Sea-Chukchi Sea benthic study (RU 5).

Feder, H.M., 1975-76, Summary of literature: distribution, abundance, and productivity in the Gulf of Alaska, Bering Sea, and Chukchi Sea (RU 282, 301).

Feder, H.M., and Jewett, S.C., 1977, Trawl survey of benthic epifauna of the Chukchi Sea, Norton Sound, and Kotzebue Sound (RU 502).

Galt, J.A., 1977, Numerical studies of Alaskan region (RU 140).

Hayes, M.O., 1977-78, Coastal morphology, sedimentation, and oilspill vulnerability (RU 59).

Hayes, M.O., and Cannon, P.J., 1977, Environmental geology, geomorphology, and sediments/coastal environments in Kotzebue Sound and Chukchi Sea (RU 99).

Hopkins, D.M., 1981-82, Offshore permafrost studies in Arctic lease areas (RU 204).

Hopkins, D.M., 1977-78, 1981, Shoreline history of the Chukchi Sea as an aid to predicting offshore permafrost conditions (RU 473).

Horner, R.A., 1978, 1980, Bering Sea plankton studies (RU 359).

Hufford, G.L., 1977-78, Beaufort shelf and northern Chukchi surface currents (RU 81).

Hunt, G.L., and Naske, C.M., 1977, Baseline study of historic ice conditions in the Bering Strait, Chukchi Sea, and Beaufort Sea (RU 261).

Kaplan, I.R., and Reed, W.E., 1977, Characterization of organic matter in sediments from the Gulf of Alaska, Bering Sea, and Beaufort Sea (RU 480).

Kozo, T.L., 1981-82, Nearshore meteorological regimes in the Arctic (RU 519).

Laursen, G., and Frank, M., 1978, Development and operation of a remote sensing data acquisition platform for OCS studies (RU 536).

Leendertse, J.J., and Liu, S.K., 1982, Oceanic circulation modelling and oilspill risk analysis (RU 435).

Lensink, C.J., 1976, Review and analysis of literature and unpublished data on marine birds (RU 339).

Lensink, C.J., and Bartonek, J.C., 1976, Preliminary catalog of seabird colonies (RU 343).

Lowry, L.F., Frost, K., and Burns, J.J., 1977-80, Trophic relationships among ice-inhabiting phocid seals and functionally related mammals (RU 232).

Malins, D.C., 1978-79, Arctic and subarctic oil pollution effects upon marine species (RU 72, 73, 74, 75).

Marquette, W.M., 1976, Distribution and abundance of bowhead and beluga whales (RU 70).

Martin, S., 1975, 1978, Interaction of oil with sea ice (RU 87).

Matthews, J.B., 1982, Characterization of the nearshore hydrodynamics of the Arctic seas (RU 526).

McCain, B.B., Hodgins, H.O., and Gronlund, W.D., 1977, Determination of frequency and pathology of marine fish diseases in the Bering Sea, Gulf of Alaska, and Beaufort Sea (RU 332).

Michelson, P.G., 1977, Avian community ecology at two sites on Dapenberg Peninsula in Kotzebue Sound (RU 441).

Mungall, C.H., 1981, Wilson, D., 1982, Numerical modelling and associated drift measurements of Beaufort Sea and Chukchi Sea oceanographic trajectories (RU 531).

Osterkamp, T.E., and Harrison, W.D., 1977-78, 1980-82, Subsea permafrost: probing thermal regime and data analysis (RU 253).

Pereyra, W.T., and Dunn, J.R., 1977, Baseline studies of fish and shellfish resources of the eastern Bering Sea, Norton Sound, and southeastern Chukchi Sea (RU 175).

Pritchard, R., 1977-78, Dynamics of nearshore ice (Arctic Ice Dynamics Joint Experiment) (RU 98).

Ray, G.C., and Wartzok, D., 1976-77, Analysis of marine mammal remote sensing data (RU 34).

Risebrough, R.W., 1978, 1980-81, Shorebird dependency on Arctic littoral habitats (RU 172).

Rogers, J.C., 1977-78, 1981, Seismic studies of offshore permafrost (RU 271).

Roseneau, D.G., and Springer, A.M., 1977-82, Populations and trophics of large seabird colonies in the Arctic (RU 460).

Royer, T.C., 1978, Circulation and water masses in the Gulf of Alaska (RU 289).

Schell, D.M., 1981, Nutrient dynamics in nearshore under-ice waters, and determination of relative fractions of carbon from different sources in active Arctic trophic systems (RU 537).

Schumacher, J.D., Coachman, L.K., Aagaard, K., Kinder, T.H., et al., 1978-80, Chukchi Sea and Norton Sound, oceanographic processes (RU 541, 550).

Science Applications, Inc., 1981, Analysis of nearshore marine and anadromous fishes of the Chukchi Sea (RU 618).

Sellman, P.V., and Chamberlain, E.J., 1981-82, Delineation and engineering characteristics of permafrost beneath the Arctic (RU 105).

Shapiro, L.H., and Harrison, W.D., 1980-82, Mechanics of origin of pressure ridges, shear ridges, and hummock fields in landfast ice (RU 250, 265).

Shaw, D.G., 1977, Hydrocarbons: natural distribution and dynamics on the Alaskan OCS (RU 275).

Stringer, W.J., 1977-78, Morphology of Beaufort, Chukchi, and Bering Seas nearshore ice conditions by means of satellite and aerial remote sensing (RU 257, 258).

Weeks, W.F., and Kovacs, A., 1977-82, Dynamics of nearshore sea ice (RU 88).

Wise, J.L., 1977, Marine climatology of the Gulf of Alaska, Bering Sea, and Beaufort Sea (RU 347, 496).

Three new studies in the Arctic have been proposed and funded for 1982, although the contracts for these studies have not yet been awarded. They are as follows:

Bering and Chukchi Sea ice edge data synthesis (funded for Chukchi Sea) (PU 2023).

Arctic ecological systems analysis (funded for the Beaufort and Chukchi Seas) (PU 2033).

Remote sensing data acquisition and analysis (funded for the Beaufort and Chukchi Seas) (PU 2036, was RU 267).

U.S. Geological Survey

The U.S. Geological Survey (USGS) programs in Alaska encompass a broad range of activities. The results of studies carried out under these programs are generally first released through the open literature and subsequently published in open-file reports or other USGS publications. There are two offices in Alaska where Survey publications can be purchased, in Anchorage and in Fairbanks; however, open-file reports are available only at the Anchorage location:

Public Inquiries Office
508 Second Avenue
Anchorage, AK 99501
(907) 277-0577.

Each month the U.S. Geological Survey publishes a catalog, **New Publications of the Geological Survey**, which contains a list of new reports and maps released during the month. These lists are compiled into a single volume at the end of the year. Most open-file reports and water resource investigations can be ordered from:

Open-File Services Section
Box 25425, Federal Center
Denver, CO 80225

Some of these reports also are available from:

National Technical Information Service (NTIS)
5285 Port Royal Road
Springfield, VA 22161

Some of the National Petroleum Reserve in Alaska study results are released through the National Oceanic and Atmospheric Administration's open-filing system. An index to these reports and the reports themselves (see National Oceanic and Atmospheric Administration section, below) can be ordered from:

NOAA/Environmental Data Center
EDIS-D62
325 Broadway
Boulder, CO 80303
(303) 497-6118

One of the best sources of information on current USGS programs in Alaska is USGS Circular 843, entitled **The U.S. Geological Survey in Alaska--1981 Programs**, which can be obtained from the Public Inquiries Office in Anchorage.

Reed, K.M. (ed.), 1981, The U.S. Geological Survey in Alaska--1981 programs: prepared for the U.S. Geological Survey, Geological Survey Circular 843, 111 p. Available from the Anchorage Public Inquiries Office.

This circular describes the Fiscal Year 1981 programs and projects of the U.S. Geological Survey in Alaska. A brief description of the Alaska operations of each office and division of the Survey is followed by project descriptions arranged by geographic regions in which the work takes place. A directory at the end of this booklet lists project chiefs and summarizes other general information. A listing of cooperating agencies is also included.

A companion circular, 844, consists of articles describing significant accomplishments of the Survey's topical and field investigations in Alaska during 1980.

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration conducts the Outer Continental Shelf Environmental Assessment Program for the Bureau of Land Management. A discussion of the program and summaries of OCSEAP final reports and synthesis reports are included in the section on the Department of the Interior, Bureau of Land Management.

Frost, Kathryn J., and Lowry, Lloyd F., 1981, Feeding and trophic relationships of bowhead whales and other vertebrate consumers in the Beaufort Sea: prepared for the National Marine Fisheries Service by the Alaska Department of Fish and Game, Fairbanks, AK, 106 p. and appendixes. Available from the National Marine Mammal Laboratory, 7600 Sand Point Way, NE., Seattle, WA 98115.

This three-part study examines trophic interactions among major vertebrate consumers, particularly bowhead whales, in the Alaska Beaufort Sea. All available data on foods and feeding of bowhead whales are analyzed and synthesized. Field studies in the eastern portion of the Alaska Beaufort Sea during September 1980 examined foods utilized by ringed seals and Arctic cod in areas where bowheads were known to feed. The study assesses the kinds and quantities of prey required on an annual basis to support populations of bowheads and their potential trophic competitors. The report concludes that it is not possible at present to determine with certainty if competition for food is affecting the recovery of the Bering-Chukchi-Beaufort stock of bowhead whales, and that further studies are needed to understand the magnitude and effects of competition for food among vertebrate consumers in the Beaufort Sea.

Hittleman, Allen M., 1982, Catalog of geological and geophysical data for the National Petroleum Reserve in Alaska: Boulder, Colorado, 91 p. Key to Geophysical Records Documentation No. 16. Available from NOAA/EDIS/NGSDC, 325 Broadway (D62), Boulder, CO 80303.

This catalog describes all geological and geophysical data available from the National Geophysical and Solar-Terrestrial Data Center for the National Petroleum Reserve in Alaska (NPRA) through September 1981. The catalog includes (1) common depth point (CDP) seismic reflection data and documentation, 1972-81; (2) well logs and associated information, 1946-81; (3) free-air and Bouguer gravity data, 1974-80; (4) aerial gamma ray and magnetic profiles, 1977; and (5) geological and geophysical data reports. The data sets described include, where appropriate, data set name and number; survey date and size; fold or multiplicity; seismic source; description and format of data provided; and optional data (items in the main data set that may be purchased separately, and alternate formats of the main data set). Prices for each item are given in the price list at the end of the catalog.

National Oceanic and Atmospheric Administration, 1978, A special report to the International Whaling Commission--bowhead whales: prepared for the International Whaling Commission, Washington, D.C., 63 p. and appendixes.

This special report to the International Whaling Commission details the United States' bowhead whale research and management programs and the results of that program relating to the bowhead whale hunt of spring 1978. Chapters of the report include interim reports on the 1978 management and research programs and 1978 weapons improvement, along with a chapter on Alaska Eskimo subsistence dependence. Included in the appendixes is a status report submitted by the Alaska Eskimo Whaling Commission, an organization that was formed to represent subsistence bowhead whalers and the U.S. regulations for the bowhead management program.

U.S. Army Corps of Engineers

Arcone, S.A., Delaney, A.J., and Sellmann, P.V., 1979, Effects of seasonal changes and ground ice on electromagnetic surveys of permafrost: prepared for the Directorate of Military Programs, Office, Chief of Engineers, by the U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, 29 p., CRREL Report 79-23. Available from CRREL, U.S. Army COE, Box 282, Hanover, NH 03755.

The performance of surface impedence and magnetic induction electromagnetic subsurface exploration techniques was studied seasonally at various sites in Alaska where permafrost and massive ground ice occurred. The methods used distinguish subsurface materials by the electrical resistivity of the materials. Because they have the greatest sensitivity within 66 feet (20 m) of the surface, they are most applicable for shallow subsurface investigations. The magnetic induction method was found to be generally superior to the surface impedence method for delineating permafrost and zones of massive ground ice when the surface layer is frozen. It is also concluded that because the resistivity contrasts between frozen ground and massive ice may be eliminated, careful attention must be paid to the geological and thermal aspects of a site or region.

Johnson, Lawrence A., 1981, Revegetation and selected terrain disturbances along the trans-Alaska pipeline, 1975-78: prepared for the Office of the Chief of Engineers by the

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire, 124 p., CRREL Report 81-12. Available from CRREL, U.S. Army COE, Box 282, Hanover, NH 03755.

This study observed revegetation techniques employed by Alyeska Pipeline Service Company along the trans-Alaska pipeline during the summers of 1975-78. The objectives included determining the success of treatments, identifying problem areas, and noticing long-term implications. Observations and photographs at 60 sites indicated frequent occurrences of successful revegetation as well as frequent problems such as erosion, slope instability, poor scheduling of seed application, occurrence of weed species, failure to optimally reuse topsoil and fine-grained soil, and low rates of native species reinvasion. Alyeska's visual impact engineering was found to be successful based on high first-season survival. A related program for establishing willow cuttings, while unsuccessful in 1977, appeared promising in 1978, largely due to improved management and favorable growing conditions. Other disturbances related to pipeline construction were examined and are discussed in the report.

Lawson, D.E., Brown, J., Everett, K.R., Johnson, A.W., and others, 1978, Tundra disturbances and recovery following the 1949 exploratory drilling, Fish Creek, northern Alaska: prepared for the U.S. Geological Survey by the Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers, Hanover, New Hampshire, 91 p., CRREL Report 78-28. Available from CRREL, U.S. Army COE, Box 282, Hanover, NH 03755.

This study examines a 1949 drill site in the NPRA to determine the disturbance caused by drilling activities and to analyze the response and recovery of the vegetation, soils, permafrost, and surficial materials to that disturbance. The most intense and lasting disturbance resulted from bulldozing of surface materials, diesel fuel spills, and tracts developed by multiple passes of vehicles. A hypothetical model of natural revegetation is proposed, and recommendations on cleanup and restoration of sites are presented.

Simmons, Carol L., Walker, Donald A., Webber, Patrick J., and Everett, Kaye R., Sensitivity of selected plant communities to sea-water spills, Prudhoe Bay, Alaska: supported by USA/CRREL in cooperation with the Sohio-Alaska and ARCO petroleum companies, manuscript in press.

This study was undertaken to evaluate the relative sensitivities of different plant communities to seawater. Eight sites representing the range of vegetation types along the Prudhoe Bay waterflood pipeline route were treated with single saturating applications of sea water during the summer of 1980. The sites include dry, moist, and wet tundra, with either slightly acidic (pH 5.3-6.2) or alkaline (pH 7.1-8.5) soils. In the wet sites, spills at the experimental volumes are quickly diluted and the salts flushed from the soil. In the dry sites, on the other hand, salts are retained in the soil. The sensitivity of tundra plant communities to sea water is synergistically related to the soil-moisture/salt-retention gradient and to the growth forms of the component species. Shrubs, forbs, and bryophytes are most sensitive, while graminoids are least sensitive. Plants on dry and moist sites that retain salts are most susceptible to sea-water dmaage, while those on wet sites that retain little salt are least susceptible. The distinctiveness of the relationships among site moisture regime, plant community, and site-sensitivity to sea water will permit the construction of maps showing the relative sensitivities of tundra habitats to seawater spills. Such maps may be used to route pipelines and locate seawater injection sites over the least susceptible tundra.

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, 1981, CRREL Technical Publications: Supplement, 1 January 1976 to 1 July 1981: Hanover, New Hampshire, 150 p. Available from USACRREL, Hanover, NH 03755.

The Cold Regions Research and Environmental Laboratory publishes approximately 100 technical reports, engineering technical letters, and draft translations each year. This publication contains citations and abstracts published during the stated reporting period. The reports are indexed by type of publication, author, and title.

U.S. Department of Energy

Hanson, W.C., and Eberhardt, L.E., 1982, Ecological investigations of Alaska resource development in Pacific Northwest Laboratory annual report for 1981 to the DOE Office of Energy Resources, Part 2, ecological sciences: prepared by Batelle for the U.S. Department of Energy, Richland, Washington, 4 p. Available from the NTIS.

The objective of this research is to provide an integrated program for the definition of ecological consequences of resource developments in northern Alaska. The qualitative and quantitative results obtained describe the environmental costs incurred by petroleum resource extraction and transportation, and the interaction of wildlife populations with industrial activities. This annual report briefly summarizes results of research on affected populations of Arctic foxes, small mammals, and tundra-nesting birds along the Trans-Alaska pipeline and Haul Road; field studies on the nitrogen fixation patterns of lichens; and on amounts of radionuclides from worldwide fallout in the lichen-caribou-Eskimo food chain.

National Petroleum Council, 1981, U.S. Arctic oil and gas: prepared for the U.S. Department of Energy, Washington, D.C., 130 p. and appendixes. Available from the National Petroleum Council, 1625 K Street, NW., Washington, D.C.

This comprehensive study of Arctic oil and gas was undertaken by the National Petroleum Council at the request of the U.S. Secretary of Energy. The study includes resource assessment information, a description of the physical and biological environment, analysis of exploration, production, and transportation technology, an economic assessment of these technologies, a review of community and environmental impacts, and a discussion of regulatory considerations. The study concludes that oil and gas production from undeveloped areas in the U.S. Arctic could make a significant contribution to the Nation's future energy supplies.

OTHER STUDIES

American Association for the Advancement of Science, Alaska Division, and University of Alaska, Institute of Social and Economic Research, 1980, Agenda 80's, proceedings, 31st Alaska Science Conference, Anchorage, Alaska, September 17-19, 1980: Anchorage, Alaska. Available at cost from Institute of Social and Economic Research, University of Alaska, 707 A Street, Suite 206, Anchorage, AK 99501.

This document contains abstracts of the 134 papers presented in 34 panel sessions during the conference. The thematic emphasis of the conference was on the social sciences and Alaska's natural resources. Panels concerning OCS-related issues included "Arctic Oil and Gas in National and International Perspective" and "Outer Continental Shelf Studies." The entire conference proceedings and full transcripts of

the papers will not be published, and it is recommended that authors be contacted directly for selected papers.

Alaska Department of Fish and Game, 1981, Potential impacts of the proposed Dow-Shell petrochemical complex on fish and wildlife resources in Alaska: Anchorage, Alaska, 104 p. Available from Alaska Department of Fish and Game, Anchorage, Alaska.

This report, prepared in response to the Dow-Shell progress reports on a proposed petrochemical complex in Alaska, identifies the Alaska Department of Fish and Game's concerns regarding potential impacts of such an industry on the fish and wildlife resources of the State. The report describes the proposed project, identifies fish and wildlife resources that might be affected, and discusses the nature of potential impacts. The study concludes that insufficient information is available to predict the full magnitude of impacts, but that the industry has the capability of adversely impacting several important fish and wildlife resources.

Arctic Environmental Information and Data Center, 1981, Alaska coastal bibliography and index statewide: prepared for the Alaska Office of Coastal Management, 407 p. Available at cost from Information Services, Arctic Environmental Information and Data Center, University of Alaska, 707 A Street, Anchorage, AK 99501.

This bibliography is generated from a data base containing relevant publications, data files, and current research concerning the coastal zone. The research in these documents is intended to help the State's coastal communities in the formulation of their coastal management responsibilities. Citations can be searched by author, subject, or geographic index (including regions). Citations listed can, in most cases, be obtained for the cost of reproduction. Custom data searches are also available upon request.

NOTE: A list of special collections available on microfiche and a description of the Center's databases are available from the address above.

Arctic Environmental Information and Data Center, 1981, Current research profile for Alaska, 1980: Anchorage, Alaska, 487 p. Available from Information Services, Arctic Environmental Information and Data Center, 707 A Street, Anchorage, AK 99501.

This report contains abstracts of research in physical, biological, and related social sciences conducted during 1980. Research projects are divided into 28 categories. Each entry lists principal investigator, telephone number, affiliation, and address; co-investigator (if any) and affiliation; funding agency, funding period, and funding amount; geographic location of research in Alaska; objectives of research; and subject key words. Indexes are keyed to investigator, affiliation, funding agency, subject, region, and geographic location.

Dow-Shell Group, 1981, Report to the State of Alaska--feasibility of a petrochemical industry--Summary/Conclusions: prepared for the State of Alaska, Anchorage, Alaska, volume 1 of 10, 55 p. Inquiries regarding availability of volume 1 as well as the other volumes should be directed to The Dow-Shell Group, 101 West Benson Boulevard, Suite 320, Anchorage, Alaska 99503.

This report is the result of a year-long study undertaken by a group of nine companies to determine the economic feasibility of utilizing Prudhoe Bay natural gas liquids to develop a petrochemical industry in Alaska and to determine the compatibil-

ity of such industrial development with Alaska's environmental, social, and economic goals. This volume summarizes the results of this study, which is reported in detail in volumes 2 through 10. Chapters of this volume deal with safety, industrial hygiene, and environmental studies; economic feasibility; petrochemical plants; financing plan and feasibility; site studies; infrastructure and socioeconomic impact energy study; and project organization, construction timeline, and personnel requirements, recruiting, and training. A final chapter presents conclusions.

Emmel, Karen S., 1982, Geological literature on the North Slope of Alaska, 1974-1980: published by the Division of Geological and Geophysical Surveys, Alaska Department of Natural Resources, Anchorage, Alaska, 127 p. Available for review or purchase at DGGS, P.O. Box 8007, College, Alaska 99708, or at any DGGS Office.

This collection includes references to most geological literature published between July 1974 and December 1980 on that part of Alaska north of lat 68 deg N. Most reports on offshore areas are included as well as some reports on adjacent areas in Canada. Special emphasis was placed on petroleum geology and related fields. Because of its impact on exploration and development, permafrost also is represented, but no exhaustive effort was made to include all articles on this subject. Subject and area indexes are included, along with an index map showing physiographic provinces and the National Petroleum Reserve-Alaska, an index map showing USGS quadrangles on the North Slope, and a generalized geologic map of northern Alaska.

Kruse, John A., 1982, Subsistence and the North Slope Inupiat: the effects of development: prepared for the University of Alaska, Institute of Social and Economic Research, Man in the Arctic monograph series, Anchorage, Alaska, draft report, 65 p. Requests for information should be directed to the Institute of Social and Economic Research, University of Alaska, Anchorage, Alaska.

This report is one of a series of monographs on man in the Arctic. It examines current patterns of subsistence activity on the North Slope and compares these patterns with observed patterns in nearby regions that have not had as intense a recent exposure to outside influences. A major focus is the extent to which the rapid increase in wage employment, personal incomes, and lifestyle options associated with energy development have reduced the economic and social roles played by the subsistence activities of the North Slope Inupiat.

Northern Technical Services, 1981, Environmental effects of gravel island construction--Endeavor and Resolution Islands, Beaufort Sea, Alaska: prepared for Sohio Alaska Petroleum Company, Anchorage, Alaska, 62 p. Available from Sohio Alaska Petroleum Company, Pouch 6-612, 3301 C Street, Anchorage, Alaska 99502.

This study reports the results of an environmental monitoring program implemented to assess physical aspects of the effects of gravel island construction on water quality and seafloor deposition. The objectives were to determine the extent and range of suspended solids concentration in the plume during construction and to assess the character and amount of seafloor deposition outside the immediate construction site.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1982— 361-614/95