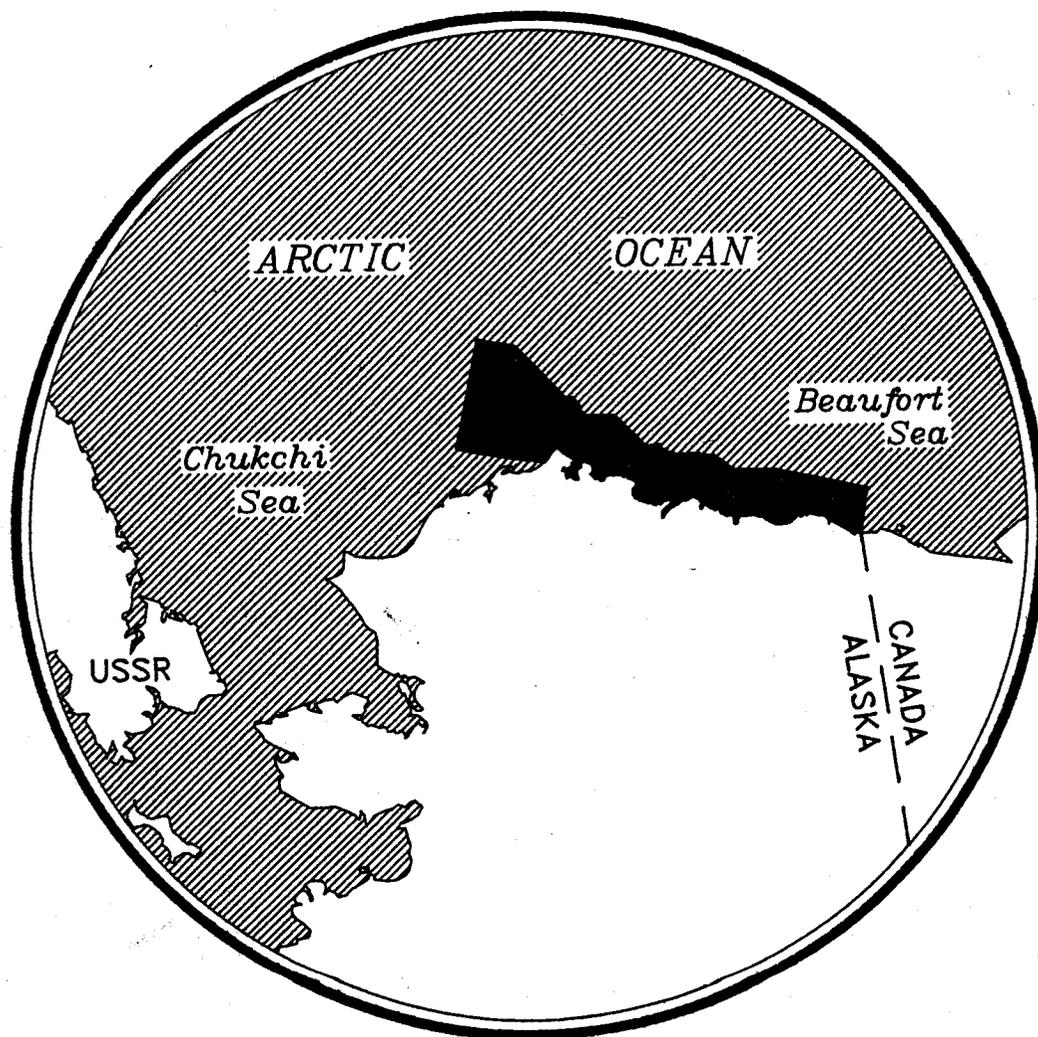


Alaska Outer Continental Shelf

# Beaufort Sea Planning Area Oil and Gas Lease Sale 124

Final Environmental  
Impact Statement

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U.S. Department of the Interior  
Minerals Management Service  
Alaska OCS Region

**MMS**

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**This Environmental Impact Statement (EIS) is not intended, nor should it be used, as a local planning document by potentially affected communities. The exploration, development and production, and transportation scenarios described in this EIS represent best-estimate assumptions that serve as a basis for identifying characteristic activities and any resulting environmental effects. Several years will elapse before enough is known about potential local details of development to permit estimates suitable for local planning. These assumptions do not represent a Minerals Management Service recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.**

**With reference to the extent of the Federal Government's jurisdiction of the offshore regions, the United States has not yet resolved some of its offshore boundaries with neighboring jurisdictions. For the purposes of the EIS, certain assumptions were made about the extent of areas believed subject to United States' jurisdiction. The offshore-boundary lines shown in the figures and graphics of this EIS are for purposes of illustration only; they do not necessarily reflect the position or views of the United States with respect to the location of international boundaries, convention lines, or the offshore boundaries between the United States and coastal states concerned. The United States expressly reserves its rights, and those of its nationals, in all areas in which the offshore-boundary dispute has not been resolved; and these illustrative lines are used without prejudice to such rights.**

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Alaska Outer Continental Shelf

# Beaufort Sea Planning Area Oil and Gas Lease Sale 124

Final Environmental  
Impact Statement

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# Summary Sheet

Proposed Outer Continental Shelf

## Beaufort Sea Planning Area Oil and Gas Lease Sale 124

Environmental Impact Statement

Draft       Final

U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region, 949 East 36th Avenue, Room 110, Anchorage, Alaska 99508-4302.

1. **Type of Action:** Proposed Oil and Gas Lease Sale 124, Beaufort Sea.

Administrative       Legislative

2. **Description of the Proposed Action:** The proposed action would offer about 4,095 blocks (approximately 8.95 million hectares or 22.1 million acres) of the Beaufort Sea Planning Area for leasing. These blocks are located in waters that are from about 5 to 260 kilometers (3-140 nautical miles) offshore and from 2 to about 1,000 meters (6-3,280 feet) deep. To examine the potential range of effects that might occur as a result of the lease sale, three cases--low, base, and high--are analyzed for Alternative I. The low-case analyses are based on the discovery of a quantity of oil, about 270 million barrels, that is too low to be economically developed and produced. Thus, the low case represents the minimum amount of industry activity that is expected to occur if the quantity of oil discovered as a result of the lease sale is less than the amount required for economical recovery. If commercially recoverable oil resources are discovered and developed and produced as a result of lease Sale 124, MMS estimates the amount most likely would be represented by 900 million barrels; this estimate is the basis for the base-case analyses. The high-case analyses are based on an estimate of 2,600 million barrels of oil, which is the maximum resources if hydrocarbons are present in commercially recoverable quantities and if the sale occurs. The marginal probability for hydrocarbons existing in the sale area is estimated to be 0.16, which indicates there is about a 16-percent chance of recoverable oil being present.

It is assumed that natural gas also will be discovered but will not be economical to produce for the foreseeable future (Appendices A and B).

If implemented, this lease sale tentatively is scheduled to be held in April 1991.

3. **Environmental Effects:** Petroleum-industry activities pose some degree of risk to the environment if blocks are leased, explored, and developed and produced. The risk is related to adverse effects on the environment and other resource uses that may result from those activities associated with petroleum development that include accidental or chronic oil spills, noise disturbances, and habitat alterations or disturbances. Socioeconomic effects from onshore development could have State, regional, and/or local implications.

Several deferral alternatives and mitigating measures have been evaluated that may reduce the type, occurrence, and extent of adverse effects associated with this proposal. Other measures, which are beyond the authority of this agency to apply, also have been identified. In spite of mitigating measures, some effects are considered unavoidable. For instance, if oil were discovered and produced, oil spills would be statistically probable, there would be some disturbance to biological resources, and some onshore development could occur in undeveloped areas.

4. **Alternatives to the Proposed Action:**

a. No Sale (Alternative II).

## Continued

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- b. Delay the Sale (Alternative III); this alternative would delay the sale for a 2-year period.
- c. Modify the proposed lease sale by deleting 201 blocks in the vicinity of Point Barrow (Alternative IV--Barrow Deferral Alternative); this alternative would offer 3,894 blocks for lease.
- d. Modify the proposed lease sale by deleting 143 blocks in the vicinity of Barter Island east to the Canadian boundary line (Alternative V--Barter Island Deferral Alternative); this alternative would offer 3,952 blocks for lease.

5. **Other Environmental Impact Statements and Technical and Reference Papers:** This environmental impact statement (EIS) refers to other EIS's, technical and reference papers, and MMS OCS reports previously prepared by the Alaska OCS Region. The applicable portions of such EIS's, technical papers, and reports are summarized in appropriate discussions throughout this document; and the EIS's, technical papers, and reports are herein incorporated by reference. Copies of these EIS's, technical papers, and MMS OCS reports have been placed in a number of libraries throughout Alaska; in the Department of the Interior Library in Washington, D.C.; and in many Government Printing Office libraries throughout the continental United States. Single copies of these papers and reports are available from the Alaska OCS Region and also from the National Technical Information Service.

6. **Public Hearings:** Public hearings on the Sale 124 draft EIS were held during April 1990 in the following Alaska communities: Barrow on the 17th, Kaktovik on the 18th, Nuiqsut on the 19th, and Anchorage on the 20th. Oral and written comments were obtained and responded to in this final EIS.

7. **Contacts:** For further information regarding this EIS, contact:

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## Summary of the Environmental Impact Statement

This environmental impact statement (EIS) discusses a proposed oil and gas lease sale in the Beaufort Sea Planning Area, analyzes its potential effects on the environment, describes alternatives, presents major issues determined through the scoping process and through staff analyses, and evaluates potential mitigating measures.

Alternative I, the proposed action, is based on offering for lease about 4,095 blocks (approximately 8.95 million hectares--22.1 million acres) in the Beaufort and Chukchi Seas that range from about 3 to 140 nautical miles (5-260 kilometers) offshore. Alternative II (No Sale) would cancel the proposed lease sale, tentatively scheduled for April 1991. Alternative III (Delay the Sale) would delay the proposed lease sale for a period of 2 years. Alternative IV (Barrow Deferral Alternative) would defer leasing on 201 blocks that are located in the vicinity of Point Barrow. Alternative V (Barter Island Deferral Alternative) would defer leasing on 143 blocks in the vicinity of Barter Island east to the Canadian boundary line. After a thorough review, the Secretary of the Interior will decide which alternative or combination of alternatives will be included in the Notice of Sale.

To examine the potential range of effects that might occur as a result of the lease sale, three cases--low, base, and high--are analyzed for Alternative I. The low-case analyses are based on the discovery of a quantity of oil, about 270 million barrels, that is too low to be economically developed and produced. If commercially recoverable oil resources are discovered and developed and produced as a result of Lease Sale 124, Minerals Management Service (MMS) estimates the amount most likely would be represented by the estimate of 900 million barrels; this estimate is the basis for the base-case analyses. The high-case analyses are based on an estimate of a quantity of oil, 2,600 million barrels, that are the maximum resources if hydrocarbons are present in commercial quantities and if the sale occurs. The marginal probability for hydrocarbons existing in the sale area is estimated to be 0.16, which indicates there is about a 16-percent chance of recoverable oil being present.

The scenarios used to assess the potential effects that petroleum exploitation may have on the environment describe possible activities and timing of events. For the base case, exploration and delineation wells are predicted to be drilled primarily from 1992 to 1996. Oil would be produced from four platforms installed between 1997 and 1999; drilling of the production and service wells would occur between 1997 and 2000. Pipelines would carry the produced oil from the production platforms to the Trans-Alaska Pipeline; pipeline laying would occur between 1997 and 1999. Following transit through the Trans-Alaska Pipeline, the oil would be carried in tankers to United States coastal markets outside of Alaska.

For the base case, analysis indicates that there is a 68-percent chance that one or more oil spills of at least 1,000 barrels might occur in the Beaufort Sea Planning Area from production platforms or pipelines and a 45-percent chance in Prince William Sound and the Gulf of Alaska from tankers. The risks from spills would be lessened to the extent that weathering of oil occurs and by the success of any oil-spill-cleanup measures undertaken.

Table S-1 summarizes the possible effects that could occur as a result of leasing one of three possible areal alternatives--Alternative I, IV, or V--on the environmental resources, social systems, or programs discussed in the EIS; the table also summarizes possible effects for a cumulative case. Table S-2 presents the definitions used for assessing the potential effects of the alternatives to the proposed lease sale. The analyses supporting the conclusions in Table S-1 assume that all laws, regulations, and orders are part of the proposed lease sale. If the potential mitigating measures described in Section II.G of the EIS were adopted, some of the effects described in this EIS would be reduced. (The effectiveness of the potential mitigating measures is discussed in Sec. II.G.2.)

This EIS is not intended, nor should it be used, as a local planning document by potentially affected communities. The facility locations and transportation scenarios described in this EIS represent assumptions that were made as a basis for identifying characteristic activities and any resulting environmental effects. These assumptions do not represent a MMS recommendation, preference, or endorsement of any facility, site, or development plan. Local control of events may be exercised through planning, zoning, land ownership, and applicable State and local laws and regulations.

# Summary of Effects

Table S-1

Summary of Effects<sup>1/</sup> for Alternatives I, IV, and V  
and for the Cumulative Case<sup>2/</sup>

Resource Category	Alternative I			Alternative IV	Alternative V	Cumulative Case
	Low Case	Base Case	High Case	Barrow Deferral Alternative	Barter Island Deferral Alternative	
1. Water Quality						
Local	VERY LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Regional	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	LOW
2. Lower-Trophic-Level Organisms <sup>3/</sup>	LOW	LOW	LOW	LOW	LOW	LOW
3. Fishes						
Other Migratory Species	LOW	MODERATE	MODERATE	MODERATE	MODERATE	VERY HIGH
Pacific Salmon						MODERATE
Pacific Herring						MODERATE
4. Marine and Coastal Birds						
Waterfowl	LOW	MODERATE	HIGH	MODERATE	MODERATE	VERY HIGH
Sea Birds	LOW	MODERATE	HIGH	MODERATE	MODERATE	HIGH
Shorebirds	LOW	MODERATE	HIGH	MODERATE	MODERATE	HIGH
Bald Eagles						HIGH
5. Marine Mammals						
Pinnipeds						
Ice Seals (Ringed, Spotted, & Bearded)	LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Northern Fur Seals						HIGH
Harbor Seals	LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Walrus						HIGH
Sea Lions	LOW	MODERATE	MODERATE	MODERATE	MODERATE	VERY HIGH
Polar Bears	LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Belukha Whales	LOW	LOW	LOW	LOW	LOW	HIGH
Sea Otters						
6. Endangered and Threatened Species						
Bowhead Whales	VERY LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Gray Whales	VERY LOW	LOW	LOW	VERY LOW	VERY LOW	MODERATE
Arctic Peregrine Falcons	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW	LOW
7. Caribou	LOW	MODERATE	MODERATE	MODERATE	MODERATE	HIGH
8. Economy of the North Slope Borough	VERY LOW	MODERATE	HIGH	MODERATE	MODERATE	HIGH
9. Sociocultural Systems	LOW	MODERATE	MODERATE	MODERATE	MODERATE	HIGH
10. Subsistence-Harvest Patterns						
Barrow (Atkasuk)	LOW	MODERATE	MODERATE	MODERATE	MODERATE	HIGH
Kaktovik	LOW	MODERATE	MODERATE	MODERATE	MODERATE	HIGH
Nuiqsut	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
Wainwright	LOW	MODERATE	MODERATE	MODERATE	MODERATE	HIGH
Regional	LOW	HIGH	HIGH	HIGH	HIGH	HIGH
11. Archaeological Resources	LOW	LOW	MODERATE	VERY LOW	VERY LOW	MODERATE
12. Air Quality	VERY LOW	LOW	LOW	LOW	LOW	HIGH
13. Land Use Plans and Coastal Management Programs	LOW	HIGH	HIGH	HIGH	HIGH	HIGH

Source: USDOl, MMS, Alaska OCS Region.

<sup>1/</sup> Refer to Table S-2 for the definitions of levels of effect for each resource category.

<sup>2/</sup> Alternative II (No Sale)—The effects associated with Alternative I or other alternatives would not occur with this alternative. Alternative III (Delay the Sale)—The effects associated with this alternative would be the same as those of Alternative I, except their occurrence could be delayed 2 years. Adverse effects of the sale in future years may be of less consequence to species whose populations are currently increasing (i.e., gray whales).

<sup>3/</sup> The effects on the Boulder Patch in Stefansson Sound would be HIGH if it were contacted by spilled oil.

# Effect-Level Definitions

Table S-2  
Definitions Used in Effects Assessment

Resource Category	Effect-Level Definitions				
	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
<b>Water Quality<sup>1/</sup></b>	No regulated contaminant is discharged into the water column, or some amount is discharged, but the resulting concentration of contaminant does not exceed the acute or chronic State standards or EPA criterion.	A regulated contaminant is discharged into the water column and resulting concentration of contaminant occasionally exceeds but does not increase the average beyond the chronic State standard or EPA criterion. Turbidity only occasionally exceeds State standards or EPA criterion. Acute State standards or EPA criteria are not exceeded.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant averages more than the chronic State standard or EPA criterion but does not exceed acute (toxic) State standards or EPA criterion. Average water turbidity exceeds State standards or EPA criterion but does not exceed 7,500 ppm suspended solid concentration. Acute State standards or EPA criteria are not exceeded.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period. Or, turbidity exceeds 7,500 ppm suspended solid concentration more than once in a 3-year period.	A regulated contaminant is discharged into the water column and the resulting concentration of contaminant is above the acute (toxic) State standard or EPA criterion more than once in a 3-year period and averages more than the chronic State standard or EPA criterion. Or, turbidity exceeds 7,500 ppm suspended solid concentration more than once in a 3-year period and averages more than chronic State standards or EPA criteria.
<b>Biological Resources</b>	Individuals in a population experience sublethal effects that do not change population abundance or distribution.	A population or portion of a population changes in abundance and/or distribution in a localized area and/or for a short time period.	A population or portion of a population changes in abundance and/or distribution but would recover to its former status within one generation.	A population changes in abundance and/or distribution requiring one or two generations to recover to its former status.	A population changes in abundance and/or distribution requiring three or more generations to recover to its former status.
<b>Endangered and Threatened Species</b>	No discernible population decline (no lethal effects), but a number of individuals experience sublethal effects and would recover to pre-activity conditions within 1 year.	No discernible population decline (no lethal effects), but a number of individuals experience sublethal effects and would recover to pre-activity conditions within 1 to 3 years. Distribution changes affecting a low number of individuals in a small local area would last no longer than the project.	A population decline (including lethal effects to a low number of individuals), resulting in a minor change in the distribution and/or abundance of the species. The expected duration of the effects on the population is 3 to 6 years.	A population decline resulting in a change in the distribution and/or abundance of the species with recovery in less than one generation or 6 to 10 years.	A substantial population decline that results in a change in the distribution and/or abundance of the species with recovery in more than one generation or more than 10 years.
<b>Economy of the North Slope Borough</b>	Economic effects that will not have a measurable effect on the economic well-being of the residents of the area. Local employment is increased by less than 20 percent.	Economic effects that may marginally affect the economic well-being of residents of the area. Local employment is increased by 10 to 19 percent for less than 5 years.	Economic effects that will immediately affect the economic well-being of residents of the area. Local employment is increased 10 to 19 percent for at least 5 years.	Economic effects that will significantly affect the economic well-being of residents of the area. Local employment is increased by 20 percent or more for less than 5 years.	Economic effects that will cause important and sweeping changes in the economic well-being of residents of the area. Local employment is increased by 20 percent or more for at least 5 years.

# Effect-Level Definitions

Table S-2 (Continued)  
Definitions Used in Effects Assessment

	Effect-Level Definitions				
	VERY LOW	LOW	MODERATE	HIGH	VERY HIGH
<b>Resource Category</b>					
<b>Sociocultural Systems</b>					
Periodic disruption of sociocultural systems occurs without the displacement of existing institutions.	Disruption of sociocultural systems occurs for a period of less than 1 year without a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 1 to 2 years without a tendency toward the displacement of existing institutions.	Chronic disruption of sociocultural systems occurs for a period of 2 to 5 years with a tendency toward the displacement of existing institutions.	Continuous disruption of sociocultural systems occurs for a period of more than 5 years with a tendency toward the displacement of existing institutions.	
<b>Subsistence-Harvest Patterns</b>					
Subsistence resources could be periodically affected but with no apparent effects on subsistence harvests.	Subsistence resources would be affected for a period not exceeding 1 year, but no resource would be unavailable, undesirable for use, or greatly reduced in number.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period not exceeding 1 year.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1 to 2 years.	One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 2 to 5 years.	
<b>Air Quality<sup>2/</sup></b>					
Emissions cause measurable increases in concentrations of criteria pollutants (e.g. SO <sub>2</sub> , CO, NO <sub>2</sub> , O <sub>3</sub> , and PM <sub>10</sub> ) over one localized portion of a Federal attainment area, resulting in the consumption of less than 5 percent of the available Prevention of Significant Deterioration (PSD) increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available National Ambient Air Quality Standards (NAAQS) concentration for PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or no significant decrease in onshore visibility. <sup>3/</sup>	Emissions cause measurable increases in concentrations of criteria pollutants over more than a localized portion of a Federal attainment area; resulting in the consumption of at least 5 percent but less than 20 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for PM <sub>10</sub> , CO, or O <sub>3</sub> ; no observed adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 20 percent but less than 50 percent of the available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or 5 percent of the available NAAQS concentration for PM <sub>10</sub> , CO, or O <sub>3</sub> ; small but measurable short-term adverse effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause measurable increases in concentrations of criteria pollutants over more than half of a Federal attainment area (regional effect), resulting in the consumption of at least 50 percent but not all of the available PSD or NAAQS concentration increments; readily identifiable adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.	Emissions cause substantial increases in concentrations of criteria pollutants over an entire Federal attainment area, resulting in consumption of the entire available PSD increment for NO <sub>2</sub> , SO <sub>2</sub> , or TSP or all of the available NAAQS concentration for PM <sub>10</sub> , CO, or O <sub>3</sub> , causing the area to become a nonattainment area; serious adverse long-term effects on human health or vegetation; and/or significant decrease in onshore visibility.	
<b>Archaeological Resources</b>					
Little damaging interaction between an effect-producing factor and an archaeological site occurs.	An interaction between an archaeological site and an effect-producing factor occurs, but effects are temporary and reversible.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of archaeological data that are not significant.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of significant, but not unique, archaeological information.	An interaction between an archaeological site and an effect-producing factor occurs and results in the loss of unique archaeological information.	

Table S-2 (Continued)  
Definitions Used in Effects Assessment

Effect-Level Definitions				
VERY LOW	LOW	MODERATE	HIGH	VERY HIGH

Resource Category

**Land Use Plans and Coastal Management Programs**

<p>Activities generally conform with existing land use and with policies of local, State, and Federal coastal management programs and land use plans.</p>	<p>Activities infringe on proposed land use, or they conflict with one policy of local, State, or Federal coastal management programs and land use plans.</p>	<p>Activities infringe on existing land use, or they conflict with two policies of local, State or Federal coastal management programs and land use plans.</p>	<p>Activities alter a preferred land use, or they conflict with three policies of local, State, or Federal coastal management programs and land use plans.</p>	<p>Activities are incompatible and displace a preferred land use, or they conflict with four or more policies of local, State, or Federal coastal management programs and land use plans.</p>
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Source: USDOl, MMS, Alaska OCS Region.

- 1/ LOCAL—Changes in water quality from one or more sources, extending beyond the edge of a mixing zone (100-m radius), but affecting less than 1,000 km<sup>2</sup> about each discharge. REGIONAL—Changes in water quality over an area of at least 1,000 km<sup>2</sup> or larger about a discharge source.
- 2/ NAAQS are based on the protection of human health. Numerical standards for each pollutant are given in Table III-A-3. PSD increments are supplements to the NAAQS protecting existing high air-quality areas. Regional refers to effects on areas that are as large as, or larger than, about one-half the area of the North Slope of Alaska. Local refers to effects limited to tens of miles near the shoreline. Short term refers to hours, days, or weeks; long term refers to seasons or years.
- 3/ Visibility criteria are applied only to PSD Class I areas; significance is determined by EPA visibility-analysis guidelines.

# **SECTION I**

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## **PURPOSE AND BACKGROUND OF THE PROPOSED ACTION**

## Section I Table of Contents

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# I. PURPOSE AND BACKGROUND OF THE PROPOSED ACTION

The U.S. Department of the Interior (USDOI) is required by law to manage the exploration and development of oil and gas resources on the Outer Continental Shelf (OCS). To help meet the energy needs of the Nation, these resources are to be developed as expeditiously, and yet as carefully, as possible. While overseeing this development, the Federal Government must, among other things, balance orderly resource development with protection of the human, marine, and coastal environments; ensure that the public receives a fair return for these resources; and preserve and maintain free-enterprise competition.

In compliance with the Outer Continental Shelf Lands Act of 1953 (OCSLA), as amended (43 U.S.C. 1331 et seq.), the Secretary of the Interior submits a proposed 5-year leasing program to the Congress, the Attorney General, and the governors of affected states. The Secretary annually reviews, revises as necessary, and maintains the oil and gas leasing program. Goals of the leasing program include (1) the orderly development of OCS oil and gas resources in an environmentally acceptable manner, (2) the maintenance of an adequate supply of OCS production to help meet the Nation's energy needs, and (3) the reduction of dependency on foreign oil. The purpose of this proposed lease sale is to contribute to attaining those goals.

Current U.S. energy demands are met primarily by domestic and foreign fossil fuel. Since the 1973 Arab oil embargo, it has become increasingly apparent that our Nation must become less dependent on foreign imports, lessen our vulnerability to supply economics and supply interruptions, and prepare for the time when oil production approaches its capacity limitation. In 1978, Congress mandated the USDOI to engage in "expedited exploration and development of" the OCS in order to "assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade."

The OCS leasing program does not represent a decision to lease in a particular area. Instead, it is representative only of the Department's intent to consider leasing in certain areas and to proceed with the offering of such areas only if it should be determined that leasing and development would be technically feasible and environmentally acceptable. As a part of the current 5-year OCS leasing program released in April 1988, the USDOI has scheduled the Beaufort Sea Sale 124 for April 1991.

## A. Leasing Process

The OCSLA charges the Secretary of the Interior with administering mineral exploration and development on the U.S. OCS and with conserving its natural resources. The Secretary has delegated authority to carry out offshore leasing and resource management functions to the Minerals Management Service (MMS). A vital part of the leasing program is the continuing MMS Studies Program; its direction is principally guided by the OCS leasing schedule. This program provides relevant information about potential effects of oil and gas activities on the environment (OCS Environmental Studies Program) and on communities and regions or Alaska as a whole (Social and Economic Studies Program). The Environmental Studies Program also supports monitoring of potential postsale changes in environmental conditions to provide a basis for mitigating any unforeseen effects. For specific information on the MMS Studies Program, refer to Appendix F. The OCS leasing program is implemented by 30 CFR Part 256. Lease supervision and regulation of offshore operations is implemented by 30 CFR Part 250. The following steps summarize the leasing process for the proposed lease sale.

1. **Leasing Schedule:** The OCSLA, as amended, requires that the Secretary prepare and maintain a 5-year OCS oil and gas leasing program and that he review the program annually to ensure that it meets the Nation's energy needs. The current 5-year OCS Oil and Gas Lease Sale Schedule announced by the USDOI in April 1988 consists of 38 proposed lease sales for the period August 1987 through June 1992, including 12 sales offshore Alaska. Of these 12 sales, 2 have been held (Sale 97 in the Beaufort Sea Planning Area and Sale 109 in the Chukchi Sea Planning Area) and 1 sale has been cancelled (Sale 129 in the Shumagin Planning Area). Beaufort Sea Sale 124 is currently scheduled to be held in April 1991.

On June 26, 1990, President Bush announced a series of decisions related to oil and gas development of the Nation's important domestic energy resources and protection of the environment in sensitive areas. The decisions cancel all sales in the Pacific OCS Region through 1992. Also cancelled are one sale scheduled in the Gulf of Mexico OCS Region (offshore Florida) and one sale scheduled in the Atlantic Region (Georges Bank).

2. **Call for Information and Nominations and Notice of Intent to Prepare an Environmental Impact Statement (EIS):** A Call for Information and Nominations (Call) and Notice of Intent to Prepare an EIS (NOI) are notices published in the Federal Register inviting the oil industry, governmental agencies, environmental groups, and the general public to comment on areas of interest or special concern in the proposed lease-sale area. The Call for the proposed Beaufort Sea Sale 124 was published in the Federal Register on September 14, 1988 (53 FR 35632). The Beaufort Sea Sale 124 Call area was located generally off the northern coast of Alaska in the Arctic and covered approximately 21 million hectares (approximately 52 million acres) containing 9,468 blocks (see Fig. I-1).

In response to the Call, nine companies submitted indications of interest in areas for leasing. Nominations received indicated interest in 4,095 blocks. Comments were received from five companies as well as from the North Slope Borough (NSB), the State of Alaska (SOA), the National Park Service (NPS), U.S. Fish and Wildlife Service (FWS), National Oceanic and Atmospheric Administration (NOAA), and the U.S. Navy. Comments received on the Call provided information on the size of the area being offered for lease and lease terms and identified significant environmental issues.

The comments received from the NOI are discussed under scoping, below, and in Section I.D.

3. **Area Identification:** Based on information received in response to the Call, on December 23, 1988, the Secretary of the Interior selected 4,095 blocks in the Beaufort Sea, an area of approximately 8.95 million hectares (22.1 million acres), for analysis in this EIS (see Fig. I-2).

4. **Scoping:** The NOI, published in the same document as the Call (Step 2), serves to announce the scoping process that will be followed for the EIS. The Council on Environmental Quality defines scoping as "an early and open process for determining the scope of issues to be addressed in an EIS and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). It is a means for early identification of important issues deserving of study in an EIS. The intent of scoping is to avoid overlooking important issues that should be analyzed in the EIS.

Comments are invited from any interested persons, including affected Federal, State, and local governmental agencies; any affected Native groups; environmental groups; and private industry. Information obtained from the scoping meetings and the Call is considered part of scoping.

Based on information gained through the scoping process--which includes staff evaluation and input--major issues, alternatives to the proposed action, and measures that could mitigate the effects of the proposed action are identified for analysis in the EIS.

For the proposed Beaufort Sea Sale 124, MMS held a scoping meeting in Barrow on December 7, 1988. In addition, scoping comments for the proposed lease sale were requested from the public through newspaper, radio, and television advertisements in the NSB. Letters were sent to the Mayor of the North Slope Borough; the Mayors, village coordinators, and representatives of the North Slope Borough Planning Commission for the communities of Barrow, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright; and the Alaska Eskimo Whaling Commission (AEWC) informing them of the scoping process and requesting their comments. The results of the scoping process for this proposed lease sale are presented in Section I.D of this EIS. Section VI lists those consulted prior to and during the preparation of this EIS.

5. **Preparation of Draft EIS (DEIS):** As required by Section 102 (2)(C) of the National Environmental Policy Act of 1969, an EIS must be prepared for any major Federal activity having the potential of significantly affecting the quality of the human, marine, and coastal environments. Offshore leasing is considered a major Federal activity for which an EIS must be prepared.

An integral part of preparing an EIS is the exchange of technical information that occurs during MMS-sponsored Information Update Meetings (IUM's) and Information Transfer Meetings (ITM's). The IUM's are held to provide an opportunity for MMS staff to discuss with investigators from the OCS Environmental Studies Program current results of studies in a lease-sale-specific area (for information about MMS-sponsored studies, see Appendix F). An IUM for the Beaufort Sea was held March 6 and 7, 1985, at Anchorage, Alaska, to review the status of environmental knowledge and to discuss the implications of proposed oil and gas development for the Beaufort Sea Planning Area. The ITM's are public meetings held to present a general overview of regional knowledge. Participants at ITM's include researchers from public and private institutions; MMS staff; representatives of other Federal agencies, SOA, private industry, and

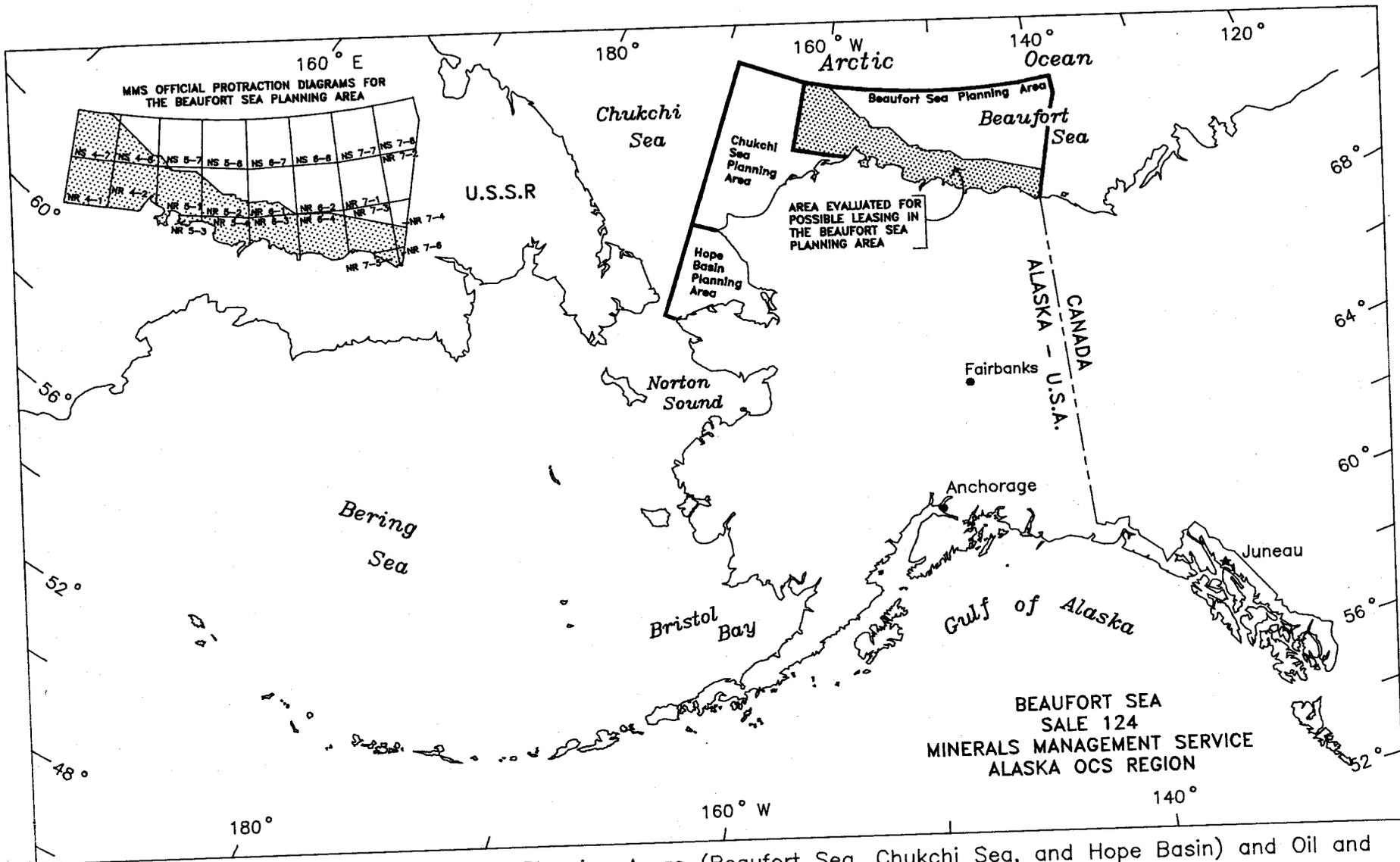


Figure I-1. Location of the Arctic Region Planning Areas (Beaufort Sea, Chukchi Sea, and Hope Basin) and Oil and Gas Lease Sale 124 Area

BEAUFORT SEA  
SALE 124  
MINERALS MANAGEMENT SERVICE  
ALASKA OCS REGION

BEAUFORT SEA  
LEASE SALE 124  
(FEBRUARY 1991)

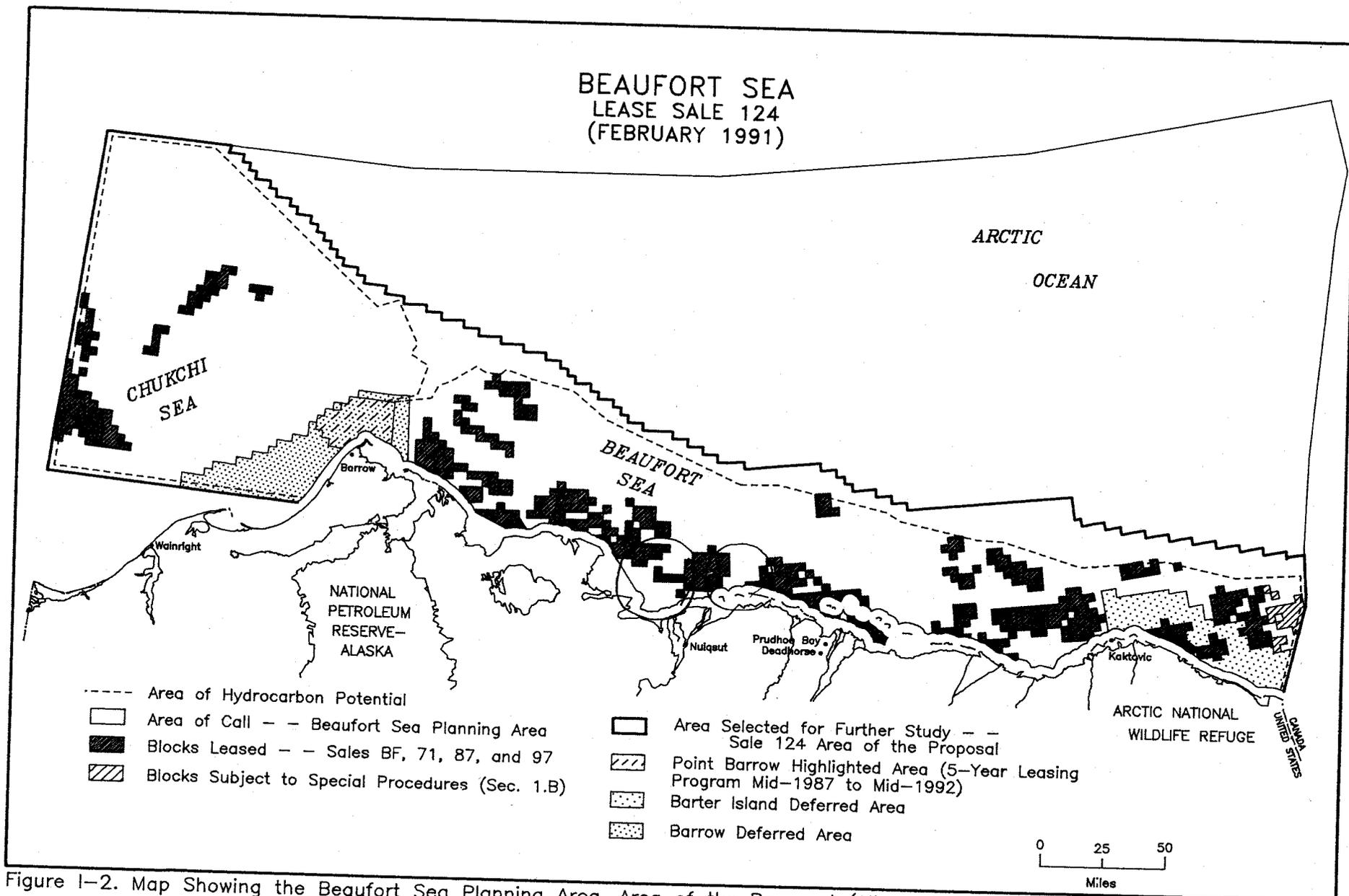


Figure 1-2. Map Showing the Beaufort Sea Planning Area, Area of the Proposal (Alternative I), and the Proposed Deferred Areas

regional organizations; and members of the MMS Alaska Regional Technical Working Group. An Arctic ITM was held on November 17-20, 1987, in Anchorage, Alaska.

The DEIS describes the potentially affected marine and onshore environment, presents an analysis of potential adverse effects on this environment and the area's inhabitants, describes potential mitigating measures to reduce the adverse effects of offshore leasing and development, describes alternatives to the proposal, and presents a record of consultation and coordination with others during EIS preparation.

The document is filed with the Environmental Protection Agency (EPA), and its availability is announced in the Federal Register. Any interested party may request a copy of the DEIS by contacting the MMS office listed in the Federal Register.

6. **Endangered Species Consultation:** Pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended, MMS consults with the FWS and National Marine Fisheries Service (NMFS), as appropriate, to determine whether a species that is listed as endangered or threatened may be jeopardized by the proposed action. Both formal and informal consultations are conducted on the potential effects of OCS leasing and subsequent activities on endangered and threatened species in the Beaufort and Chukchi Seas.

In accordance with the ESA Section 7 regulations governing interagency cooperation, MMS notified NMFS and FWS on March 3, 1989, of the endangered and threatened species that would be included in a biological evaluation for Section 7 consultation. Both agencies responded confirming the species to include in the biological evaluation. The biological evaluation was completed; and in accordance with Section 7(a) of the ESA, as amended, formal consultations on the proposed Beaufort Sea Sale 124 were initiated with NMFS and FWS on December 1 and 11, 1989, respectively. Formal consultations with NMFS and FWS were completed with the receipt of March 9, 1990, and May 17, 1990, biological opinions. Both NMFS and FWS were notified on June 4, 1990, by correspondence of the updating of Sale 124 information since their respective biological opinions. Both agencies agreed that the new information would not change their opinions (FWS June 11, 1990, memorandum; NMFS August 8, 1990, letter). On August 7, 1990, NMFS notified MMS that it had amended their biological opinion to include an Incidental Take Statement. This statement allows a take of bowhead and gray whales (by harassment) incidental to oil and gas exploration in the Beaufort and Chukchi Seas for the next 5 years. (See Appendix K for the biological evaluation, biological opinions, and other documentation of the Section 7 consultation process.)

7. **Public Hearings:** Public hearings are held after release of the DEIS, and specific dates and locations for public hearings are announced in the Federal Register. Oral and written comments are obtained. Public hearings on the DEIS for Sale 124 were held in April 1990 in the following communities: Barrow on the 17th, Kaktovik on the 18th, Nuiqsut on the 19th, and Anchorage on the 20th.

8. **Preparation of Final EIS (FEIS):** Oral and written comments obtained on the DEIS during the public comment period are addressed in the FEIS, which is then made available to the public and filed with the EPA. The availability of the FEIS is announced in the Federal Register.

9. **Secretarial Issue Document (SID):** The SID, which is based in part on the FEIS, includes a discussion of significant information connected with the proposed lease sale. The SID provides relevant environmental, economic, social, and technological information to the Secretary to assist him in making a decision on whether to conduct a lease sale and, if so, what terms and conditions should be applied to the sale and leases.

10. **Proposed Notice of Sale (NOS):** At least 90 days before the proposed lease sale, a proposed NOS is prepared and its availability is announced in the Federal Register. A copy of the actual notice is furnished to the Governor of Alaska, pursuant to Section 19 of the OCSLA, so that he and any affected local governments may comment on the size, timing, and location of the proposed sale. Comments must reach the Secretary within 60 days after notice of the proposed lease sale.

11. **Decision and Final NOS:** The entire prelease process culminates in a final decision by the Secretary on whether to hold a lease sale and, if so, its size, terms, and conditions. The Secretary of the Interior has the option of deferring from the sale area any or all of the deferred areas analyzed in the EIS or areas proposed for deletion after consultation with the Governor of Alaska, pursuant to Section 19 of the OCSLA, as amended. The final Notice of Sale must be published in the Federal Register at least 30 days before the sale date. It may differ from the proposed Notice depending on the Secretary's final terms, i.e.,

size of lease sale, bidding systems, and mitigating measures.

12. **Lease Sale:** The Beaufort Sea Sale 124 is scheduled to be held in April 1991. Sealed bids for individual blocks and bidding units (those listed in the NOS) are opened and publicly announced at the time and place of the sale. The MMS assesses the adequacy of the bids and the Department of Justice--in consultation with the Federal Trade Commission--may review them for compliance with antitrust laws. If bids are determined to be acceptable, leases may be awarded to the highest bidders. However, the Secretary reserves the right to withdraw any blocks from consideration prior to written acceptance of a bid and the right to accept or reject bids, generally within 90 days of the lease sale.

The area proposed for lease includes approximately 5 million acres of submerged lands east of the 141st meridian, which is claimed by the Government of Canada. The Federal Government offered portions of this area during the Department of the Interior's OCS Sales 87 and 97. The high bids received for 20 blocks within the contested area were determined to be adequate; however, leases were not issued. The one-fifth-bonus amounts submitted with these bids are being held in escrow pending a decision to accept or reject the bids. For Sale 124, the United States intends to follow procedures similar to those established for Sales 87 and 97 with regard to bids received on blocks in the contested area. These procedures are without prejudice to the United States' interests in a future settlement. The U.S. State Department is currently negotiating the issue with Canada.

13. **Lease Operations:** After leases are awarded, the MMS Field Operations Office is responsible for supervising and regulating operations conducted on the lease. Prior to any exploration activities on a lease, except preliminary activities, a lessee must submit an exploration plan, an Oil Spill Contingency Plan, and an Application for Permit to Drill to MMS for approval. The Office of Ocean and Coastal Resource Management, FWS, NMFS, EPA, NPS, U.S. Army Corps of Engineers (COE), U.S. Coast Guard, the SOA, and the public are provided an opportunity to comment on the exploration plan. The exploration plan must be approved or disapproved within 30 days, subject to the SOA's concurrence or presumed concurrence with the lessee's coastal zone consistency certification (pursuant to the Federal Coastal Zone Management Act). The Environmental Studies Program also supports activities to detect and measure postsale changes in environmental conditions, thereby providing a basis for mitigating unforeseen or inaccurately predicted effects.

## **B. Leasing History**

This section summarizes and incorporates by reference Section I.B, Leasing History, of the FEIS for Sale 97. Additional updated information is included in this summary.

1. **Previous Lease Sales:** There have been four Federal offshore lease sales conducted for the Beaufort Sea. Sale BF (a joint Federal/State sale) was held in December 1979, Sale 71 was held in October 1982, Sale 87 was held in August 1984, and Sale 97 was held in March 1988. All four sales resulted in a total of 574 leases (covering 3,067,114 acres) being issued for 10-year terms. As of December 1989, 79 leases have been relinquished.

The SOA has held 18 competitive lease sales on the North Slope and in adjacent State waters in the Beaufort Sea, including Sale BF. The 1990 SOA Five-Year Oil and Gas Leasing Program, released in January 1990, has scheduled two offshore lease sales in the Beaufort Sea between January 1990 and September 1994.

2. **Drilling:** Drilling on the Beaufort Sea OCS began in 1981, and 21 exploratory wells have been drilled on Federal leases in the Beaufort Sea as of August 21, 1989. Eight wells have been determined to be producible.

3. **Litigation:** The following information supplements information provided in Section I.B.3 of the FEIS for Beaufort Sea Sale 97.

a. **Coastal Definition and Delineation:** Controversies between the U.S. Government and the SOA over jurisdiction of offshore lands resulted in United States v. State of Alaska, U.S. Supreme Court No. 84, Original [1979], to settle disagreements over the definition and delineation of the coastline. Hearings and the presentation of evidence on all of the issues in the case have been concluded. The Special Master

assigned to the case has drafted an opinion on all of the issues and is expected to file his final report sometime during the spring of 1990.

b. Aboriginal Rights: In January 1981, the Inupiat community filed suit (Inupiat Community of the Arctic Slope v. United States, 746 F.2d 570 [9th Cir. 1984]) claiming aboriginal rights to the OCS in the Beaufort and Chukchi Seas. A district court ruling denying the aboriginal rights was affirmed by the Ninth U.S. Court of Appeals in November 1984. A petition filed by the Inupiat was affirmed Supreme Court to hear their case was denied in October 1985. In June 1987, the Inupiat filed a motion to vacate the circuit court's judgment and consolidate the case for purposes of briefing and oral arguments with The People of the Village of Gambell, et al., v. Donald P. Hodel, 746 F.2d 572 (9th Cir. 1984), which, in part, also alleged that plaintiffs retained aboriginal title to OCS lands and that the Alaska Native Claims Settlement Act did not extinguish those claims. The motion was denied in September 1987. The Circuit Court's denial was based on the fact that it was the U.S. Supreme Court that denied the petition for review of their November 2, 1984, judgment; therefore, any remedy sought would be with the U.S. Supreme Court.

c. Seasonal Drilling Restriction: In July 1986, the North Slope Borough filed suit in response to the Department of the Interior granting a one-time exception to the seasonal drilling restriction requested by Shell Western E&P, Inc., and Amoco Production Company for exploratory drilling on Sale 87 leases in the Beaufort Sea. In the suit, North Slope Borough v. Donald Hodel, et al., Civ. No. A86-393 (D. Alaska, filed July 31, 1986), the North Slope Borough alleged violation of the Endangered Species Act, the Marine Mammal Protection Act, the OCSLA, the Coastal Zone Management Act, the Alaska National Interest Land Claims Act, and the Alaska Coastal Management Act. A Motion for Temporary Restraining Order filed by the plaintiffs was denied and a hearing for preliminary injunction was vacated at the request of the North Slope Borough because the Borough, Shell Western E&P, Inc., and Amoco Production Company had agreed upon terms of a settlement. In September 1986, the case was dismissed at the request of the parties.

d. Revenues: In September 1985, the SOA filed suit (State of Alaska v. United States of America, et al., Civ. No. A85-502 [D. Alaska, filed September 3, 1985]), seeking an order effecting the fair and equitable division between the U.S. and the SOA of revenues generated as a result of oil and gas leasing on the OCS. The State also alleged that from the time of passage of the 1978 amendments to the OCSLA until February 1985, the U.S. has violated 43 U.S.C. 1337 (g)(1) by refusing to provide certain geological and geophysical data. In July 1986, the parties filed for dismissal. The dispute became moot with passage of the OCSLA amendments of 1985.

### C. Legal Mandates, Authorities, and Federal Regulatory Responsibilities

The OCS Report MMS 86-0003, "Legal Mandates and Federal Regulatory Responsibilities," September 1986 (Alaska OCS Region Technical Paper No. 4, 2nd Edition [Rathbun, 1986]), incorporated herein by reference, describes legal mandates and authorities for offshore leasing and outlines Federal regulatory responsibilities. This report contains, among other things, summaries of the OCSLA, as amended, and related statutes, and a summary of the requirements for exploration and development and production activities. Also included are a discussion of authorities of other Federal agencies that affect OCS activities and a discussion of significant litigation affecting OCS leasing policy.

On August 18, 1990, Public Law 101-380, the Oil Pollution Act of 1990, was signed. This law repeals section 311(k) of the Federal Water Pollution Control Act and strikes out the entire section on liability in the Deepwater Port Act of 1974. Title III of the OCSLA amendments of 1978 also was repealed. All monies remaining in the funds established by these sections and Title III of the 1978 OCSLA amendments will be deposited in the Oil Spill Liability Trust Fund pursuant to the Oil Pollution Act of 1990.

The MMS, Alaska OCS Region, Reference Paper No. 83-1, "Federal and State Coastal Management Programs" (McCrea, 1983), incorporated herein by reference, describes the coastal management, legislation, and programs of the Federal Government and the SOA. This paper highlights sections particularly pertinent to offshore oil and gas development and briefly describes some of the effects of the Alaska Native Claims Settlement Act and the Alaska National Interest Lands Conservation Act on coastal management.

## D. Results of the Scoping Process

The scoping process for Beaufort Sea Sale 124 included (1) the Call and NOI, (2) a scoping meeting in Barrow in December 1988 (the meeting also included scoping for the Chukchi Sea Planning Area Sale 126), (3) information gathered through personal communications between MMS staff and others, (4) an evaluation of issues analyzed in the EIS's prepared for past Beaufort Sea (formerly Diapir Field) Planning Area oil and gas lease sales, and (5) MMS staff suggestions. The comments received during the scoping process for Sale 124 also noted that issues raised and mitigating measures and alternatives suggested for past Beaufort Sea Planning Area lease sales were relevant to Sale 124.

1. Major Issues Analyzed in the EIS: The major issues analyzed in the EIS resulted from MMS staff evaluation of the issues raised during the scoping process for Sale 124. These issues are defined in terms of the effects that significant types of petroleum-industry activities or events might have on important classes of environmental resources, sociocultural systems, or programs. The classes of resources, systems, and programs are described in Section III. The effects of the activities or events on these resources, systems, or programs are analyzed in Section IV; the analysis for the base case is in Section IV.C. References to the appropriate descriptive or base-case analyses sections are in parentheses at the end of each of the major issues identified in the following sections.

a. Effects on Water Quality from

- oil spills
- discharges (drilling muds and cuttings and formation waters)
- construction activities (dredging--excavation and dumping of dredged material, dumping of material excavated from onshore sites to build offshore structures)
- artificial barriers

(Secs. III.A.5 and IV.C.1)

b. Effects on Lower-Trophic-Level Organisms from

- oil spills
- discharges (drilling muds and cuttings and formation waters)
- construction activities that affect the seafloor and water column

(Secs. III.B.1 and IV.C.2)

c. Effects on Fishes from

- oil spills
- discharges (drilling muds and cuttings and formation waters)
- construction activities as related to habitat disturbance and alteration

(Secs. III.B.2 and IV.C.3)

d. Effects on Marine and Coastal Birds from

- oil spills
- noise and other disturbances (from man's activities on land, in the water, and in the air)
- habitat alteration

(Secs. III.B.3 and IV.C.4)

e. Effects on Pinnipeds, Polar Bears, and Belukha Whales (Marine Mammals) from

- oil spills

- noise and other disturbances (marine- and over-the-ice seismic activities and marine and aircraft traffic)
- habitat alteration

(Secs. III.B.4 and IV.C.5)

f. Effects on Endangered and Threatened Species

(1) Effects on Bowhead and Gray Whales from

- oil spills
- noise and other disturbances (seismic activities, marine and aircraft traffic, offshore-drilling operations, and dredging)
- disturbance of important habitats (spring-lead system and fall-feeding areas) during migration, feeding, and rearing

(Secs. III.B.5 and IV.C.6)

(2) Effects on Arctic Peregrine Falcons from

- oil spills
- noise and other disturbances (from man's activities on land and in the air)

(Secs. III.B.5 and IV.C.6)

g. Effects on Caribou from

- land-vehicular and aircraft traffic along roads and onshore pipelines
- reduction in habitat use near petroleum-development facilities

(Secs. III.B.6 and IV.C.7)

h. Effects on the Economy from Changes in

- revenues from any activities associated with oil and gas development
- NSB operating expenditures
- employment
- population

(Secs. III.C.1 and IV.C.8)

i. Effects on Sociocultural Systems from

- changes in social organizations
- changes in cultural values
- industrial activities
- changes in population and employment
- changes in subsistence-harvest patterns
- increases in social problems as a result of stress on the sociocultural system

(Secs. III.C.2 and IV.C.9)

j. Effects on Subsistence-Harvest Patterns from

- oil spills
- noise and disturbance
- construction activities
- reduced access to resources

- changes in subsistence practices related to activities associated with oil and gas exploration and development
- increased human population

(Secs. III.C.3 and IV.C.10)

k. Effects on Archaeological Resources from

- onshore activities associated with offshore oil-spill cleanup
- disturbance of archaeological-resource sites

(Secs. III.C.4 and IV.C.11)

l. Effects on Air Quality from

- discharges of combustion gases and particulates into the atmosphere
- accidental emissions from gas blowouts, evaporation of spilled oil, or burning of spilled oil

(Secs. III.A.6 and IV.C.12)

m. Effects on Land Use Plans and Coastal Management Programs from

- changes in land use as a result of land requirements for activities associated with petroleum development (including onshore-support facilities, pipeline rights-of-way, transportation corridors, docking facilities, and airfields)
- potential conflicts with coastal management programs

(Secs. III.C.5 and IV.C.13)

n. Cumulative Effects: The cumulative effects of present and future major projects on each of the resources, systems, or programs that were identified as significant issues in Sections I.D.1.a through I.D.1.m are analyzed in Section IV.I. Major projects considered in the cumulative-effects assessment are shown in Section IV.A.4 and described in Appendix E.

2. Issues Not Analyzed in the EIS: The following concerns raised during the scoping process are not analyzed in this EIS for the reasons noted:

a. Issue Raised Specifically for Sale 124--Size of the Proposed Lease-Sale Area: The NSB noted that the proposed lease-sale area for Sale 124 is too large and diversified to be fully evaluated and should be reduced. The MMS successfully has evaluated the potential environmental effects associated with proposed leasing of the areas for Sale 97, about 19.4 million acres, and Sale 87, about 17.2 million acres, in the Beaufort Sea Planning Area; the size of the area proposed for leasing for Sale 124 is about 22.1 million acres.

The issue of diversity is addressed through the use of available information to describe the environment and to analyze the effects of petroleum development on that environment. For the Sale 97 FEIS, the environmental information was based on about 650 references listed in the bibliography; this information base, augmented by new or additional information, has been used to prepare the Sale 124 EIS. The MMS recognizes the diversity of the arctic region and from 1975 through March 1988 has expended about \$120 million on environmental studies in the Beaufort and Chukchi Seas. These studies include geology, sea ice, pollutant transport, living resources including endangered species, ecosystems, oil-spill effects, noise effects, sociocultural systems, socioeconomics, transportation, and monitoring; Appendix F lists about 220 completed or ongoing studies in the Beaufort Sea area that have been sponsored by MMS.

b. Issues Raised for Past Beaufort Sea Planning Area Sales:

(1) Streamlining and Accelerated Leasing: The lease schedule and streamlining

(one aspect is the identification of large areas instead of specific tracts) were developed in accordance with Section 18 of the OCS Lands Act, as amended, and are beyond the scope of this EIS.

(2) Permitting and Monitoring of Seismic-Exploration Activities: These concerns deal directly with procedural matters. The questions regarding the permitting and monitoring of seismic-exploration activities have been addressed in a letter to the NSB describing the permitting process, the monitoring procedures, and the responsible officials to notify in case there are suspected violations of the permit(s).

(3) Causeways: The construction and use of causeways in the Alaskan Beaufort Sea will not be analyzed as a separate significant issue. However, causeways are considered part of the scenarios and analyzed in the context of habitat disturbance, alteration, and destruction for affected species or species groups. The MMS anticipates that the SOA, the NSB, and the U.S. Army COE will review causeway plans for consistency with State and Borough coastal management programs and for compliance with applicable State and Federal regulations.

(4) Offshore-Gravel Mining: Offshore mining of sand and gravel is not discussed as a separate significant issue. Offshore mining was raised as an issue at a time when there was some speculation that offshore sand and gravel might be used to construct the manmade islands used as exploratory drilling platforms in the shallow waters of the Beaufort Sea. Also, MMS proposed an Arctic Sand and Gravel Lease Sale for October 1983. This lease sale was cancelled, but MMS did prepare an EIS on the effects of offshore sand and gravel mining (USDOI, MMS, 1983). In addition, recent advances in the technology of offshore-drilling units have decreased the likelihood that manmade islands may be used for exploration and development and production.

3. Mitigating Measures Analyzed in the EIS: During the Sale 124 scoping process, commenters supported the inclusion of measures that were analyzed in the past Beaufort Sea Planning Area EIS's or that appeared in past NOS's by incorporating into their comments for Sale 124 references to their comments on past lease sales.

Detailed descriptions of the potential mitigating measures analyzed in this EIS are contained in Section II.G. These measures are:

- Stipulations:
  - No. 1 - Protection of Archaeological Resources
  - No. 2 - Protection of Biological Resources
  - No. 3 - Orientation Program
  - No. 4 - Transportation of Hydrocarbons
  - No. 5 - Industry Site-Specific Bowhead Whale-Monitoring Program
  - No. 6 - Subsistence Whaling and Other Subsistence Activities
  - No. 7 - Oil-Spill-Resource Preparedness
  - No. 8 - Seasonal Drilling Restriction
  
- Information to Lessees (ITL's):
  - No. 1 - Information on Bird and Marine Mammal Protection
  - No. 2 - Information on Areas of Special Biological and Cultural Sensitivity
  - No. 3 - Information on Arctic Peregrine Falcon
  - No. 4 - Information on Beaufort Sea Biological Task Force
  - No. 5 - Information on Coastal Zone Management
  - No. 6 - Information on Endangered Whales and MMS Monitoring Program
  - No. 7 - Information on Development and Production Phase Consultation with NMFS to Avoid Jeopardy to Bowhead Whales
  - No. 8 - Information on Oil-Spill-Cleanup Capability

If adopted, the potential mitigating measures addressed in this EIS should either reduce or eliminate the potential effects to the environment caused by the proposed action--these effects of the action are analyzed in Section IV. Measures not directly affecting environmental protection are not part of the EIS but may be included in the NOS after consideration and coordination with affected State and local governments in accordance with Section 19 of the OCSLA, as amended. Stipulations that are contained in the NOS will be

included in leases as noted.

The mitigating measures considered as ITL's provide the lease operators with notice of special concerns in or near the lease area. These measures, however, are merely advisory in nature and in most cases carry no specific requirements that the USDOJ will impose. The USDOJ's authority relates to operations actually conducted on the OCS. Regardless of their advisory nature, these measures do provide positive mitigation by creating greater awareness of these special concerns on the part of the operator(s).

4. **Alternatives Suggested During the Scoping Process:** The following alternatives were suggested during the scoping process for past lease sales and were incorporated into the scoping comments for Sale 124; areas specifically suggested during the scoping process for Sale 124 have been included in these suggested alternatives. These alternatives were evaluated by MMS staff to develop the proposed alternatives to be analyzed in the Sale 124 EIS. The results of this evaluation also are shown below.

a. **Delete Areas Used by Migrating Bowhead Whales, Marine Mammals, Fishes, and Birds:** Information obtained from scoping, MMS-sponsored studies, and published sources was used to identify the deletion of two specific areas from the Sale 124 Proposal--Alternative I. One of these areas extends along the coast from Elson Lagoon on the Beaufort Sea side of Point Barrow to Peard Bay on the Chukchi Sea side (Fig. I-2) and comprises the proposed Barrow Deferred Area. Deletion of this area from the Sale 124 Proposal forms the area of the Barrow Deferral Alternative--Alternative IV. The other potential deletion area lies in the eastern Beaufort Sea between Barter Island and the Canadian border; this area comprises the proposed Barter Island Deferred Area. Deletion of the area from the Proposal forms the Barter Island Deferral Alternative--Alternative V. Each of the two potential deferred areas includes important areas used by migrating animals, feeding bowhead whales, and subsistence hunters.

Areas off specific river deltas, refuges, or lagoons that were presented as possible deletions have not been analyzed as reasonable alternatives because (1) some of the tracts in waters shoreward of the potential deferred areas have been leased as a result of past SOA oil and gas lease sales and (2) some of the blocks in and near the potential deferred areas have been leased as a result of previous OCS oil and gas lease sales in the Beaufort Sea Planning Area (Fig. I-2) and (3) there are no known unique biological resources in the potential deferred areas. Also, the potential Information to Lessees on Areas of Special Biological and Cultural Sensitivity (see Sec. IV.A.2.b) advises lessees of areas of biological importance that should be considered when preparing their oil-spill-contingency plans.

b. **Delete Traditional Subsistence-Use Areas:** Information obtained from scoping, various studies, and published sources on traditional subsistence-use areas was used to develop the Barrow and the Barter Island Deferral Alternatives. These alternatives were suggested by the SOA, NSB, and AEWC.

c. **Delete Bowhead Whale-Feeding Areas:** Information on bowhead whale-feeding areas acquired from scoping, MMS-sponsored studies, and published sources was incorporated into the Barrow and Barter Island Deferral Alternatives. These deferral alternatives were suggested by the NSB, AEWC, and NOAA.

d. **Delete Pack-Ice-Zone Tracts (Waters Deeper than 40 Meters):** Removal of tracts located in the pack-ice zone was recommended by NOAA because of (1) ice hazards throughout the year, (2) the proposed use of exploratory drilling technologies and procedures that had not been used previously in the Alaskan Beaufort Sea, and (3) the proximity of the bowhead whale-migration routes in the pack-ice zone.

Deletion of the pack-ice zone will not be analyzed as a separate alternative in this EIS for the following reasons: (1) approximately 120 blocks in waters 40 meters or deeper in the Beaufort Sea already have been leased and about 15 of these blocks lie in waters approximately 100 meters deep, (2) technologies and procedures used to drill exploration wells in waters deeper than 40 meters will be the same as those proven by use in both the Alaskan and Canadian parts of the Beaufort Sea, (3) the adequacy of technology to operate in the pack-ice zone is more appropriately evaluated on a site-specific basis when exploration plans are submitted in accordance with Consolidated Offshore Operating Regulations (30 CFR Part 250 Oil and Gas and Sulphur Operations in the Outer Continental Shelf), and (4) mitigating measures (such as the Industry Site-Specific Bowhead Whale Monitoring Program, Oil-Spill-Response Preparedness, and the Seasonal Drilling Restriction) affecting the potential for oil spills and noise could be adopted that would reduce the risks to bowheads during the spring and fall migrations.

e. Delete the Chukchi Sea Shelf: An alternative based on deleting the Chukchi Sea shelf part of the Beaufort Sea Planning Area will not be analyzed in the Sale 124 EIS.

The NOAA previously had recommended deleting this area as part of a deferral alternative for the following reasons: (1) the Chukchi Sea shelf and the summer polar pack-ice edge are important habitats; and (2) in general, fish, bird, and marine-mammal abundances and distributions, physical processes, and environmental hazards in the Chukchi Sea are less well known than they are in the Beaufort Sea. The Chukchi Sea shelf was deleted from the area offered for leasing during the Proposed Notice of Sale for Sale 87. For Sale 97, the shelf seaward of the area identified in Figure I-2 as the Barrow Deferred Area was proposed as an area to be deleted from the Sale 97 Proposal; the effects of deleting this area were analyzed as part of the Chukchi Deferral Alternative in the Sale 97 EIS. This environmental analysis indicated that the effects on the various resources, systems, and programs of deleting the Chukchi Sea shelf would not be significantly different than the Proposal.

Since the recommendation to delete the Chukchi Sea shelf was made, MMS has prepared an EIS for oil and gas leasing in the Chukchi Sea Planning Area (Sale 109), which lies west and south of the Chukchi Sea part of the Beaufort Sea Planning Area. Most of the alternatives suggested during the scoping process for Sale 109 recommended deleting from the Proposal areas up to 50 miles from the coast. As a result of these recommendations, three coastal deferral alternatives were proposed and analyzed in the Sale 109 EIS. For one of the alternatives--the Coastal Deferral Alternative--it was proposed to delete an area lying along the southeastern part of the sale area from Point Hope to Peard Bay and 5 to 60 nautical miles off the coast from the proposed sale area. The other two alternatives were based on deleting a part of the Coastal Deferral Alternative. For Sale 109, 494 blocks along the shoreward boundary between Point Hope and Peard Bay were deleted from the sale area.

Two other alternatives based on the adequacy of technology to operate in the sea-ice regime of the Chukchi Sea also were recommended. However, alternatives based on these two recommendations were not analyzed because (1) a variety of operating prototypes have been successfully used to prove the capability of drilling units to operate in the sea-ice regimes of the Beaufort Sea, (2) ice-management strategies and forecasting procedures have been developed to minimize the threat that moving sea ice poses to drilling operations, and (3) the adequacy of technology to operate in the pack-ice zone is more appropriately evaluated on a site-specific basis when exploration and development and production plans are submitted to MMS for review and approval in accordance with Coordinated Offshore Operating Regulations (30 CFR Part 250, Oil and Gas and Sulphur Operations in the Outer Continental Shelf).

Preparation of the EIS for the Chukchi Sea Planning Area oil and gas lease Sale 109 and the analysis of the Chukchi Sea Alternative in the EIS for the Beaufort Sea Planning Area oil and gas lease Sale 97 indicates the presence of a body of knowledge sufficient to analyze the effects of oil and gas leasing in the Chukchi Sea part of the Beaufort Sea Planning Area.

f. Delete Disputed Tracts: The SOA may request deletion of the Sale 124 blocks where both the State and Federal Governments claim ownership if there is no agreement between the USDOJ and the SOA on leasing and unitization. Resolution of this matter is beyond the scope of this EIS and involves an agreement between the USDOJ and the SOA.

g. Delete Areas Around Biologically Sensitive Areas: The deletion of areas around such biologically sensitive areas as Harrison Bay and the Colville River Delta, Simpson Lagoon, Stefansson Sound Boulder Patch area, Thetis Island, and saltmarshes was recommended by the EPA. Alternatives for deferral of blocks adjacent to the Colville River Delta and Simpson Lagoon were analyzed in the Sale 71 EIS. This analysis indicated that the alternatives would have essentially the same oil-spill-risk and -disturbance effects on the biological resources as would the leasing of the Proposal for that sale. As shown in Graphic 3, there are many OCS leases adjacent to the Federal-State boundary from Dease Inlet to the US-Canada boundary. In addition, State waters (extending from the shoreline out 3 nautical miles) from Dease Inlet to the US-Canada boundary have been offered for oil and gas leasing. Deleting the remaining unleased OCS blocks in areas near the biological habitats probably would not significantly reduce the potential effects of petroleum development.

Lessees have the primary responsibility for identifying biologically sensitive areas in their oil-spill-contingency plans and providing specific protective measures.

h. Delay the Sale for At Least 3 Years: This alternative, which was suggested by the NSB, recommends delay of the sale until much more detailed information is available on the following: (1) areawide sea-ice dynamics; (2) the refinement of the oil-spill-trajectory model; (3) the importance of the waters between Barter Island and the Canadian border as a bowhead whale-feeding area; (4) the area used by the bowheads during their spring and fall migrations; (5) possible seaward displacement of the fall bowhead migration by industrial noises; and (6) the influence of industrial noise, particularly seismic noise, on fall-migrating and -feeding bowheads.

The factors affecting sea-ice dynamics and bowhead whales are part of past and present MMS-sponsored studies. Oil-spill trajectories presently are available from an operational oil-spill-trajectory model. Further data would be useful, but MMS has successfully used the existing database in the past to provide an adequate analysis of these factors. The 2-year delay analyzed in the EIS is based on the time interval between oil and gas lease sales for a specific planning area; in the past, this interval has been 2 years. The potential effects of a 2-year delay are analyzed in Section IV.F.

**SECTION II**

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**ALTERNATIVES  
INCLUDING  
THE  
PROPOSED  
ACTION**

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## II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

### A. Introduction

1. **Summary of Section Contents:** This section contains (1) descriptions of Alternative I (low, base, and high cases), Alternative II--No Lease Sale, Alternative III--Delay the Sale, Alternative IV--Barrow Deferral Alternative, and Alternative V--Barter Island Deferral Alternative; (2) resource estimates and scenario assumptions for Alternatives I, IV, and V; (3) summaries of the effects of Alternatives I, IV, and V on the physical and biological resources, social systems, and programs in and adjacent to the Sale 124 area; and (4) potential mitigating measures--including their purpose and effectiveness. The summaries of the effects of the alternatives include the terms VERY LOW, LOW, MODERATE, HIGH, and VERY HIGH; the special definitions assigned to these terms are given in Table S-2.

2. **Resource Estimates:** Estimates of undiscovered oil and gas in the sale area are developed by Minerals Management Service (MMS) to provide the basis for the exploration, development and production, and transportation scenarios used to assess the potential effects of the proposed lease sale. The general and sale-specific (Sale 124) methodologies used to obtain resource estimates for Outer Continental Shelf (OCS) oil and gas lease sales are described Appendix A. Differing assumptions regarding both economic and engineering factors will affect the estimate of recoverable resources. Economic factors include exploration and development costs, operating expenses, price and market value for oil and natural gas, taxes, depreciation, and royalty and production rates. Included among the engineering factors are reservoir thickness and area, properties of the hydrocarbon-bearing rocks, feasibility and effectiveness of pressure maintenance through secondary recovery, well spacing, deviation in depth, climate, surficial geology, and other environmental factors affecting the design and technology of surface drilling, and development and production operations.

The inherent uncertainties associated with estimating resources indicate the undiscovered oil and gas resources of a sale area would be best represented by a range of values. From this range, a total of three values are selected for both oil and gas to develop the scenarios used to assess the potential environmental effects of the sale. The lower and upper limits of the range are represented by low- and high-case-resource estimates, respectively. Assuming hydrocarbons exist in a sale area, the oil and gas resources believed likely to be leased, discovered, and developed and produced are represented by the base-case estimates.

The evaluation of data used to estimate petroleum resources in a sale area is an ongoing process. The resource estimates for the Sale 124 area used in the Sale 124 Draft Environmental Impact Statement (DEIS) were based on available geological and geophysical data. Since publication of the Sale 124 DEIS, an analysis of additional geological and geophysical data has resulted in a revision to the resource estimates for the Sale 124 area; these revised estimates are used to evaluate the potential effects of petroleum development in this final EIS.

The unleased, conditional resource estimates in the Sale 124 area are reported by MMS (Table II-A-1 and Appendices A and B) for (1) a low case--270 million barrels (MMbbl) of oil (Appendix B, Table 1); (2) a base case--900 MMbbl of oil (Appendix B, Table 2); and (3) a high case--2,600 MMbbl of oil (Appendix B, Table 3). The base- and high-case estimates are assumed to represent economically recoverable oil resources present in the area. The marginal probability, estimated by MMS to be about 0.16, indicates there is about a 16-percent chance of economically recoverable hydrocarbons being present in the unleased part of the sale area (Appendix A). The discussion in Appendix A of the methodology used to obtain resource estimates includes the bases for estimating the low, base, and high cases.

For the Sale 124 DEIS, the unleased, conditional resource estimates were reported by MMS for (1) a low case--200 MMbbl of oil, (2) a base case--530 MMbbl of oil and (3) a high case--1,920 MMbbl of oil (USDOI, MMS, 1990). Based on these resource estimates, MMS estimated a level of development activities for each of the three cases. For the low case, only 4 exploration wells would be drilled because the amount of oil estimated to be present in the sale area is below the minimum economic resource required for development. The development activities for the base case included the drilling of 14 exploration and delineation wells, installation of 2 production platforms and drilling of 69 production and service wells, and installation of 600 mi of pipeline. For the high case, 41 exploration and delineation wells would be drilled, 6 production platforms installed, 249 production and service wells drilled, and 650 mi of pipeline installed. The timing and

Table II-A-1

Summary of Basic Scenario Assumptions Regarding Estimated  
OCS-Related Activities in the Beaufort Sea Planning Area  
and Arctic Region Planning Areas for Sale 124  
(Page 1 of 2)

PHASE Facility or Event	Beaufort Sea Planning Area						Arctic Region Planning Areas		
	Low Case <sup>1/</sup>		Alternative I Base Case <sup>2/</sup>		High Case <sup>3/</sup>		Alternative IV <sup>4/</sup> Alternative V <sup>5/</sup>		Cumulative Case <sup>6/</sup>
	Number or Amount	Time- frame	Number or Amount	Time- frame	Number or Amount	Time- frame	Number or Amount	Time- frame	Number or Amount
<b>EXPLORATION</b>									
Exploration- and Delineation-Well Drilling		1992- 1993	14	1992- 1996	36	1992- 1998	14	1992- 1996	68
Number of Wells - Total	4		14		36		14		
Floating Drilling Units	3		11		29		11		
Bottom-Founded Mobile Units	1		2		5		2		
Manmade Islands (Ice)			1		2		1		
Support Helicopter Flights	360		1,260		3,240		1,260		6,120
Supply Boat Trips	50		140-170		370-450		140-170		
Total Drilling Muds and Cuttings Disposed									42,840
Drilling Muds--Short Tons	2,520		8,820		22,680		8,820		55,760
Cuttings--Short Tons	3,280		11,480		29,520		11,480		
Shallow-Hazards Surveys <sup>7/</sup>									605
Total Area Covered--mi <sup>2</sup>	36		125		320		125		132
Total Days Required	8		28		72		28		
<b>DEVELOPMENT AND PRODUCTION</b>									
Work Force--Peak Year Oil (Work Years)									11
Number of Platforms Installation			4	1997- 1999	7	1998- 2000	4	1997- 1999	
Production- and Service-Well Drilling			120	1997- 2000	346	1999- 2003	120	1997 2000	685
Number of Wells									
Production Total--MMbbl			900	2000- 2018	2,600	2001- 2019	900	2000- 2018	5,480
Peak			76	2001- 2005	218	2002- 2006	76	2001- 2005	
Yearly--MMbbl			208		597		208		
Daily--Mbbl									
Support Helicopter Flights During Development Drilling			5,400		15,570		5,400		30,825
After Development Drilling			3,744		9,984		3,744		
Total Drilling Muds and Cuttings Disposed									102,750-
Drilling Muds--Short Tons			18,000-		51,900-		18,000-		465,800
Cuttings--Short Tons			81,600		235,280		81,600		808,300
			141,600		408,280		141,600		
Shallow-Hazards Surveys <sup>7/</sup>									391
Total Area Covered--mi <sup>2</sup>			142		248		142		77
Total Days Required			28		49		28		

Table II-A-1

Summary of Basic Scenario Assumptions Regarding Estimated  
OCS-Related Activities in the Beaufort Sea Planning Area  
and Arctic Region Planning Areas for Sale 124  
(Page 1 of 2)

PHASE Facility or Event	Beaufort Sea Planning Area								Arctic Region Planning Areas
	Low Case <sup>1/</sup>		Alternative I				Alternative IV <sup>4/</sup> Alternative V <sup>5/</sup>		Cumulative Case <sup>6/</sup>
	Number or Amount	Time- frame	Base Case <sup>2/</sup>		High Case <sup>3/</sup>		Number or Amount	Time- frame	Number or Amount
			Number or Amount	Time- frame	Number or Amount	Time- frame			
<b>TRANSPORTATION</b>									
Oil Pipelines Installation									
Offshore Length--mi			1997- 1999		1997- 2000		1997- 1999		
Trenched Length--mi			275		325		275		
Offshore Area Disturbed <sup>6/</sup> --mi <sup>2</sup>			75		75		75		
			4.60		4.60		4.60		
Onshore Length--mi			325		325		325		
Road Length <sup>9/</sup> --mi			325		325		325		
Short Causeways/Jetties (1,000 ft - 2,500 ft)			4		4		4		
<b>OIL SPILLS</b>									
Assumed for Analysis $\geq 1,000$ bbl									
Offshore Arctic	0		1		3		1		10
Prince William Sound and Gulf of Alaska	0		1		2		1		16
Assumed for Analysis $\leq 1,000$ bbl									
Offshore Arctic									
Number of Spills	0		213		612		213		1,900
Total Oil--bbl	0		3,000		8,500		3,000		27,000

Source: USDOJ, MMS, Alaska OCS Region.

<sup>1/</sup> Appendix B, Table 1

<sup>2/</sup> Appendix B, Table 2

<sup>3/</sup> Appendix B, Table 3

<sup>4/</sup> Appendix B, Table 4

<sup>5/</sup> Appendix B, Table 5

<sup>6/</sup> Appendices A and B

<sup>7/</sup> See Appendix H, Table 3, for assumptions.

<sup>8/</sup> See Appendix H, Table 4, for assumptions and calculations.

<sup>9/</sup> The number of miles of road associated with onshore pipelines is estimated to equal the length of the pipelines. Road construction will occur at about the same time as the pipeline is installed.

level of activities associated with these estimates were used to evaluate the potential effects of petroleum exploration, development and production, and transportation in the Sale 124 DEIS (USDO, MMS, 1990).

The base-case resource represents an estimate of the amount of unleased oil resources in the Beaufort Sea Sale Area estimated to be leased, discovered, and developed and produced as a result of Sale 124 (Appendix A). This amount is derived by multiplying the unleased, conditional, mean estimate of 1,450 MMbbl of oil by a factor that represents the fraction of the unleased oil expected to be leased and developed; MMS estimates this fraction to be about 62 percent. The base-case-resource estimate is 900 MMbbl of oil (1,450 MMbbl x 0.62 is about equal to 900 MMbbl). The low-case-resource estimate is derived by multiplying the 95-percent-conditional estimate (430 MMbbl) by the 62-percent factor. This amount, 270 MMbbl, is below the predicted minimum economic resource required for development and, thus, only exploration activities are predicted for the low case. The high-case-resource estimate (2,600 MMbbl) represents a quantity of oil that is the maximum amount of resources if hydrocarbons are present; it is determined by multiplying the 5-percent-conditional estimate (4,190 MMbbl) by the 62-percent factor.

Sale 124 is the fifth OCS oil and gas lease sale in the Beaufort Sea, and any economically recoverable petroleum resources discovered as a result of this sale will be developed simultaneously with those discovered resources from previous lease sales: the Joint Federal and State of Alaska Oil and Gas Lease Sale (Sale BF) (held in Dec. 1979), Diapir Field Sale 71 (held in Oct. 1982), the Diapir Field Lease Offering (June 1984) (Sale 87, held in Aug. 1984), and the Beaufort Sea Sale 97 (held in Mar. 1988). To date, 13 exploration wells have been drilled in Sales 71 and 87 leased blocks and 9 wells in the federally managed disputed blocks of Sale BF (Appendix H, Table H-1). Eight wells have been determined to be producible.

For analytical purposes, it is assumed that exploration activities would not occur in the spring-lead system.

It is assumed that natural gas also will be discovered but will not be economical to produce for the foreseeable future (Mast et al., 1989); Appendices A and B. However, the effects of potential gas development and production on the environment are discussed in Section IV.M, separate from the analysis of the effects of oil development and production in Sections IV.B, C, and D.

The strategies and technologies that are described in the exploration, development and production, and transportation scenarios, Sections II.B.1 through 3, represent only some of the possible types of activities that might be used to exploit the petroleum resources of the Beaufort Sea Planning Area; they will depend on many factors, any number of which are unique to each leaseholder or operator. These strategies and technologies are used to identify characteristic activities and areas where these activities may occur; but they do not represent a recommendation, preference, or endorsement by the U.S. Department of the Interior.

## **B. Alternative I**

Alternative I would offer about 4,095 blocks (approximately 8.95 million hectares [ha] or 22.1 million acres) of the Beaufort Sea Planning Area for leasing; this is the unleased part of the planning area that has been identified for further study. Approximately 594 whole and partial blocks covering about 0.92 million ha (about 2.26 million acres) in the study area have been leased as a result of previous Beaufort Sea Planning Area oil and gas lease sales (Appendix H, Table H-1). Lease relinquishments received and approved by MMS prior to issuance of the Notice of Sale may result in additional areas being included in the lease sale. The blocks that comprise the proposed action are located about 3 to 140 nmi (5-260 km) offshore in water depths that range from about 6 to 3,280 ft (2-1,000 m). For Alternative I, three hypothetical scenarios have been developed to assess the potential environmental effects of the sale; these effects are analyzed in Sections IV.B through IV.D. The scenarios are based on oil-resource estimates of 270 MMbbl for the low case, 900 MMbbl for the base case, and 2,600 MMbbl for the high case. Natural gas also may be discovered and, although it will not be economical to produce for the foreseeable future, the effects of gas exploitation are discussed in Section IV.M.

### **1. Low Case**

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The low-case-resource estimate, 270 MMbbl, is a

quantity of oil that is less than an estimated minimum amount that would have to be discovered before development and production could occur. This case represents the minimum amount of industry activity that is expected to occur as a result of the lease sale. Because future recovery of resources estimated to be present in low quantities may depend on advances in technology and changes in economics, a considerable time interval might exist between exploration and future development and production of these resources. The level of activities and scheduling of events associated with the Sale 124 low-case-resource estimate are shown in Table II-A-1 and Appendix B, Table 1.

Prior to drilling, the lessee/operator is required to conduct surveys to determine if shallow hazards are present at the proposed drill site; these surveys should incorporate seismic profiling. The projected level of seismic activity is based on the nature and extent of the surveys that may be required (Notice to Lessees [NTL] 83-5, Minimum Requirements, Shallow Hazards Survey) and the predicted number of wells drilled. Seismic surveys of the exploration-well sites would be conducted during the open-water period. The total seismic activity for the low case is estimated to take about 8 days and cover 160 seismic-line miles in four areas that total about 36 square miles (mi<sup>2</sup>). (The assumptions used to determine the amount of seismic activity are shown in Appendix H, Table H-3.)

Exploratory drilling is estimated to begin in 1992 with the drilling of two wells and end the following year after two additional wells have been drilled. The amount of time required to drill and test each of the exploration wells is estimated to average about 90 days (Roberts, 1987). Upon completion of drilling and testing, the exploration wells will be plugged and abandoned in accordance with the requirements of 30 CFR Parts 250 and 256: Oil and Gas and Sulphur Operations in the Outer Continental Shelf; Final Rule (Federal Register, 1988).

Since most of the unleased blocks in the Sale 124 area lie in waters deeper than 20 m, it is estimated that bottom-founded mobile-drilling units, such as the Concrete Island Drilling System (CIDS) or the Single Steel Drilling Caisson (SSDC), and floating vessels, such as ice-strengthened drillships or the Conical Drilling Unit (CDU), would be used to drill the exploration wells. Present-day bottom-founded mobile units are designed to operate year-round in waters as deep as about 25 m. Movement of these units would require the assistance of 3 to 6 tugs (Alaska Oil and Gas Association [AOGA], 1985). With icebreaker assistance, the floating units are capable of operating in limited sea-ice conditions.

Drilling of each exploratory well will require the disposal of about 630 tons (dry weight) of drilling muds and approximately 820 tons (dry weight) of drill cuttings (Appendix B). The total amount estimated to be disposed is about 2,520 tons (dry weight) of drilling muds and about 3,280 tons (dry weight) of cuttings. The disposal of these materials will be, primarily, at the drilling site under conditions prescribed by the Environmental Protection Agency's (EPA's) pollutant-discharge permit (see Rathbun, 1986; Clean Water Act, as amended).

Where possible, support and logistic activities will use, or upgrade, existing facilities. Major support for exploration drilling will be from Prudhoe Bay; some support functions also might be conducted from onshore facilities located closer to the drill sites. Personnel and routine supplies and material are expected to be transported to the drilling units from the support base by helicopter. It is estimated that a total of 360 helicopter flights will be flown in support of exploration drilling. This estimate is based on the assumption that, for each well, there will be one flight per drilling unit for each day of drilling.

The number of required support vessels for each drilling unit will depend, at least in part, on the type and characteristics of the unit and the sea-ice conditions. If there are drilling operations during the open-water season, MMS requires the operator to maintain an emergency-standby vessel within the immediate vicinity of the drilling unit. (Immediate vicinity is defined as being within 5 mi or a 20-minute steaming distance of the unit, whichever is less.) The primary reason for this requirement is to ensure emergency evacuation of personnel, but the standby vessel also could assist in the deployment of the oil boom in the unlikely event of an oil spill. Depending on ice conditions, two or more icebreaking vessels may be required to perform ice-management tasks for the floating units. Also, during the open-water season, it is estimated that there will be about one supply-boat trip per drilling unit per week; for exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to be about 50.

The projected direct industry-employment requirements for the low case are given in Appendix J, Table J-2.

b. Summary of Effects of the Low Case: The summaries presented in this section are

based on the analyses in Section IV.B of this EIS. The types and levels of activities that might be associated with the low case for Alternative I are summarized in Table II-A-1 and described in the preceding section (Sec. II.B.1.a).

(1) Effects on Water Quality: In the low case, oil spills and production discharges are assumed not to occur. Deliberate discharges during exploration are regulated by EPA such that any effects on water quality should be negligible outside the 100-m mixing zone; water-quality criteria must be met at the edge of the mixing zone established by the EPA-issued discharge permit, resulting in a VERY LOW effect on both LOCAL and REGIONAL water quality.

(2) Effects on Lower-Trophic-Level Organisms: For the low case, it is assumed that oil spills would not occur. Effects from other activities (seismic exploration, discharge of drilling fluid, and construction activities) should be very localized. The effects of these activities on lower trophics are expected to be LOW.

(3) Effects on Fishes: For the low case, it is assumed that oil spills would not occur. Effects from other activities (seismic exploration, discharge of drilling fluid, and construction activities) should be very localized. The effects of these activities on fishes are expected to be LOW.

(4) Effects on Marine and Coastal Birds: Noise and disturbance of marine and coastal birds during exploration would come from low-flying aircraft and boats. Sensitivity of birds to these disturbance sources is highly variable, from no visible response to brief panic-flight response. Industrial activities associated with exploration are likely to briefly (perhaps a few minutes to an hour) disturb some local populations of nesting, feeding, and molting birds on barrier islands, lagoons, and tundra habitats. However, nesting activities of most species of marine and coastal birds are widely dispersed over the coastal tundra; and disturbance of local nesting birds probably would have little effect on North Slope bird populations as a whole. Effects of disturbance are expected to be LOW. For the low case, the effects of exploration activities on marine and coastal birds are expected to be LOW.

(5) Effects on Pinnipeds, Polar Bears, and Belukha Whales: For the low case, noise and disturbance due to air and vessel traffic, seismic activities, and construction activities--noise associated with drilling-unit installations and operations--could have some adverse effects on pinnipeds, polar bears, and belukha whales found in the lease-sale area. Noise associated with seismic activities and air and vessel traffic could cause brief startle, annoyance, and/or flight responses of pinnipeds, polar bears, and belukha whales. Helicopter trips and boat traffic to and from exploration-drilling units could disturb some hauled out ringed, bearded, and spotted seals and walruses, causing them to charge in panic into the water and resulting perhaps in the injury or death of some seal pups and walrus calves. Because the walrus-nursery herds and nursing seals and pups are widely distributed along the ice front, aircraft moving to and from the two drill platforms are expected to temporarily disturb only a small portion of the walrus and seal populations. Thus, aircraft-disturbance effects are expected to be LOW. Vessel traffic supporting the drilling units and seismic vessels operating during the open-water season could temporarily displace or interfere with some marine-mammal movements and distribution for a few hours to perhaps a few days. Noise generated during installation and operation of the drilling units is expected to have a temporary, local effect on the distribution of some marine mammals. Such short duration and local displacement is expected to have a LOW effect on pinnipeds, polar bears, and belukha whales. The effects of the low case are expected to be LOW on pinnipeds, LOW on polar bears, and LOW on belukha whales.

(6) Effects on Endangered and Threatened Species: Exploration noise and disturbance would be the major effect-producing agent associated with the low case that could influence the behavior of endangered and threatened species. There would be no adverse effects from oil spills under this case, because it is assumed that none will occur since producible hydrocarbon resources would not be discovered. The potential noise and disturbance effects from exploration activities (seismic surveys, drilling units, and aircraft and vessel support) are expected to result in no discernible population decline in the affected area; however, a low number of individuals within populations could experience some sublethal effects, such as short-term avoidance. The effects of the low case are expected to be VERY LOW for each of the three endangered and threatened species--the bowhead and the gray whales and the arctic peregrine falcon.

(7) Effects on Caribou: For the low case, caribou would be exposed to and potentially affected by air traffic to and from the two drill platforms and existing onshore-support facilities at

Deadhorse, Barter Island, Camp Lonely, or other existing airstrips on the North Slope. Aircraft disturbance of caribou groups is likely to be short term in duration (a few minutes to no more than 1 hour) when the aircraft passes nearby or overhead or when the aircraft flies below 1,000 ft. The duration of the disturbance (time it takes caribou to return to undisturbed behavior) and the amount of stress on individual animals is not likely to have an appreciable effect on the health of affected caribou. The area in which the caribou would be displaced is expected to be local--within 1 mi of the aircraft path--representing a LOW effect. The effects of the proposed Sale 124 low-case activities on caribou are expected to be LOW.

(8) Effects on the Economy of the North Slope Borough (NSB): Economic gains to the NSB resulting from this case would be negligible relative to the economy of the North Slope as a whole. The economic effect in the low case is expected to be VERY LOW.

(9) Effects on Sociocultural Systems: Industrial activities for the low case are not expected to be significant enough to have more than VERY LOW effects on sociocultural systems. None of the communities are expected to experience much of an increase in sale-related employment under the low case, although there may be some degree of sale-induced employment. These changes in employment are not expected to be significant and would not cause more than VERY LOW effects on the sociocultural systems of these communities in addition to the effects already experienced under the NSB Capital Improvements Program (CIP). Although subsistence-harvest patterns would experience some LOW to MODERATE disruptions, these are expected to be short term in the low case and would not have a tendency to displace sociocultural systems--a LOW effect. In the low case, the effects of the proposed sale on sociocultural systems are expected to be LOW.

(10) Effects on Subsistence-Harvest Patterns: Effects on subsistence-harvest patterns would be expected to occur only as a result of noise and disturbance. Noise from bottom-founded exploration-drilling units, support vessels, or icebreakers could disrupt the whaling effort. If a vessel or rig were in the path of a whale chase, it could cause that particular harvest to be unsuccessful. Icebreakers moving through a whale-harvest area also could cause an unsuccessful harvest in that area--a MODERATE effect, but it is more likely that some whales would be harvested--a LOW effect. Barrow has similar conditions but also has more opportunities (a higher quota) for harvests. Like bowhead whales, belukha whales also may avoid industrial activities in the Arctic. Although disruptions are most likely to be short term, they could affect harvest levels but would not cause the harvest to be unavailable (LOW effects) during the belukha-hunting season.

Noise and disturbance are expected to have insignificant effects on subsistence-fish stocks. Effects on subsistence fishing from noise and disturbance activities associated with Sale 124 are expected to be VERY LOW. Seals are somewhat susceptible to noise and disturbance from aircraft and vessel traffic; however, industrial activities associated with Sale 124 are not expected to result in distributional changes in seal populations. Disturbance from aircraft or vessels could cause short-term, localized effects on seals and some short-term disruption to the seal harvest; however, this would not affect annual harvest levels, and seals would not become unavailable during the year--a LOW effect.

Noise and disturbance generally would not affect walrus-distribution patterns; however, noise and disturbance from aircraft could have localized, short-term effects that would cause some disruption to the harvest but would not cause walrus to become unavailable--a LOW effect.

Noise and disturbance from activities associated with exploration drilling may disturb waterfowl-feeding and -nesting activities. Such low-level biological effects would be too brief to have significant effects on bird harvesting by the communities in the Sale 124 area--a VERY LOW effect.

Polar bears could experience short-term, localized, aircraft-noise-disturbance effects that would cause some disruption in the polar bear harvest but would not affect annual harvest levels--a LOW effect.

For the low case, the effects on subsistence-harvest patterns are expected to be LOW in Barrow (Atkasuk), Nuiqsut, Kaktovik, and Wainwright. Regional effects on subsistence-harvest patterns are expected to be LOW.

(11) Effects on Archaeological Resources: The effects of this alternative are due to (1) the low probability that archaeological resources could survive the effects of the physical forces in the sale area and (2) the estimate that only exploration activities would occur for the low case. Therefore, the effects

of the low case on archaeological resources are expected to be LOW.

(12) Effects on Air Quality: The U.S. Department of the Interior (USDOI) regulatory exemption levels for regulated air pollutants would not be exceeded, and air-pollution concentrations permitted by air-quality standards would be easily attained. For the low case, operations and any accidental spills and emissions would be relatively small and well offshore. Air pollutants would be very diffuse at the shoreline and unable to cause even local or short-term effects. Consequently, effects from air quality are expected to be VERY LOW.

(13) Effects on Land Use Plans and Coastal Management Programs: North Slope Borough Land Management Regulations apply only to activities that occur within the NSB. In the low case, no development is assumed to occur to support the offshore-exploration activities. As a result, no conflict with the land use plan for the NSB is anticipated.

The Statewide standards and NSB district policies of the Alaska Coastal Management Program (ACMP) apply to all activities that occur within the coastal boundaries of the NSB or directly affect the use of the coastal zone. Noise and disturbance are identified in Sections IV.B.1 through 12 as the primary sources of conflict. Disturbances would be subject to transportation policies that require buffers to ameliorate potential disruption (NSB Coastal Management Plan [CMP] 2.4.4[a]). Noise and disturbance also could disrupt the bowhead whale harvest. Activities would be subject to the Statewide standard for subsistence, which guarantees opportunities for subsistence use of coastal areas and resources (6 AAC 80.120), and NSB CMP 2.4.3(b), which regulates offshore drilling and other development within the area of the bowhead whale migration during the migration seasons.

Potential conflicts between activities assumed in the low case and land use and coastal management policies are expected to be LOW.

## 2. Base Case

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The base-case oil-resource estimate, 900 MMbbl, represents a quantity that is estimated to be leased, discovered, and developed and produced in the Sale 124 area. The base-case-resource estimate was used to formulate the primary oil-development scenario for the Sale 124 area.

(1) Timing of Activities: The level of activities and the scheduling of events associated with the Sale 124 base-case-resource estimate are shown in Table II-A-1 and Appendix B, Table 2. Exploratory drilling is estimated to begin in 1992 and continue through 1996. The first delineation well is expected to be drilled in 1993 (during the second year of drilling). Production-platform installation and pipeline laying are estimated to begin in 1997. Production is anticipated to begin in 2000 and continue through 2018.

It is estimated that about 45 days might be available for performing such tasks as production-platform installation and pipeline trenching and laying. The time interval generally would be from about mid-August to the first part of October. This estimate is based on data in the Alaska Marine Ice Atlas (LaBelle et al., 1983) for the sea route from Point Barrow to Prudhoe Bay.

The earliest date when ice concentrations were five-tenths or less was July 19, and the latest was September 13. The earliest date for ending prudent navigation was September 9, and the latest was November 1; the dates listed in these two categories exclude 1975, when the route from Point Barrow to Prudhoe Bay was not open. The average number of days the route was ice free was about 28; the range was from 0 to 92. The average number of days the ice concentrations were five-tenths or less was about 56; the range was from 0 to 99.

Based on average conditions, activities requiring ice-free conditions might have only about a month in which to work. Activities that include ice-management capabilities and ice-strengthened vessels might be able to operate about 2 months if ice concentrations up to 50 percent can be tolerated in the work area. Assuming some work can be performed in the presence of sea-ice concentrations of less than 50 percent, a period of 45 days--the average of 1 and 2 months--was chosen as the amount of time that might be available in an average year.

## (2) Activities Associated with Exploration Drilling

(a) Shallow-Hazards Surveys: In support of the proposed exploration and production activities, the lessee/operator is required to conduct surveys of sufficient detail to define shallow hazards or the absence thereof; these surveys should incorporate seismic profiling. The projected level of seismic activity is based on the nature and extent of the surveys that may be required (NTL 83-5, Minimum Requirements, Shallow Hazards Survey) and the predicted number of wells drilled. Surveys of the exploration/delineation-well sites would be conducted in the ice-free seasons during the years of the exploration phase. A well site-specific survey requires about 40 seismic-line miles in an area of about 8.9 mi<sup>2</sup> and takes about 2 days. The total seismic activity in the Sale 124 area is estimated to take 28 days and cover 560 seismic-line miles in 14 areas that total about 125 mi<sup>2</sup>. (The assumptions used to determine the amount of seismic activity are shown in Appendix H, Table H-3.)

(b) Exploration Drilling: For the base case, 10 exploration and 4 delineation wells are estimated to be drilled; the drilling of these wells would begin in 1992 and could be completed by 1996. The amount of time required to drill and test each of the exploration or delineation wells is estimated to average 90 days. The types of units that may be used to drill exploration and delineation wells in the Sale 124 area will depend on (1) the water depth, (2) sea-ice conditions, (3) ice-resistant capabilities of the units, and (4) availability of drilling units.

A preliminary estimate of the water depths of the blocks in the Sale 124 area indicates that about 5 percent of the blocks lie in waters less than 20 m deep, 15 percent in waters 20 to 40 m deep, and 80 percent in waters deeper than 40 m.

Drilling units that are capable of operating in water depths of less than 20 m include (1) artificial (gravel) islands, (2) ice islands, and (3) bottom-founded mobile drilling units such as the CIDS or the SSDC. A total of 16 artificial islands have been constructed in the Alaskan Beaufort Sea--12 in State of Alaska waters and 4 in Federal waters. Three ice islands were used to drill one well in State waters and two wells in Federal waters. The CIDS has been used to drill three wells and the SSDC to drill two wells in Federal waters. The artificial islands and bottom-founded mobile units can be used year-round but the ice islands only from about midwinter to early spring.

Bottom-founded mobile units and floating units also can be used to drill wells in waters deeper than 20 m. Present-day bottom-founded mobile units that are designed to operate year-round in the Arctic marine environment have been used in waters as deep as about 25 m. Movement of these units requires the assistance of three to six tugs (AOGA, 1985). With icebreaker assistance, floating vessels, such as ice-strengthened drillships or the CDU, are capable of operating in limited sea-ice conditions. The Canmar II, an ice-strengthened drillship, has been used to drill three exploration wells in the eastern part of the Alaskan Beaufort Sea. The CDU also has been used to drill one exploration well in the eastern Beaufort Sea. The drillships can be used in waters as deep as 300 m and the CDU in waters as deep as 180 m.

Based on the water depths of the Sale 124 blocks, it is anticipated that 11 of the exploration wells will be drilled from ice-strengthened floating vessels, 2 wells from bottom-founded mobile units, and 1 well from a manmade island. Although manmade gravel islands have been used to drill exploration wells in waters less than 20 m deep in the Beaufort Sea, recent construction and operation experience has indicated spray-ice islands also can be used to safely and successfully drill wells.

However, if a gravel island is selected as the platform from which to drill an exploration well, construction is expected to take place during the winter. The island would be constructed in waters about 15 m deep with material mined from onshore ground deposits and hauled by truck over the ice; most of the Beaufort Sea islands have been constructed using this technique. Hence, the islands most likely would be constructed east of Cape Halkett because of an apparent shortage of onshore gravel west of the Colville River (Schlegel and Mahmood, 1985). An island in 50 ft (15 m) of water would require about 844,000 yd<sup>3</sup> (645,000 m<sup>3</sup>) of fill material; it would have a surface diameter of about 400 ft (122 m), freeboard of 20 ft (6 m), side slopes of 1:3, and a base diameter of 815 ft (248 m) (area of the base would be about 520,000 ft<sup>2</sup> [48,300 m<sup>2</sup>]).

(c) Drilling Muds and Cuttings: Drilling of each exploratory well will require the disposal of about 630 tons (dry weight) of drilling muds and approximately 820 tons (dry weight) of drill cuttings (Appendix B). The total amount estimated to be disposed is about 8,820 tons (dry weight) of drilling

muds and 11,480 tons (dry weight) of cuttings. The disposal of these materials will be, primarily, at the drilling site under conditions prescribed by EPA's pollutant-discharge permit (see Rathbun, 1986; Clean Water Act, as amended).

(d) Support and Logistic Activities: Offshore exploration-drilling operations in the Sale 124 area will require onshore support facilities. Where possible, existing facilities would be used or upgraded. The onshore facilities would have to provide (1) a staging area for construction equipment, drilling equipment, and supplies; (2) a transfer point for drilling and construction personnel; (3) a harbor to serve as a base for vessels required to support offshore operations; and (4) an airfield for fixed-wing aircraft and helicopters (Han-Padron, 1985).

Also, existing systems would be utilized to transport equipment, material, supplies, and personnel. The description of North Slope Transportation Systems as contained in Section III.D.2 of the 87 final EIS (FEIS) (USDOJ, MMS, 1984) is incorporated by reference; a summary of this description follows.

The NSB is linked to interior Alaska by the Dalton Highway. Use of the Haul Road north of Dietrich Camp is restricted to commercial carriers. The Annual Average Daily Vehicle Traffic (AADT) vehicle counts in the past few years have been at or below 100 AADT; this is well below the estimated capacity of 175 to 550 AADT. Regional surface transportation is accomplished via gravel roads within and between unitized oil fields and through an extensive system of trails, river drainages, and ice roads.

Barges transport most heavy and bulky cargo associated with petroleum-related activities in the Borough (NSB, 1989[a]). Prudhoe Bay has three barge docks--one at the east dock and two at the west dock. Oliktok dock was constructed in 1982 to expedite shipping to Kuparuk Field. Barge traffic in support of continued development on the North Slope of Alaska typically has ranged from 10 to 15 barges per year. During the initial development of the Prudhoe Bay Unit in 1970, 48 barges were used. With the new generation of barges, an equivalent tonnage could be shipped on 32 barges (Louis Berger and Associates, 1984).

Air transportation is the primary means of travel into the NSB. All public airstrips, except those at Barrow and Deadhorse, are gravel. Upgrading of local roads and airports has occurred continuously through the NSB CIP.

Personnel and routine supplies and materials are expected to be transported to the drilling units from the support base by helicopters; these helicopters would be certified for instrument flight. The number of helicopter trips flown in support of exploration- and delineation-well drilling is estimated to range from about 180 in the years when two wells are estimated to be drilled to 360 in the years from 1993 and 1994 when four wells could be drilled in each year. These estimates are based on the assumptions that, for each well, there will be one flight per drilling unit for each day of drilling and, as noted previously, the time required to drill and test a well is about 90 days. During the period from 1992 to 1996, the total number of helicopter flights supporting drilling operations is estimated to be 1,260.

The number of required support vessels for each drilling unit will depend, at least in part, on the type and characteristics of the unit and the sea-ice conditions. If there are drilling operations during the open-water season, MMS requires the operator to maintain an emergency-standby vessel within the immediate vicinity of the drilling unit. (Immediate vicinity is defined as being within 5 mi or a 20-minute steaming distance of the unit, whichever is less.) The primary reason for this requirement is to ensure emergency evacuation of personnel, but the standby vessel also could assist in the deployment of the oil boom in the event of an oil spill. Depending on ice conditions, two or more icebreaking vessels may be required to perform ice-management tasks for the floating units. The number of potential drilling units that might be operating during the open-water period could range from two to four.

Also, during the open-water season, it is estimated that there will be about 1 supply-boat trip per drilling unit per week; for exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to be between 140 and 170.

(e) Personnel: Estimates on the number of workmonths of direct OCS employment for each unit of work during the exploration phase are given in Appendix J, Table J-1. The projected direct industry-employment requirements for the exploration phase for the base case are given in Appendix J, Table J-2.

(3) Activities Associated with Development and Production: It is assumed that the oil resources discovered as a result of previous lease sales and Sale 124 will be developed simultaneously. The discovery of economically recoverable oil in the previous-lease-sale tracts would initiate the process to plan, design, and construct the production platforms, support facilities, and transportation infrastructure for petroleum exploitation in the Federal waters of the Beaufort Sea.

Work on offshore and onshore production and transportation facilities would not begin until the engineering and economic assessments of the potential reservoirs have been completed and the conditions of all the permits have been evaluated. The initial discovery of previous-sale oil is projected to occur in the second or third year of the lease; the first delineation well is projected to be drilled in 1993. The first oil discovery in the Sale 124 leased blocks could be in 1993.

(a) Shallow-Hazards Surveys: Shallow-hazards seismic surveys also will be conducted prior to the installation of the production platforms. Since the size of the individual prospects is unknown, it is assumed that blockwide surveys will be conducted for all the production platforms. A blockwide survey requires about 190 seismic-line miles in an area of about 35.5 mi<sup>2</sup> and takes about 7 days. (For additional assumptions, see Appendix H, Table H-3.) The total seismic activity associated with platform installation in the Sale 124 area is estimated to take about 28 days and cover about 760 line miles in four areas that total about 142 mi<sup>2</sup>. Individual platform sites may be surveyed several years prior to installation of the platforms; surveys would be conducted during the open-water period.

(b) Production-Platform Assumptions and Locations: If commercial discoveries are made in the Sale 124 area, the hydrocarbons would be produced from platforms installed on the seafloor between 1997 and 1999. Depending on the water depth, seafloor conditions, ice conditions, and size of the reservoir, several types of platforms could be used.

For the Sale 124 area, it is estimated the production platforms would be bottom-founded concrete structures that can withstand extreme ice conditions; the base would have an inverted cone shape to divert ice around the structure. A variety of steels are available for construction use in low-temperature environments; and concrete has been used to construct many different types of structures that resist seawater, ice, and freeze-thaw cycles. The platforms would be constructed and outfitted in ice-free harbors outside of Alaska. After staging, the platforms would be moved to the production site, where installation would be completed during the open-water season.

The production platforms would have to be designed so that installation, which might require the assembly of modular units, could be accomplished within a relatively short time--probably less than 45 days (Sec.II.B.2.a[1]). In addition to the vessels (8-10 tugs) used to tow the platform components to the site, installation also might require a large-capacity derrick barge and a vessel to accommodate the workers.

Artificial and caisson-retained islands may be used as production platforms in the shallower parts of the Beaufort Sea. To accommodate multiple wells, production equipment, and drilling rigs, these platforms would be larger than the islands used for exploratory drilling. Two artificial islands have been constructed in State of Alaska waters to produce oil from the Endicott Reservoir (U.S. Department of Defense, U.S. Army, Corps of Engineers, 1984). (See Appendix E for a description of the Endicott Development Project.)

For the base-case development and production scenario, four production platforms are assumed to be located in the sale area: three in the Beaufort Sea and one in the Chukchi Sea. Platform BC-1 is assumed to be located in the eastern part of the Beaufort Sea about 35 mi northeast of Barter Island in waters about 80 m deep. A second platform, BC-2, would be located about 40 mi north of Oliktok Point in waters about 40 m deep. BC-3, the third platform, is assumed to be located in the western part of the Beaufort Sea about 50 mi northwest of Pitt Point in waters about 60 m deep. The fourth platform, BC-4, located in the Chukchi Sea, is assumed to be about 70 mi northwest of Point Belcher in waters about 50 m deep. These assumptions have been made to evaluate the effects of platform installation and operation, even though predicting the types of platforms and the locations of future oil prospects is extremely uncertain.

(c) Development Drilling: It is estimated that a total of 120 production and service wells would be drilled from these four platforms from 1997 through 2000. Production of oil is forecast to begin in 2000, peak from 2001 through 2005, and continue through 2018; during peak years, the yearly production is estimated to be about 76 MMbbl. Many of the tracts in the Beaufort Sea that may be leased as a result of Sale 124 could be potential drainage tracts (USDOI, MMS, 1985b). (A drainage tract is

an offshore tract contiguous to producing tracts whose subsurface geologic structure is a continuation of the producing area and therefore more or less valuable as a source of additional oil or gas.) Thus, some Sale 124 oil could be produced as a result of discoveries made in tracts leased during previous sales.

Further assumptions regarding development drilling are as follows: Drilling of the production and service wells will use from 150 to 680 tons (dry weight) of drilling mud (Appendix B). Some of the mud used in drilling production and service wells may be recycled through each subsequent well drilled on a particular platform. Depending on the quantity recycled, the amount of drilling mud disposed could range from 150 to 680 tons (dry weight) for each well and from 18,000 to 81,600 tons for all the wells drilled. Also, each well is expected to produce approximately 1,180 tons (dry weight) of drill cuttings (Appendix B); the total amount of cuttings disposed of would be about 141,600 tons (dry weight). The disposal of the drilling muds and cuttings would be in accordance with approved EPA National Pollutant Discharge Elimination System permits for development-well drilling; muds and cuttings also may be transported to shore and disposed at approved sites. The amount of time required to drill and complete each production or service well is estimated to average 45 days (Roberts, 1987).

(d) Support and Logistic Activities: For the purpose of this scenario, it is assumed that the infrastructure at Prudhoe Bay will provide the major support for construction and operation activities associated with the development and production and transportation of crude oil. If development were to occur in the Chukchi Sea as a result of Beaufort or Chukchi Sea Planning Area lease sales, a support base adjacent to or near the northeastern part of the Chukchi Sea may be developed.

The total number of helicopter flights to be flown in support of the drilling of production and service wells in the Sale 124 area is estimated to be 5,400 during 1997 through 2000; the number of flights would range from 315 in 1997 when 7 wells are drilled to 2,250 in 1999 when 50 wells are drilled. These estimates are based on the assumption that there will be one flight per drilling unit for each day of drilling. From 2001 to 2018, it is estimated the number of helicopter flights to the production platforms will average about 2 per week per platform, or about 3,744 flights.

Major resupply for the production platforms will be by barge in the summer.

(e) Personnel: Estimates on the number of workmonths of direct OCS employment for each unit of work during the development and production phase are given in Appendix J, Table J-1. The projected number of projected direct industry-employment requirements for the development and production phase for the base case are given Appendix J, Table J-2.

#### (4) Activities Associated with Oil Transportation--Pipelines

(a) Pipeline Assumptions and Routes: The hypothetical pipeline locations for this scenario involve a number of assumptions; and although estimates are given for the total length of both offshore and onshore segments of pipelines for Sale 124 (Table II-A-1), many factors--including the potential locations of the offshore production platforms--are unknown. The purpose of the pipeline-transportation scenario is to identify a range of activities and a variety of locations to analyze the potential effects of pipeline construction and operation on the environment; the purpose is not to identify future pipeline routes.

For the transportation scenario, it is assumed (1) pipelines would be used to transfer oil from the production platforms to Trans-Alaska Pipeline (TAP) Pump Stations No. 1 or No. 2; (2) the configuration of the pipelines basically would be that of a combination offshore/onshore-gathering system--total length of the offshore and onshore segments would be about equal; and (3) the landfalls would be in the vicinity of Point Thomson in the eastern part of the Beaufort Sea, Oliktok Point in the central part, in the vicinity of Pitt Point in the western Beaufort, and Point Belcher in the Chukchi Sea. Installation of the pipelines for the Sale 124 leases is expected to begin in 1997 and continue through 1999.

The Beaufort Sea Sale 124 Exploration and Development Report (E&D Report), Appendix B, indicates oil might be transported to TAP through either an onshore- or offshore-gathering system. In the onshore-gathering system, the onshore segment is longer than the offshore segment, whereas for the offshore system, the offshore segment is longer; for the offshore-gathering system, the E&D Report indicates the length of the offshore segment would be much greater than the onshore segment. Based on the present state of pipeline development in the arctic region, it is assumed that the onshore-gathering system currently would be the preferred choice. For the scenario assumptions, the production platforms and pipeline routes were given

hypothetical locations to ensure a common basis for the effects assessment in Section IV of this environmental impact statement (EIS). Because of the location uncertainties involved in the sale area, the estimate of pipeline length is assumed to be 1.3 times the straight-line distance between two points. The E&D Report also notes four possible landfall sites: Point Thomson, Pitt Point, Oliktok Point, and Point Belcher (Barrow Area).

The amount of pipeline needed to connect the production platforms to the TAP is estimated to be about 600 mi; 275 mi offshore (75 mi trenched) and 325 mi onshore. The pipeline from production platform BC-1, located northeast of Barter Island, would have a landfall in the vicinity of Point Thomson. Current regulations pertaining to petroleum exploitation in the Arctic National Wildlife Refuge (ANWR) prevent the use of pipelines in the refuge; Point Thomson lies west of ANWR. The landfall for the pipeline from the BC-3 production platform, located northwest of Pitt Point, would be near Pitt Point. The amount of onshore pipeline could be reduced if the onshore segments of the pipelines from platforms BC-1 and BC-3 connected to the Endicott and Kuparuk Pipelines, respectively.

The platform north of Oliktok Point, BC-2, would be connected to Pump Station No. 1 via an offshore pipeline that crosses the shoreline at or near Oliktok Point and an onshore pipeline that joins with the pipeline from Pitt Point to Pump Station No. 1.

The pipeline from the Chukchi Sea platform BC-4 would connect to an onshore pipeline at Point Belcher. Point Belcher was selected as the landfall for the Sale 124 Chukchi Sea pipeline because a pipeline from this location along the Chukchi Sea coast to TAP has been part of the hypothetical transportation scenarios developed for the oil and gas lease sales in the Beaufort Sea Planning Area (Sale 97) and the Chukchi Sea Planning Area (Sale 109) (USDOI, MMS, 1987a, and USDOI, MMS, 1987b). The pipeline from Point Belcher to TAP Pump Station No. 2 would be about 400 mi long (USDOI, MMS, 1987b).

A support base might be located in the vicinity of a pipeline landfall to support offshore-development drilling and pipeline trenching and laying--it would occupy about 60 to 75 acres (25 to 30 ha) and include a 1.2-mi airstrip, living accommodations, storage facilities for drilling and pipeline laying, and maintenance facilities (USDOI, MMS, 1987b). The construction of the base would require an estimated 654,000 yd<sup>3</sup> (500,000 m<sup>3</sup>) of gravel (Han-Padron, 1985). Booster-pump stations would be required at the Point Thomson, Oliktok Point, Pitt Point, and Point Belcher landfalls; these stations would occupy the sites of the former support bases.

(b) Trenching and Installation: Pipelines would be buried in trenches to prevent damage by the keels of drifting ice masses and by current scouring. The trenches may be excavated by cutter-suction dredges or mechanical plows (Han-Padron, 1985). Cutter-suction dredges are more efficient than plows for deep-trenching in a variety of soils. However, because existing cutter-suction dredges may have forward speeds that are too slow for the short open-water season in the sale areas, specially designed new equipment will be required (Han-Padron, 1985). The cutter-suction dredges that have been used in artificial-island construction in the Canadian Beaufort Sea have operating drafts of 4.4 and 1.2 m and cutter depths of 70 and 18.3 m, respectively.

Design studies indicate that trenches as deep as 1 to 2 m can be cut by a single pass of a large mechanical plow but that cutting trenches deeper than 2 m probably will require multiple passes (Brown and Palmer, 1985). In the Beaufort Sea, Brown and Palmer (1985) estimate that trenching to a depth of 1 m can be done at an average rate of 3 mi per day.

Trenching probably will be done during the open-water period. The relatively short period of time in the summer and early fall when the amount of sea-ice cover is less than 50 percent indicates that some of the trenching may have to be done in the presence of ice. As experience in other areas increases, plowing or dredging systems may be developed that can cut trenches more rapidly or deeper on a single pass, or both.

For the purpose of developing a set of activities associated with installation of pipelines, it is assumed that pipelines in waters shallower than 40 m will be buried in trenches. As noted in Appendix B, it is anticipated that pipelines from OCS production platforms will be buried in trenches, deep enough to avoid being adversely affected by the keels of drifting ice masses and shallow enough to avoid the effects of permafrost. Burial depth is dependent, at least in part, on water depth; in waters shallower than about 130 ft (40 m), the burial depth increases with water depth (Appendix H, Table H-4). As noted in Section III.A.4.a(2), the zone of most dense ice gouges lies between the 20- and 40-m isobaths. The length of pipeline shoreward of the

40-m isobath is estimated to be about 75 mi. As noted previously, pipeline installation is estimated to begin in 1997. If the 75 mi of trench were excavated from 1997 to 1999, the yearly rate would be about 25 mi. As noted in Section II.B.2.a(1), it is assumed that there would be about 45 days in the summer when an activity such as trenching could occur. Based on this assumption, it is estimated that trenching would have to average about 0.5-0.6 mi per day.

The total area disturbed by trenching is estimated to be about 4.60 mi<sup>2</sup>; the area disturbed by excavation is about 0.92 mi<sup>2</sup>, and the area disturbed by disposal of the excavated sediments is about 3.68 mi<sup>2</sup>. The assumptions used to estimate the amount of disturbed area are shown in Appendix H, Table H-4. For the purpose of the transportation scenario, it is assumed that most of the pipeline will be laid from a conventional lay barge during the open-water season. Other techniques for laying offshore pipelines include laying from a reel barge or by bottom or surface tows. Most present-day techniques for laying marine pipe were developed in an ice-free environment. Only the ice in the landfast zone may be thick and stable enough to support the equipment used to lay pipe in the winter. Short pipelines and shallow-water sections of longer pipelines probably will be installed by the bottom-pull method.

Pipeline installation is predicted to occur from 1997 to 1999. The length of the offshore segments is about 275 mi and the onshore segments about 325 mi. The yearly average length of offshore pipeline laid is estimated to be about 92 mi; for a 45-day operating period, this is about 2 mi per day.

Shallow-hazards surveys also are required along offshore-pipeline routes. However, specific requirements for pipeline shallow-hazards surveys in the Alaskan OCS have not been drafted.

At the landfall sites, the pipelines must be protected from the effects of waves and currents, sea ice, and unstable sediment or soil condition--including possible erosion and permafrost freeze/thaw cycles. Protection may be through burial in a causeway or in the marine sediments and terrestrial soils. The type and extent of protection would depend on the characteristics at the site as determined by site-specific surveys of present conditions and an estimate of the maximum forces that the pipeline must withstand during its expected operational life.

Burial in causeways or jetties is another method that might be used to protect pipelines at landfalls. Also, if the produced oil has a low pour point (the lowest temperature at which an oil will flow after being cooled and left undisturbed for a prescribed length of time), a causeway or jetty might have to be constructed at a landfall that crosses a shallow permafrost zone to insulate the oil from being cooled to the extent that it no longer flows (Appendix B). Long causeways, ranging in length from about 2.5 to 5 mi, presently are being used to connect a seawater-treatment plant and dock and offshore-production islands to the mainland in the Prudhoe Bay area of the Beaufort Sea. However, the length--perhaps 1,000 to 2,500 ft--of any causeway or jetty that might have to be constructed for a pipeline from an OCS production platform is expected to be much shorter than West Dock or the Endicott Causeway.

It is assumed that the onshore segments of the pipelines will be mounted on vertical-support members spaced about 60 ft apart with expansion loops every 1,000 ft; this is similar to other pipelines in Alaska's North Slope Region--including TAP and the Kuparuk Pipeline. Depending on oil characteristics and production and soil conditions, it may be desirable to bury the pipeline in some areas and elevate it in others (Office of Technology Assessment, 1989). Construction of the pipelines will likely occur in the winter unless roads parallel to the pipelines are required and could support summer construction. The pipeline-laying rate is assumed to be about 108 mi per year per crew.

The FEIS on oil and gas leasing in the National Petroleum Reserve-Alaska (NPR-A) has evaluated a number of potential pipeline routes from hypothetical fields to TAP (USDOI, BLM, 1983). These include routes beginning (1) east of Teshekpuk Lake; (2) on the peninsula separating Dease Inlet, Admiralty Bay, and Smith Bay; and (3) in the southern part of NPR-A. Pipelines in the northern part of the reserve would join TAP at Pump Station No. 1, while those in the southern part would join TAP at Pump Station No. 3.

b. Summary of Effects of the Base Case: The summaries presented in this section are based on the analyses in Section IV.C of this EIS. The types and levels of activities that might be associated with the base case for Alternative I are described in the preceding section (Sec. II.B.2.a).

(1) Effects on Water Quality: In the base case, an oil spill of 1,000 bbl or greater would temporarily and locally increase hydrocarbon concentrations in the water column. The large number

of very small spills anticipated over the production life of the field could result in local, chronic contamination within the margins of the oil field. Construction activities would at most increase turbidity over a few square kilometers in the immediate vicinity of the construction and only while the activity persisted. Oil spills and construction activities are expected to have a LOW LOCAL effect and a VERY LOW REGIONAL effect on water quality.

Deliberate discharges of muds and cuttings are regulated by EPA such that any effects on water quality must be extremely local; water-quality criteria must be met at the edge of the mixing zone established by the EPA-issued discharge permit. Discharge of formation waters (with whatever the formation waters contain)--rather than their reinjection into the seafloor--would result in local pollution over the life of the field, an expected MODERATE effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality.

The effect of causeways on LOCAL water quality would be long term but MODERATE. The effect of causeways on REGIONAL water quality would be VERY LOW.

The overall effects of these agents would be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality.

(2) Effects on Lower-Trophic-Level Organisms: Oil spills are more likely to cause widespread effects to marine plants and invertebrates than are other activities associated with exploration and development and production of oil resources. In general, oil spills are expected to have LOW effects on marine plants and invertebrates. At greater risk to effects are benthic and epibenthic organisms living in nearshore shallow environments where contact with oil is more probable. Even if the abundant epibenthic invertebrates in nearshore environments were affected locally, it is most likely that populations of their fish predators would not be affected significantly and that recolonization by invertebrates could be rapid. Oil-spill effects on the planktonic and epontic communities are expected to be LOW due to the limited area likely to be affected. Some local effects to higher-trophic-level organisms may be observed.

Effects from other activities associated with the base case are expected to be very localized and are not expected to exceed LOW.

The Stefansson Sound Boulder Patch community is more vulnerable to effects from oil-related activities, since it is a very restricted community spatially. If oil contacted the community, then a HIGH effect is possible, since productivity and successful recruitment could be affected. If construction activities were sited too close to this community, then a HIGH effect is possible. However, LOW effects to this community are expected.

(3) Effects on Fishes: The greatest effect on fishes (MODERATE) is expected to occur from oil spills.

Anadromous fishes migrating to feeding, overwintering, or spawning areas and juvenile stages in nearshore areas are susceptible to spilled oil. An oil spill contacting the nearshore zone in the open-water season when these fishes are widely dispersed is expected to have a MODERATE effect on them. However, HIGH effects are possible if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. Oil is unlikely to contact the river deltas where these fishes are most vulnerable. A MODERATE effect is expected for anadromous fishes.

Capelin spawn in coastal sandy areas and thus are susceptible to negative effects from an oil spill. The effect of an oil spill on capelin is expected to be MODERATE but could be HIGH if spawning fish and/or their offspring were affected.

The level of effects on fishes from seismic surveys and discharge of drilling fluids should be very localized and thus LOW.

Construction activities, in particular the projected construction of four relatively short (1,500-2,500 ft) causeways or jetties, is likely to have a LOW effect on fishes, principally anadromous species, due to localized and short-term effects on movements and migrations.

The effect on fishes in the Sale 124 area is expected to be MODERATE.

(4) Effects on Marine and Coastal Birds: For the base case, potential adverse effects on marine and coastal birds primarily would come from (1) oil spills, (2) exploration activities and development and production activities, and (3) alteration of marine and terrestrial habitats associated with offshore pipelines and onshore pipeline and road construction. There is a 68-percent chance of one or more oil spills of 1,000 bbl or greater occurring during exploration and development under the Proposal. A potential oil spill of an average size of about 22,000 bbl poses a high risk of contact to one or more bird coastal-habitat areas or an important seabird pelagic habitat, resulting in perhaps the death of several hundred to several thousand birds, particularly abundant oldsquaw and other sea ducks. This bird mortality is not expected to result in a long-term population decline, because natural recruitment probably would replace losses of abundant species within 1 to 3 years (one generation). Bird species with low regional populations or species with low reproductive rates (such as alcid species) are not likely to suffer high mortality due to one oil spill in the Beaufort Sea. The effect of an oil spill on marine and coastal birds such as eiders and Pacific brants is expected to be MODERATE, with population recovery occurring within one generation.

The sensitivity of birds to disturbance sources is highly variable. Industrial activities associated with exploration and development are likely to disturb some local populations of nesting, feeding, and molting birds on barrier islands, lagoons, and tundra habitats. However, nesting activities of most species of marine and coastal birds are widely dispersed over the coastal tundra; and disturbance of local nesting birds probably would have little effect on North Slope-bird populations as a whole. Effects of disturbance are expected to be LOW.

Other industrial activities associated with the base case that could affect birds include installation of four production platforms, the laying of 275 mi (75 mi trenched) of offshore pipeline, and construction of 325 mi of onshore pipeline and roads. Offshore-construction activities temporarily would displace some birds near the activity sites and also would temporarily disrupt or remove some food sources near the four platforms and near the laying of offshore pipeline, representing a LOW effect. Onshore-construction activities would destroy or alter tundra-nesting and -feeding habitat of marine and coastal birds within 100 to 200 m along the onshore pipelines and associated roads. The permanent loss of about 30 mi<sup>2</sup> of local onshore habitats from onshore-facility construction, pipelines, roads, and gravel mining during the development phase would represent a small portion of the available tundra habitat. Thus, effects on birds from onshore development are expected to be MODERATE.

The combined effects of potential oil spills, noise and disturbance, and habitat alteration on marine and coastal birds is expected to be MODERATE for the base case.

(5) Effects on Pinnipeds, Polar Bears, and Belukha Whales: For the base case, an oil spill, noise and disturbance, and habitat alterations could have some potential adverse effects on pinnipeds, polar bears, and belukha whales found in the lease-sale area. There is a 68-percent chance of one or more oil spills of 1,000 bbl or greater occurring during exploration and development under the base case (Table IV-A-1-2). A potential oil spill of an average size of about 22,000 bbl poses the highest risk of contact to marine mammals in the Point Barrow offshore area (Spring-Migration Area) and in the Smith Bay to Camden Bay offshore ice-flaw-zone habitat. Some aggregations of about 10 to perhaps a few thousand ringed, spotted, and bearded seals occurring in these habitats could be contaminated and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups are expected to be contaminated by a winter oil spill, resulting perhaps in the death of some pups--probably no more than 100 (due to the sparse distribution of pupping lairs). This loss is expected to be replaced within one generation (a MODERATE effect). Polar bears also would be most vulnerable to oil spills in the ice-flaw zone; however, a small number of bears (probably fewer than 50) are likely to be affected due to their sparse distribution (a LOW effect). Walrus herds of several thousand and their seasonal feeding habitat west and north of Point Barrow could be at some risk of oil-spill contact. Direct effects of oil are likely to be MODERATE. Healthy adult walrus are not likely to die from oil-spill contact, but several hundred or more young calves could be killed if oiling occurs. Such a loss is likely to be replaced by natural recruitment within one generation (a MODERATE effect). Belukha whales are somewhat vulnerable to oil-spill contact during spring migration off Point Barrow. However, few belukha whales are likely to be seriously affected by the probable brief exposure to the spill (a VERY LOW effect).

Helicopter trips and boat traffic to and from exploration-drilling units and production platforms under the base case could disturb some hauled out ringed, bearded, and spotted seals and walrus, causing them to

panic and charge into the water and resulting perhaps in the injury or death of some seal pups and walrus calves. Because the walrus-nursery herds and nursing seals and pups are widely distributed along the ice front, aircraft moving to and from drill platforms are likely to temporarily disturb only a small portion of the walrus and seal populations. Thus, aircraft-disturbance effects are expected to be LOW.

Vessel traffic associated with the drilling units, production platforms, and seismic vessels operating during the open-water season temporarily could displace some marine mammals and change local distribution for a few hours to a few days. Such short-duration and local displacement is expected to have a LOW effect on pinnipeds, polar bears, and belukha whales. Drilling-platform installation, offshore-pipeline laying and trenching, and other construction activities associated with the base case are likely to have a short-term and local or LOW effect on these marine mammals.

For the base case, the combined effect of oil spills, noise and disturbance, and habitat alterations is expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales.

(6) Effects on Endangered and Threatened Species: Potential oil spills and noise and disturbance associated with the base case would be the major effect-producing agents to endangered and threatened species. There is a low probability of any oil spills occurring or contacting any bowhead or gray whale-habitat areas; however, a few individuals of both species could experience one or more of the following effects if a spill occurred: skin contact with oil, baleen fouling, inhalation of hydrocarbon vapors, a localized reduction of food resources, the consumption of oil-contaminated prey items, and perhaps a temporary displacement from some feeding areas. Some bowhead and gray whales would be affected by noise and disturbance activities associated with seismic surveys, drilling-unit operations, aircraft and vessel traffic, and production-platform installation and operations. Reactions generally would be short term and temporary in nature, consisting of localized movements away from the sound source. Whales may avoid feeding within several hundred yards of drilling units and production platforms. Arctic peregrine falcon-nest sites could be exposed to a limited amount of aircraft noise and disturbance; however, it is expected to be only occasional, of short duration, and localized. The overall effects are expected to be MODERATE for the bowhead whale, LOW for the gray whale, and VERY LOW for the arctic peregrine falcon.

(7) Effects on Caribou: For the base case, the primary source of disturbance to caribou would be vehicle traffic that could be associated with onshore transportation of oil from offshore leases. Possible oil spills, offshore construction, and marine transportation would probably have a LOW effect on caribou. The construction and presence of over 325 mi of onshore pipelines and roads and the development of other facilities and associated motor-vehicle traffic are disturbance factors to caribou, particularly cow/calf groups on their summer range.

The use of onshore pipelines to transport oil could increase motor-vehicle disturbance of caribou, particularly cows and calves of the Central Arctic herd (CAH), Teshekpuk Lake herd, and Western Arctic herd (WAH) along the pipeline-maintenance roads. Approximately 20 percent of the WAH (that portion of the herd that winters on the North Slope) may be temporarily disturbed by vehicle traffic associated with construction of a pipeline and maintenance road crossing part of the NPR-A from Pitt Point to TAP north of the WAH calving range. Disturbance of caribou along the pipeline crossing NPR-A would be most intense during the construction period (perhaps 6 months), when motor-vehicle traffic is highest, but would subside after construction is complete. Caribou are likely to successfully cross the pipeline corridor, even during high traffic periods, within a short period of time (a few minutes to a few days) during breaks in the traffic flow. Little or no restriction of caribou movement is expected. A pipeline from offshore lease blocks east of Flaxman Island is assumed to come onshore at Point Thomson. Such a pipeline would cross a portion of the calving range of the CAH and cause disturbance and some displacement of caribou on a small portion (estimated to be less than 1%) of the calving and summer range. This onshore pipeline is likely to have no effect on caribou abundance or overall distribution, although very local changes in habitat use near the pipeline and road might persist.

If a spill occurred during the open-water season, caribou that frequent coastal habitats such as in the Cape Halkett or Prudhoe Bay areas possibly could be directly exposed to and be contaminated by the spill along the beaches and in shallow waters during periods of insect-pest-escape activities. Caribou might inhale or absorb oil through their skin if they become oiled. However, even in a severe situation, a comparatively small number of animals (a few hundred to perhaps a thousand) is likely to be directly exposed to the oil spill and die as a result. This effect probably would be LOW to any of the caribou herds, with losses replaced within less than one generation (a LOW effect). For the most part, onshore oil spills are likely to

be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter caribou range within the pipeline corridor. The effect of onshore oil spills on caribou is therefore expected to be VERY LOW.

The effects of the base case on caribou are expected to be MODERATE.

(8) Effects on the Economy of the North Slope Borough: Due to the projected declines in NSB revenues and in resident employment, the economic effects of the base case for Alternative I are not expected to put undue pressure on the economic system. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though this would be less than 10 percent of the projected no-sale conditions. The subsistence economy is expected to experience some adverse effects due to development. The economic effects on the NSB are expected to be MODERATE.

(9) Effects on Sociocultural Systems: Effects on sociocultural systems would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. Wainwright, Barrow, Nuiqsut, and Kaktovik are most likely to be affected due to their proximity to possible shore bases at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson and effects on their bowhead whale harvests. Wainwright, Nuiqsut, and Kaktovik are small, relatively homogeneous communities that would not absorb the presence of non-Natives as well as a community such as Barrow. Interactions with non-Natives, increased non-Native population, and Natives leaving the community to work in the industrial enclave could lead to a breakdown of kinship networks as well as increase social stress in the community. Disruptions to the social organization could lead to a decreased emphasis on the importance of the family, cooperation, and sharing. Multiyear disruptions of Nuiqsut's subsistence-harvest patterns could disrupt sharing networks, subsistence task groups, and crew structures and could cause disruptions of subsistence as a way of life. These disruptions also could cause a breakdown in sharing patterns, family ties, and the community's sense of well-being and could damage sharing linkages with other communities.

Other effects might be a decreasing emphasis on subsistence as a livelihood, with an increased emphasis on wage employment, individualism, and entrepreneurialism. Wainwright, Kaktovik, and Nuiqsut also may experience an increase in social problems due to the increased presence of oil workers in the community and possible ice roads connecting Wainwright to Point Belcher, Nuiqsut to Pitt Point or Oliktok Point, and Kaktovik to Point Thomson, enabling easier access to drugs and alcohol and affecting the social health of the community. Effects on the sociocultural systems, such as increased drug and alcohol abuse, breakdown in family ties, and weakening of social well-being, would lead to additional stresses on the health and social services available to Wainwright, Nuiqsut, and Kaktovik. These effects could be long term. There could be a tendency for additional stress on the sociocultural systems but without tendencies toward displacement, resulting in MODERATE effects on Wainwright's, Nuiqsut's, and Kaktovik's sociocultural systems.

Although Barrow would be in proximity to industrial activities, would have increases in population and employment, and also would experience potential MODERATE effects on the bowhead whale harvest, these changes should not be more significant than those changes that have already been felt in Barrow. The expected effect on sociocultural systems in Barrow would be LOW.

Atqasuk is too distant from onshore industrial activities to experience direct, sale-related increases in population and employment. This community may experience some indirect rises in population and increases in employment, but they are not expected to be significant. MODERATE effects are expected on bowhead whale harvests. Disruptions in Atqasuk would be short term and would not have a tendency toward displacement of existing sociocultural institutions--a LOW effect on social organization as a result of lease-sale activities.

For the base case, the overall effects of proposed Sale 124 on sociocultural systems are expected to be MODERATE.

(10) Effects on Subsistence-Harvest Patterns: Effects on subsistence-harvest patterns in the base case would be expected to occur from oil spills, noise and disturbance, and construction activities. An oil spill could affect whaling in Barrow (Atqasuk) for no more than 1 year--a MODERATE effect. An oil spill in the Barrow subsistence-harvest area is unlikely to have more than LOW effects on harvests of belukha whales, seals, walrus, polar bears, caribou, or fishes. While an oil spill also could make some waterfowl locally unavailable for 1 year, other waterfowl would continue to be harvested at other times

in the year--a LOW effect. In Wainwright, Nuiqsut, and Kaktovik the low probability of an oil spill occurring and contacting these subsistence-harvest areas indicates little likelihood that subsistence harvests would be affected by an oil spill.

Localized, short-term effects from noise and disturbance are not expected to have long-term biological consequences on bowhead whales. However, since whaling occurs in narrow leads in Wainwright and Barrow and whales can easily escape into the pack ice, this activity may be particularly sensitive to noise disturbance. During exploration and development, noise from support vessels may disrupt whaling at Barrow or Wainwright during most likely no more than one season, particularly if ice conditions were severe. Although development would last for many years, disturbance of such activities in Barrow is not likely to occur to the extent that no whales are harvested for more than one season because there are more bowheads harvested in Barrow than in other whaling communities--a LOW effect. In Wainwright, Nuiqsut, and Kaktovik, noise during exploration and development and from support vessels could disrupt the whale harvest, causing it to be unavailable--a MODERATE effect. In all communities, noise and disturbance is not expected to have more than LOW effects on harvests of belukha whales, seals, walruses, caribou, fishes, polar bears, and birds.

The landfall at Point Thomson is onshore across from Flaxman Island, the primary location for Nuiqsut bowhead whale harvests. Construction activities could cause bowhead whales to avoid the area and force Nuiqsut whalers to travel farther to hunt bowheads. Disruption from construction activities could cause the bowhead whale to become unavailable or greatly reduced to Nuiqsut whalers for 1 to 2 years--a HIGH effect. Construction of a landfall either at Pitt Point or at Point Thomson is unlikely to have more than LOW effects on caribou harvests. Construction activities at Point Belcher would concentrate noise and disturbance and construction activities in Peard Bay and could disturb Wainwright's bowhead whale harvest, causing it to be locally unavailable for up to 1 year--a MODERATE effect. Wainwright walrus harvests, because they occur in a short timeframe, also could be similarly affected. Construction activities should not affect other harvests in Barrow (Atqasuk), Nuiqsut, or Kaktovik.

Effects from the proposed lease sale in the base case are expected to be HIGH in Nuiqsut and MODERATE in Wainwright, Barrow (Atqasuk), and Kaktovik. Regional effects on subsistence-harvest patterns are expected to be HIGH.

(11) Effects on Archaeological Resources: The effects of the base case would be due mainly to the low probability that offshore archaeological resources would survive in the ice-gouged parts of the sale area. Disturbance to onshore resources should be modest. Therefore, the effects of the base case on archaeological resources are expected to be LOW.

(12) Effects on Air Quality: The USDOJ regulatory exemption levels for regulated air pollutants would not be exceeded, and air-pollution concentrations permitted by air-quality standards would be easily attained. The effects of air pollutants other than those addressed by air-quality standards could cause short-term, local effects on vegetation from coating by soot. Consequently, a LOW effect on air quality would be expected.

(13) Effects on Land Use Plans and Coastal Management Programs: Potential conflicts between activities assumed for this lease sale and the NSB Land Management Regulations and the Statewide standards and the NSB district policies of the ACMP are particularly evident in three areas.

First, the proximity of the proposed landfall sites to Point Belcher and Flaxman Island, primary locations for bowhead whale harvests, could lead to conflict with the Statewide standard for energy-facility siting that requires facilities to be compatible with existing and subsequent uses (6 AAC 80.070 [2]) and two subsistence policies of the NSB. The NSB CMP 2.4.5.1[b] requires development that restricts subsistence-user access to a subsistence resource meet three criteria: (1) there is a significant public need, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse impacts the policy was intended to prevent. The NSB CMP 2.4.5.2(h) relates both to subsistence and cultural resource areas and requires development to be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas, subject to the three criteria identified above.

Second, user conflicts between offshore activities and the subsistence bowhead whale hunt may have a potential conflict with the energy-facility siting policy identified above and with NSB CMP 2.4.3(b), which

requires that offshore drilling and other development within the area of the bowhead whale migration not significantly interfere with subsistence activities.

Third, additional shore approaches for the pipelines could create conflict with the energy-facility-siting policy related to free passage of fish (6 AAC 80.070 [12], NSB CMP 2.4.4 [i], and NSBMC 19.70.050.I.9) and the water-quality criteria (6 AAC 80.140).

Potential conflicts between activities assumed to follow this sale and NSB Land Management Regulations and the Alaska Coastal Management Program are expected to be HIGH.

### 3. High Case

a. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: The high-case-resource estimate, 2,600 MMbbl, represents a quantity of oil that is estimated to be the maximum amount of resources if hydrocarbons are present. The level of activities and scheduling of events associated with the Sale 124 high-case-resource estimate are shown in Table II-A-1 and Appendix B, Table 3. Some of the assumptions regarding the types and levels of activities associated with the high-case-resource estimate are the same as for the base case; the assumptions are noted in Section II.B.2.a for exploration-drilling activities (Sec. II.B.2.a[2]), development and production activities (Sec. II.B.a[3]), and transportation activities (Sec. II.B.2.a[4]).

#### (1) Activities Associated with Exploration Drilling

(a) Shallow-Hazards Surveys: Prior to drilling, the lessee/operator is required to conduct surveys to determine if shallow hazards are present or absent at the proposed drill site; these surveys should incorporate seismic profiling. The total seismic activity associated with site-specific surveys for the high case is estimated to take about 72 days and cover 1,440 seismic-line miles in 36 areas that total about 320 mi<sup>2</sup>.

(b) Exploration Drilling: Drilling of the estimated 25 exploration and 11 delineation wells is anticipated to begin in 1992 and continue through 1998. Based on the water-depth ranges of the Sale 124 blocks (Sec. II.B.2.a[2][b]), it is estimated that 29 exploration wells for the high case will be drilled from floating drilling units, 5 from bottom-founded mobile units, and 2 from artificial islands. It is anticipated that manmade islands used to drill in waters shallower than 20 m will be constructed from spray ice; if the islands are constructed with gravel, they would be similar to the island noted in Section II.B.2.a.(2)(b).

Drilling of each exploratory well would require the disposal of about 630 tons (dry weight) of drilling muds and 820 tons (dry weight) of drill cuttings. The total amount estimated to be disposed is about 22,680 tons (dry weight) of drilling muds and about 29,520 tons (dry weight) of cuttings.

(c) Support and Logistic Activities: The total number of helicopter flights flown in support of the high-case exploration drilling is estimated to be about 3,240. The number of flights per year range from 180 in 1997 and 1998 when two wells are drilled each year to 810 in 1993 when nine wells are drilled.

During drilling operations in the open-water season, an emergency-standby vessel is required to be within the immediate vicinity of the drilling unit. Also, depending on ice conditions, two or more vessels may be required to perform ice-management tasks for the floating units. The potential number of drilling units that might be operating during the open-water season could be about five or six. Also, during the open-water season, it is estimated that there will be 1 supply-boat trip per drilling unit per week; for exploration drilling, the total number of supply-boat trips is estimated (based on 90 days to drill a well) to range from about 370 to 450.

(2) Activities Associated with Development and Production: The initial discovery of oil is projected to occur in the second or third year of the lease; the first delineation well is projected to be drilled in 1993. The first oil discovery in the Sale 124 leased blocks could be in 1993.

The production platforms for the Sale 124 area are assumed to be located in seven general areas of the Beaufort Sea Planning Area; installation of the platforms is estimated to occur between 1998 and 2000. In

addition to the locations of the four platforms assumed for the base case (Sec. II.B.a[3][b]), the three additional platforms for the high case are assumed to be located as follows: (1) about 30 mi northwest of Barter Island in waters about 90 m deep--HC-1; (2) about 19 mi north of BC-4 in waters about 50 m deep--HC-2; and (3) about 19 mi northeast of platform BC-4 in waters about 60 m deep--HC-3.

(a) Shallow-Hazards Surveys: Prior to installation, the operator/lessee is required to conduct shallow-hazards surveys. Since the size of the individual prospects is unknown, it is assumed that blockwide surveys will be conducted for all the production platforms in the Sale 124 area. The total seismic activity associated with platform installation in the Sale 124 area is estimated to take about 49 days and cover about 1,330 line miles in seven areas that total about 248 mi<sup>2</sup>.

(b) Development-Well Drilling: It is estimated that a total of 346 production and service wells would be drilled from seven platforms located in the Beaufort and Chukchi Seas. Drilling of the wells would occur between 1999 and 2003.

Drilling of each production and service well will use from 150 to 680 tons (dry weight) of drilling mud. Some of the mud used in drilling production and service wells may be recycled through each subsequent well drilled on a particular platform. Depending on the amount recycled, the amount of drilling mud disposed could range from 150 to 680 tons (dry weight) for each well and from 51,900 to 235,280 tons for all the wells drilled. Also, each well in the Sale 124 area is expected to produce approximately 1,180 tons (dry weight) of drill cuttings; the total amount of cuttings disposed would be about 408,280 tons (dry weight).

Production of oil is forecast to begin in 2001 and continue through 2019. Peak production, 218 MMbbl per year, would occur between 2002 and 2006.

(c) Support and Logistic Activities: For the purpose of this scenario, it is assumed that the infrastructure at Prudhoe Bay will be used to support major construction and operation activities for the development and production and transportation of crude oil. If development were to occur in the Chukchi Sea as a result of Beaufort Sea or Chukchi Sea Planning Area lease sales, a support base adjacent to or near the northeastern part of the Chukchi Sea may be developed.

The total number of helicopter flights to be flown in support of the drilling of production and service wells is estimated to be 15,570 during 1999 through 2003; the number of flights would range from 1,800 in 1999 when 40 wells are drilled to 3,825 in 2001 through 2002 when 85 wells are drilled each year. From 2004 to 2019, it is estimated the number of helicopter flights to the production platforms will average about two per week per platform, or about 9,984 flights.

(d) Personnel: Estimates on the number of workmonths of direct OCS employment for each unit of work during the development and production phase are given in Appendix J, Table J-1. The projected direct industry-employment requirements for the development and production phase for the base case are given Appendix J, Table J-2.

### (3) Activities Associated with Oil Transportation--Pipelines

(a) Pipeline Assumptions and Routes: Pipelines would be used to transfer the oil from the production platforms to TAP Pump Stations No. 1 or No. 2. The amount of pipeline required is estimated to be about 650 mi. It is assumed about 325 mi of the pipeline lies offshore and the other 325 mi onshore; 275 mi of the offshore pipeline and 325 mi of onshore pipeline would be the same as assumed for the base case. Installation of the pipelines is expected to begin in 1997 and continue through 2000.

The pipelines from the three additional platforms assumed for the high case would connect to the pipelines that transport oil from the base-case platforms to TAP; the additional amount of pipeline is estimated to be about 50 mi.

The pipeline from the platform HC-1, located northwest of Barter Island, would connect to the pipeline from Platform BC-2 to Point Thomson. The pipelines from the Chukchi Sea platforms HC-6 and HC-7 connect with the pipeline from platform BC-4 to Point Belcher. (The assumptions regarding the landfall at Point Belcher are discussed in Sec. II.B.2.a[4][a].)

(b) Pipeline Trenching and Laying: As noted in Section II.B.a(4)(b), offshore

pipelines in waters shallower than 40 m are assumed to be buried in trenches. For the high case, it is estimated that about 75 mi of the pipeline route would have to be trenched; this is the same as assumed for the base case. If the 75 mi of trench were excavated from 1997 to 1999, the yearly rate would be about 25 mi. As noted in Section II.B.2.a(1), it is assumed that there would be about 45 days in the summer when an activity such as trenching could occur. Based on this assumption, it is estimated that trenching would have to average about 0.5-0.6 mi per day.

It is estimated that the total area disturbed by trenching would be about 4.60 mi<sup>2</sup>, the area disturbed by excavation would be about 0.92 mi<sup>2</sup>, and the area disturbed by disposal of the excavated sediments would be about 3.68 mi<sup>2</sup>. These estimates are the same as the base case. The assumptions used to estimate the amount of disturbed area are shown in Appendix H, Table H-4.

Shallow-hazards surveys also are required along offshore-pipeline routes. However, specific requirements for pipeline shallow-hazards surveys in the Alaskan OCS have not been drafted.

Pipeline installation is predicted to occur from 1997 to 2000. The length of the offshore segments is about 325 mi and the onshore segments about 325 mi. These estimates include segments assumed for the base case: 275 mi of offshore segments and 325 mi of onshore segments. The yearly average length of offshore pipeline laid is estimated to be about 108 mi; for a 45 day-operating period, this is about 2.4 mi per day. As noted in Section II.B.2.a(4)(b), pipelines at landfall sites may be buried in trenches or short causeways or jetties to protect them from the effects of waves and currents, sea ice, and unstable sediment or soil conditions.

It is assumed that the onshore segments of the pipelines will be elevated or buried in a manner similar to other pipelines in Alaska's North Slope region.

b. Summary of Effects of the High Case: The summaries presented in this section are based on the analyses in Section IV.D of this EIS. The types and levels of activities that might be associated with the high case for Alternative I are described in the preceding section (Sec. II.B.3.a).

(1) Effects on Water Quality: Three oil spills of 1,000 bbl or greater would temporarily and locally increase hydrocarbon concentrations in waters of the Beaufort Sea Planning Area. The large number of very small spills anticipated over the production life of the field could result in local, chronic contamination within the margins of the oil field.

Construction activities would at most increase turbidity over a few square kilometers in the immediate vicinity of the construction and only while the activity persisted. Oil spills and construction activities are expected to have a LOW LOCAL effect and a VERY LOW REGIONAL effect on water quality.

Deliberate discharges of muds and cuttings are regulated by EPA such that any effects on water quality must be extremely local; water-quality criteria must be met at the edge of the mixing zone established by the EPA-issued discharge permit. Discharge of formation waters (with whatever the formation waters contain), rather than their reinjection into the seafloor, would result in local pollution--over the life of the field, an expected MODERATE effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality.

The effect of causeways on LOCAL water quality would be long term but MODERATE. The effect of causeways on REGIONAL water quality would be VERY LOW.

The overall effects of these agents are expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality.

(2) Effects on Lower-Trophic-Level Organisms: The threefold increase in oil resources assumed in the high case probably would result in an increased probability of oil spills. A greater number of platforms and wells would mean a proportional increase in the amount of dredging and platform-construction activity and the amount of drilling discharges. These increased activities and events are expected to differ in the amount of time and space with activities of the base case to represent additional local effects. Even though the number and extent of site-specific effects on marine plants and invertebrates could be greater than those projected for the base case, populations that for the most part are regional in extent are unlikely to be affected; and the effects are most likely to be LOW. However, HIGH effects are possible for the Boulder Patch community in the unlikely event it were contacted by an oil spill. For the high case, effects on lower-trophic-level organisms are expected to be LOW.

(3) Effects on Fishes: The threefold increase in oil resources assumed in the high case probably would result in an increased probability of oil spills, more platforms and wells with a greater quantity of drilling discharges, and increased dredging and construction activities. Therefore, an increased number and extent of site-specific effects are expected compared to the base case. Greater numbers of organisms and a greater extent of habitat are expected to be affected. Because no long causeways are expected to be built, only four relatively short causeways or jetties (see Table II-A-1), greater negative effects are more likely to result from oil spills. For the high case, the effect on fishes are expected to be MODERATE.

(4) Effects on Marine and Coastal Birds: For the high case, the most likely number of oil spills of 1,000 bbl or greater increases from one (for the base case) to three. An increase in spill-contact probabilities indicates that a larger portion of the oil spills could contact important coastal habitats of waterfowl and shorebirds and offshore habitats of seabirds and thus contact a much larger number of birds (for example, oil-spill contact for one habitat-area lagoon could increase from perhaps a few thousand for the base case to several thousand-10,000 birds for the high case). An increase in spill-contact probability also indicates that a greater portion of the coastline and surface area of habitat such as a saltmarsh on the Colville River Delta could be covered by the oil. Such an increase in habitat contamination could increase the number of Pacific brants and other waterfowl species and shorebirds affected by the high case. The total loss of brants, ducks, and shorebirds could exceed 100,000 birds if extensive areas of coastline were contaminated. Species such as oldsquaw, which have a very abundant regional population, probably would recover from the loss of a few thousand to perhaps 10,000 individuals within one generation (a MODERATE effect), while species with depressed regional populations such as Pacific brants are expected to take more than one to two generations to recover the loss of several thousand birds (a HIGH effect).

The effects of habitat alteration from pipeline-road construction and shore-base construction on tundra habitats of marine and coastal birds are expected to be similar to those described for the base case (see Sec. IV.C). Some localized changes in the distribution or abundance of shorebirds and waterfowl (such as tundra swans) are expected within the near vicinity (about 1 mi) of pipeline-road corridors or near other facilities (a LOW effect).

Noise and disturbance of marine and coastal birds are expected to increase somewhat, with an increase in air-traffic levels, from that described under the base case; but the level of effect is expected to remain LOW.

The effects of the high case on marine and coastal birds are expected to be HIGH.

(5) Effects on Pinnipeds, Polar Bears, and Belukha Whales: The most likely number of oil spills of 1,000 bbl or greater increases from one for the base case to three for the high case. The probabilities of spill contact to important marine-mammal-concentration areas and habitats such as the pack-ice front and ice-lead system off Point Barrow would increase significantly. Assuming extensive oil contact occurs, perhaps several hundred to several thousand seals and walrus could be contaminated with oil; and several young seals and walrus calves could die as a result of stress associated with toxic-hydrocarbon inhalation and absorption through the skin. The above loss of young seals and walrus is expected to be replaced by the populations within one generation (a MODERATE effect). The number of ringed seals and ringed seal lairs contaminated with oil could increase somewhat (perhaps a few hundred seal pups could be lost due to oil contamination and/or abandonment by adult seals). This loss of seal pups is likely to be replaced within one generation (a MODERATE effect). Perhaps 100 polar bears could be lost due to oil ingestion from grooming and/or eating contaminated prey such as oiled seals. This loss is expected to be replaced within one generation (a MODERATE effect). The effect of habitat alteration from platform installation and pipeline laying is expected to result in some very localized changes in the distribution of some seals, walrus, and polar bears within 1 or 2 mi of the platforms during construction-installation activities (one season), representing a LOW effect. Noise and disturbance of pinnipeds, polar bears, and belukha whales are expected to increase somewhat from that described under the base case, but the level of effect is expected to remain LOW. The effect of the high case is expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales.

(6) Effects on Endangered and Threatened Species: Potential oil spills and noise and disturbance associated with the high case would be the major effect-producing agents to endangered and threatened species. Probabilities of any oil spills occurring or contacting any bowhead or gray whale-habitat areas are increased from those in the base case. However, only a few individuals of both species would be

expected to experience one or more of the following effects if a spill were to occur: skin contact with oil, baleen fouling, inhalation of hydrocarbon vapors, a localized reduction of food resources, the consumption of oil-contaminated prey items, and perhaps a temporary displacement from some feeding areas. Also, there would be about twice the number of platforms and three times the number of wells as under the base case with a corresponding increase of such noise and disturbance activities as seismic surveys, drilling units, and aircraft and vessel traffic--all of which could affect bowhead and gray whales. Although the noise and disturbance sources would be more abundant and whale reactions more frequent, reactions generally would be short term and temporary in nature, consisting of localized movements away from the sound source. Whales may avoid feeding within several hundred yards of drilling units and production platforms. Arctic peregrine falcon-nest sites could be exposed to a limited amount of aircraft noise and disturbance; however, it is expected to be only occasional, of short duration, and localized. The overall effects are expected to be MODERATE for the bowhead whale, LOW for the gray whale, and VERY LOW for the arctic peregrine falcon.

(7) Effects on Caribou: For the high case, four landfalls for offshore pipelines are assumed at the following locations: Point Belcher, Pitt Point, Oliktok Point, and Point Thomson; and each one connects by onshore pipeline and road to TAP. Motor-vehicle traffic would be associated with these pipeline-road corridors during development-construction activities. During such activities, some portion (several thousand) of all the following four caribou herds on the North Slope--Western Arctic herd, Teshekpuk Lake herd, Central Arctic herd and the Porcupine Caribou herd--would be temporarily disturbed by some of this traffic and displaced from a small part (less than 1%) of the summer range within a few miles of the pipeline corridors. This reduction in distribution is expected to subside within one generation (about 2 years) after pipeline and road construction is complete (a MODERATE effect). However, a very local reduction in habitat use by some cows and calves within about 1 mile of the pipeline corridors might persist and would represent a LOW effect. Caribou are likely to successfully cross all four pipeline corridors within a short period of time (a few minutes to a few days) during breaks in the traffic flow, even during construction activities (high periods of traffic), with little or no restriction of caribou movements (a LOW effect). Caribou abundance and productivity are not expected to be affected under the high case. The effects of the high case on caribou are expected to be MODERATE.

(8) Effects on the Economy of the North Slope Borough: Increases in NSB property taxes and increases in employment opportunities resulting from the high case are expected to have a MODERATE effect on the economy. Employment gains in the NSB are expected to range between 10 and 20 percent for more than 5 years. The effects of the high case are expected to be HIGH.

(9) Effects on Sociocultural Systems: As in the base case, the effects of the high case on sociocultural systems are expected to be MODERATE in Wainwright, Nuiqsut, and Kaktovik and LOW in Barrow and Atqasuk. This is because industrial activity is the same, effects on subsistence-harvest patterns are the same, and population and employment are not expected to change significantly. In the high case, Wainwright would be expected to experience similar effects--MODERATE--as Nuiqsut and Kaktovik on its sociocultural system due to its proximity to the shore-base facility at Point Belcher. These effects--as in the base case--would be long term; and there could be a tendency for additional stress on the sociocultural system but without tendencies toward displacement, resulting in MODERATE effects on sociocultural systems in Nuiqsut, Kaktovik, and Wainwright. For the high case, the effects of proposed Sale 124 on sociocultural systems are expected to be MODERATE.

(10) Effects on Subsistence-Harvest Patterns: Effects in Barrow (Atqasuk), Wainwright, Nuiqsut, and Kaktovik would be the same in the high case as in the base case, only intensified. Barrow (and Atqasuk) and Kaktovik subsistence-harvest patterns could experience MODERATE effects from the effects of an oil spill on their bowhead whale harvest; Wainwright subsistence-harvest patterns could experience MODERATE effects on bowhead whale and walrus harvests from construction activities at Point Belcher and noise and disturbance, and Nuiqsut subsistence-harvest patterns could experience HIGH effects as a result of construction activities on bowhead whale harvests near Flaxman Island at Point Thomson. Effects from the proposed lease sale for the high case on subsistence-harvest patterns are expected to be HIGH in Nuiqsut and MODERATE in Barrow (Atqasuk), Wainwright, and Kaktovik. The regional effects on subsistence-harvest patterns are expected to be HIGH.

(11) Effects on Archaeological Resources: The effects of this alternative are due to (1) the probability of a transportation spill occurring and its effects on offshore resources; (2) the probability of the oil getting in the water column and its effect on bottom sediments, which could contain offshore

archaeological resources; (3) the large amount of oil resources expected to be discovered; and (4) the winter ice in the Arctic and its effect on lengthening the duration of the spill. Therefore, the effects of the high case on archaeological resources are expected to be MODERATE.

(12) Effects on Air Quality: The USDOJ regulatory exemption levels for regulated air pollutants would not be exceeded, and air-pollution concentrations permitted by air-quality standards would be easily attained. The effects of air pollutants other than those addressed by air-quality standards could cause short-term, local effects on vegetation from coating by soot. Consequently, a LOW effect on air quality would be expected.

(13) Effects on Land Use Plans and Coastal Management Programs: Potential conflicts between activities assumed for the high case and the NSB LMR's and the Statewide standards and the NSB district policies of the ACMP are comparable to the base case. Conflicts reflect the proximity of the proposed landfall site to Flaxman Island and Point Belcher, primary locations for launching bowhead whale harvests, and user conflicts between offshore activities and the subsistence bowhead whale hunt, and additional berms along the Beaufort Sea coast.

In the high case, another area of conflict may arise reflecting the effect of oil spills on saltmarshes. Oil spills are expected to limit the habitat value of these wetlands for waterfowl and shorebirds. Such an effect would conflict with the Statewide standard for wetland habitat (6 AAC 80.130 [b][3]).

Potential conflict between activities assumed to follow the high case for this sale and NSB Land Management Regulations and the ACMP are expected to be HIGH.

### C. Alternative II - No Sale

This alternative would eliminate the entire area proposed for leasing from further consideration. Table II-B-1 shows the amount of energy needed from other sources to replace the anticipated oil production from the base case. If this alternative were adopted, there would not be any exploration and development and production activities. The effects estimated to occur as a result of Alternative I would not occur.

### D. Alternative III - Delay the Sale

This alternative would delay the proposed sale for a 2-year period. The effects estimated to occur as a result of Alternative I would be delayed for 2 years.

### E. Alternative IV - Barrow Deferral Alternative

The Barrow Deferral Alternative would offer for leasing 3,894 blocks; this is 201 blocks--about 412,000 ha--smaller in size than the area of Alternative I. The deleted blocks comprise the Barrow Deferred Area.

1. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: For Alternative IV (base case), MMS has estimated that the amount of oil expected to be leased, discovered, and developed and produced is 900 MMbbl (Table II-A-1 and Appendix B, Table 4)--the same amount (900 MMbbl) as estimated for the base case for Alternative I. The methodology used to estimate the petroleum resources for deferral alternatives is discussed in Appendix A.

Seismic data have delineated numerous structural and stratigraphic traps in the area identified as the Barrow Deferred Area in Figure I-2 (USDOJ, MMS, 1989). The traps in this area have a potential for hydrocarbons, particularly natural gas, but they are smaller in size than are the traps of the onshore Barrow gas fields. The probability of a major discovery of hydrocarbons in the deferred area is estimated to be quite low. Therefore, MMS estimates that the amount of oil estimated to be leased, discovered, and developed and produced in the area defined by the Barrow Deferral Alternative is 900 MMbbl.

Because of the low potential for economic development of petroleum resources in the Barrow Deferred

Table II-B-1  
 Energy Needed from Other Sources to Replace Anticipated  
 Oil Production from Proposed  
 Beaufort Sea Planning Area Oil and Gas Lease Sale 124  
 (Base-Case Level of Resources)

	Billions
Total Estimated Crude-Oil Production, Base Case (bbl) (19-year production schedule)	0.900
Crude Oil BTU Equivalent at $5.6 \times 10^6$ BTU/bbl (BTU)	5,040,000
<u>Alternative-Energy-Sources Equivalents</u>	
Oil (bbl)	0.900
Gas <sup>1/</sup> (cf)	4,890
Coal (tons)	0.198
Anthracite <sup>2/</sup>	0.192
Bituminous <sup>3/</sup>	0.265
Sub-bituminous <sup>4/</sup>	0.376
Lignite <sup>5/</sup>	
Oil Shale <sup>6/</sup> (tons)	1.290
Tar Sands <sup>7/</sup> (tons)	1.200
Nuclear (Uranium Ore) <sup>8/</sup> (tons)	0.0084

Source: As indicated in the footnotes below.

- 1/ 1,031 BTU/cf.  
 2/  $25.4 \times 10^6$  BTU/ton (Williams and Myers, 1976, p. 115).  
 3/  $26.2 \times 10^6$  BTU/ton (Ibid).  
 4/  $19.0 \times 10^6$  BTU/ton (Ibid).  
 5/  $13.4 \times 10^6$  BTU/ton (Ibid).  
 6/ 0.7 barrels/ton (Science and Public Policy Program, 1975, pp. 2-3).  
 7/  $4.2 \times 10^6$  BTU/ton (Ibid, pp. 5-3).  
 8/ 100,000 tons of ore = Mwe = 3 million tons of coal at 10,000 BTU/lb  
 (Science and Public Policy Program, 1975, pp. 6-9).

Area, the types, levels, and schedule of exploration, development and production, and transportation activities estimated for the Barrow Deferral Alternative, Alternative IV, are assumed to be the same as they are for the base case for Alternative I (Table II-A-1; Appendix B, Table 4; and Sec. II.B.2.a).

2. **Significance of the Barrow Deferred Area--Summary:** The 201 blocks deleted from the area of Alternative I to form this alternative contain, at various times, significant biological resources and hold important cultural values for the Natives who inhabit the nearby areas. These blocks are located along the coast from Elson Lagoon on the Beaufort Sea side of Point Barrow to Peard Bay on the Chukchi Sea side (Fig. I-1) and comprise the proposed Barrow Deferred Area. This area is part of the area that the State of Alaska (SOA), NSB, Alaska Eskimo Whaling Commission (AEWC), National Oceanic and Atmospheric Administration (NOAA), and EPA recommended for deleting for Sale 97 and, similarly, for Sale 124.

Bowhead whales pass through the deferred area during their spring and fall migrations to and from the eastern Beaufort Sea and during some years have been observed feeding within the deferred area. The Inupiat people of Barrow use the deferred area in the spring and fall to hunt bowhead whales for subsistence purposes. The area also contains polar bears, ringed seals, and migratory birds that are hunted for subsistence purposes by people from Barrow and Wainwright.

The Barrow Deferred Area was part of the Barrow Deferral Alternative analyzed in the Sale 97 EIS and the Western Deletion Alternative analyzed in the Sale 87 EIS. The boundaries of the deferred area lie between 3 to 25 nmi (5 and 47 km) offshore. The deferred area includes the Point Barrow Highlighted Area that was analyzed in the FEIS for the 5-Year Leasing Program, Mid-1987 to Mid-1992. The Highlighted Area consists of 59 blocks, about 95,463 ha, located in the vicinity of Point Barrow.

3. **Summary of Effects of Alternative IV--Barrow Deferral Alternative:** The summaries presented in this section are based on the analyses in Section IV.G of this EIS. The types and levels of activities associated with Alternative IV (Sec. II.E.1) are estimated to be the same as they are for the base case for Alternative I (Sec. II.B.2.a).

a. **Effects on Water Quality:** Alternative IV does not significantly reduce the oil resource, number of wells, number of platforms, or the amount of pipeline needed; therefore, this alternative does not significantly reduce the expected level of effects on water quality for any of the agents discussed for the base case. There would be some local lessening of pollution risks within the deferred area from construction and local, deliberate (permitted) discharges. Oil-spill risk to the deferred area would be mostly from spills outside the deferred area. The effects of Alternative IV are expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality, the same as for the base case.

b. **Effects on Lower-Trophic-Level Organisms:** This alternative would insignificantly alter the probability of oil spills occurring and contacting marine plants and invertebrates of greatest concern. Effects from other oil-associated activities are not expected to be appreciably affected by this deferral alternative. Although MODERATE effects are unlikely but possible for the Stefansson Sound Boulder Patch if it were contacted by oil, the level of effects is expected to be the same as for the base case--LOW.

c. **Effects on Fishes:** Alternative IV would reduce somewhat the probability of oil spills occurring and contacting fishes of greatest concern; however, its overall effect is probably not significant. Effects from other oil-associated activities are not expected to be appreciably affected by this deferral alternative. Although HIGH effects are unlikely but possible for some anadromous species and capelin, the effects of this alternative are expected to be the same as for the base case--MODERATE.

d. **Effects on Marine and Coastal Birds:** This alternative could slightly reduce potential oil-spill effects on thousands of seabirds that forage in the concentration area off Point Barrow by deferring exploration drilling near Barrow and Elson Lagoon. However, a potential spill from lease blocks east of the deferred area poses an equivalent spill-contact risk to marine and coastal bird-concentration areas within the deferred area. Thus, this alternative would not significantly reduce the risks of oil-spill effects on marine and coastal birds. Oil-spill, noise and disturbance, and adverse habitat-alteration effects on marine coastal birds in other parts of the planning area would be the same as those of the base case. Thus, the effects of Alternative IV are expected to be the same as those of the base case for Alternative I (MODERATE).

e. Effects on Pinnipeds, Polar Bears, and Belukha Whales: This deferral alternative could somewhat reduce oil-spill effects on marine mammals and their habitats near Point Barrow. Noise and disturbance of marine mammals and habitat alterations due to industrial activities also could be reduced locally in this area. However, the overall effects are expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales (the same as for the base case for Alternative I), because ringed seals, polar bears, walruses, and other species would be exposed to potential oil spills and other effects in other parts of the planning area.

f. Effects on Endangered and Threatened Species: The Barrow Deferral Alternative would defer the major coastal spring and part of the fall bowhead whale-migration corridor from petroleum exploration and development. Consequently, the oil-spill probabilities and noise and disturbance effects would be reduced in the deferred area. Although this alternative would reduce effects on migrating bowhead whales, the potential for some adverse effects from vessel and aircraft disturbance and oil spills remains. Bowheads could be affected by noise and disturbance activities and potential oil spills in the nondeferred area. Although the effects on the bowhead whale would be reduced by this alternative, the overall effects are expected to remain the same as for the base case--MODERATE. Because most of the gray whales in the proposed sale area are found within the deferred area (summer feeding area), the potential for effects on the gray whales would be substantially reduced, but some disturbance to individual gray whales in the nondeferred area could occur. Therefore, this alternative would be expected to lower the potential effects on gray whales from LOW (base case) to VERY LOW. Potential effects on the arctic peregrine falcon would not be reduced from the base case--VERY LOW.

g. Effects on Caribou: Alternative IV is assumed to include the same onshore-pipeline transportation as the base case for Alternative I; thus, the potential onshore disturbance and habitat-alteration effects on caribou are expected to be the same as they are for the base case. The effects of Alternative IV are expected to be the same as those of Alternative I for the base case (MODERATE).

h. Effects on the Economy of the North Slope Borough: Due to the projected declines in NSB revenues and in resident employment, the economic effects for Alternative IV are not expected to put undue pressure on the economic system. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though they would be less than 10 percent of the projected no-sale conditions. As discussed for the base case, the subsistence economy is expected to be adversely affected. The economic effects on the North Slope Borough are expected to be MODERATE--the same as for the base case for Alternative I.

i. Effects on Sociocultural Systems: Alternative IV would not alter the onshore industrial activities and population and employment projections for this sale because the resource estimate for this alternative is the same as for the base case in Alternative I, and the effect on subsistence-harvest patterns would be the same as for the base case. Consequently, the effect of this alternative on sociocultural systems would be the same as for the base case in Alternative I--MODERATE.

j. Effects on Subsistence-Harvest Patterns: This alternative would not change the regionwide levels of oil-related activities. While deferring an area along the coast would remove the possibility of an oil spill occurring in the midst of the Barrow subsistence-harvest area, an oil spill could still travel to the Barrow subsistence area and thus would not reduce the MODERATE level of effects expected in the base case for Alternative I. However, this alternative would remove most exploration and development and production activities from much of the area intensively used by Barrow's hunters and from virtually all of the area used by Wainwright's hunters. Supply activities still would occur within the deferred area; however, the deferral alternative nevertheless would reduce effects of noise and disturbance on Wainwright's subsistence-harvest patterns from MODERATE to LOW. However, the moderate effects on Wainwright's subsistence harvests of bowhead and belukha whales due to construction activities and noise disturbance in Peard Bay still would be expected. This deferral also would not alter the expected HIGH effect on Nuiqsut or the MODERATE effect on Kaktovik. For this alternative, effects on subsistence harvests are expected to remain MODERATE in Barrow (Atqasuk), Wainwright, and Kaktovik, and remain HIGH in Nuiqsut. Regional effects on subsistence-harvest patterns are expected to be HIGH.

k. Effects on Archaeological Resources: The effects of this alternative would be due to the lack of appreciable difference in the archaeological areas affected and the expected oil resource without the Barrow Deferral Area. Therefore, the effects of the Barrow Deferral Alternative on archaeological resources are expected to be VERY LOW, whereas the expected effects of the base case are LOW.

1. Effects on Air Quality: Air-quality-exemption levels at the shoreline would not be exceeded. However, short-term, local effects from smoke soot could occur as in the base case for Alternative I. The effects on air quality with respect to air-quality standards and with respect to effects other than addressed by air-quality standards are expected to be LOW--the same as for the base case.

m. Effects on Land Use Plans and Coastal Management Programs: Although the Barrow Deferral Alternative reduces potential negative effects in that area for many resources and for subsistence, effect levels are reduced only for archaeological resources. The development and transportation scenario also remains the same. As a result, land use changes and potential conflicts with the NSB Land Management Regulations and the Statewide standards and NSB district policies of the ACMP would remain the same.

Potential conflicts between activities assumed to follow Alternative IV of Sale 124 and NSB Land Management Regulations and the ACMP are expected to be HIGH.

## **F. Alternative V - Barter Island Deferral Alternative**

The Barter Island Deferral Alternative would offer for leasing 3,952 blocks; this is 143 blocks--about 290,000 ha--smaller in size than the area of Alternative I. The deleted blocks comprise the Barter Island Deferred Area.

1. Resource Estimates and Basic Exploration, Development and Production, and Transportation Assumptions for Effects Assessment: For Alternative V (base case), MMS has estimated that the amount of oil expected to be leased, discovered, and developed and produced is 900 MMbbl (Table II-A-1 and Appendix B, Table 5)--the same amount (900 MMbbl) as estimated for the base case for Alternative I. The methodology used to estimate the petroleum resources for deferral alternatives is discussed in Appendix A.

Seismic data have identified a number of relatively small structural traps in the proposed Barter Island Deferred Area (Fig. I-2); stratigraphic traps also may occur in the area (USDOI, MMS, 1989). The geologic structures estimated to be most prospective for hydrocarbons lie outside the deferred area and have already been leased. These factors suggest that the probability of a major discovery of hydrocarbons in the deferred area is low. Therefore, MMS estimates that the amount of oil expected to be leased, discovered, and developed and produced in the area defined by the Barter Island Deferral Alternative is 900 MMbbl.

Because of the low potential for economic development in the Barter Island Deferred Area, the types, levels, and schedule of exploration, development and production, and transportation activities estimated for the Barter Island Deferral Alternative, Alternative V, are assumed to be about the same as they are for the base case for Alternative I (Table II-A-1; Appendix B, Table 5; and Sec. II.B.2.a).

2. Significance of the Barter Island Deferred Area--Summary: The blocks deleted from the area of Alternative I to form this alternative contain, at various times, significant biological resources and hold important cultural values for the Natives who inhabit the nearby areas. These blocks are located between Barter Island and the Canadian border and comprise the Barter Island Deferred Area. This area is part of areas that the SOA, NSB, AEWC, and NOAA recommended for deletion from the sale area.

Bowhead whales use this area as part of the fall-migration route and for feeding. The Inupiat residents of Kaktovik use the area to hunt bowheads--as well as polar bears, ringed seals, and migratory birds--for subsistence purposes.

The Barter Island Deferred Area also was part of the analysis of the Kaktovik Deferral Alternative analyzed in the Sale 97 EIS and the Eastern Deletion Alternative analyzed in the Sale 87 EIS. (The Barter Island Deferred Area basically is the Kaktovik Deferral Area analyzed in the Sale 97 EIS except for the removal of 17 blocks that were leased as a result of Sale 97.) Blocks that were leased as a result of Sales 87 and 97 are located near or adjacent to the boundaries of the deferred area.

3. **Summary of Effects of Alternative V--Barter Island Deferral Alternative:** The summaries presented in this section are based on the analyses in Section IV.H of this EIS. The types and levels of activities associated with Alternative V (Sec. II.F.1) are estimated to be the same as they are for the base case for Alternative I (Sec. II.B.2.a).

a. **Effects on Water Quality:** Alternative V would not significantly reduce the projected oil spillage or level of effects on water quality for any of the agents discussed in the base case for Alternative I. There would be less likelihood of pollution from construction and local, deliberate (permitted) discharges near Barter Island. This alternative would lessen the slight risk of spills occurring or contacting waters of the deferred area because of the westward movement of spills across the sale area. The effect of Alternative V is expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality, the same as for the base case.

b. **Effects on Lower-Trophic-Level Organisms:** This alternative offers some advantage to epibenthic invertebrates in nearshore waters by reducing the probability of an oil spill contacting land. For other marine plants and invertebrates of concern, this alternative changes effects insignificantly. Effects from other oil-associated activities should not be appreciably affected by this deferral alternative. MODERATE effects are possible for the Stefansson Sound Boulder Patch in the unlikely event it were contacted by oil. The level of effects is expected to be the same as for the base case, LOW.

c. **Effects on Fishes:** Alternative V would reduce somewhat the probability of oil spills occurring and contacting fishes of greatest concern; however, its overall effect is probably not significant. Anadromous fishes in nearshore areas derive no real benefit from this deferral alternative since there is a negligible change in the probability of oil contacting their most sensitive and important habitat, the river deltas. Effects from other oil-associated activities are not expected to be appreciably affected by this deferral alternative. Although HIGH effects are possible for some anadromous species and capelin, the level of effects of this Alternative is expected to be the same as for the base case, MODERATE.

d. **Effects on Marine and Coastal Birds:** This alternative could substantially reduce local oil-spill effects to moderate numbers of birds in habitats east of Kaktovik, but it would not reduce potential oil-spill effects to high numbers of birds west of Kaktovik. Neither would it reduce noise and disturbance and habitat-alteration effects to greater numbers of marine and coastal birds throughout other parts of the planning area. Therefore, the effects on marine and coastal birds are expected to be MODERATE, the same level of effects as that of the base case for Alternative I.

e. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** Although local oil-spill, disturbance, and habitat-alteration effects on marine mammals would be reduced or eliminated in offshore habitats east of Kaktovik, effects on the populations of walruses, bearded seals, belukha whales, and important marine-mammal habitats west of Kaktovik would not be reduced from those effects described in the base case for Alternative I because, under this alternative, potential oil spills, noise and disturbance, and habitat alterations would occur west of the deferral area. The effects of Alternative V are expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales (the same as for the base case for Alternative I).

f. **Effects on Endangered and Threatened Species:** The Barter Island Deferral Alternative would defer from petroleum exploration and development an area east and north of Kaktovik used by bowhead whales for feeding and migration during the late summer and fall. Consequently, the oil-spill probabilities and noise and disturbance effects to bowhead whales would be slightly reduced from the base case. Bowhead whales feeding and migrating through the deferred area may occasionally be disturbed by activities from adjacent areas (seismic surveys, aircraft or vessel traffic, and drilling and production activities). Bowhead whales in the area of the deferral alternative would be subject to the same level of disturbance as for the base case; therefore, the overall effect level is expected to remain the same as for the base case--MODERATE. Effects on the gray whale and arctic peregrine falcon would not be decreased by this alternative and would remain the same as those of the base case--LOW for the gray whale and VERY LOW for the arctic peregrine falcon.

g. **Effects on Caribou:** This alternative could reduce potential disturbance of caribou and possible oil-spill effects on caribou using the coastal barrier islands and beaches between Jago Lagoon (Kaktovik) and Demarcation Bay for insect relief. However, caribou of the Western Arctic herd and of the

Central Arctic herd still would be exposed to disturbance sources and habitat alteration associated with onshore-pipeline transportation of oil from leases in other parts of the Sale 124 area. Caribou of these two herds still would be displaced during construction of the onshore pipelines and roads, although their use of summer-forage range is not likely to be greatly affected by this alternative. The effects of Alternative V are expected to be the same as those of the base case for Alternative I--MODERATE.

h. Effects on the Economy of the North Slope Borough: Due to the projected declines in NSB revenues and in resident employment, the economic effects of Alternative V are not expected to put undue pressure on the economic system. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though this would be less than 10 percent of the projected no-sale conditions. As discussed for the base case, the subsistence economy is expected to be adversely affected. The economic effects of this alternative on the North Slope Borough are expected to be MODERATE--the same as for the base case for Alternative I.

i. Effects on Sociocultural Systems: This alternative would not alter the onshore industrial activities and population and employment projections for this sale because the resource estimate for this alternative is the same as that of the base case for Alternative I, and the effect on subsistence-harvest patterns would be the same as for the base case. Consequently, the effect of this alternative on sociocultural systems would be the same as for the base case for Alternative I--MODERATE.

j. Effects on Subsistence-Harvest Patterns: Alternative V would not reduce the HIGH regionwide effects of the lease sale on subsistence resources or on subsistence activities. While deferring a nearshore area would remove the possibility of an oil spill occurring in the Kaktovik subsistence-harvest area, it would not reduce the level of effect from an oil spill. However, this alternative would remove most exploration and development and production activities from much of the area intensively used by Kaktovik's hunters. This alternative would not remove the pipeline landfall near Flaxman Island, an area critical to Nuiqsut's bowhead whale harvests and results in HIGH effects. This alternative also would mitigate, to a degree, effects in the area east of Kaktovik, an area used by a community whose subsistence areas to the west may be affected. Overall, effects on subsistence are expected to remain MODERATE in Barrow (Atqasuk), Wainwright, and Kaktovik and HIGH in Nuiqsut. Regional effects on subsistence-harvest patterns are expected to be HIGH, the same as for the base case for Alternative I.

k. Effects on Archaeological Resources: The effects of this alternative would be due to the lack of appreciable difference in the affected archaeological resources, the deferral of some lease blocks, and the expected oil resource without the deferred area. Therefore, the effects of the Barter Island Deferral Alternative on archaeological resources are expected to be VERY LOW, whereas the effects of the base case are expected to be LOW.

l. Effects on Air Quality: Air-quality exemption levels at the shoreline would not be exceeded. However, short-term local effects from smoke soot could occur as in the base case. The effects on air quality with respect to air-quality standards and with respect to effects other than addressed by air-quality standards are expected to be LOW--the same as for the base case.

m. Effects on Land Use Plans and Coastal Management Programs: Deferring the area west of Kaktovik would slightly reduce the potential effects of oil on biological resources. The reduction would be most marked for marine and coastal birds using the area around Jago Lagoon. Although this alternative eliminates one area where potential conflicts could occur with the Statewide standard for barrier islands and lagoon habitat, other lagoon areas remain susceptible to negative effects. Therefore, potential conflict with this policy still could occur. No other potential conflicts are eliminated entirely with this alternative.

Potential conflicts between activities assumed to follow Alternative V of Sale 124 and the NSB LMR's and the Statewide standards and district policies of the ACMP would remain HIGH.

## **G. Mitigating Measures:**

1. **Mitigating Measures That Are Part of the Proposed Lease Sale:** Laws and regulations that provide mitigation are considered part of the proposed lease sale. Examples include the OCS Lands Act, which grants broad authority to the Secretary of the Interior to control lease operations and, where appropriate, undertake environmental monitoring studies (Appendix F); the Fisherman's Contingency Fund; and the Offshore Oil Pollution Compensation Fund. Incorporated by reference and summarized in Section I.C are: OCS Report MMS 86-0003, Legal Mandates and Federal Regulatory Responsibilities for the Alaska Outer Continental Shelf (Rathbun, 1986), and Reference Paper No. 83-1, Federal and State Coastal Management Programs (McCrea, 1983). Also incorporated by reference are the Consolidated Offshore Operating Rules--30 CFR Parts 250 and 252 Oil and Gas and Sulphur Operations in the Outer Continental Shelf; Final Rule (Federal Register, 1988). These rules describe in detail requirements and specifications for oil and gas operations, including the requirement to use the best available and safest technologies (BAST). Permit requirements, engineering criteria, testing procedures, and information requirements also are outlined. These requirements are developed and administered by MMS. The mitigating effect of these measures has been factored into the environmental effects analysis.

2. **Potential Mitigating Measures:** The following measures are considered to help reduce or eliminate effects identified in Section IV and summarized in Section II. A Secretarial decision on these mitigating measures has not occurred; they are noted here as potential measures that could further mitigate the effects of this proposed lease sale. The Secretary has imposed similar measures in previous Federal oil and gas lease sales. If any of these measures are adopted, they will appear in the NOS. The analysis in this EIS does not assume that the following mitigating measures are in place; however, they are evaluated in the discussions of the effectiveness of stipulations or ITL's that follow each of the potential measures.

a. **Potential Stipulations:** The following stipulations will be considered for Beaufort Sea Sale 124:

- No. 1 - Protection of Archaeological Resources
- No. 2 - Protection of Biological Resources
- No. 3 - Orientation Program
- No. 4 - Transportation of Hydrocarbons
- No. 5 - Industry Site-Specific Bowhead Whale-Monitoring Program
- No. 6 - Subsistence Whaling and Other Subsistence Activities
- No. 7 - Oil-Spill-Response Preparedness
- No. 8 - Seasonal Drilling Restriction

### • **Stipulation No. 1--Protection of Archaeological Resources**

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (Section 301(5), National Historic Preservation Act, as amended, 16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction, or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Supervisor, Field Operations (RSFO), believes an archaeological resource may exist in the lease area, the RSFO will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RSFO, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and a geophysicist, shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RSFO for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee

shall either:

- (i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or
  - (ii) Establish to the satisfaction of the RSFO that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RSFO. A report on the investigation shall be submitted to the RSFO for review.
- (3) If the RSFO determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, the RSFO will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RSFO has told the lessee how to protect it.
- (c) If the lessee discovers any archaeological resource while conducting operations in the lease area, the lessee shall report the discovery immediately to the RSFO. The lessee shall make every reasonable effort to preserve the archaeological resource until the RSFO has told the lessee how to protect it.

Purpose of Stipulation No. 1: The purpose of this measure, which would apply to all lease blocks, is to protect prehistoric and historic archaeological resources that are known or may be discovered in a lease area by surveying prior to any petroleum-industry activities that would disturb the area. The measure also protects historic resources such as shipwrecks if these are detected on the lease blocks. The January 1983 MMS Archaeological Analysis, Proposed Lease Sale No. 87, Beaufort and Northeast Chukchi Seas Offshore Areas, Appendix I, concludes that the zone to 20 meters offshore is extensively ice-gouged, which would eliminate any chance of prehistoric-site survival. The 1989 MMS Archaeological Analysis, Appendix I, confirms this analysis. If new data become available, this analysis could be reassessed to further evaluate those blocks that might require an archaeological resource report at the postlease stage.

A stipulation for protection of archaeological resources has appeared in the NOS's for all Federal lease sales offshore Alaska.

Effectiveness of Stipulation No. 1: Stipulation No. 1 provides both a positive method to determine if archaeological resources are present in the lease area prior to the start of any operations associated with petroleum-industry activities and ways to develop effective measures to protect known archaeological resources. Therefore, the effects of industry operations on archaeological resources would be reduced from LOW to VERY LOW with the adoption of this stipulation.

• Stipulation No. 2--Protection of Biological Resources

If biological populations or habitats that may require additional protection are identified by the Regional Supervisor, Field Operations (RSFO), in the lease area, the RSFO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RSFO shall give written notification to the lessee of the RSFO's decision to require such surveys.

Based on any surveys which the RSFO may require of the lessee or on other information available to the RSFO on special biological resources, the RSFO may require the lessee to:

- (1) relocate the site of operations;
- (2) establish to the satisfaction of the RSFO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
- (3) operate during those periods of time, as established by the RSFO, that do not adversely affect the biological resources; and/or

- (4) modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RSFO and make every reasonable effort to preserve and protect the biological resource from damage until the RSFO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RSFO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RSFO provides written directions to the lessee with regard to permissible actions.

Purpose of Stipulation No. 2: This stipulation is intended to provide protection from potential adverse effects of oil and gas activities for those biological populations or habitats that may exist in the sale area but have not been identified in the Information to Lessee on Areas of Special Biological and Cultural Sensitivity (ITL No. 2). This stipulation provides a formal mechanism for identifying important or unique biological populations or habitats that require special protection because of their sensitivity and/or vulnerability as well as a means for developing measures to reduce possible adverse effects from oil and gas activities.

Surveys may be required; and if the results identify important or unique biological populations or habitats requiring special protection because of their sensitivity and/or vulnerability, measures can be developed to eliminate or reduce potential adverse effects. Such measures could include relocating operational sites, modifying drilling procedures or other operations, and/or increasing the attention given to protecting areas of special biological and cultural sensitivity during oil-spill-contingency planning.

Effectiveness of Stipulation No. 2: The effectiveness of this measure will depend on (1) the population size of those species that might be subjected to potential adverse effects and the number of individuals within a given species population affected by measures to reduce or eliminate such effects; (2) the size of a habitat and the area that might be affected by any proposed action and mitigating measures; or (3) the uniqueness of any population or habitat. Thus, the effectiveness of this stipulation in protecting a variety of biological resources could vary widely. If only a few members of a large population are affected by the remedial measures, the effectiveness of such measures may be too small to cause any change in the levels of effects noted in Section IV. However, if an operational site is relocated away from a unique habitat of limited geographic extent, the level of adverse effects may be significantly reduced.

Also, the effectiveness of this stipulation may be indirect. For example: (1) additional protection for important or unique benthic habitats and their associated faunal populations could provide some local benefits to birds and mammals that directly or indirectly prey upon the benthic fauna, or (2) surveys of biological populations or habitats requiring additional protection could provide data to the environmental report for the exploration and development plans that must be reviewed and approved in accordance with 30 CFR 250.34.

Stipulation No. 2 may reduce some local effects to the biological populations or habitats, but it is not likely to change the overall effect levels of the base case for Alternative I on lower-trophic-level organisms (LOW), marine and coastal birds (MODERATE), or nonendangered marine mammals (MODERATE).

Although the Artic Region Biological Opinion (ARBO) did not find a possibility of jeopardy to bowhead whales during exploration drilling, it did suggest some optional conservation measures. Accordingly, MMS will consider these measures and use its authority to keep areas used by bowhead whales free of spilled oil and noise disturbance when bowheads are present.

• Stipulation No. 3--Orientation Program

The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.33 and 250.34 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the Regional Supervisor, Field Operations. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns which

relate to the sale and adjacent areas. The program shall be formulated by qualified instructors experienced in each pertinent field of study and shall employ effective methods to ensure that personnel are informed of archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and to ensure that personnel understand the importance of not disturbing archaeological resources and of avoidance and nonharassment of wildlife resources. The program shall also be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program also shall include information concerning avoidance of conflicts with subsistence activities. The program also shall include presentations and information about all pertinent lease sale stipulations and information to lessees provisions.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program. This record shall include the name and date(s) of attendance of each attendee and shall be kept onsite for so long as the site is active, not to exceed 5 years.

Purpose of Stipulation No. 3: The purpose of the orientation program and stipulation is to address the concerns expressed by Natives and local residents during the scoping process for this and other Alaska OCS lease sales regarding protection of environmental resources and cultural values. The orientation program would promote an understanding of, and appreciation for, local community values, customs, and lifestyles of Alaskans. It also would provide necessary information to industry personnel about the biological resources used for commercial and subsistence activities, about the archaeological and cultural resources of the area and appropriate ways to protect them from adverse effects, and about the concerns for reducing industrial noise and disturbance effects on marine mammals and marine and coastal birds.

Since 1980, similar programs have been implemented for all Alaska OCS Region oil and gas lease sales in the Gulf of Alaska/Cook Inlet, Bering Sea, Chukchi Sea, and Beaufort Sea Planning Areas (USDOI, MMS, 1989 [Sires and Thomas])--these programs have been quite successful in providing information to industry personnel.

Effectiveness of Stipulation No. 3: This measure provides positive mitigating effects, in that it would make all personnel involved in petroleum-industry activities aware of the unique environmental, social, and cultural values of North Slope Inupiat residents and their environment. There is concern that uninformed workers and subcontractors could unknowingly destroy or damage the biological environment and resources, be insensitive to local historical or cultural values, or unnecessarily disrupt the local economy. This stipulation also would help to minimize conflicts between subsistence-hunting activities and activities of the oil and gas industry.

By increasing awareness, the Orientation Program would help reduce the risk of activities that might inadvertently conflict with the values of the Inupiat people or harm the biological environment and resources. However, the extent of this reduction in risk may be difficult to measure directly and/or too small to change the levels of effect identified for the base case of Alternative I in Section IV for the biological resources and sociocultural systems (Table S-1).

• Stipulation No. 4--Transportation of Hydrocarbons

Pipelines will be required: (a) if pipeline rights-of-way can be determined and obtained; (b) if laying such pipelines is technologically feasible and environmentally preferable; and (c) if, in the opinion of the lessor, pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts. The lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to any recommendation of the Regional Technical Working Group, or other similar advisory groups with participation of Federal, State, and local

governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the Regional Supervisor, Field Operations.

**Purpose of Stipulation No. 4:** This stipulation provides a formal way of selecting the environmentally preferable means of transporting petroleum from a lease-sale area. It also informs the lessee that (1) MMS reserves the right to require the placement of pipelines in certain designated management areas and (2) pipelines must be designed and constructed to withstand the hazardous conditions that may be encountered in the lease-sale area. This stipulation is intended to ensure that the decision on which method to be used in transporting hydrocarbons considers the social, environmental, and economic consequences of pipelines.

**Effectiveness of Stipulation No. 4:** The analysis of the effects of Sale 124 Alternative I on the physical and biological resources of the sale and adjacent areas considered pipelines as the method of transporting produced oil in the sale area. Thus, this stipulation is not expected to significantly reduce the overall effect levels of the lease sale on water quality (LOCAL--MODERATE; REGIONAL--VERY LOW); marine and coastal birds (MODERATE); pinnipeds and polar bears (MODERATE); belukha whales (LOW); caribou (MODERATE); or endangered species (bowhead whales--MODERATE) for the base case for Alternative I. However, implementing this stipulation does reinforce two policies of the NSB CMP--NSB CMP 2.4.4(h), which requires pipelines to be specifically designed to withstand sea ice and other hazards, and NSB CMP 2.4.5.1(h), which discourages development that accommodates movement of produced hydrocarbons by tankers.

• **Stipulation No. 5--Industry Site-Specific Bowhead Whale-Monitoring Program**

Lessees shall conduct a site-specific monitoring program during exploratory drilling activities to determine when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these activities. The lessee shall provide its proposed monitoring plan to the Regional Supervisor, Field Operations (RSFO), for review and approval no later than 60 days prior to commencement of drilling activities. Information obtained from this site-specific monitoring program shall be provided to the RSFO in accordance with the approved monitoring plan. This stipulation will remain in effect until termination or modification by the Department of the Interior after consultation with the National Marine Fisheries Service.

This stipulation applies to the following blocks for the following time periods: (Official Protraction Diagram [OPD])

**SPRING MIGRATION AREA**

**April 15 to June 15**

<b><u>OPD</u></b>	<b><u>Blocks Included</u></b>
NR 4-1	770, 771, 813-815, 856-859, 899-903, 942-947, 985-991.
NR 4-2	241, 242, 283-286, 326-330, 369-375, 411-419, 454-463, 496-507, 538-551, 579-590, 593-595, 621-633, 663-676, 705-719, 749-763, 793-806, 837-850, 881-893, 925-937, 969-980.
NR 5-1	243-264, 287-308, 331-352, 374-396, 418-440, 462-484, 506-528, 550-572, 594-616, 654-660, 699-704.
NR 5-2	221-224, 265-269, 309-315, 353-360, 397-405, 441-451, 485-499, 529-545, 573-591, 617-637, 661-683.
NR 6-1	682-684.

**FALL MIGRATION AREAS**

**Western Blocks - September 15 through October 31**

<b><u>OPD</u></b>	<b><u>Blocks Included</u></b>
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- NR 4-1 416-419, 460-463, 500-507, 542-551, 584-595, 626-639, 669-683, 712-727, 756-771, 798-815, 841-859, 884-903, 925-947, 969-991.
- NR 4-2 231-242, 275-286, 314-330, 358-375, 397-419, 441-463, 485-507, 529-551, 573-590, 593-595, 617-633, 661-676, 705-719, 749-763, 793-806, 837-850, 881-893, 925-937, 969-980.

Central Blocks - September 1 through October 31

<u>OPD</u>	<u>Blocks Included</u>
NR 5-1	243-264, 287-308, 331-352, 374-396, 418-440, 462-484, 506-528, 550-572, 594-616, 639-660, 684-704, 729-748, 775-792, 821-836, 867-880, 912-924, 957-968, 1001-1012.
NR 5-2	221, 265-267, 309-312, 353-356, 397-401, 441-447, 485-492, 529-537, 573-587, 617-637, 661-683, 705-727, 749-771, 793-815, 837-859, 881-903, 925-947, 969-991.
NR 5-3	35-44, 81-86.
NR 5-4	1-23, 46-67, 93-111, 139-155, 184-199, 228-244, 273-288, 318-332, 362-376, 407-417, 452-459, 496-500, 541-542.
NR 6-1	726-738, 770-784, 814-829, 858-874, 902-921, 946-967, 990-1012.
NR 6-2	969.
NR 6-3	22-44, 66-88, 110-132, 154-176, 198-220, 241-264, 285-308, 329-352, 373-396, 422-440, 469-484, 515-517, 519, 520, 522-528, 560, 566-572, 611-616, 659, 660.
NR 6-4	1-8, 45-52, 89-96, 133-140, 177-184, 221-228, 265-272, 309-316, 353-360, 397-404, 441-448, 485-492, 529-536, 573-580, 617-624, 661-668, 706-712, 755, 756.

Eastern Blocks - August 1 through October 31

<u>OPD</u>	<u>Blocks Included</u>
NR 6-4	9-23, 53-67, 97-111, 141-155, 185-199, 229-244, 273-288, 317-332, 361-376, 405-420, 449-464, 493-508, 537-552, 581-596, 625-640, 669-684, 713-728, 757-772, 802-816, 847-860, 893-902, 940-944, 986, 987.
NR 7-3	134, 178-181, 221-227, 265-274, 309-321, 353-368, 397-415, 441-462, 485-508, 529-552, 573-596, 617-640, 661-684, 705-728, 749-772, 793-816, 844-860, 890-904, 935-948, 981-992.
NR 7-4	485, 529-532, 573-579, 617-623, 661-667, 705-710, 749-754, 793-798, 837-842, 881-886, 925-929, 969-973.
NR 7-5	15-25, 60-69, 105-113, 150-157, 196-201, 242-245, 286-289.
NR 7-6	1-4, 45-48, 89-91, 133-135, 177-179, 221, 222, 265, 266, 309.

Purpose of Stipulation No. 5: The intent of this stipulation is to determine when bowhead whales are present in the vicinity of leases during exploratory-drilling operations and study the effects of these activities on the behavior of the bowheads.

This stipulation specifically excludes those blocks and Federal parts of blocks of OPD's NR 6-3 and NR 6-4 located between the Alaskan coast and the barrier islands. (Other blocks inside the barrier islands that have been relinquished and included in the list of blocks offered for leasing that appears in the NOS also may be excluded.) Whale-sighting data indicates that the bowhead whale-migration corridor is located seaward of the barrier islands. Because bowheads do not migrate shoreward of the barrier islands, it is highly unlikely that they would respond to noise associated with drilling, testing, or other downhole exploratory activities from federally leased blocks located shoreward of the barrier islands.

Effectiveness of Stipulation No. 5: The effectiveness of this stipulation depends on the quality of the information it contributes to the consultation and regulatory actions governing exploratory-drilling activities on the leases.

This stipulation was adopted for the previous Beaufort Sea sale (Sale 97), but there has not been any exploration to date in areas requiring site-specific monitoring. However, in seasonal-drilling-restriction waivers granted for exploration activities for Sale 87 in the Beaufort Sea, two drill sites were monitored for bowhead whale/industry interaction and resulted in useful information on interactions and bowhead-sighting data (Davis, 1987; see Sec. IV.B.6.).

If the information obtained from this or other monitoring programs indicates that there is a threat of serious, irreparable, or immediate harm (threat of harm) to the species, the RSFO will require the lessee to suspend operations causing such threat in accordance with 30 CFR 250.10. By providing information that prevents a threat of harm to the species, this stipulation helps to minimize the likelihood of disrupting whale feeding, migration, or socialization. However, it is likely that some endangered whales would interact with the activities associated with exploratory drilling, and there might be some inadvertent conflicts or incidental "taking" situations. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of exploration-drilling activities would not constitute a threat of harm to the species.

Information obtained from the site-specific monitoring program of bowhead whales will contribute to measures that can be taken to reduce the threat of harm of the species. This stipulation, in conjunction with ITL No. 6 (Information on Endangered Whales and MMS Monitoring Program), addresses the NMFS's Conservation Recommendation No. 4 in the ARBO and will help protect endangered bowhead whales during their migration from significant adverse effects due to exploratory activities. The effects of this measure, if adopted, are likely to be incremental, and thus the effect level on bowhead whales is expected to be same as for the base case for Alternative I--MODERATE.

The subsistence harvest of bowhead whales might directly or indirectly benefit from the adoption of this monitoring-program stipulation. The prohibition of exploratory-drilling activities would decrease or eliminate the effects of such activities on bowheads. In the absence of exploratory-drilling disturbances on bowhead whales, the success of subsistence whaling ventures would depend entirely on the natural vagaries of that activity. Some aspects of the exploratory drilling activities might interfere with subsistence whaling, but they are not expected to be significant enough to pose a threat of harm to bowheads--which would result in a suspension of operations (according to 30 CFR 250.10).

Although the information obtained if Stipulation 5 is adopted incrementally would contribute to bowhead whale-research efforts and the whalers' knowledge about bowheads, the effects of the base case for Alternative I on subsistence-harvest activities would remain MODERATE in Kaktovik and Wainwright and HIGH in Barrow (Atqasuk) and Nuiqsut.

• **Stipulation No. 6--Subsistence Whaling and Other Subsistence Activities**

All exploration and development and production operations shall be conducted in a manner that minimizes any potential for conflict between the oil and gas industry and subsistence activities, particularly the subsistence bowhead whale hunt.

Prior to submitting an exploration plan or development and production plan to the lessor for activities proposed during the bowhead whale migration period, the lessee shall contact the potentially affected communities, Wainwright, Barrow, Kaktovik, or Nuiqsut, and the Alaska Eskimo Whaling Commission to discuss potential conflicts with the siting, timing, and methods of proposed operations. Through this consultation, the lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in undue interference with subsistence harvests.

A discussion of resolutions reached during this consultation process and any unresolved conflicts shall be included in the exploration plan or the development and production plan. In particular, the lessee shall show in the plan how mobilization of the drilling unit and crew and supply boat routes will be scheduled and located to minimize conflicts with subsistence activities. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan.

The lessee shall send a copy of the exploration plan or development and production plan to the potentially affected whaling communities and the Alaska Eskimo Whaling Commission at the same time they are submitted to the lessor to allow concurrent review and comment as part of the lessor's plan approval process.

Subsistence whaling activities occur generally during the following periods:

April to June: Barrow whalers use lead systems off Point Barrow and west of Barrow in the

Chukchi Sea. Wainwright whalers use lead systems between Wainwright and Peard Bay.

August to October: Kaktovik/Nuiqsut hunters use the area circumscribed from Anderson Point in Camden Bay to a point 30 kilometers north of Barter Island to Humphrey Point east of Barter Island. The area of use may extend from Thetis Island to Flaxman Island seaward of the barrier islands.

September to October: Barrow hunters use the area circumscribed by a western boundary extending approximately 15 kilometers west of Barrow, a northern boundary 50 kilometers north of Barrow, then southeastward to a point about 50 kilometers off Cooper Island, with an eastern boundary on the east side of Dease Inlet. Occasional use may extend eastward as far as Cape Halkett.

Purpose of Stipulation No. 6: The activities and attitudes that surround subsistence form the basis of Native cultures in the Beaufort Sea and Chukchi Sea areas, and local concerns about the effects of oil and gas activities to subsistence activities are a major scoping issue. The purpose of this stipulation is to require lessees to contact potentially affected communities and the AEWG and to make reasonable efforts to conduct all aspects of their operations in a manner that recognizes Native subsistence requirements and avoids adverse effects on local subsistence harvests and cultural values.

Effectiveness of Stipulation No. 6: The effects of awareness and sensitivity are difficult to measure directly; and while there may be some reduction in adverse effects on local subsistence harvests and sociocultural systems, the amount may be too small to reduce the expected effects on subsistence-harvest patterns or sociocultural systems.

For subsistence harvests, the expected effects are MODERATE for Barrow (Atkasuk) as a result of potential effects from an oil spill if it occurred during the bowhead whale harvest or HIGH for Nuiqsut as a result of development construction and production activities offshore of Flaxman Island. Although the effects on subsistence harvests from noise and disturbance during the exploration phase are expected to be LOW in Barrow, Nuiqsut, and Kaktovik, when development and production activities are added, the effects are expected to be MODERATE in Kaktovik and Wainwright and HIGH in Nuiqsut. With this stipulation, however, the expected MODERATE effects on subsistence harvests due to noise and disturbance could be reduced to LOW effects. Noise and disturbance due to construction activities are more difficult to mitigate; therefore, the HIGH effects expected at Nuiqsut would be reduced to MODERATE.

Through cooperation and coordination, the possibility of reducing the potential effects that noise and disturbance might have on the bowhead whale harvest can occur. The Oil/Whalers Cooperative Program for the Beaufort Sea (in effect from 1986 to 1989) between Nuiqsut and Kaktovik whalers and oil industry companies is an example of such cooperation and coordination. Although this program has expired, similar cooperation and coordination efforts have been required for Sales 97 and 109 as a part of the lease stipulations.

As noted in Section IV.C.10.b, oil spills also may have MODERATE effects on subsistence-harvest patterns (bowhead whales), which is one of the factors affecting sociocultural systems (Sec. IV.C.9). This stipulation would not reduce the MODERATE effects on subsistence-harvest patterns that may be caused by oil spills; and without such a reduction, MODERATE effects on sociocultural systems are expected as a result of the proposed action.

- **Stipulation No. 7--Oil-Spill-Response Preparedness**

Lessees must be prepared to respond to oil spills, which includes training of personnel for familiarization with response equipment and strategies, and conducting drills to demonstrate readiness. Prior to approval of exploration or development and production plans, lessees shall submit for review and approval oil-spill-contingency plans (OSCP's) in accordance with 30 CFR 250.42. The OSCP must address all aspects of oil-spill-response readiness including an analysis of potential spills and spill-response strategies; type, location, and availability of appropriate oil-spill equipment; and response times and equipment capability for the proposed activities. The plan must also address response drills and training requirements. The lessee shall conduct drills under realistic conditions to the extent necessary to demonstrate continued readiness and response capability for appropriate environmental conditions: e.g., solid-ice, open-water, and

broken-ice conditions. For production operations, drills shall be conducted at least semiannually. Drills shall include deployment of onsite response equipment and additional equipment, available from a cooperative or other sources identified in the OSCP, to the extent necessary to demonstrate adequate response preparedness for the type, location, and scope of proposed activities and anticipated environmental conditions.

Purpose of Stipulation No. 7: The purpose of this stipulation is to ensure lessees are (1) ready to respond to a platform oil spill that might occur as a result of their operations and (2) have the appropriate equipment and trained personnel available to conduct cleanup operations. Response readiness is addressed in the OSCP's that are submitted to MMS for approval and demonstrated, to a limited extent, by oil-spill-response drills conducted under appropriate environmental conditions. Readiness also would be demonstrated in cleaning up an actual oil spill.

Effectiveness of Stipulation No. 7: The requirements of this stipulation reiterate the oil-spill-response preparedness requirements contained in 30 CFR 250.42, Oil Spill Contingency Plans, and 250.43, Training and Drills. Lessees are required to submit OSCP's for MMS approval either with or prior to submitting Exploration Plans or Development and Production Plans; approved OSCP's are to be reviewed and updated annually.

To assure a prompt response in the event of a platform oil spill, OSCP's must address items such as (1) various spill-response strategies; (2) types, capabilities, and local and regional inventories of various types of response equipment, material, and supplies; and (3) training of personnel, including conducting drills. (The drills are to be realistic and include the deployment of equipment.) Knowledge of the response strategies and the training of personnel in the use of the response equipment ensure a more rapid and efficient response to an oil spill.

Response strategies are based in part on the source of the spilled oil, including the anticipated size of the spill. The flow rate of oil from OCS wells ranges from 10 to more than 8,000 bbl per day (bbl/day)--the average flow rate is about 180 bbl/day. The average flow rate for Sale 124 wells is estimated to be 1,800 bbl/day. Thus, strategies to clean up crude oil from a well blowout might be based on volumes of ten to several thousand barrels of oil per day. In contrast, tanker spills sometimes involve the release of large volumes of oil in a relatively short time. As a result of the grounding of the Exxon Valdez, about 260,000 bbl of oil were released into the waters of Prince William Sound within several hours.

The procedures taken in advance to respond to a platform oil spill help provide for a more effective response. However, as noted in Appendix M (I.D), the effectiveness of oil-spill cleanup at sea is quite variable and depends on (1) sea, weather, and ice conditions; (2) time of response; (3) type of cleanup procedure used; and (4) type of oil spill. With so many variables, recovery of most of the the spilt oil is unlikely.

As noted in Section II.G.1, laws and regulations that provide mitigation are considered part of the proposed lease sale; the mitigating effects of these laws and regulations are considered in the analyses of the effects of Sale 124 (Sec. IV). Because the requirements reiterate existing regulations, the mitigating effects of this stipulation have been considered in the analyses of the effects of Sale 124. Thus, adoption of the stipulation would not be expected to reduce the effects on any of the resources that might be affected by a platform or other type of oil spill.

The MMS responsibilities for operations on the OCS are directed toward assuring operational safety and preventing pollution, with major emphasis on preventing oil spills. To this end, MMS inspects all OCS exploratory drilling operations throughout the year on a near-continuous basis to ensure compliance with stringent safety and pollution-prevention regulations.

• Stipulation No. 8--Seasonal Drilling Restriction

Exploratory drilling, testing, and other downhole exploratory activities will be prohibited during the spring bowhead whale migration period, generally from April 15 through June 15, in the Spring Migration Area. Exploratory drilling, testing, and other downhole exploratory activities will be prohibited in the Fall Migration Areas, generally from August 1 through October 31 in the Eastern Blocks, from September 1 through October 31 in the Central Blocks, and from September 15 through October 31 in the Western Blocks. The precise dates will be set each

season by the Regional Supervisor, Field Operations (RSFO), based on available information concerning the presence of bowhead whales in the area. The RSFO may determine that continued operations are necessary to prevent a loss of well control or to ensure human safety. This stipulation will remain in effect until termination or modification by the Department of the Interior, after conferring with the State of Alaska and the North Slope Borough, and in consultation with the National Marine Fisheries Service.

This stipulation applies to the following blocks for the following time periods: (Official Protraction Diagram [OPD])

SPRING MIGRATION AREA

April 15 to June 15

<u>OPD</u>	<u>Blocks Included</u>
NR 4-1	770, 771, 813-815, 856-859, 899-903, 942-947, 985-991.
NR 4-2	241, 242, 283-286, 326-330, 369-375, 411-419, 454-463, 496-507, 538-551, 579-590, 593-595, 621-633, 663-676, 705-719, 749-763, 793-806, 837-850, 881-893, 925-937, 969-980.
NR 5-1	243-264, 287-308, 331-352, 374-396, 418-440, 462-484, 506-528, 550-572, 594-616, 654-660, 699-704.
NR 5-2	221-224, 265-269, 309-315, 353-360, 397-405, 441-451, 485-499, 529-545, 573-591, 617-637, 661-683.
NR 6-1	682-684.

FALL MIGRATION AREAS

Western Blocks - September 15 through October 31

<u>OPD</u>	<u>Blocks Included</u>
NR 4-1	416-419, 460-463, 500-507, 542-551, 584-595, 626-639, 669-683, 712-727, 756-771, 798-815, 841-859, 884-903, 925-947, 969-991.
NR 4-2	231-242, 275-286, 314-330, 358-375, 397-419, 441-463, 485-507, 529-551, 573-590, 593-595, 617-633, 661-676, 705-719, 749-763, 793-806, 837-850, 881-893, 925-937, 969-980.

Central Blocks - September 1 through October 31

<u>OPD</u>	<u>Blocks Included</u>
NR 5-1	243-264, 287-308, 331-352, 374-396, 418-440, 462-484, 506-528, 550-572, 594-616, 639-660, 684-704, 729-748, 775-792, 821-836, 867-880, 912-924, 957-968, 1001-1012.
NR 5-2	221, 265-267, 309-312, 353-356, 397-401, 441-447, 485-492, 529-537, 573-587, 617-637, 661-683, 705-727, 749-771, 793-815, 837-859, 881-903, 925-947, 969-991.
NR 5-3	35-44, 81-86.
NR 5-4	1-23, 46-67, 93-111, 139-155, 184-199, 228-244, 273-288, 318-332, 362-376, 407-417, 452-459, 496-500, 541-542.
NR 6-1	726-738, 770-784, 814-829, 858-874, 902-921, 946-967, 990-1012.
NR 6-2	969.
NR 6-3	22-44, 66-88, 110-132, 154-176, 198-220, 241-264, 285-308, 329-352, 373-396, 422-440, 469-484, 515-517, 519, 520, 522-528, 560, 566-572, 611-616, 659, 660.
NR 6-4	1-8, 45-52, 89-96, 133-140, 177-184, 221-228, 265-272, 309-316, 353-360, 397-404, 441-448, 485-492, 529-536, 573-580, 617-624, 661-668, 706-712, 755, 756.

Eastern Blocks - August 1 through October 31

<u>OPD</u>	<u>Blocks Included</u>
NR 6-4	9-23, 53-67, 97-111, 141-155, 185-199, 229-244, 273-288, 317-332, 361-376, 405-420, 449-464, 493-508, 537-552, 581-596, 625-640, 669-684, 713-728, 757-772, 802-816, 847-860, 893-902, 940-944, 986, 987.
NR 7-3	134, 178-181, 221-227, 265-274, 309-321, 353-368, 397-415, 441-462, 485-508, 529-552, 573-596, 617-640,

661-684, 705-728, 749-772, 793-816, 844-860, 890-904, 935-948, 981-992.

NR 7-4 485, 529-532, 573-579, 617-623, 661-667, 705-710, 749-754, 793-798, 837-842, 881-886, 925-929, 969-973.

NR 7-5 15-25, 60-69, 105-113, 150-157, 196-201, 242-245, 286-289.

NR 7-6 1-4, 45-48, 89-91, 133-135, 177-179, 221, 222, 265, 266, 309.

**Purpose (Including Background) of Stipulation No. 8:** The seasonal drilling restriction (SDR) was originally proposed in previous OCS oil and gas lease sales to protect the endangered bowhead whales from the risk of an oil spill. The SDR stipulation was written in response to an earlier jeopardy opinion by the NMFS. In the ARBO (November 23, 1988), NMFS found that exploratory-drilling activities will not jeopardize the continued existence of the bowhead whales. The MMS has agreed to reinitiate consultation with NMFS in the event oil is discovered and development and production activities are proposed. The SDR is analyzed here to measure its effects on subsistence whaling.

Since 1985, 4 (out of 21 wells drilled) waivers on the SDR have been granted for Sales 71 and 87 leases. The granting of these waivers was based on the operator (1) conducting site-specific monitoring of the reactions of bowhead whales to drilling noises and (2) cooperating with whalers in an effort to eliminate industry and whaling conflicts. Eight waivers have been granted, but only four wells--located between Beechey and Demarcation Points--have been drilled during fall bowhead whale migrations. While there is no evidence to suggest that industrial noise would affect the migration of bowhead whales, there is evidence that bowhead whales respond to noises from approaching vessels and, to a lesser extent, from stationary sources such as drilling units, by altering their movement or behavior (Sec. IV.B.6.b). Such alterations during a subsistence-harvest hunt could affect the success of that hunt (Sec. IV.C.10.b[1]). Because only a limited number of wells have been drilled during the fall-migration period, the effects of drilling noise and disturbance on the subsistence hunting of bowhead whales are still being examined. Exploratory-drilling activities were conducted during the 1986 and 1988 bowhead whale migration. Bowhead whale harvests in (1) Kaktovik were 3 in 1986, 0 in 1987, 1 in 1988, and 3 in 1989 and (2) Nuiqsut were 1 in both 1986 and 1987, 0 in 1988, and 2 in 1989; the number of bowhead whales harvested during these years is similar to the number harvested in previous years for the two communities.

For Sale 124, the SDR would extend generally from April 15 through June 15 for the Spring-Migration Area. For the Fall-Migration Areas, it would extend generally from August 1 through October 31 for the Eastern Blocks, September 1 through October 31 for the Central Blocks, and September 15 through October 31 for the Western Blocks. These extensions represent the peak bowhead whale-migration periods.

Information on general locations of bowhead whales would be provided by a bowhead-monitoring program, ITL No. 6, Information on Endangered Whales and MMS Monitoring Program. The bowhead whale-studies effort is continuing and may provide new information to allow further refinement, modification, or replacement of this proposed measure.

This stipulation specifically excludes those blocks and Federal parts of blocks of OPD's NR 6-3 and NR 6-4 located between the Alaskan coast and the barrier islands. (Other blocks inside the barrier islands that have been relinquished and included in the list of blocks offered for leasing that appears in the NOS also may be excluded.) Whale-sighting data indicates that the bowhead whale-migration corridor is located seaward of the barrier islands. Because bowheads do not migrate shoreward of the barrier islands, it is highly unlikely that they would respond to noise associated with drilling, testing, or other downhole exploratory activities from federally leased blocks located shoreward of the barrier islands.

**Effectiveness of Stipulation No. 8:** As discussed below, implementation of the SDR in bowhead whale subsistence-harvest areas during the whale-migration periods would reduce the risk of noise and disturbance associated with exploratory-drilling activities from interfering with the hunting of bowhead whales and consequently is expected to reduce the potential effects from exploratory-drilling activities on subsistence harvests of Barrow, Kaktovik, Nuiqsut, and Wainwright. However, because this stipulation applies only to activities during the exploratory phase, it is not expected to reduce the potential effects on Barrow, Kaktovik, or Nuiqsut bowhead harvests from an oil spill or the potential effects on the Nuiqsut whale harvests from development and production activities.

Exploratory-drilling activities in the presence of bowhead whales could interfere with the subsistence harvest of bowhead whales. The causative factors, such as noise or disturbance from drilling units and from support

vessels and helicopters, that might produce such an interference are analyzed in Section IV.C.10.b(1). The generation of noise in subsistence-harvest areas possibly could cause (1) the whales to move farther offshore away from the noise and beyond the reach of the whalers and (2) the whalers to move their camps or suspend whaling activities until the disturbance ceased. The presence of a vessel in the whale-harvest area also could possibly interfere with the pursuit of a whale. During the years when weather or ice conditions restrict whaling, the season may be a only few weeks long; and noise disturbance during a short whaling season could cause a loss of all or part of that year's harvest.

Based on the analysis of the base case for Alternative I, Section IV.C.10, it is estimated that exploration noise and disturbance from Sale 124 would have MODERATE effects on the bowhead whale subsistence harvest in Kaktovik and Nuiqsut and LOW effects in Barrow. For the small communities of Kaktovik and Nuiqsut, not harvesting a whale as a result of exploration noise and disturbance could mean an important subsistence resource would not be available for the community during that harvest period--a MODERATE effect. For Barrow, the loss of one or two whales attributed to exploration noise and disturbance would represent an effect, but other whales are likely to be harvested. Also, Barrow is the only community that hunts bowhead whales during both the spring and fall migrations; therefore, the effects of exploration noise and disturbance on Barrow's subsistence harvest of bowhead whales are expected to be LOW. The communities of Nuiqsut and Kaktovik hunt bowhead whales only in the fall.

Implementation of the SDR in bowhead whale subsistence-harvest areas during the whale-migration periods would reduce the risk of noise and disturbance associated with exploration-drilling activities from interfering with hunting bowhead whales. This reduction in noise and disturbance would reduce the potential effects from exploration-drilling activities on subsistence harvests in Kaktovik and Nuiqsut from MODERATE to LOW and in Barrow from LOW to VERY LOW.

The above discussion, and the analysis in Section IV.C.10.b(1), recognize that noises associated with exploratory-drilling operations could possibly interfere with subsistence hunting; and a separate stipulation is proposed to mitigate these potential effects--see Stipulation No. 6, Subsistence Whaling and Other Subsistence Activities.

The probability of an oil spill occurring and contacting a bowhead whale subsistence-harvest area during exploration drilling is very low; and, as noted in the analysis in Section IV.C.10, effects from oil spills during exploratory drilling are not expected because of the very low probability of such a spill occurring. However, if such a spill did occur, it might be perceived that whales passing through the affected area would be unsuitable for consumption and thus would not be harvested, or their quota might be curtailed. Implementation of the SDR would reduce the risk of bowhead whales contacting spilled oil in subsistence-harvest areas.

Although a drilling suspension would reduce or eliminate the effects of exploratory-drilling activities on migrating whales, the success of subsistence-whaling ventures would still be affected by the natural vagaries associated with whaling and by the population dynamics of migrating whales. Additionally, this stipulation is only for exploratory activities and would not reduce the potential MODERATE effects on Barrow, Nuiqsut, or Kaktovik bowhead whale harvests from an oil spill or the potential HIGH effects on the Nuiqsut whale harvest during development and production.

Sale 124:

b. Potential Information to Lessees: The following ITL's are proposed for Beaufort Sea

- No. 1 - Information on Bird and Marine Mammal Protection
- No. 2 - Information on Areas of Special Biological and Cultural Sensitivity
- No. 3 - Information on Arctic Peregrine Falcon
- No. 4 - Information on Beaufort Sea Biological Task Force
- No. 5 - Information on Coastal Zone Management
- No. 6 - Information on Endangered Whales and MMS Monitoring Program
- No. 7 - Information on Development and Production Phase Consultation with NMFS to Avoid Jeopardy to Bowhead Whales

- ITL No. 1--Information on Bird and Marine Mammal Protection

Lessees are advised that during the conduct of all activities related to leases issued as a result of this sale, the lessee and its agents, contractors, and subcontractors will be subject to, among others, the provisions of the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. 1361 et seq.); the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.); and applicable International Treaties.

Lessees and their contractors should be aware that disturbance of wildlife could be determined to constitute harm or harassment and thereby be in violation of existing laws and treaties. With respect to endangered species and marine mammals, disturbance could be determined to constitute a "taking" situation. Under the ESA, the term "take" is defined to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct." Under the MMPA, "take" means "harass, hunt, capture, collect, or kill or attempt to harass, hunt, capture, or kill any marine mammal." Violations under these Acts and applicable Treaties may be reported to the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (FWS), as appropriate.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met. Section 101(a)(5) of the MMPA allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section 7(b)(4) of the ESA allows for the incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Under the MMPA, the NMFS is responsible for species of the order Cetacea (whales and dolphins) and the suborder Pinnipedia (seals and sea lions) except walrus; the FWS is responsible for the polar bears, sea and marine otters, and walrus. Procedural regulations implementing the provisions of the MMPA are found at 50 CFR Part 18.27 for FWS, and at 50 CFR Part 228 for NMFS.

Lessees are advised that specific regulations must be applied for and in place and the Letters of Authorization must be obtained by those proposing the activity to allow the incidental take of marine mammals whether or not they are endangered or threatened. The regulatory process may require one year or longer.

Of particular concern is disturbance at major wildlife concentration areas, including bird colonies, marine mammal haulout and breeding areas, and wildlife refuges and parks. Maps depicting major wild-life concentration areas in the lease area are available from the Regional Supervisor, Field Operations. Lessees are also encouraged to confer with the FWS and NMFS in planning transportation routes between support bases and leaseholdings.

Behavioral disturbance of most birds and mammals found in or near the lease area would be unlikely if aircraft and vessels maintain at least a 1-mile horizontal distance and aircraft maintain at least a 1,500-foot vertical distance above known or observed wildlife concentration areas, such as bird colonies and marine mammal haulout and breeding areas.

For the protection of endangered whales and marine mammals through-out the lease area, it is recommended that all aircraft operators maintain a minimum 1,500-foot altitude when in transit between support bases and exploration sites. Lessees and their contractors are encouraged to minimize or reroute trips to and from the lease-hold by aircraft and vessels when endangered whales are likely to be in the area. Human safety should take precedence at all times over these recommendations.

**Purpose of ITL No. 1:** The purpose of this measure is to help minimize behavioral disturbance of wildlife, particularly at known concentration areas. The Beaufort Sea Planning Area is an important habitat for endangered and nonendangered marine mammals and marine birds. Of particular concern are (1) bowhead whale populations that migrate through the area from April through June and from September through October; (2) gray whales that spend the summer and early fall feeding in the far western part of the planning area (June through October), (3) other endangered whale species (fin and humpback) that occasionally occur in the far western part of the planning area during the summer, (4) large groups of Pacific walrus hauled

out along the pack-ice front in the far western part of the planning area, (5) fairly large numbers of bearded and ringed seals occurring throughout the planning area, especially along the pack-ice front; (6) large concentrations of spotted seals that haul out along the Colville River Delta and in Dease Inlet; (7) polar bear denning habitats on barrier islands, mainland coastal areas (especially of ANWR), and shorefast- and pack-ice zones; (8) large numbers of seabirds that concentrate off Point Barrow during the summer; (9) waterfowl and shorebird concentrations at Elson and Simpson Lagoons and the Colville and Canning River Deltas; and (10) other areas identified in ITL No. 2 as areas of special biological sensitivity.

Effectiveness of ITL No. 1: Although advisory, it is expected that this measure will help reduce the number of inadvertent incidences of wildlife disturbance by alerting lessees to (1) the provisions of those acts and treaties protecting marine mammals, endangered species, and birds; and (2) the locations of major wildlife concentration areas. In addition, the measures encourage lessees to confer with the appropriate wildlife-protection agencies regarding procedures that could be used to avoid disturbing wildlife--especially during aircraft and vessel operations. Because of the uncertainties that often accompany the movements of animals and of man and his vehicles, some interactions between marine mammals and birds and lease exploration and development and production activities, especially during aircraft and vessel operations, are likely to occur. Thus, it is assumed that inadvertent disturbance events and human interactions cannot be completely avoided.

• ITL No. 2--Information on Areas of Special Biological and Cultural Sensitivity

Lessees are advised that certain areas are especially valuable for their concentrations of marine birds, marine mammals, fishes, or other biological resources or cultural resources. Identified areas and time periods of special biological and cultural sensitivity include:

- (1) the lead system off Point Barrow, April-June;
- (2) the salt marshes from Kogru Inlet to Smith Bay, June-September;
- (3) Plover Islands, June-September;
- (4) the Boulder Patch in Stefansson Sound, June-October;
- (5) the Camden Bay area (especially the Nuvugag and Kaninniivik hunting sites), January, April-September, November;
- (6) the Canning River Delta, January-December;
- (7) Barter Island - Demarcation Point Area, January-December;
- (8) the Colville River Delta, January-December;
- (9) Cross, Pole, Egg, and Thetis Islands, June-September; and
- (10) Flaxman Island waterfowl use and polar bear denning areas (Leffingwell Cabin, a National Historic Site, is located on Flaxman Island).

These areas are among areas of special biological and cultural sensitivity to be considered in the oil spill contingency plan required by 30 CFR 250.42. Lessees are advised that they have the primary responsibility for identifying these areas in their oil spill contingency plans and for providing specific protective measures. Additional areas of special biological and cultural sensitivity may be identified during review of exploration plans and development and production plans.

Consideration should be given in oil spill contingency plans as to whether use of dispersants is an appropriate defense in the vicinity of an area of special biological and cultural sensitivity. Lessees are advised that prior approval must be obtained before dispersants are used.

Purpose of ITL No. 2: The purpose of this ITL is to protect birds, marine mammals, fishes, and lower-trophic-level organisms from oil spills in those areas that have been identified by the public (Federal and State agencies, regional and local public agencies, local individuals, and public-interest groups) as important to the continued well-being of the biological resources.

Effectiveness of ITL No. 2: Consideration in oil-spill-contingency plans of the identified areas of special biological and cultural sensitivity would help develop measures to protect these areas, as well as other identified areas, from oil spills. Protection of special biological areas would reduce the oil-spill effects on the biological and cultural resources of the areas. While this also may reduce oil-spill effects on local water quality and some coastal wetland habitats of birds or the chance of caribou encountering oil along the coast, the overall levels of effect on caribou and marine and coastal birds--as well as effects on pinnipeds, polar bears, belukha whales, and water quality--would not be reduced by this ITL.

- **ITL No. 3--Information on Arctic Peregrine Falcon**

Lessees are advised that the arctic peregrine falcon (Falco peregrinus tundrius) is listed as threatened by the U.S. Department of the Interior and is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Peregrines are generally present in Alaska from mid-April to mid-September and are most disturbed by human activities in the vicinity of nest sites. The conduct of Outer Continental Shelf exploration or development and production activities will not conflict with arctic peregrine falcons if onshore facilities are located away from known nest sites. The lessee should contact the Fish and Wildlife Service (FWS) for information on locations of known nest sites of peregrine falcons. Aircraft should maintain at least a 1-mile horizontal and 1,500-foot vertical distance from known or potential peregrine nest sites to avoid conflict.

Lessees are advised that the FWS will review exploration plans and development and production plans submitted by lessees to the Minerals Management Service (MMS). The FWS review may determine that certain restrictions could apply to further protect arctic peregrine falcon habitats. Lessees and affected operators should establish regular communication with MMS and FWS. Human safety should take precedence at all times over these recommendations.

**Purpose of ITL No. 3:** The purpose of this measure is to protect peregrine falcons adjacent to the sale area from adverse effects associated with noise and disturbance associated with OCS exploration and development and production activities from adversely affecting peregrine falcons adjacent to the sale area; according to the Alaska Peregrine Falcon Recovery team, the primary threat to peregrines during the nesting season is human disturbance. This protection is accomplished by advising the lessees (1) of minimum distances that aircraft should maintain from known or potential peregrine nest sites and (2) the role of FWS in reviewing exploration plans and development and production plans and determining what restrictions, if any, may be applied.

**Effectiveness of ITL No. 3:** Compliance by lessees with the recommendations described in the ITL should help reduce the adverse effects of aircraft traffic on peregrines. Likewise, it is believed that noise-disturbance effects from onshore facilities can be precluded if such facilities are located away from known nest sites.

- **ITL No. 4--Information on Beaufort Sea Biological Task Force**

Lessees are advised that in the enforcement of the Protection of Biological Resources stipulation, the Regional Supervisor, Field Operations (RSFO), will consider recommendations from the Beaufort Sea Biological Task Force (BTF) composed of designated representatives of the Minerals Management Service, Fish and Wildlife Service, National Marine Fisheries Service, and Environmental Protection Agency. Personnel from the State of Alaska and local communities are invited and encouraged to participate in the proceedings of the BTF. The RSFO will consult with the Beaufort Sea BTF on the conduct of biological surveys by lessees and the appropriate course of action after surveys have been conducted.

**Purpose of ITL No. 4:** The purpose of this ITL is to establish a formal means of advising the RSFO about matters regarding enforcement of the Protection of Biological Resources stipulation. The RSFO's consideration of the recommendations of the Beaufort Sea BTF should provide for better decisionmaking concerning biological resources and increased protection of these resources from possible adverse effects.

**Effectiveness of ITL No. 4:** The Beaufort Sea BTF has proven helpful in providing technical guidance to the RSFO in decisions concerning the Sales BF, 71, 87, and 97 areas. The imposition of this ITL for the next lease sale in the Beaufort Sea would extend the area of concern of the BTF throughout the Beaufort Sea region. However, effect levels of Sale 124 on marine and coastal birds, pinnipeds, polar bears, belukha whales, caribou, and water quality would remain the same as expected for the base case for Alternative I (Table S-1).

- **ITL No. 5--Information on Coastal Zone Management**

Lessees are advised that the Alaska Coastal Management Program (ACMP) may contain policies and standards that are relevant to exploration and development and production activities associated with leases resulting from this sale.

In addition, The North Slope Borough Coastal Management Program (NSB CMP) has been incorporated into the ACMP and contains more specific policies related to energy facility siting; areas with particular geologic hazards, subsistence uses, habitats, and transportation uses; and areas which have historic or prehistoric resources.

Relevant policies are applicable to ACMP consistency reviews of postlease activities. Lessees are encouraged to consult and coordinate early with those involved in coastal management review.

**Purpose of ITL No. 5:** The purpose of this ITL is to inform lessees of pertinent policy areas contained in the ACMP and to alert lessees that the State reviews exploration plans and development and production plans, including the siting of energy-related facilities, for consistency with these policies. Furthermore, it informs the lessee of local coastal management programs that may have policies supplementing those of the ACMP. An awareness of the ACMP and relevant Statewide standards and district policies enables lessees to coordinate early with the State and affected coastal district to achieve mutually satisfactory solutions to policy conflicts and to incorporate these solutions into a lessee's exploration or development and production plans.

**Effectiveness of ITL No. 5:** This ITL could help to alleviate potential conflicts with both land use regulations and the ACMP by alerting lessees that Alaska has an approved CMP with Statewide standards and district policies for the NSB. Statewide standards and NSB policies included in the ACMP are designed to prevent or to mitigate environmental and social problems associated with development. Although the application of ACMP policies probably would not modify the levels of effect that result from accidental oil spills, conformance with these standards and policies would help to alleviate some potential adverse effects, especially those identified for caribou subsistence. Moreover, the process of achieving consensus and obtaining final approval of projects could be substantially eased and potential conflicts with the ACMP reduced if lessees do coordinate early with those involved in coastal management reviews.

• **ITL No. 6--Information on Endangered Whales and MMS Monitoring Program**

Lessees are advised that the Minerals Management Service (MMS) intends to continue its areawide endangered whale monitoring program in the Beaufort Sea during exploration activities. The program will gather information on whale distribution and abundance patterns and will provide additional assistance to determine the extent, if any, of adverse effects to the species.

The MMS will perform an environmental review for each proposed exploration plan and development and production plan, including an assessment of cumulative effects of noise on endangered whales. Should the review conclude that activities described in the plan will be a threat of serious, irreparable, or immediate harm to the species, the Regional Supervisor, Field Operations (RSFO), will require that activities be modified, or otherwise mitigated before such activities would be approved.

Lessees are further advised that the RSFO has the authority and intends to limit or suspend any operations, including preliminary activities, as defined under 30 CFR 250.31, on a lease whenever bowhead whales are subject to a threat of serious, irreparable, or immediate harm to the species. Should the information obtained from MMS or lessees' monitoring programs indicate that there is a threat of serious, irreparable, or immediate harm to the species, the RSFO will require the lessee to suspend operations causing such effects, in accordance with 30 CFR 250.10. Any such suspensions may be terminated when the RSFO determines that circumstances which justified the ordering of suspension no longer exist. Notice to Lessees No. 86-2 specifies performance standards for preliminary activities.

Incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met. Section 101(a)(5) of the MMPA allows for the taking of small numbers of marine mammals incidental to a specified activity within a specified geographical area. Section 7(b)(4) of the ESA allows for the

incidental taking of endangered and threatened species under certain circumstances. If a marine mammal species is listed as endangered or threatened under the ESA, the requirements of both the MMPA and the ESA must be met before the incidental take can be allowed.

Information regarding endangered whales will be reviewed annually by the MMS in consultation with the NMFS and the State of Alaska until it is determined that annual reviews are no longer necessary. The sources of information include: the MMS monitoring program; the industry site-specific monitoring required by Stipulation No. 5 (including data obtained within 90 days of completion of a drilling season); pertinent results of the MMS environmental studies and other applicable information. The purpose of the review will be to determine whether existing mitigating measures adequately protect the endangered whales. Should the review indicate the threat of serious, irreparable, or immediate harm to the species, the MMS will take action to protect the species, including the possible imposition of a seasonal drilling restriction, or other restrictions if appropriate.

Purpose of ITL No. 6: The purpose of this measure is (1) to inform the lessees that MMS plans to continue an areawide program to monitor the effects of exploration activities on the behavior of bowhead whales and (2) to use this information in regulatory actions required by 30 CFR 250.10 to protect the species from the threat of serious, irreparable, and immediate harm (threat of harm); this protective action may occur either during the planning stages before operations on the lease begin or after operations have started. If there are indications that planned or actual operations on a lease pose a threat of harm, the RSFO will require modifications to the exploration and development and production plans or suspension of operations. The ITL also advises the lessees that (1) the incidental taking of marine mammals and endangered and threatened species is allowed only when the statutory requirements of the MMPA and/or the ESA are met and (2) the information regarding endangered whales will be reviewed annually by MMS in consultation with NMFS and the State of Alaska to determine if existing mitigating measures adequately protect the whales.

Effectiveness of ITL No. 6: The effectiveness of this ITL depends on the quality of the information it contributes to the regulatory and consultation actions associated with exploration and development and production activities.

If the information indicates that there is a threat of harm to the species, the RSFO will require the lessee to modify exploration and development and production plans or suspend the operations that cause such effects. By providing information that prevents a threat of harm to the species, the ITL helps to minimize the likelihood of disrupting whale feeding, migration, or socialization. This ITL, in conjunction with Stipulation No. 5 on the industry monitoring program, satisfies the NMFS' Conservation Recommendation No. 4 in the ARBO and will help protect bowhead whales during migration from significant adverse effects due to exploratory activities.

It is likely that some endangered whales would interact with the exploration and development and production activities and cause inadvertent conflicts or incidental "taking" situations. These inadvertent conflicts or incidental "taking" situations on some individual whales do not constitute a threat of harm to the species. If adopted, this measure will help to reduce the threat that oil and gas activities pose to endangered whales. However, the amount of reduction may be too small to change the effect level of the base case for the Proposal, which is MODERATE.

Adoption of this ITL also might provide some benefit to the subsistence harvest of bowhead whales. Bowheads are the only endangered whales harvested in the Sale 124 area. If suspended, the effects of exploration-drilling activities on the whales would be reduced or eliminated. In the absence of exploration-drilling disturbances, the success of subsistence whaling ventures would depend entirely on the natural vagaries associated with that activity.

Another benefit of the monitoring program is that it would provide additional information about whale behavior that might help the whalers in their subsistence whaling efforts. However, although the information obtained from the MMS Monitoring Program might help in reducing potential adverse effects on bowhead whales, this ITL would not reduce the levels of effect noted in Section IV. These would remain the same as those of the base case for the Proposal--MODERATE in Barrow (Atqasuk), Kaktovik, and Wainwright and HIGH in Nuiqsut.

- **ITL No. 7--Information on Consultation with NMFS to Protect Bowhead Whales in the Spring-Lead System**

The Minerals Management Service (MMS) has been advised by the National Marine Fisheries Service (NMFS) that, based on currently available information and technology, NMFS believes that development and production activities in the spring lead systems used by bowhead whales in the western part of the lease sale area along the Chukchi Sea coast and extending to the northeast of Point Barrow would likely jeopardize the continued existence of the bowhead whale population. The NMFS has advised that they will reconsider this conclusion when new information, technology, and/or measures become available or are proposed that would effectively eliminate or otherwise mitigate this potential jeopardy situation. In addition, the biological opinions (the ARBO and Sale 124; see Appendix K) are based on the assumption that there will not be any exploration within the spring-lead system. Therefore, the lessees are advised that MMS and NMFS will review exploration plans to ascertain if endangered species consultation will be required for activities planned during the spring (April 15 to June 15). Lessees are advised that specific options, alternatives, and/or mitigating measures may be developed for exploration, production, and development activities during MMS consultation with NMFS as new information or technology is developed for specific development plans, but that the possibility exists that exploration, development, and production on leases in this area may be constrained or precluded.

This ITL applies to the following blocks for the following time periods: OPD

SPRING MIGRATION AREA

April 15 to June 15

<u>OPD</u>	<u>Blocks Included</u>
NR 4-1	770, 771, 813-815, 856-859, 899-903, 942-947, 985-991.
NR 4-2	241, 242, 283-286, 326-330, 369-375, 411-419, 454-463, 496-507, 538-551, 579-590, 593-595, 621-633, 663-676, 705-719, 749-763, 793-806, 837-850, 881-893, 925-937, 969-980.
NR 5-1	243-264, 287-308, 331-352, 374-396, 418-440, 462-484, 506-528, 550-572, 594-616, 654-660, 699-704.
NR 5-2	221-224, 265-269, 309-315, 353-360, 397-405, 441-451, 485-499, 529-545, 573-591, 617-637, 661-683.
NR 6-1	682-684.

**Purpose of ITL No. 7:** The ITL's purpose is to ensure protection for the bowhead whale population from possible adverse effects if oil and gas exploration, development, and production were to occur in the area of the spring-lead system along the Chukchi/Beaufort Sea coast by advising lessees that NMFS will be consulted before exploration and development, and production will be allowed within this area. The NMFS believes that development and production in the spring-lead system would likely jeopardize the continued existence of the bowhead whale population. This opinion is stated in the biological opinions and is based on currently available information and technology. Revision of the jeopardy opinion is possible if new information and/or advances in technology can be shown to eliminate or mitigate the jeopardy opinion. In addition, exploration activities within the spring-lead system were not addressed in the NMFS biological opinions.

**Effectiveness of ITL No. 7:** ITL No. 6 (Information on Endangered Whales and MMS Monitoring Program), along with Stipulation No. 5 (Industry Site-Specific Bowhead Whale-Monitoring Program), will provide additional biological information about the effects of oil and gas activities on the bowhead whales. This information, along with any advances in technology, will aid both NMFS and MMS in developing alternatives to prevent a jeopardy situation during future consultations, especially consultations concerning development and production within the identified spring-lead system. While this ITL will assist in preventing a jeopardy situation and lead to the control of noise and disturbance effects on bowhead whales during their spring migration, the overall effect level of sale-related activities on the bowhead whale population is expected to be the same as for the base case for the Proposal--MODERATE.

- **ITL No. 8--Information on Oil-Spill-Cleanup Capability**

Exploratory drilling, testing, and other downhole activities may be prohibited in broken-ice

conditions unless the lessee demonstrates to the Regional Supervisor, Field Operations (RSFO), the capability to detect, contain, clean up, and dispose of spilled oil in broken ice. The adequacy of such oil-spill-response capability will be determined with the Best Available and Safest Technologies requirements, and will be considered at the time the oil-spill-contingency plans are reviewed. The adequacy of these plans will be determined by the RSFO prior to approval of exploration or development and production plans.

Purpose of ITL No. 8: The intent of this measure is to remind lessees that oil-spill-contingency technology used to respond to an oil spill during broken-ice conditions must be the best available and that this technology will be in place and available prior to conducting drilling activities below threshold depth during broken-ice conditions.

Effectiveness of ITL No. 8: The information contained in this ITL notifies the lessee of the requirements for oil-spill-response preparedness as contained in 30 CFR 250.42 OSCP. Lessees are required to submit OSCP's for approval by MMS with or prior to submitting Exploration Plans or Development and Production Plans.

To assure a prompt response in the event of an oil spill, OSCP's must address items such as (1) various spill-response strategies; (2) types, capabilities, and local and regional inventories of various types of response equipment, material, and supplies; and (3) training of personnel, including conducting drills. (The drills are to be realistic and include the deployment of equipment.) Knowledge of the response strategies and the training of personnel in the use of the response equipment ensures a more rapid and efficient response to an oil spill.

The procedures taken in advance to respond to an oil spill help to provide for a more effective response. However, as noted in Appendix M (I.D), the effectiveness of oil-spill cleanup at sea is quite variable and depends on (1) sea, weather, and ice conditions; (2) time of response; (3) type of cleanup procedure used; and (4) type of oil spilt. With so many variables, recovery of most of the spilt oil is unlikely.

As noted in Section II.G.1, laws and regulations that provide mitigation are considered part of the proposed lease sale; the mitigating effects of these laws and regulations are considered in the analyses of the effects of Sale 124 (Sec. IV). Because the information supplements existing regulations, the mitigating effects of this ITL have been considered in the analyses of the effects of Sale 124. Thus, adoption of the ITL would not be expected to reduce the effects on any of the resources that might be affected by an oil spill.

## **H. Summary and Comparison of Effects of Alternatives**

Table II-H-1 presents a summary and comparison of potential effects for Alternatives I, IV, and V. See Sections IV.B through IV.H for the comprehensive analyses of the potential effects of Sale 124; it is particularly important to refer to these analyses rather than use only this summary table as the indicator of potential effects. Terms that indicate levels of effect (i.e., VERY LOW, LOW, MODERATE, HIGH, AND VERY HIGH) are defined in Table S-2 (located in the front of this EIS).

Table II-H-1  
Summary of Effects<sup>1/</sup> for Alternatives I, IV, and V<sup>2/</sup>

Resource Category	Alternative I			Alternative IV	Alternative V
	Low Case	Base Case	High Case	Barrow Deferral Alternative	Barter Island Deferral Alternative
1. Water Quality					
Local	VERY LOW	MODERATE	MODERATE	MODERATE	MODERATE
Regional	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW
2. Lower-Trophic-Level Organisms <sup>3/</sup>	LOW	LOW	LOW	LOW	LOW
3. Fishes	LOW	MODERATE	MODERATE	MODERATE	MODERATE
4. Marine and Coastal Birds	LOW	MODERATE	HIGH	MODERATE	MODERATE
5. Marine Mammals					
Pinnipeds	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Polar Bears	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Belukha Whales	LOW	LOW	LOW	LOW	LOW
6. Endangered and Threatened Species					
Bowhead Whales	VERY LOW	MODERATE	MODERATE	MODERATE	MODERATE
Gray Whales	VERY LOW	LOW	LOW	VERY LOW	LOW
Arctic Peregrine Falcons	VERY LOW	VERY LOW	VERY LOW	VERY LOW	VERY LOW
7. Caribou	LOW	MODERATE	MODERATE	MODERATE	MODERATE
8. Economy of the North Slope Borough	VERY LOW	MODERATE	HIGH	MODERATE	MODERATE
9. Sociocultural Systems	LOW	MODERATE	MODERATE	MODERATE	MODERATE
10. Subsistence-Harvest Patterns					
Barrow (Atqasuk)	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Kaktovik	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Nuiqsut	LOW	HIGH	HIGH	HIGH	HIGH
Wainwright	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Regional	LOW	HIGH	HIGH	HIGH	HIGH
11. Archaeological Resources	LOW	LOW	MODERATE	VERY LOW	VERY LOW
12. Air Quality	VERY LOW	LOW	LOW	LOW	LOW
13. Land Use Plans and Coastal Management Programs	LOW	HIGH	HIGH	HIGH	HIGH

Source: USDOl, MMS, Alaska OCS Region.

<sup>1/</sup> Refer to Table S-2 for the definitions of levels of effect for each resource category.

<sup>2/</sup> Alternative II (No Sale)--The effects associated with Alternative I or other alternatives would not occur with this alternative. Alternative III (Delay the Sale)--The effects associated with this alternative would be the same as those of Alternative I, except their occurrence could be delayed 2 years. Adverse effects of the sale in future years may be of less consequence to species whose populations are currently increasing (i.e., gray whales).

<sup>3/</sup> The effects on the Boulder Patch in Stefansson Sound would be HIGH if it were contacted by spilled oil.

**SECTION III**

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**DESCRIPTION  
OF  
THE  
AFFECTED  
ENVIRONMENT**

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### III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

#### A. Physical Characteristics of the Beaufort Sea Planning Area

The description of the physical characteristics of the Beaufort Sea Planning Area as contained in Section III.A of the Sales 87 Final Environmental Impact Statement (FEIS) and 97 FEIS (USDOJ, MMS, 1984 and 1987a, respectively) is incorporated by reference; a summary of this description, augmented by additional material, as cited, follows.

##### 1. Geology:

a. Petroleum Geology: The petroleum provinces into which the Beaufort Sea Planning Area have been divided are based on the classification used by Craig, Sherwood, and Johnson (1985) to describe the geological framework and hydrocarbon potential of the area. The locations of the provinces are shown in Figure III-A-1. The geologic ages and names of stratigraphic and seismic sequences are shown in Figure III-A-2.

As shown in Figure III-A-1, the petroleum provinces of the Beaufort Sea shelf can be incorporated into two major provinces separated by a highly faulted boundary called the Hinge Line. The Arctic Platform provinces lie south of the Hinge Line, and the Brookian Basin provinces lie north.

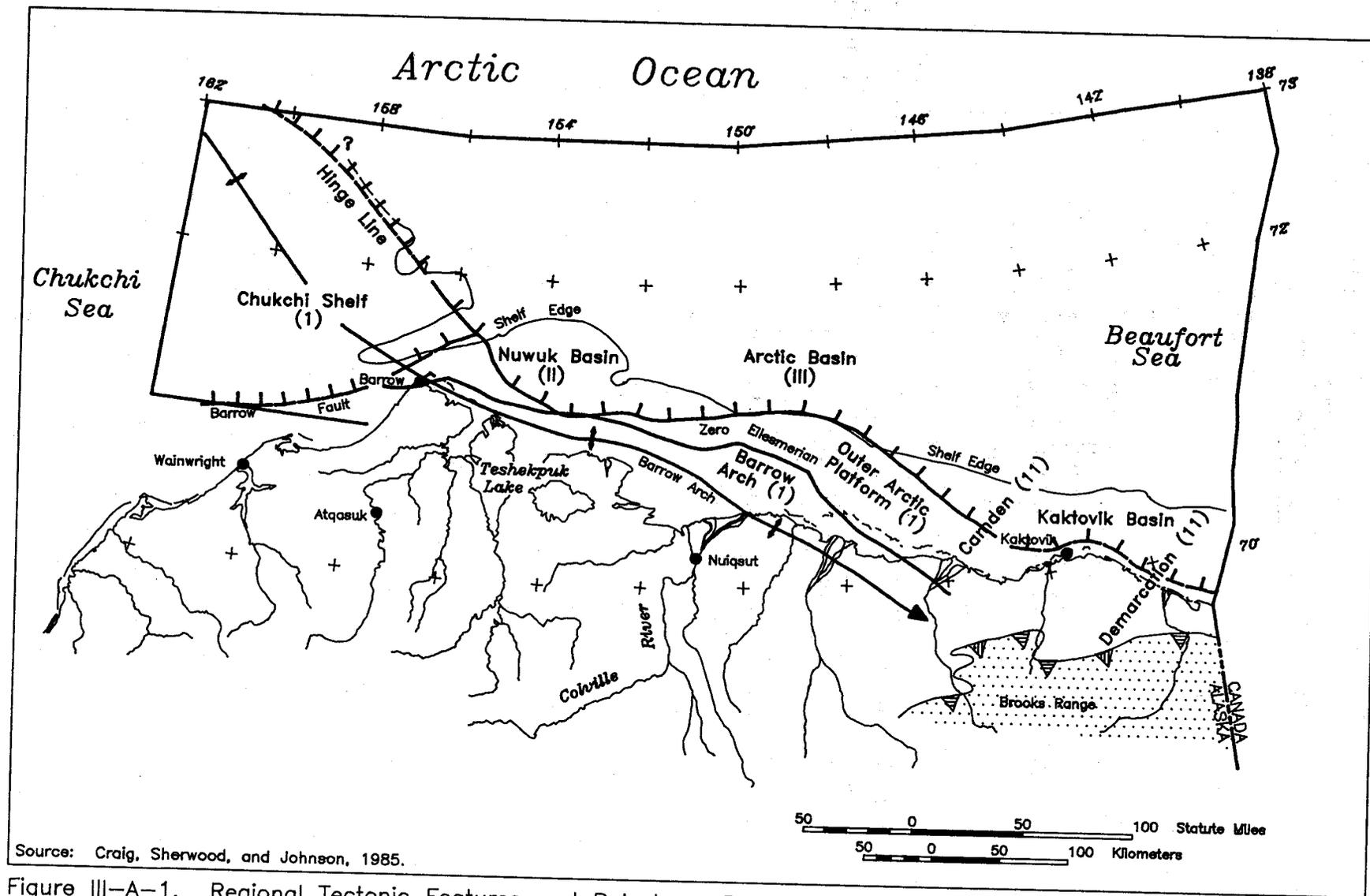
The Arctic Platform provinces are more prospective for petroleum in the southern part, south of the Zero Ellesmerian line (Fig. III-A-1), than they are in the northern part. Thick, wedge-shaped layers of Ellesmerian Sequence formations are present in the southern part of the province, but they become thinner in the northerly direction and are absent in the northern part. As shown in Figure III-A-2, all of the oil produced from North Slope reservoirs comes from formations equivalent to the Ellesmerian Sequence. Known accumulations of petroleum are trapped by a variety of stratigraphic and structural features. Grabens are present in the northern part of the Arctic Platform, and they may contain reservoir rocks deposited as part of the Rift Sequences, Figure III-A-2. Throughout the Beaufort shelf, source beds are thought to be present at levels of thermal maturity adequate for petroleum generation and expulsion.

The Brookian Basin provinces contain many structural and stratigraphic traps in the thick wedge of clastic sediments north of the Hinge Line. Petroleum reservoirs are most likely to occur in sands deposited in a deltaic or prodelta environment: individual accumulations may be small because of the lense-shaped characteristics of the deposits.

##### b. Other Geological and Environmental Considerations:

(1) Physiography and Bathymetry: The Beaufort Sea Sale 124 area includes the continental shelves and upper part of the continental slopes of the northeastern Chukchi Sea and the Alaskan Beaufort Sea. Water depths within the Chukchi Sea part of the sale area range from about 65 ft (20 m) to slightly more than 650 ft (200 m) and in the Beaufort Sea from about 6 ft (2 m) to slightly more than 3,280 ft (1,000 m). Most of the Chukchi shelf is characterized as being broad and flat-lying. The major bathymetric features are the Barrow Sea Valley and the eastern flank of Hanna Shoal. The Alaskan Beaufort Sea continental shelf is a relatively narrow feature extending from the Alaska-Yukon border to the Barrow Sea Valley. The distance from the shore to the shelf break ranges from 37 to 75 mi (60-120 km). The major bathymetric features of the Beaufort shelf are the barrier islands and shoals. Some islands are migrating westward at rates of 60 to 100 ft per year (19-30 m/year) and landward 10 to 23 ft per year (3-7 m/year). Shoals that rise 16 to 33 ft (5-10 m) above the surrounding seafloor have been observed in water depths of 33 to 65 ft (10-20 m).

(2) Surficial Sediments: The surficial sediments of the Alaskan Beaufort Sea continental shelf consist predominantly of mud (clay- and silt-size particles) (Fig. III-A-3). The seafloor out to a depth of at least 30 m is an area where sediment erosion is more dominant than deposition (Reimnitz, Graves, and Barnes, 1988). Coarser grained sediments (sand- and gravel-size particles) are for the most part relict deposits found in the nearshore areas, in the vicinity of the offshore barrier islands, and on shoals and along the shelf break. Overconsolidated sediments are widespread on the Beaufort Sea shelf.



Source: Craig, Sherwood, and Johnson, 1985.

Figure III-A-1. Regional Tectonic Features and Petroleum Provinces in the Beaufort Sea Planning Area

Arctic Platform Provinces (Chukchi Shelf, Barrow Arch, and Outer Arctic Platform—Province 1) are geologic basins formed in mid-Paleozoic to mid-Mesozoic time on a continental basement complex. The hinge line is the crustal flexure along the continental margin formed after mid-Mesozoic rifting. Post-breakup basins along the subsiding continental margin (Nuwuk and Kaktovik Basins—Province II) contain thick sections of Cretaceous to Tertiary clastic sediments beneath the present Beaufort shelf. The Arctic basin (Province III) is an oceanic basin north of the Beaufort shelf edge.

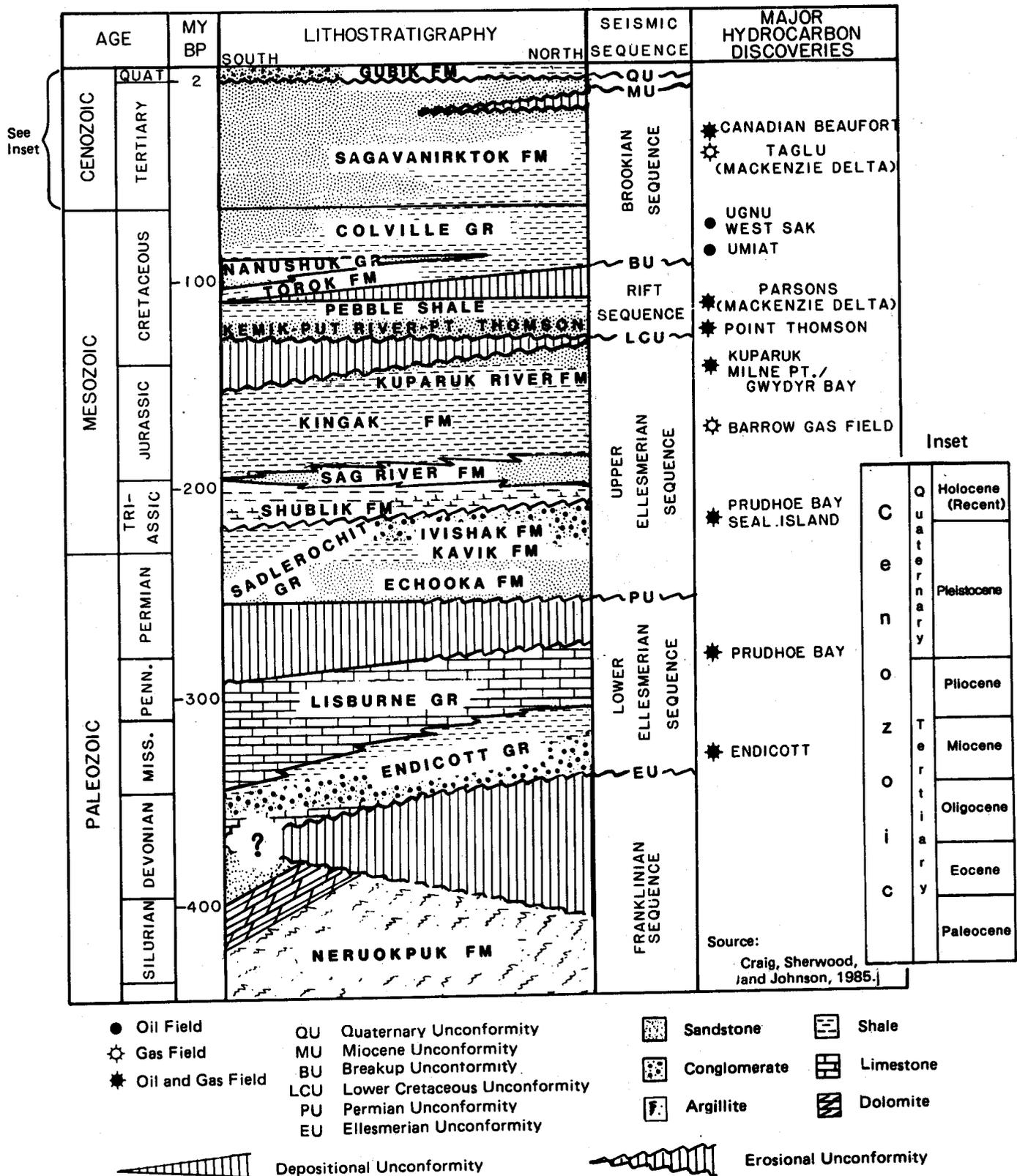


Figure III-A-2. Generalized Lithostratigraphic Column Showing the Relationship of Onshore Rock Units in Northern Alaska to Offshore Seismic Sequences in the Beaufort Sea Planning Area

Source: Craig, Sherwood, and Johnson, 1985.

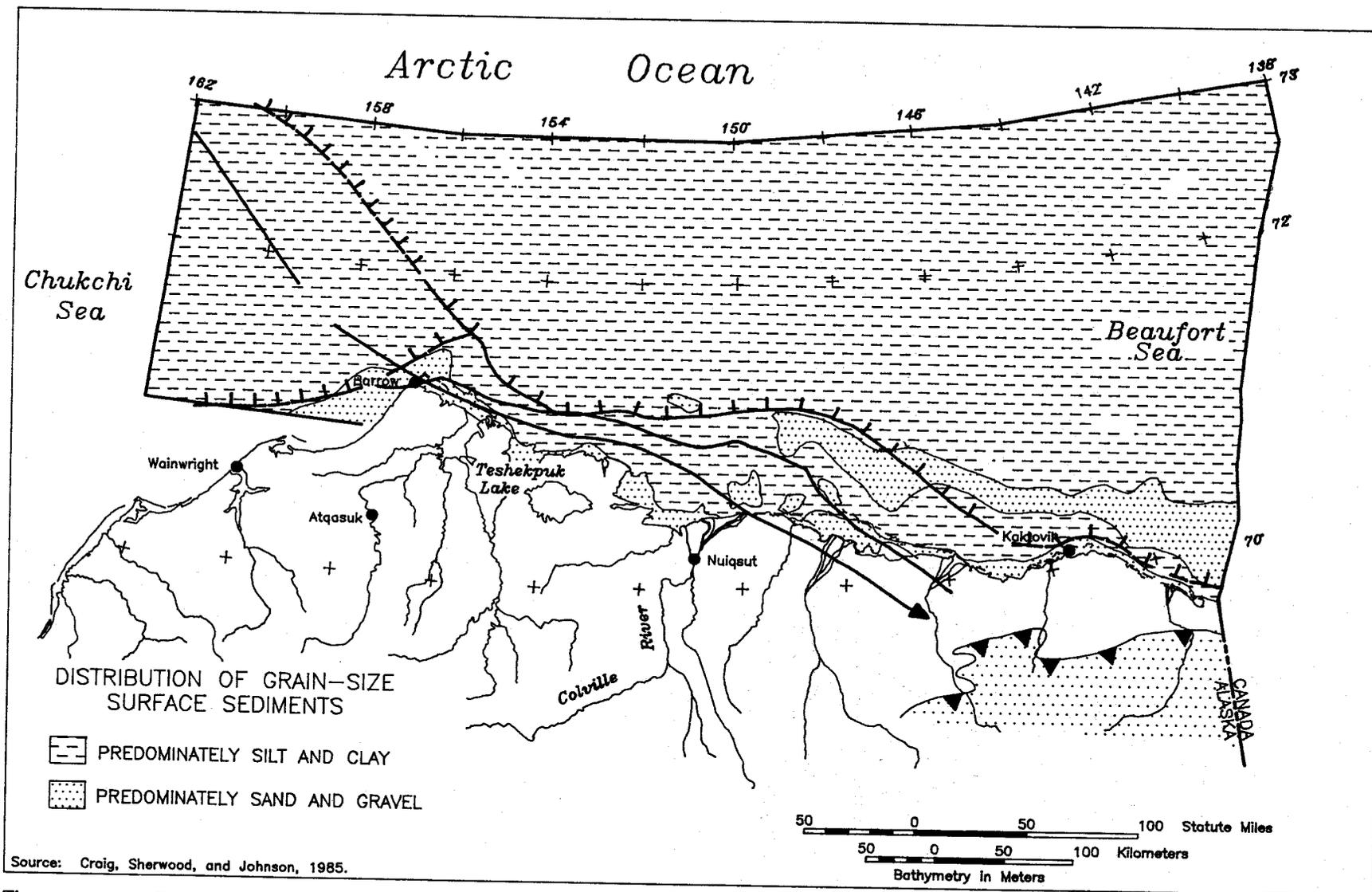


Figure III-A-3. Generalized Distribution of Coarse-Grained (Sand and Gravel) and Fine-Grained (Silt and Clay) Sediments in the Beaufort Sea Planning Area

Only a relatively thin layer of unconsolidated sediment overlies the bedrock throughout much of the Chukchi continental shelf. The thickness of this layer averages about 2 to 5 m; exposed bedrock is frequently found in areas where the water depth is greater than 30 m. The sediments consist predominantly of silt- and clay-size particles. Sand and gravel deposits are found along the coast, in the Barrow Sea Valley, and on Hanna Shoal.

(3) Mudslides: Most of the Beaufort and Chukchi shelves seaward of the 50- to 65-m isobath and the upper part of the slopes consist of a relatively thick mass of unconsolidated and poorly consolidated sediments that show a variety of features associated with the downslope movement of large, tabular sediment blocks (Grantz et al., 1982). The size of the blocks varies, but masses up to 38 km long and from 20 to 230 m thick have been observed. Estimates of the downslope movement ranges from 0.2 to 2.3 km. The sediments of the outer shelf and upper slope of the eastern Beaufort Sea appear to be relict deposits; and the mass-movement phenomenon may be related to processes that are not active today (Reimnitz, Barnes, and Phillips, 1983). However, if fine-grained sediments are presently accumulating along the outer shelf and upper slope, mass-movement processes that would include slumping and sliding may be active now and in the future.

(4) Coastal Erosion: The rates of coastal retreat vary from year to year and depend on the timing of the sea-ice breakup, variations in the size of the open-water areas (exposure to the sea), the timing of late summer and autumn storms, the composition of the coastal bluffs, beach width, and the morphology of the adjacent seafloor. Most of the erosion occurs in late summer and autumn. Data from the 344 km shoreline between Prudhoe Bay west to Drew Point indicate the coastline is eroding at an average annual rate of about 2.5 m/yr; this average excludes the Colville River Delta, which is advancing seaward at an average rate of 0.4 m/yr (Reimnitz, Graves, and Barnes, 1988). In the western third of this area, the coastal-plain deposits are fine-grained muds and the average erosion rates are about 5.4 m/yr; coastal deposits in the rest of the area consist of sandy to gravelly sediments and the average erosion rate is about 1.4 m/yr. Long-term, local erosion rates may be as high as 18 m/yr in places and near the active mouths of the Colville River, the shoreline may be advancing seaward at rates as high as 20 m/yr. Coastal-erosion rates of other locations along the coast adjacent to the sale area are shown in Figure III-A-4.

(5) Faults and Earthquakes: Subsurface faults that have been mapped are shown in Figure III-A-5. Generally, the faults in the Harrison Bay area and in the middle part of the western Beaufort shelf do not displace Pleistocene or Holocene sediments. Thus, differential movement along these faults may have ended prior to the beginning of the Quaternary Period. However, the faults may provide migration routes for gas from the lower Cretaceous beds or create traps for gas at shallow depths.

Movement along the faults of the outer shelf and upper slope of the western Beaufort may be as great as 1,055 m. However, these faults have not generated earthquakes of sufficient magnitude to be detected by regional and local seismograph networks in place since 1968. Thus, the age of the faults is unknown.

Earthquakes indicate active movement along the faults in the Camden Bay area and tend to occur along the axes of anticlines and synclines. The earthquakes are part of the central Alaska seismic system. The magnitudes of the earthquakes measured in this region range from less than 1.0 to 5.3 on the Richter scale; most of the earthquakes recorded since 1968 range in magnitude from 3.0 to 4.0.

(6) Permafrost: The permafrost that underlies the present-day Beaufort Sea continental shelf shoreward of the 90-m isobath is, for the most part, a relict feature overlain by a layer of unconsolidated sediment.

Shallow zones of the bonded permafrost occur locally in the Beaufort Sea. A large area of permafrost occurs off the Saganvanirktok (Sag) River, where ice-bonded sediments are commonly found less than 10 m below the surface. Also, seismic data indicate that some nearshore areas in Harrison Bay may be underlain by ice-bonded permafrost. Other areas of ice-bonded permafrost occur (1) in adjacent zones landward of the 2-m isobath that are overlain by bottomfast ice in the winter, (2) at highly variable depths up to several hundred m beneath the seafloor, (3) in areas between the barrier islands and the shore, and (4) onshore and on some of the barrier islands. Based on seismic studies, permafrost also may exist on the Beaufort Shelf at depths that range from 100 to 1,900 m.

(7) Natural Gas Hydrates: The presence of natural gas hydrates is favored by



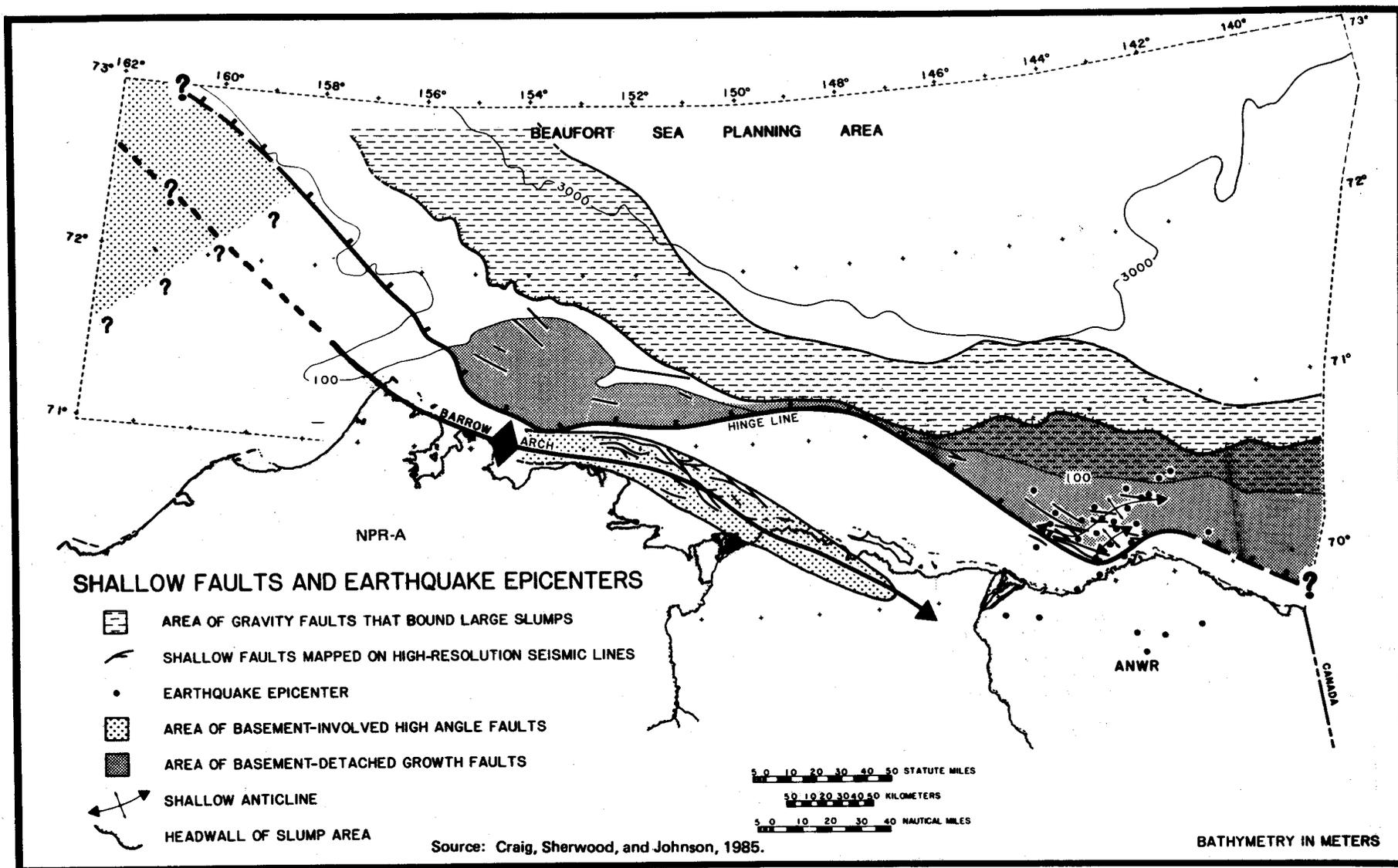


Figure III-A-5. Shallow Faults and Earthquake Epicenters in the Beaufort Sea Planning Area

the pressure and temperature conditions found in or below the permafrost layer. The presence of hydrates has been inferred from seismic profiles in the Alaskan Beaufort Sea. Where water depths in the planning area exceed 400 m, the upper 300 to 700 m of the sediments lie in the temperature-pressure range for the formation and stability of natural gas hydrates. Inferred locations of natural gas hydrates are shown in Figure III-A-6.

(8) Shallow Gas: On the inner and middle continental shelf, the shallow-gas accumulations are most commonly associated with buried Pleistocene delta and channel systems and with active faults overlying natural gas sources (Fig. III-A-6). In the eastern part of Harrison Bay, the acoustic anomalies of the seismic-reflection profiles indicate that shallow gas may be present in a region where there also are numerous faults.

(9) Overpressured Shale: The Kaktovik Basin contains numerous diapirs that disturb the Tertiary sediments along the continental shelf east of 146° W. longitude. These structures are interpreted to have shale cores on the basis that they appear to be a westward extension of the western Canadian Beaufort shelf shale-diapir province. Shale diapirism is the result of lower density in the shale section than in the overlying strata due to incomplete dewatering of the shale and is an indication of overpressuring within the shale section. The occurrence of abnormal pressure is probably confined to areas of thick Cenozoic strata as in the Kaktovik, Camden, and Nuwuk Basins.

2. Meteorology: The region is in the Arctic climate zone. Mean annual temperature is about -12 °C. Precipitation ranges from 13 cm at Barrow to 18 cm at Barter Island and occurs mostly as summer rain. Fog frequently reduces visibility along the coast in the open-water season. Winds are persistent in direction and speed. Mean annual wind speed is 5 m per second at Barrow and 6 m per second at Barter Island. Winds are usually easterly but shift to westerly from January through April. Part of this shift in winter, particularly along the eastern shores of the proposed sale area, is caused by air piling up against the Brooks Range. Sea breezes occur during about 25 percent of the summer and extend to at least 20 km offshore.

### 3. Beaufort Shelf Water Characteristics, Circulation, and Mixing:

a. Outer Continental Shelf (Water Depths Greater than 40 M) and Continental Slope: In waters deeper than about 40 m, the large-scale circulation of surface waters on the Outer Continental Shelf (OCS) and slope within the Beaufort Sea Planning Area is dominated by the Beaufort Gyre, which moves water to the west at a mean rate of about 5 to 10 cm/sec.

The subsurface waters, 40 to 50 m below the surface, move predominantly in an eastward direction but may experience frequent reversals to the west (Aagaard et al., 1989). This movement appears to be part of the large-scale circulation of the Arctic Ocean and in the Beaufort Sea is called the Beaufort Undercurrent. Long-term, mean speeds of the undercurrent are about 5 to 10 cm/sec, but daily mean values may be as much as 10 times greater.

The subsurface water extends from near the surface to the bottom between the 40- to 50- and 2,500-m isobaths and contain two distinctive watermasses, both of which originate in the Bering Sea (Mountain, 1974). One of these watermasses, the Alaska Coastal Water, forms in the nearshore environments of the Bering and Chukchi Seas from warm, low-salinity runoff and warmed Bering Sea water. The other watermass, the Bering Sea Water, is colder and more saline than the Alaska Coastal Water. Near Barrow, the Alaska Coastal Water has temperatures of 5 to 10 °C and salinities that are generally less than 31.5 parts per thousand (‰); the Bering Sea Water temperatures are near 0 °C and have salinities of 32.2 to 33‰ (Lewbel and Gallaway, 1984). These watermasses move into the Beaufort Sea through the Barrow Sea Valley; the Bering Sea Water flows beneath the Alaska Coastal Water. The Alaska Coastal Water mixes rapidly with the surface water in the Beaufort Sea and is not clearly identifiable east of Prudhoe Bay. The Bering Sea Water has been traced as far east as Barter Island.

b. Inner Shelf (Water Depths Less than 40 M): The inner-shelf environment lies in waters shallower than 40 m and includes the barrier islands, open bays, lagoons, and river deltas.

#### (1) General Characteristics and Considerations:

(a) Water Temperature and Salinity Characteristics: The water overlying the inner shelf is composed of freshwater, marine water, or a mixture of fresh and marine waters (Hachmeister and Vinelli, 1984). The

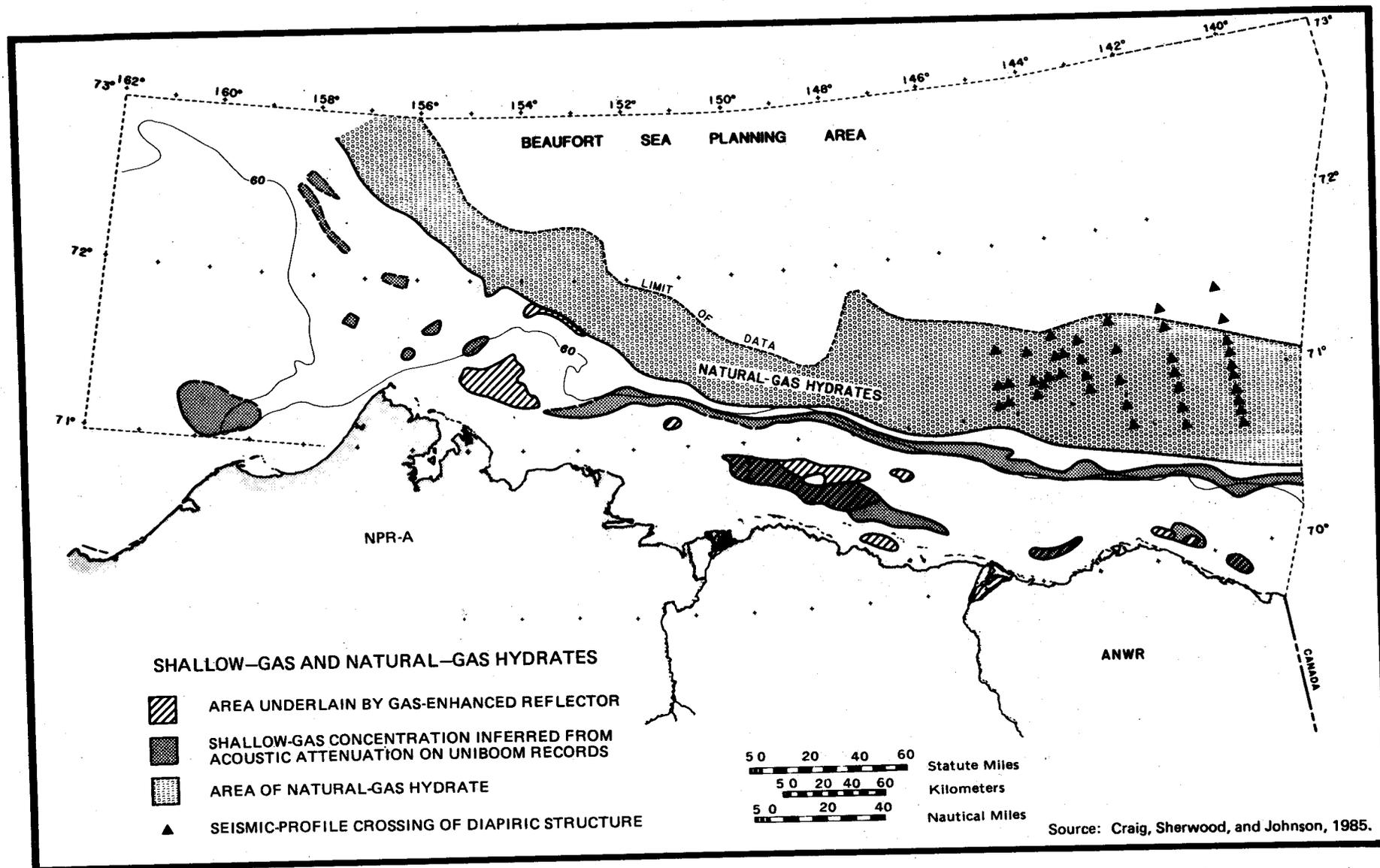


Figure III-A-6. Distribution of Shallow-Gas Concentrations, the Minimum Area Inferred to be Underlain By Natural-Gas Hydrates, and the Distribution of Diapiric Structures in the Beaufort Sea Planning Area

characteristics of these waters vary with the year, season, location (bays, lagoons, deltas, and open shelf), winds (direction, speed, and persistence), river discharge, solar heating, and coastal geomorphology (Envirosphere, 1988a,b). The spatial and temporal variations are reflected in the thermal and saline properties of the waters. Because of the many factors affecting the water characteristics, the temperature and salinity changes are described in terms that represent a general range of values (Table III-A-1) or relative differences between watermasses.

The temperature and salinity values associated with the water types noted in Table III-A-1 are based on the description of the waters in the area directly affected by the West Dock and Endicott Causeways (Envirosphere, 1988a,b). This area has been more extensively studied than any other along the Beaufort Sea coast (Hachmeister and Vinelli, 1984) and includes Gwydyr Bay and the Kuparuk River Delta, West Dock Causeway, Prudhoe Bay and the Putuligayuk River Delta, the Sag River Delta and the Endicott Causeway, and Foggy Island Bay. The range of temperature and salinity values of waters in this area is on the order of the range for other areas along the Beaufort Sea coast and indicates differences in the degree of mixing between river-plume, delta, coastal, and marine watermasses. The amount of mixing depends primarily on the forces associated with the winds; strong, sustained winds are more effective in mixing than are light, variable winds.

(b) Seasonal Generalizations: For descriptive purposes, summer--the period between the breakup and freezeup of sea ice--can be divided into three intervals: early, mid, and late.

Early Summer (Mid-June to Mid-July): Early summer is that period when the ice begins to melt and open-water areas form in the river deltas and adjacent bays and lagoons (Envirosphere, 1988b). Freshwater from the river discharge and ice melt form a surface layer of water 3 to 4 m thick; open-water areas adjacent to the deltas are dominated by river water and offshore by ice-melt water. Cold, high-salinity marine water lies below the surface layer. Because of the large density difference between the layers and the extent of the ice cover, mixing of the fresh- and marine-water layers by wind forces during early summer is negligible (Envirosphere, 1988b); ice cover during this period is greater than 50 percent (LaBelle et al., 1983).

Both the Endicott and West Dock Causeways retain fast ice and packed floes along their margins (Envirosphere, 1988b). The loss of heat energy from the water because of ice melting reduces the amount of warm water in the vicinity of the causeways.

Midsummer (Mid-July to Mid-August): The transition to the midsummer regime occurs as the open-water areas become large enough for the winds to affect mixing and circulation. The lagoons from the Colville River Delta to the Sag River Delta are dominated by warm, low-salinity water (Envirosphere, 1988b). The increase in open-water areas is the result of the ice continuing to melt and being blown farther offshore. With the increase in open-water areas, the surface layer spreads along the shore and offshore; spreading reduces the thickness of the surface layer and also increases the potential for winds to mix the surface layer of freshwater with the lower layer of marine water. Mixing produces intermediate, delta, or coastal watermasses with a range of intermediate temperatures (0-9 °C) and salinity values (5-15‰) whose distribution is determined by naturally occurring physical processes and the causeways (Envirosphere, 1988b).

The early- to midsummer transition often occurs after strong easterly or westerly winds that have sufficient force to mix the surface layer of fresh river and ice-melt water with the underlying marine water (Envirosphere, 1988b).

Late Summer (Mid-August to Mid-September): Late summer is that time of falling air temperatures and decreasing freshwater discharge (Envirosphere, 1988b). The decrease in air temperature and freshwater discharge tends to reduce the temperature and salinity gradients throughout the water column (Envirosphere, 1988a); as the waters become more homogeneous, the effects of mixing different watermasses are reduced. Sometime in mid- to late August, the water temperature on the river deltas consistently remains below about 8 °C; later, the temperature of the river waters becomes colder than the coastal water temperatures. Water temperatures in the upper 3 to 4 m of the water column tend to become uniform--about 2 to 3 °C; salinities, however, remain distinguishable (Hale and Hameedi, 1989).

If a major storm affects all or part of the Beaufort Sea coast, the transition to the late-summer regime can occur rapidly in the affected areas; such storms tend to occur from the end of July to mid-August (Envirosphere, 1988b). As a result of late-summer-storm conditions, water temperatures along the coast can decrease from 8 to 12 °C to 3 to 5 °C, and salinities can increase 10 or more parts per thousand within 24

Table III-A-1  
Temperatures and Salinities of  
Inner-Shelf Water Types

Water Type	Temperature (°C)	Salinity (Parts per Thousand [‰])
River Discharge (Freshwater)	8 - 15	<5
River Plume	2 - 5	<10
East Channel Sag River Plume		10 - 16
West Channel Sag River Plume		10 - 15
Put River Plume		10 - 15
Delta	<8 to <5	
Ice Melt	<8	
Coastal, Intermediate, Mixed Offshore		15 - 25
Coastal	0 - 9	5 - 15
Marine	0 - 2	>25 to >30 >30
Relative Temperature Related		
Cold	<2	
Cool	2 - 5	
Moderate	5 - 9	
Warm	8 - 12	
Relative Salinity Related		
Fresh		<5
Low		10 - 15
Moderate		15 - 25
High		25 - 30

Source: Hachmeister and Vinelli, 1984; Envirosphere, 1988a; and Envirosphere, 1988b.

hours. Following a storm, the warmer, lower salinity watermass regimes may be reestablished, especially in the river deltas and adjacent bays and lagoons.

(2) Circulation: Circulation on the inner shelf is primarily wind driven (Hachmeister and Vinelli, 1984); other factors controlling water movement include river discharge, ice melt, bathymetry, and geomorphology of the coast. The speed of wind-driven currents is approximately 3 to 4 percent of the wind speed (Hachmeister and Vinelli, 1984). Wind direction and frequency of wind shifts influence the direction of the surface currents, resident times of watermasses in the various marine environments, and the amount of mixing between different watermasses. The change in the flow direction of nearshore surface water responds quickly, within several hours, to changes in the wind direction from sustained easterly (or westerly) to sustained westerly (or easterly) (Segar, 1989). Natural circulation patterns along the shelf tend to exhibit a strong continuity in the direction parallel to the shelf and large zonal variations across the shelf (Hachmeister and Vinelli, 1984). The circulation of water below the mixed-layer appears to be primarily by ocean circulation rather than the winds (Aagaard et al., 1988).

During the open-water period, the prevailing winds along the Beaufort Sea coast are predominantly easterly (from the east-northeast) (Hachmeister and Vinelli, 1984). Westerly winds (from the west-northwest) are more common in the fall and winter and occur more frequently at Barter Island than at Point Barrow. Sustained easterly winds transport water along the shore to the west while westerly winds move the water to the east; the main flow direction generally is orientated parallel to the bathymetric contours. Along the Beaufort Sea coast, from Point Barrow to Barter Island, the year-round mean surface-current direction is to the west. East of Barter Island, there is a mean westward flow in the summer and eastward flow in the winter.

In addition to the east or west components, the alongshore-water transport also has a slight offshore or onshore component. Upper-surface water that is being transported to the west under the influence of easterly winds has a slight offshore-transport component. The transport of the nearshore, warm, less-saline surface waters offshore causes a horizontal divergence and a decrease in the sea level that is balanced by the onshore transport of cooler, more-saline marine waters flowing onshore beneath and toward the surface layer. During westerly winds, the upper-surface water is transported to the east and slightly shoreward. The shoreward transport of surface water results in the elevation of the sea surface along the shore, and this causes the water in the lower layer to move offshore. A change from easterly winds to westerly generally results in warmer water replacing the cooler, more-saline marine water that encroaches along the coast during easterly winds. During westerly winds, when the dominant flow direction is to the east, the water column tends to become more vertically homogeneous (Segar, 1989).

The residence time of fresh or low-salinity water in the nearshore environments largely depends on the frequency and direction of the easterly and westerly winds (Envirosphere, 1988a). During the years dominated by persistent easterly winds, the residence time of freshwater is relatively short because the coastal watermasses are transported offshore. However, in the years when westerly winds predominate, the freshwater-residence time is relatively long because coastal watermasses are kept nearshore.

In addition to the wind-driven circulation, there also are several naturally occurring phenomenon that induce transverse (cross-shelf) water-transport patterns (Hachmeister and Vinelli, 1984). In the spring and summer, warm, freshwater runoff accumulates in the surface layer on and adjacent to the deltas. As part of this water spreads seaward across the shelf, there is an accompanying onshore flow of cooler, more-saline marine water in a subsurface layer--similar to estuarine flow except it occurs along the entire coastline (estuarine flow is characterized by a strong vertical stratification of the water column and a seaward flow of the surface layer and shoreward flow of the subsurface layer). This estuarine-type circulation is probably most important during the period of high runoff in late spring-early summer and continues to a lesser extent throughout the summer.

The discharge from large rivers such as the Colville and Sag modifies the coastal current patterns and influences mixing and temperature and salinity-distribution patterns (Envirosphere, 1988a). The surface plumes from these rivers have a strong offshore component that contributes to onshore flow of subsurface water, especially during easterly winds.

Transverse flow also occurs in the winter. As seawater freezes, dense brine forms and flows offshore in the lower layer; this offshore flow is probably accompanied by an onshore flow in the upper layer (Hachmeister and Vinelli, 1984). Brine flow is most important during the early freezeup, especially in the shallow,

nearshore water--and probably continues throughout the winter.

(a) Lagoon Circulation Patterns and Water Exchanges with the Nearshore Environment: The circulation and water-exchange patterns of lagoons along the Beaufort Sea coast may be classified as (1) open--lagoons are open to alongshore transport as well as cross-shelf exchange through the multiple large openings between the barrier islands, (2) pulsing--exchange with the nearshore waters primarily occurs via tidal currents through a single major entrance, and (3) limited exchange--the flow of alongshore currents through several large entrances to the lagoon is limited (Hachmeister and Vinelli, 1984).

Open-Type Lagoons (Simpson Lagoon): The lagoons between Point Barrow and Barter Island are open types (Hachmeister and Vinelli, 1984). Simpson Lagoon has been the most extensively studied of these lagoons. The following discussion of lagoon circulation pertains to Simpson Lagoon and is generally applicable to other open-type lagoons.

Easterly Winds: During easterly winds, the warmer ( $4^{\circ}\text{C}$  or warmer), lower salinity ( $24^{\circ}/_{\infty}$  or less) water, formed by mixing of lagoon water with freshwater runoff, is transported westward through the lagoon and exits through the passes in the western part of the lagoon. The transport through the lagoon is similar to the wind-driven, alongshore transport seaward of the barrier islands (Hachmeister and Vinelli, 1984). Wind-driven water seaward of the barrier islands generally enters in the eastern and central parts of the lagoon through the passes and is transported westward through the lagoon. The westward wind-driven transport through the lagoon also is accompanied by some offshore transport of the surface water. Wind-driven surface water transported seaward of the lagoon is replaced by colder ( $0^{\circ}\text{C}$ ), more-saline ( $30^{\circ}/_{\infty}$ ) marine water that flows into the lagoons through the passes.

In addition to the easterly wind-driven transport are the effects of the tidal cycle. During floodtides, tidal currents at each entrance transport colder, more-saline marine water into the lagoon where it partially mixes with lagoon water and is transported to the west. On ebb tides, the net westward flow through the lagoon is reduced, and lagoon water collects near the eastern entrances to the lagoon and forms pools of warmer, fresher water. Inside the lagoon, the tidal cycles result in the formation of alternating pools of cooler, more-saline nearshore water (formed during the flood) and warmer, less-saline lagoon water (formed by mixing of nearshore water from the previous flood with freshwater from river runoff) that are transported westward through the lagoon.

Westerly Winds: Westerly winds cause the waters to flow easterly through Simpson Lagoon. Warm, fresh water from the Colville River enters the Lagoon and Kuparuk River water flows into the eastern part (Gwydyr Bay). Also, alongshore transport of nearshore water seaward of the barrier islands is toward the east and shoreward; some of the nearshore waters are transported into the lagoon. As a result of this transport, the temperature and salinity characteristics of the nearshore and lagoon waters become similar. The formation of alternating pools of lagoon and nearshore water does not occur inside the lagoon during westerly winds.

Pulsing-Type Lagoons: Pulsing-type lagoons comprise about 15 percent of the coast east of Barter Island. This type of lagoon is characterized by one major entrance through the barrier islands, and the exchange with the nearshore water occurs primarily via tidal currents through this entrance. There also may be other entrances; but these usually are shallow, and the amount of exchange through them is small. One or more small rivers or streams may empty into this type of lagoon, providing a source of freshwater, particularly in the spring. Angun Lagoon and Pokok Bay are examples of pulsing-type lagoons.

As a result of the water transport associated with easterly winds, the nearshore water that is available for exchange with Angun Lagoon and Pokok Bay has somewhat lower temperatures and higher salinities than waters in these lagoons. During a tidal cycle, cooler, higher salinity nearshore water enters the lagoon on the flood tide. Inside the lagoon, this water mixes with the lagoon water and, during the ebb tide, mixed lagoon water flows out. Because the waters entering the lagoon do not flow through in a manner similar to the open-type lagoon (Simpson Lagoon), the circulation in a pulsing lagoon does not consist of alternating pools of lagoon and nearshore water. The flushing efficiency (percent water exchange per tidal cycle) for Pokok Bay is estimated to be between 15 and 20 percent and for Angun Lagoon between 7 and 10 percent. During westerly winds, the characteristics of the nearshore water become similar to those of the lagoon water.

Limited-Exchange-Type Lagoons: Limited-exchange lagoons comprise about 75 percent of the coast east of Barter Island; Beaufort Lagoon is an example of this type of lagoon. Although there are several large

openings in the barrier islands that enclose the seaward side of this lagoon, the flow of alongshore currents through the lagoon is limited. Water exchange between the nearshore and lagoon environment may or may not be affected by tidal action.

(b) Gwydyr Bay to Foggy Island Bay: The coastal area between Gwydyr Bay and Foggy Island Bay, Figure III-A-7, includes Gwydyr Bay and the Kuparuk River Delta, the West Dock Causeway, Prudhoe Bay and the Put River Delta, the Sag River Delta and the Endicott Causeway, and Foggy Island Bay. West Dock Causeway and the Endicott Causeway are manmade structures that act as geomorphological features affecting the circulation and mixing of watermasses (Envirosphere, 1988b). Both causeways generally are orientated perpendicular to the bathymetry. This orientation deflects the east-west transport of water along the inner shelf offshore and causes changes in the hydrographic conditions downstream from the causeways; these changes are indicated by temperature and salinity gradients between the areas east and west of the causeways.

West Dock Causeway is a 13,100-ft-long, solid-fill, gravel causeway located northwest of Prudhoe Bay (Envirosphere, 1988a). The causeway provides road and pipeline access to docks and the Seawater Treatment Plant. Construction of the causeway occurred in three stages: 4,440 ft in 1974 to 1975; 5,000 ft in 1975 to 1976; and 3,700 ft in 1981 to 1983; the only breach in the causeway is a 50-ft opening near the juncture of the second and third segments. Water depths around the causeway average about 2 to 3 m. The effects of the West Dock Causeway are largely based on data obtained from 1985 through 1987 (Envirosphere, 1988a). Estimates of precauseway conditions are based on limited data available before the construction of the causeway and knowledge of coastal processes.

The Endicott Causeway is located on the delta of the Sag River and provides road and pipeline access from the mainland to two petroleum-production islands located approximately 2.5 mi offshore (Envirosphere, 1988b). The gravel causeway consists of a mainland-to-interisland segment and an interisland segment and is about 5 mi long. The causeway contains two breaches, both located along the mainland-to-interisland segment and spanned by bridges. An inner breach, 500 ft long, spans a natural channel of the Sag River Delta near the mainland. The outer breach is located about a mile north of the inner breach and is about 200 ft long. The causeway separates the discharge from the west and east channels of the Sag River.

The effects of the Endicott Causeway on inner-shelf circulation and the characteristics of the watermasses are based on data obtained during 1985 and 1986 (Envirosphere, 1988b). Conditions prior to the causeway are hypothesized from a review and analysis of the 1985 and 1986 data, precauseway historical data, and existing knowledge and theory of coastal hydrodynamics.

#### Easterly Winds:

Endicott Causeway: The warm (8-12 °C), low-salinity (0-15‰) coastal water from Foggy Island Bay and river-plume water from the east channel of the Sag River that are transported to the west during easterly winds are blocked by the Endicott Causeway and diverted offshore (Envirosphere, 1988b). This offshore transport produces a divergence in the flow field of the surface water and a lowering of the sea level, which cause cold (0-2 °C), high-salinity (30‰) marine water to upwell onto the Sag River Delta platform on both sides of the causeway (Envirosphere, 1988a); upwelling reaches to about the 0.5- to 1-m-contour interval across the delta. The offshore diversion and upwelling enhances the mixing of the river water from the east channel of the Sag River with the marine water. The mixing changes part of the warm, less-saline river water into cooler, more-saline coastal water; this decay of part of the river plume reduces the size of the amount of warm, less-saline water transported westward. The marine water also decays as it mixes with adjacent and overlying river-plume water. Water from the west channel of the Sag River also mixes with the marine water upwelled along the delta front and in the lee of the causeway. Mixing of the surface water with cold, high-salinity marine water is enhanced if an eddy develops in the lee of the causeway during easterly winds (Segar, 1989).

Mixing of the waters from the east and west channels of the Sag River with cooler, more-saline, upwelled water reduces the amount of warm, low-salinity, river-plume water transported to the west toward Prudhoe Bay, Gwydyr Bay, and Simpson Lagoon. The westward flow of water is across the mouth of Prudhoe Bay; circulation in the Bay is clockwise.

Upwelling and mixing of the delta water and upwelled water in the lee of the causeway also forms pools of water that are colder and more saline than the water from the west channel of the Sag River that overlies the

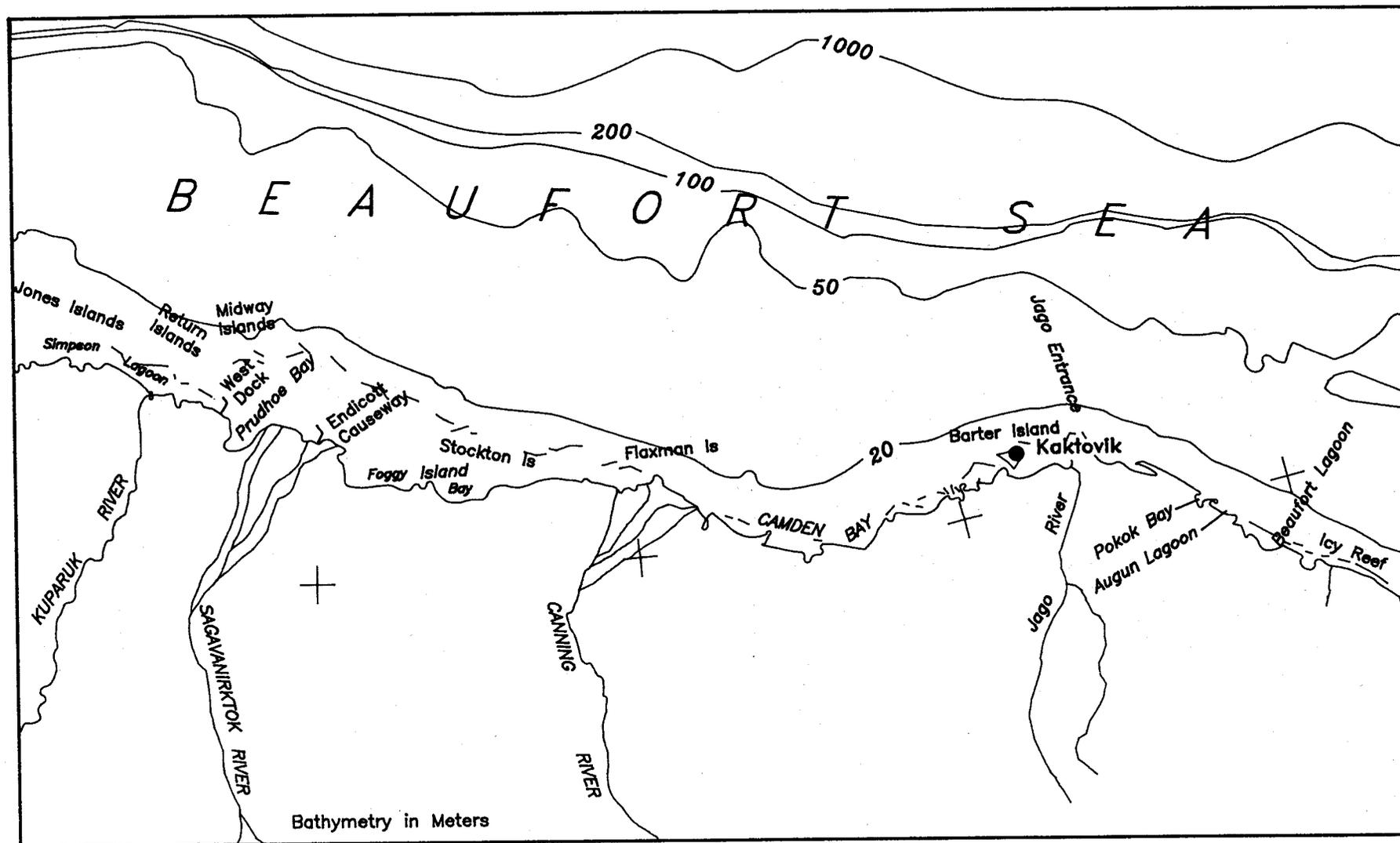


Figure III-A-7. Eastern Beaufort Sea Coastal Area

western part of the delta (Envirosphere, 1988b); the pools cause discontinuities--breaks--in the alongshore continuity of the delta water. However, the temperature and salinity differences between water in the discontinuities and delta water may be relatively small because of the inflow of warm, freshwater from the west channel. In the shallow areas where upwelled marine water does not penetrate, the temperature of the water is influenced by the temperature of the river water and solar heating.

West Dock Causeway: The general effects of the West Dock Causeway on the westerly transport of water during easterly winds are similar to those of Endicott. Waters being transported westward from the Sag River Delta and Prudhoe Bay are diverted offshore by the West Dock Causeway (Envirosphere, 1988a). This offshore transport enhances upwelling of marine water on both sides of the dock. Mixing of the cold, high-salinity marine water with the surface water is enhanced if an eddy develops in the lee of the causeway during easterly winds (Segar, 1989). The effects of mixing are greater at West Dock than at Endicott because of the lack of warm, freshwater input.

Upwelled water on the east side West Dock is transported into the passage between the dock and Stump Island and westward past the barrier islands off Gwydyr Bay and Simpson Lagoon. This water is cooler and more saline than would be the water of alongshore flow before the causeway (Hale and Hameedi, 1989) and would enter Gwydyr Bay and Simpson Lagoon through the channels between the barrier islands. A discontinuity in the Sag River plume occurs between Prudhoe Bay and Simpson Lagoon as the plume decays within a few kilometers of the end of West Dock.

In the later part of the open-water season, the temperatures in the upper 3 to 4 m of the water column become more uniform, and the effects of West Dock on temperature distributions is reduced (Hale and Hameedi, 1989). However, river discharge and upwelling continue to affect the salinity of the nearshore water, and the effects of West Dock on salinity distributions is about the same as it was during midseason.

Cumulative Effects of Endicott and West Dock Causeways: During easterly winds, the Endicott and West Dock Causeways enhance the offshore transport of warm, brackish water and upwelling of marine water along the coast (Envirosphere, 1988b). Under sustained easterly winds, cool, moderate- to high-salinity water dominates the area from Foggy Island Bay to Gwydyr Bay except for areas within the Sag River Delta directly influenced by the river plume. This reduces the amount of warm, low-salinity water on the Sag River Delta, in Prudhoe and Gwydyr Bays, and in Simpson Lagoon.

Precauseway: It is estimated that prior to the construction of the causeways, the main part of the westerly alongshore transport of water would be orientated parallel to the bathymetry (Envirosphere, 1988b). There also would be some offshore transport of coastal and river-plume waters and upwelling of marine waters. In the absence of the causeways, this offshore transport and upwelling would be less than it is with the causeways; upwelling would extend only to about the 2- to 3-m isobath.

In the absence of the Endicott Causeway, river-plume water from the east channel of the Sag River would be transported across the delta during easterly winds and diverted offshore (Envirosphere, 1988b). The nearshore water between the Sag River Delta and Gwydyr Bay would be warmer and less saline and would form a continuous alongshore band of brackish water during easterly winds. During midsummer, it is estimated that the water overlying the Sag River Delta typically would be composed of water in which the temperature at the surface decreased from greater than 6 or 7 °C nearshore to 3 or 4 °C offshore and the salinity increased from about 5 to 25 to 30‰; the bottom-water temperatures would be decreased from values ranging from 3 to 7 °C nearshore (the lower temperatures indicate a greater influence of marine waters and the higher temperatures indicate a greater influence of river or nearshore water) to 0 to -1 °C offshore. Temperature and salinity gradients generally would be parallel to the bathymetry.

The amount of Sag River plume water moving westward would be large and would incorporate a larger amount of lower salinity coastal water into the outer part of its flow pattern (Envirosphere, 1988a). At West Dock, this water would be diverted offshore, and the offshore transport of a large plume would create a larger surface divergence and enhance upwelling over the pre-Endicott regime.

In the absence of West Dock, there would be less low-temperature, high-salinity water entering Gwydyr Bay and Simpson Lagoon; upwelled water would extend only to depths of about 2 or 3 m west of West Dock (Envirosphere, 1988a).

Westerly Winds: The change from easterly winds to westerly winds slows or stops the movement of warm,

low-salinity waters offshore (Envirosphere, 1988b). Cool, moderate-salinity offshore water and marine water that has upwelled in the vicinity of the causeways are transported eastward and slightly onshore and replace any warm, low-salinity water that might exist in areas east of the causeways.

If west winds persist for several days or more, the areas west of the causeways are flushed with warm, low-salinity water (Envirosphere, 1988b). Under sustained westerly winds, part of the Colville River plume, consisting of warm, low- to moderate-salinity water, flows through Simpson Lagoon and Gwydyr Bay; and the other part flows seaward of the barrier islands and directly into Stefansson Sound. If west winds persist for more than several days, the Colville River plume may extend to the Sag River Delta.

West Dock Causeway: Coastal water flowing eastward offshore of the Simpson Lagoon-Gwydyr Bay barrier islands is diverted offshore by the West Dock Causeway and continues toward the Sag River Delta following bathymetric contours (Envirosphere, 1988a).

Surface water flowing out of Gwydyr Bay is diverted northward by the dock. When the surface water from the west side of West Dock encounters the eastward-flowing coastal waters, it turns and flows eastward along the bathymetric contours. During its eastward transport, this warm, brackish water does not enter Prudhoe Bay but remains seaward of the 4-m isobath. Cold, high-salinity marine water that has upwelled on the west side of West Dock during easterly winds also is diverted around West Dock during westerly winds. Following the change from easterly to westerly winds, this marine water enters Prudhoe Bay.

Endicott Causeway: Upwelled waters in the northeastern part of Prudhoe Bay and on the western part of the Sag River Delta are transported toward the Endicott Causeway (Envirosphere, 1988b). These waters meet and mix with river water from the west channel of the Sag River before passing around the end of the causeway or through the breaches. The water of the western part of the Sag River Delta is affected by residual marine water upwelled during previous easterly winds and by mixing of water along the west side of the causeway. Part of the water that is deflected past the causeway mixes with underlying marine water. The westward transport of cooler, high-salinity water and mixing reduces the amount of warm, low-salinity water on the western part of the Sag River Delta. The causeway also shelters the east-channel plume from the direct driving force of the westerly winds. As a result of this sheltering effect, the water from the east channel flows offshore and mixes with higher salinity water (Envirosphere, 1988b).

The effects of the Endicott Causeway are to reduce the amount of warm, low-salinity water that flows into Foggy Island Bay during westerly winds.

Precauseway Effects: In the absence of the West Dock and Endicott Causeways, there would be a natural distribution of the water in the area from Gwydyr Bay to Foggy Island Bay--the water-characteristics pattern basically would show a continuum along the shelf and offshore gradients. The residual effects of upwelling and mixing that happened during easterly winds would not occur. The waters along the coast would be warmer and less saline than are the waters affected by the presence of the causeways. Thus warmer, less-saline waters would be transported into areas east of the present causeway sites during westerly winds.

c. Waves and Swells: The entire coastline adjacent to the planning area is a low-wave-energy environment. Waves, which are generally from the northeast and east, are limited to the open-water season. The ice pack limits fetch even during this season. Because of the pack ice, significant wave heights are reduced by a factor of four from heights that would otherwise be expected in summer. Wave heights greater than 0.5 m occur in less than 20 percent of the observations summarized by Brower et al. (1988) and Prechtel (1977); wave heights greater than 5.5 m are not reported within the limited Beaufort Sea database of 5,968 observations.

d. Storm Surges: Summer and fall storms frequently generate storm surges along the Beaufort and Chukchi Sea coasts. Sea-level increases of 1 to 3 m have been observed along the Beaufort Sea coast; the largest increases have occurred on westward-facing shores. Storm surges also occur during the period from December through February, but changes in sea-level elevation are generally less than in summer and fall. Decreases in sea-level elevation also occur and appear to be more frequent in the winter months.

e. Tides: Tides in the eastern Chukchi and Beaufort Seas are very small and are generally mixed semidiurnal with mean ranges from 10 to 30 cm. The tide appears to approach the shelf from the north. Tide height increases slightly west to east along stations on the Beaufort Sea coast.

f. River Discharge: The Colville River is the major river entering the Alaskan Beaufort Sea. Annual discharge of the Colville River is  $2 \text{ km}^3$ ; this is about 73 percent of the total discharge of all rivers between the Colville and the Canning Rivers. During spring thaw in June, the Colville River discharges 50 percent of its annual flow. The Colville and other large rivers along the coast discharge as late as January, with no further measurable discharge until late April or early May. Seawater intrusions into river deltas occur from mid-autumn through winter. Spring and summer discharge of the Colville River and lesser rivers greatly affects the salinity, nutrient regimes, and turbidity of the nearshore Beaufort Sea (see Sec. III.D.4). The Chukchi Sea coast adjacent to the planning area has no major rivers, and the nearshore waters of the Chukchi Sea are much less affected by riverine discharges.

#### 4. Sea Ice:

a. Winter Conditions: Wintertime conditions in the Beaufort and Chukchi Seas begin with freezeup and an increase in the concentration of sea ice. Although there are considerable spatial and temporal variations, the edge of the arctic pack ice in September of an "average year" is from about 20 to 110 km offshore (LaBelle et al., 1983). In October, the edge has moved south of Barrow, and more than 50 percent of the planning area is covered with ice; from November through May, the ice covers more than 90 percent of the planning area. The winter sea-ice regime in the planning area can be divided into the landfast-ice zone, the stamukhi (or shear) zone, and the pack-ice zone (Figs. III-A-4 and III-A-8).

(1) Landfast-Ice Zone: The landfast-ice zone extends from the shore out to the zone of grounded ridges. These ridges first form in about 8 to 15 m of water but by the late winter may extend beyond the 20-m isobath. Wind and water stresses on floating fast-ice sheets may result in displacements and deformations. Displacements in later winter are usually on the order of tens of meters, but larger displacements up to several hundred meters have been observed. Deformations take the form of pileups and rideups on the coastal and island beaches and rubble fields and small ridges offshore. Extensive deformation within the landfast-ice zone generally decreases as the winter progresses as the ice in the landfast zone thickens and strengthens and becomes more resistant to deformation.

By late winter, first-year sea ice in the Beaufort Sea landfast-ice zone is generally about 2 m thick; out to a depth of about 2 m, it is frozen to the bottom, forming the bottomfast-ice subzone. The remaining ice in the landfast zone is floating--forming the floating fast-ice subzone. In the Chukchi Sea, the landfast ice usually thickens to about 1.3 to 2.0 m before breakup.

The onshore movement of sea ice in the landfast-ice zone is a relatively common event that generates pileups and rideups along the coast and on offshore and barrier islands. The onshore pileups frequently extend up to 20 m inland from the shoreline over both gently sloping terrain and up onto steep coastal bluffs. Ice rideups, where the whole ice sheet slides in a relatively unbroken manner over the ground surface for more than 50 m, are not very frequent; rideups that extend more than 100 m are relatively infrequent.

In addition to their effects on circulation as discussed in Section III.A.3.b.(2)(b), the causeways also affect the local breakup of ice. Observations in 1985 and 1986 indicated that the Endicott Causeway contributed to the early draining of floodwaters from the Sag River and breakup of the floating ice along the delta front (Envirosphere, 1988b). However, pack-ice floes were retained along the north and east side of the causeway after breakup of the fast ice along the delta front. The West Dock Causeway prohibits the spreading of the Kuparuk River floodwater southeastward along the shore into Prudhoe Bay and delays the melting and breakup of ice along the western shore of Prudhoe Bay (Envirosphere, 1988a). The causeway also delays the melting and breakup of ice in the more sheltered areas to the west.

(2) Stamukhi Zone: Seaward of the landfast-ice zone is the stamukhi, or shear, zone. This is a region of dynamic interaction between the relatively stable ice of the landfast-ice zone and the mobile ice of the pack-ice zone that results in the formation of ridges and leads. In the Beaufort Sea, the region of most intense ridging occurs in waters that are 15 to 45 m deep.

As shown in Figure III-A-8, one of the characteristics of the stamukhi zone is that some portions of the ice are grounded on the seafloor. The outer edge of the stamukhi zone appears to advance seaward during the ice season.

Shoreward of the 60-m isobath, long, linear depressions have been cut into the sediments of the Beaufort Sea

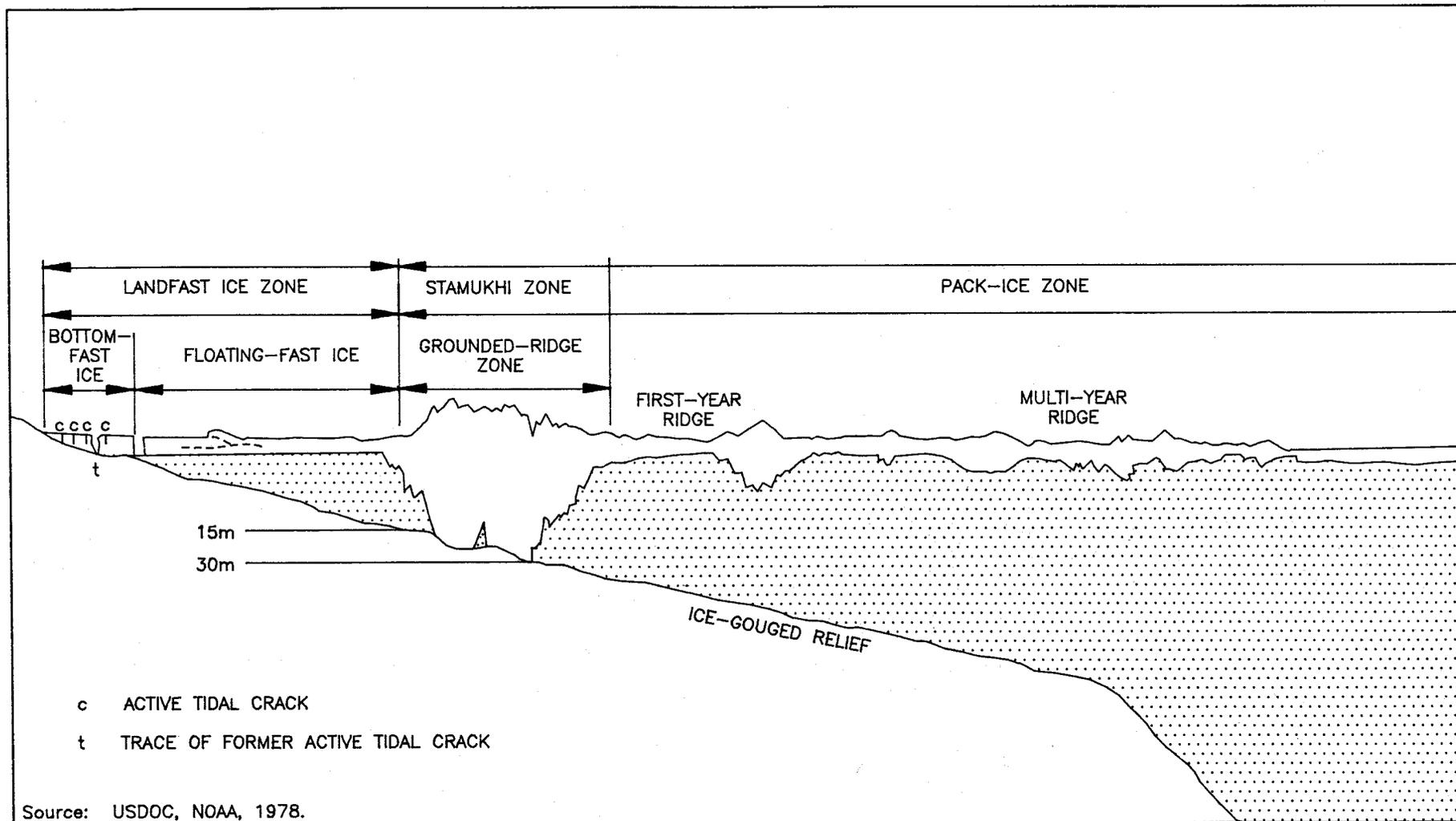


Figure III-A-8. Winter-Ice Zonation of the Beaufort Sea Coast

continental shelf by the plowing action of drifting ice masses. The dominant orientation of these ice gouges in waters 10 to 50 m deep is generally parallel to the coast. The highest average (mean) values of those features--such as individual gouge density, depth, and width--usually occur within the stamukhi zone.

Gouge densities of more than 100 gouges/km<sup>2</sup> are found in waters 20 to 40 m deep (Fig. III-A-9). Dense gouging also occurs on the seaward side of the shoals. The lowest gouge densities are located in waters that are less than 5 m deep and greater than 45 m deep.

Gouges with average depths of greater than 1 m are generally found in waters between 20 and 55 m deep. However, the maximum measured draft of sea ice in the Arctic Ocean is only 47 m. Thus, the gouges observed seaward of about 47 m may be cut by deeper keels with a return period of a few hundred years or less, or they may be relict features cut during the lower sea-level period of many thousands of years age.

In the Chukchi Sea portion of the Beaufort Sea Planning Area, ice gouging of the seafloor sediments appears to be more intense shoreward of the Barrow Sea Valley and in the vicinity of Hanna Shoal. Densities in excess of 50 gouges/km in water depths of 20 to 35 m are reported as being widespread from Point Barrow to Point Hope. Ice gouging is relatively dense on the north and southeast side of Hanna Shoal.

(3) Pack-Ice Zone: The pack-ice zone lies seaward of the stamukhi zone and includes first-year ice, multiyear undeformed and deformed ice, and ice islands. The first-year ice that forms in the fractures, leads, and polynyas (large areas of open water) within the pack-ice zone varies in thickness from a few centimeters to more than a meter. Multiyear ice is simply defined as ice that has survived one or more melt seasons; undeformed multiyear ice is believed to reach a steady-state thickness of 3 to 5 m. Undeformed ice floes with diameters greater than 500 m occupy about 60 percent of the pack-ice zone; some floes may have diameters up to 10 km.

Ridges are a prominent indicator of deformed ice. The height of most ridges appears to be about 1 to 2 m; ridge heights up to 6.4 m have been observed. The relationship between ridge sail height and keel depths suggests a sail-to-keel ratio of about 1:4.5 for first-year ice ridges and 1:3.3 for multiyear ridges. Multiyear composite maps of major ridges indicate that (1) in the nearshore region, there is a pronounced increase in ridge density in the vicinity of shoals and large promontories; (2) massive ridges occur shoreward of the 20-m isobath; and (3) in the eastern Beaufort Sea 30 to 40 km from the coast, there is an increase in ridging from east to west.

Ice islands are large, tabular icebergs that calve (break away) from the ice shelves located along the northern coasts of Ellesmere and Axel Heiberg Islands and drift into the Arctic Ocean, where they slowly circulate in a clockwise direction for many years. The size of the ice islands may be up to 1,000 or more square miles and their thicknesses up to 60 m. During the observation period from 1963 through 1986, 1,053 km<sup>2</sup> of ice were lost from the Ellesmere and Axel Heiberg ice shelves. The amount of ice lost in any year varied from 0 to 569 km<sup>2</sup>. The ice-shelf observations and ice-island sightings indicate that it may take 10 or more years for ice islands to reach locations within the Beaufort Sea Planning Area.

During the winter, movement in the pack-ice zone of the Beaufort Sea is generally small and tends to occur as discrete events associated with strong winds of several days' duration. The long-term direction of ice movement is from east to west in response to the Beaufort Gyre; however, there may be short-term perturbations from the general trend due to the passage of low- and high-pressure weather systems across the Arctic. The velocity of the pack ice has been variously reported as having (1) a mean annual net drift of 1.4 to 4.8 km per day and (2) an actual rate of 2.2 to 7.4 km per day, with extreme events up to 32 km per day.

During the winter, the pack ice in the northern part of the Chukchi Sea generally moves in a westerly direction in response to the Beaufort Gyre. The pack ice in the southern part of the Chukchi Sea usually is transported to the north or northwest. However, strong driving forces associated with northerly winds and southerly currents acting over a long period of time will force the ice in a band that is 100 or more km wide and extends from the Bering Strait northward along the Alaskan coast past Point Barrow to move southward.

Hanna Shoal is a site for the accumulation of ice features, such as ice-island fragments or ridges, that have drafts greater than 25 m. Recurrent groundings of ice islands or ridges with progressively deeper drafts result in the seasonal growth of this field.

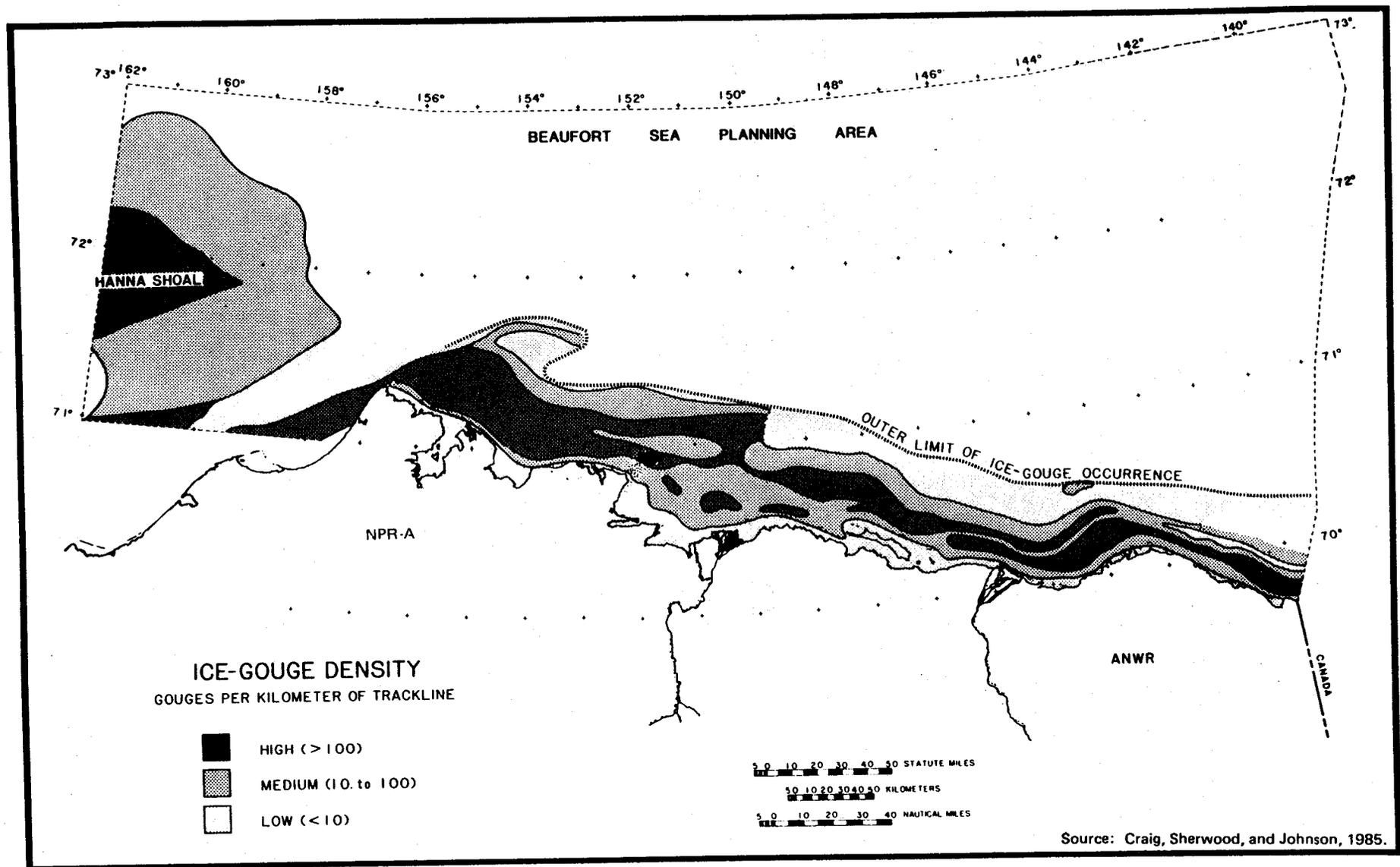


Figure III-A-9. Generalized Distribution of Ice-Gouge Density in the Beaufort Sea Planning Area

(4) Leads and Open-Water Areas: Data obtained from aerial and satellite remote sensing show that leads and open-water areas form within the pack-ice zone. Southwesterly storms cause leads to form in the Beaufort Sea.

Along the western Alaskan coast between Point Hope and Point Barrow, there is often a band of open water seaward of the landfast-ice zone during winter and spring. This opening is at some times a well-defined lead and at other times a series of openings in the sea ice or polynyas. The northern part of this open-water system extends into the Chukchi Sea portion of the Beaufort Sea Planning Area. Between February and April, the average width is less than 1 km (the extreme widths range from a few km in February to 20 km in April) and is open about 50 percent of the time. The Chukchi open-water system appears to be the result of the general westward motion seen in the Beaufort Gyre. Also, there appears to be a positive correlation between the average ice motion away from the coast and the mean wind direction, which is from the northeast for all months except July.

b. Summer Conditions: By the middle of July, much of the lagoonal and open-shelf fast ice inside the 10-m isobath has melted; and there has been some movement of the ice. After the first openings and ice movement in late June to early July, the areas of open water with few ice floes expand along the coast and away from the shore, and there is a seaward migration of the pack-ice zone. The concentration of ice floes generally increases seaward and, as the pack retreats, the width of the bands that define percentage of sea-ice cover also increases. During the summer, winds from the east and northeast are the most common along the Alaskan Beaufort Sea coast. These winds drive the ice offshore; westerly winds move the ice onshore.

5. Water Quality: The description of the water quality of the Beaufort Sea Planning Area and inshore waters as contained in Section III.D.6 of the Sale 87 FEIS (USDOJ, MMS, 1984) is incorporated by reference; a summary of this description, augmented by additional material, as cited, follows.

Because there has been little or no industrial activity, most impurities occur at low levels in the Beaufort Sea Planning Area. However, turbidity, trace metals, and hydrocarbons are introduced into the marine environment through river runoff, coastal erosion, and natural seeps. The rivers that flow into the sea remain relatively unpolluted by man's activities.

a. Turbidity: Satellite imagery and suspended-particulate-matter data suggest that, in general, turbid waters are confined to depths within the 5-m isobath and do not extend seaward of the barrier islands.

Water samples obtained in August 1978 from the continental shelf between Harrison Bay and the Canning River and seaward of the 20-m isobath had suspended-sediment concentrations that ranged from 0.3 to 2.1 parts per million (ppm). The water samples for these measurements were taken at the surface and at various depths; at one of the stations, the water at 90 m also was sampled.

In mid-June through early July, the shallow inshore waters generally carry more suspended material because runoff from the rivers produces very high turbidity adjacent to the river mouths. During the June flood, the Colville River discharges approximately 6 million metric tons of sediment into Harrison Bay; this is about 70 percent of its annual load. The resulting turbidity from the floods, along with other factors, blocks light and measurably reduces primary productivity of waters inshore of about the 13-m isobath.

Because of the absence of major rivers along the Chukchi coast, waters are clearer in the Chukchi portion of the planning area than in the Beaufort portion. Similar inputs occur elsewhere along the coast. Wave action resulting from prevailing winds and storms during the open-water season resuspends unconsolidated river delta sediments, which increases the turbidity in shallow inshore areas. Coastal erosion annually contributes about 0.3 million metric tons of sediment to Simpson Lagoon. Any ice cover in summer limits wave action and decreases turbidity.

b. Dissolved Oxygen: Dissolved oxygen levels in the Beaufort Sea Planning Area are usually high, about 8 milliliters (ml) of oxygen per liter. In deeper waters, there is an oxygen minimum of 6 ml per liter at about 150-200-m depth (Kinney, Arhleger, and Burrell, 1970). Under winter ice cover, respiration of oxygen continues, but atmospheric exchange and photosynthetic production of oxygen cease. Some oxygen is excluded into underlying water from thickening ice. Over the ice-covered period, areas with unrestricted circulation seldom drop below 6 ml of oxygen per liter. In areas of reduced circulation or high

respiration, further depletion occurs. Schell (1975) found only 2 ml of oxygen per liter underneath the ice in a basin of the Colville River Delta containing overwintering fish. Such basins sometimes turn anoxic before spring breakup.

c. Trace Metals: Trace-metal levels in waters of the Chukchi Sea and Beaufort Sea are elevated relative to levels farther east in the Arctic Ocean. These high values have been attributed to high trace-metal levels in Bering Sea waters that pass through the Chukchi Sea and then the Beaufort Sea after entering the Arctic Ocean through Bering Strait (Moore, 1981; Yeats, 1988). Nevertheless, trace-metal concentrations in waters of the Beaufort Sea Planning Area are generally considerably lower than Environmental Protection Agency (EPA) criteria and show no indication of pollution (Table III-A-2). A few mercury values up to 0.57 parts per billion (ppb)--above the EPA chronic criterion for mercury of 0.025 ppb--have been reported (6 of 72 analyses, Weiss et al., 1974), but these likely represent sample contamination rather than real values (e.g., see Gill and Fitzgerald, 1985).

Neither a 3-year baseline monitoring program sponsored by the Minerals Management Service (MMS) in 1984 nor other industry and academic studies have found evidence of trace-metal contamination of sediments (Boehm et al., 1987). Observed geographic variation in the trace metals studied (chromium, lead, zinc, cadmium, barium, copper, and vanadium) were more related to grain-size distribution than to geography, with higher trace-metal concentrations in finer sediments (Trefry et al., in review). Mercury, which was measured in an earlier Beaufort Sea study (Weiss et al., 1974), does demonstrate a geographic variation, with two- to threefold higher mercury concentrations in the inshore and offshore sediments of the western Beaufort Sea than in sediments of the eastern Beaufort Sea. The major rivers--Canning (except for mercury), Sagavanirktok, Kuparuk, and Colville Rivers--are thought to be major sources for the trace metals in the Beaufort Sea coastal sediments (Weiss et al., 1974; Boehm et al., 1987).

d. Hydrocarbons: Background hydrocarbon concentrations are low in the water, on the order of 1 ppb or less and appear to be biogenic.

Sediment hydrocarbon levels, however, are relatively high in comparison with other undeveloped OCS areas (Steinhauer and Boehm, in review). Both aliphatic and aromatic hydrocarbons occur in sediments of the Alaskan Beaufort Sea (Outer Continental Shelf Environmental Assessment Program [OCSEAP] data, National Oceanographic Data Center [NODC]/National Oceanographic and Atmospheric Administration [NOAA] data bank; Boehm et al., 1987; Steinhauer and Boehm, in review).

The aliphatic hydrocarbons range between 5 and 41 ppm dry weight. In a 3-year monitoring program sponsored by MMS, the highest levels were consistently found in Harrison Bay (Boehm et al., 1987; Steinhauer and Boehm, in review). Most of these aliphatic hydrocarbons--80 to 85 percent--are higher-molecular-weight alkanes (n-C<sub>21</sub> to n-C<sub>34</sub>) characterized by odd-carbon dominance, indicating a biogenic source from terrestrial plant materials. The presence of significant quantities of lower-molecular-weight alkanes, 0.3 to 1.2 ppm (15-20% of the total aliphatic hydrocarbons), also suggests widespread presence of petroleum hydrocarbons in the sediments. The highest concentrations were found offshore of the Colville River (Harrison Bay) and offshore of the Kuparuk River. Aliphatic-hydrocarbon composition suggestive of petroleum hydrocarbons also has been reported in sediments of the Canadian Beaufort Sea and was attributed to inflow from the MacKenzie River (Wong et al., 1976); Levy (1986), however, has contended that the data are insufficient to make this latter attribution.

The total aromatic hydrocarbons (TAH) range between 8 and 16 ppm and appear to be derived mostly from nonindustrial, abiotic source materials. The subportion of TAH constituting two-to-five-ring polynuclear aromatic hydrocarbons (PAH) range from 0.2 ppm in Camden Bay and the Endicott Field Area to 0.65 in the Kuparuk River Delta and to 1.0 ppm in Harrison Bay (Steinhauer and Boehm, in review). The predominance of two-to-three-ring PAH over most four-to-five-ring PAH (with the exception of perylene) indicates that the PAH is derived from petrogenic (e.g., crude oil or coal) rather than pyrolytic sources. This derivation requires local marine or local terrestrial sources rather than a long-distance, atmospheric source. The rivers, particularly the Colville and Kuparuk Rivers, appear to be important sources of PAH; however, marine-sediment concentrations range higher than riverine-sediment concentrations, suggesting the possibility of additional contributions from marine seeps.

There is no evidence that the hydrocarbon concentrations in Beaufort Sea sediments are derived from oil-industry activities.

Table III-A-2  
Trace-Metal Concentrations in the Beaufort Sea

	Trace Metals (Symbols Defined Below)									
	As	Cr	Hg	Pb	Zn	Cd	Ba	Cu	Ni	V
<b>SEDIMENTS (ppm)</b>										
Nearshore, Lagoons, and Bays <sup>1/</sup>	--- <sup>2/</sup>	17-19	0.02-0.09 <sup>3/</sup>	3.9-20	19-116	0.04-0.31	185-745	4.9-37	33 <sup>4/</sup>	33-153
Shelf <sup>5/</sup>	16-23 <sup>6/</sup>	85 <sup>7/</sup>	0.03-0.16 <sup>7/</sup>	3 <sup>8/</sup>	98	0.2 <sup>7/</sup>	---	57	47	140 <sup>9/</sup>
Slope and Abyssal <sup>8/</sup>	55 <sup>6/</sup>	99 <sup>9/</sup>	0.07-0.17 <sup>7/</sup>	---	82	---	---	59	56	192 <sup>9/</sup>
Average World Coastal Ocean <sup>9/</sup>	---	10-100	0.01-0.07 <sup>10/</sup>	2-20	5-200	0.2-3.0	60-1500 <sup>11/</sup>	5-40	16-47 <sup>11/</sup>	130 <sup>9/</sup>
<b>SUSPENDED SEDIMENTS (ppm of dry weight)<sup>12/</sup></b>										
	---	21-140	---	---	8-232	---	---	5-83	10-100	2-307
<b>WATER (ppb)</b>										
Total <sup>12/</sup>	---	0.1-2.1	0.005-0.57 <sup>7/</sup>	---	0.4-3.7 <sup>13/</sup>	---	---	0.4-2.1	---	---
Dissolved <sup>6/</sup>	---	0.02-0.3	0.008-0.032 <sup>14/</sup>	0.02-1.7	0.2-3.4	0.02-0.11	---	0.3-1.8	---	---
Typical Worldwide Marine Total <sup>15/</sup>	1.35-2.5 <sup>16/</sup>	0.3	0.001 <sup>17/</sup>	0.01	1	0.04	---	0.3	0.3	---
EPA Total Saltwater Criteria <sup>18/</sup>	36 <sup>19/</sup>	50 <sup>20/</sup>	0.025	5.6	86	9.3	None	2.9 <sup>21/</sup>	8.3	None

Source: As indicated in the footnotes below.

Symbol Definitions: As = Arsenic; Cr = Chromium; Hg = Mercury; Pb = Lead; Zn = Zinc; Cd = Cadmium; Ba = Barium; Co = Copper; Ni = Nickel; V = Vanadium.

<sup>1/</sup> Boehm et al., 1987.

<sup>2/</sup> No data.

<sup>3/</sup> Northern Technical Services, 1981b; Weiss et al., 1974.

<sup>4/</sup> Naidu, 1982.

<sup>5/</sup> Naidu, 1974.

<sup>7/</sup> Weiss et al., 1974.

<sup>8/</sup> Thomas, 1978.

<sup>9/</sup> Naidu et al., 1980.

<sup>10/</sup> Nelson et al., 1975, for Central Bering Shelf and Chukchi Sea.

<sup>11/</sup> Chester, 1965.

<sup>12/</sup> OCSEAP data, NODC/NOAA data bank.

<sup>13/</sup> Burrell et al., 1970.

<sup>14/</sup> Guttman, Weiss, and Burrell, 1978 (for Chukchi and Beaufort Seas).

<sup>15/</sup> Bernhard and Andreae, 1984.

<sup>16/</sup> Burton and Statham (1982) in Langston (1990).

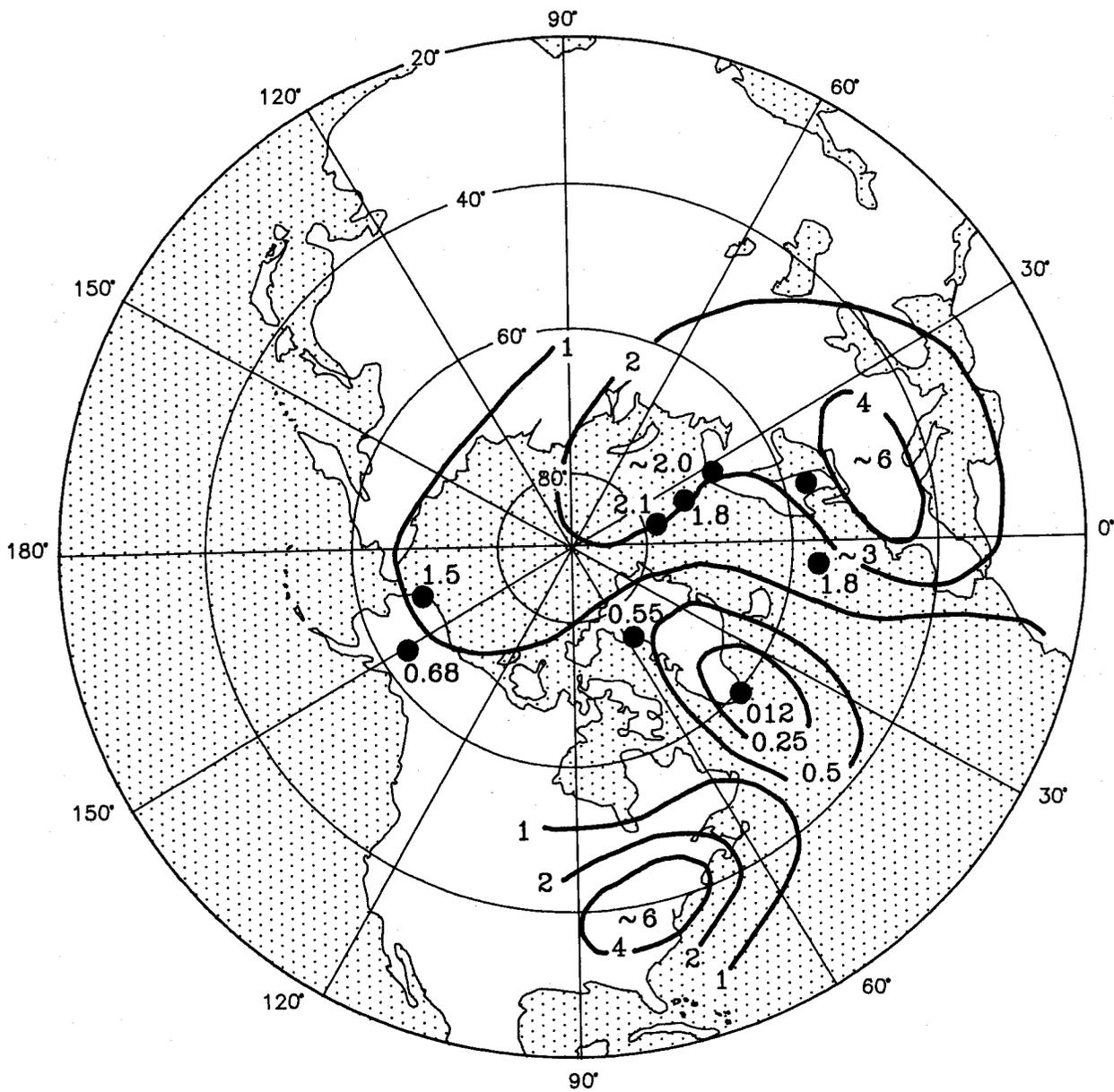
<sup>17/</sup> Gill and Fitzgerald, 1985.

<sup>18/</sup> EPA, 1986; 52 FR (40)6213; 51 FR (232)43665; (chronic) 4-day average, total-recoverable concentration not to be exceeded more than once in 3 years.

<sup>19/</sup> As Arsenic<sup>3+</sup>.

<sup>20/</sup> As Chromium<sup>6+</sup>.

<sup>21/</sup> 1-hour average, not to be exceeded more than once in 3 years.



Source: After Rahn, 1982.

FIGURE III-A-10. Mean Winter Concentrations of Pollutant Sulphate ( $\mu\text{g}/\text{m}^3$ ) in Surface Aerosol of Arctic and Environs.

6. **Air Quality:** The existing onshore air quality for most areas adjacent to the Beaufort Sea sale area is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards (national standards) and State air-quality statutes and regulations (USEPA, 1978). These standards are designed to protect human health. Areas where national standards are attained are referred to as attainment areas, others are non-attainment areas. The entire North Slope of Alaska is an attainment area. Under provisions of the Prevention of Significant Deterioration Program (PSD) of the Clean Air Act, existing air quality superior to the national standards is protected by additional limitations on nitrogen dioxide, sulfur dioxide, and total-suspended-particulate matter. Areas in Alaska are currently designated as PSD Class I or II. Class I air-quality designation is the most restrictive and applies to certain national parks, monuments, and wilderness areas. There are no Class I areas in or near the proposed sale area. The entire onshore area adjacent to the sale area is designated Class II. The applicable standards and PSD Class II increments are listed in Table III-A-3.

Over most of the onshore area adjacent to the sale area, there are only a few small, scattered emissions from widely scattered sources, principally from diesel-electric generators in small villages. The only major local sources of industrial emissions near the sale area are in the Prudhoe Bay/Kuparuk oil-production complex. This area was the subject of two monitoring programs during the 1986 to 1987 (ERT, 1987; Environmental Science and Engineering, Inc., 1987). In each case, two monitoring sites were selected, one deemed subject to maximum air-pollutant concentrations and one site selected to be more representative of the air quality of the general Prudhoe Bay area. Two values were observed that exceed standards--the 24-hour total-suspended-particulate standard at sites A and C, and the 1-hour maximum-value standard for ozone at site C (Table III-A-4). It was determined that the high ozone level may have been caused by arc welding within 150 m of the monitoring site. However, the results demonstrate that, generally, most ambient-pollutant concentrations, even for sites deemed subject to maximum concentrations, meet the ambient-air-pollution standards. This is true even if the baseline PSD concentrations (which must be determined on a site-specific basis) are assumed to be zero, limiting the allowable increase in concentrations.

During the winter and spring, pollutants are transported to arctic Alaska across the Arctic Ocean, from industrial Europe and Asia (Rahn, 1982). These pollutants cause a phenomenon known as arctic haze. Pollutant sulfate due to arctic haze in the air in Barrow--that in excess of natural background--then averages 1.5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ). The concentration of vanadium--a combustion product of fossil fuels--then averages up to 20 times the background levels in the air and snowpack. Recent observations of the chemistry of the snowpack in the Canadian Arctic also provide evidence of long-range transport of small concentrations of organochlorine pesticides (Gregor and Gummer, 1989). Concentrations of aerosol haze during winter and spring at Barrow are similar to those over large portions of the continental U.S. (see Fig. III-A-10), but they are considerably higher than levels south of the Brooks Range of Alaska. Any ground-level effects of arctic haze on the concentrations of regulated air pollutants in the Prudhoe Bay area are included in the monitoring data given in Table III-A-4. Despite this seasonal, long-distance transport of pollutants into the Arctic, regional air quality still is far better than specified by standards.

Table III-A-3  
Ambient-Air-Quality Standards Relevant to Beaufort Sea Lease Sale 124  
(Measured in ug/m<sup>3</sup>; an asterisk [\*] indicates that no standards  
have been established.)

Criteria Pollutant <sup>1/</sup>	Averaging Time					
	Annual	24 hr	8 hr	3 hr	1 hr	30 min
Total-Suspended Particulates <sup>2/</sup> Class II <sup>4/</sup>	60 <sup>3/</sup> 19 <sup>3/</sup>	150 37	* *	* *	* *	* *
Carbon Monoxide	*	*	10,000	*	40,000	*
Ozone <sup>5/</sup>	*	*	*	*	235 <sup>6/</sup>	*
Nitrogen Dioxide Class II <sup>4/</sup>	100 <sup>7/</sup> 25 <sup>7/</sup>	* *	* *	* *	* *	* *
Inhalable Particulate Matter (PM10) <sup>8/</sup>	50 <sup>9/</sup>	150 <sup>10/</sup>	*	*	*	*
Lead		1.5 <sup>11/</sup>	*	*	*	*
Sulfur Dioxide Class II <sup>4/</sup>	80 <sup>7/</sup> 20 <sup>7/</sup>	365 91	* *	1,300 512	* *	* *
Reduced Sulfur Compounds <sup>2/,12/</sup>	*	*	*	*	*	50

Source: State of Alaska, Dept. of Environmental Conservation, 1982, 80, 18, AAC, 50.010, 18 AAC 50.020; 40 CFR 52.21 (43 FR 26388); 40 CFR 50.6 (52 FR 24663); 40 CFR 51.166 (53 FR 40671)

- <sup>1/</sup> All-year-averaging times not to be exceeded more than once each year, except that annual means may not be exceeded.
- <sup>2/</sup> State of Alaska air-quality standard (not national standard).
- <sup>3/</sup> Annual geometric mean.
- <sup>4/</sup> Class II standards refer to the PSD Program. The standards are the maximum increments in pollutants allowable above previously established baseline concentrations.
- <sup>5/</sup> The State ozone standard compares with national standards for photochemical oxidants; which are measured as ozone.
- <sup>6/</sup> The 1-hour standard for ozone is based on a statistical, rather than a deterministic, allowance for an "expected exceedance during a year."
- <sup>7/</sup> Annual arithmetic mean.
- <sup>8/</sup> PM10 is the particulate matter less than micrometers in aerodynamic diameter.
- <sup>9/</sup> Attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR 50 subpart K, is equal to or less than 50 ug/m<sup>3</sup>.
- <sup>10/</sup> Attained when the expected number of days per calendar year with a 24-hour average concentration above 150 ug/m<sup>3</sup>, as determined in accordance with 40 CFR 50, subpart K, is equal to or less than 1.
- <sup>11/</sup> Measured as sulfur dioxide.

Table III-A-4  
 Measured-Air-Pollutant Concentrations  
 at Prudhoe Bay, Alaska  
 1986-1987  
 (Measured in  $\mu\text{g}/\text{m}^3$ ; absence of data  
 is indicated by asterisks [\*\*].)

Pollutant <sup>1/</sup>	Monitor Sites				Applicable National Ambient-Air Quality Standards <sup>6/</sup>	Class II PSD Standard Increments
	A <sup>2/</sup>	B <sup>3/</sup>	C <sup>4/</sup>	D <sup>5/</sup>		
<b>Total-Suspended Particulates</b>						
Annual	8.4	**	14.8	**	60	19
Annual Max. 24 hr	79.7	**	104 <sup>7/</sup>	**	150	37
<b>Ozone</b>						
Annual Max. 1 hr	92.1	170.5	265 <sup>8/</sup>	67	235	
<b>Nitrogen Dioxide</b>						
Annual	15.8	7.5	16	4	100	25
<b>Inhalable Particulate Matter (PM10)</b>						
Annual	**	**	10.5	**	50	
Annual Max. 24 hr	**	**	25 <sup>7/</sup>	**	150	
<b>Sulfur Dioxide</b>						
Annual	7.9	**	3	**	80	20
Annual Max. 24 hr	15.7	**	80.5 <sup>7/</sup>	**	365	91
Annual Max. 3 hr	21.0	**	**	**	1,300	512
<b>Carbon Monoxide</b>						
Annual Max. 8 hr	**	**	1,400	**	10,000	
Annual Max. 1 hr	**	**	2,500 <sup>7/</sup>	**	40,000	

Sources: ERT, 1987, and Environmental Science and Engineering, 1987.

- <sup>1/</sup> Lead was not monitored.
- <sup>2/</sup> Site CCP (Central Compressor Plant), Prudhoe Bay monitoring program, selected for maximum pollutant concentrations.
- <sup>3/</sup> Site Pad A (Drill Pad A), Prudhoe Bay monitoring program, site of previous monitoring, selected to be more representative of the general area or neighborhood.
- <sup>4/</sup> Site CPF-1 (Central Processing Facility), Kuparuk monitoring program, selected for maximum pollutant concentrations.
- <sup>5/</sup> Site DS-1F, Kuparuk monitoring program site selected to be representative of the general area or neighborhood.
- <sup>6/</sup> Please refer to Table III-A-3 for more specific definitions of air-quality standards.
- <sup>7/</sup> Second highest observed value (in accordance with approved procedures for determining ambient-air quality).
- <sup>8/</sup> The highest value for ozone at site A (CPF-1) may have been atypical due to field operations using arc welding within 150 m of the site. Otherwise, the highest value at the site was 174.7  $\mu\text{g}/\text{m}^3$ .

### III.B. Biological Resources

1. **Lower-Tropic-Level Organisms:** This discussion summarizes and incorporates by reference the description of lower-trophic levels contained in the FEIS's for Sales 87 and 97 (USDOI, MMS, 1984 and 1987a, respectively), with augmentation by additional information, as cited. Lower-trophic-level organisms in the Beaufort Sea can be categorized as planktonic (living in the water column), epontic (living on the underside of sea ice), or benthic (living on or in the sea bottom), depending on their general location. The abundance and spatial and seasonal distribution of these organisms are strongly influenced by the extreme physical conditions described earlier (Sec. III.A).

a. **Planktonic Communities:** The planktonic communities in this region are comprised of both phytoplankton and zooplankton.

(1) **Phytoplankton:** Abundance of phytoplankton appears to be greatest in nearshore waters with decreasing numbers farther offshore. Although observations of vertical distribution of phytoplankton vary, most reports show that phytoplankton abundance is greatest in depths less than 5 m (Alexander, 1974). Horner, Coyle, and Redburn (1974), however, found phytoplankton abundance to be greater below 5 m near Prudhoe Bay. Peak abundance occurs in late July and early August due to increased light intensity during this period.

Horner (1984) found rates of primary production to vary as much as two to three times between years. Highest production and standing-stock values occurred in the sampling year with the least amount of ice cover, while lowest production and standing stock occurred in the year with the most extensive ice cover.

Variation also seems to exist in the presence or absence of a spring phytoplankton bloom. A spring bloom apparently occurs in the nearshore Chukchi Sea at Barrow during and just after ice breakup when light levels increase and high nutrient concentrations exist (Horner, 1969). However, Horner (1984) states that "there are no data based on sufficiently intense sampling to indicate the occurrence of a spring bloom in the offshore Beaufort Sea." Schell et al. (1982), sampling in Simpson Lagoon, Harrison Bay, Prudhoe Bay, Stefansson Sound, and offshore, also did not find any evidence of a "spring" phytoplankton bloom. A spring bloom may not have been observed because of the logistical difficulties of sampling early enough (probably when ice is still present) to detect one.

(2) **Zooplankton:** The greater than 100 species of zooplankton identified from the Beaufort and northeastern Chukchi Seas can be divided into four groups: (1) species that occur throughout the Arctic Basin; (2) species that are swept into the Beaufort Sea to varying extents from the Bering and Chukchi Seas; (3) species characteristic of nearshore, less saline environments; and (4) species that are the larval forms of animals that live in the benthos (=meroplankton) (USDOD, NOAA, 1978).

**Ubiquitous Arctic Species:** Zooplankton communities found by Johnson (1956) were richer in the Chukchi Sea and western part of the Beaufort Sea than in the eastern Beaufort (east of approximately Barter Island), again possibly reflective of greater extents of shallower depths in the west. Copepods were the predominant zooplankton group, both in numbers and biomass. Horner (1979, 1981), in another study of zooplankton along the Alaskan Beaufort Sea coast, reported that copepods comprised an average of 63 percent of the individuals in the zooplankton. Richardson (1986), in a study of the eastern Beaufort Sea, found copepods represented 87 percent of the individual zooplankters and 78 percent of the wet-weight zooplankton biomass. Richardson also found a decrease in zooplankton biomass from the nearshore area to the inner shelf to the outer shelf. Zooplankton biomass above the pycnocline (the depth zone within which seawater density changes maximally) was very low except in nearshore waters. The highest biomasses of zooplankton were generally found just below the pycnocline. Distribution of zooplankton in the eastern Beaufort Sea was patchy, with patches being very extensive in the horizontal plane (e.g., 100's-1,000's of m across), but usually only 5 to 10 m thick. Off of Kaktovik, patches of zooplankton were more abundant in nearshore and inner-shelf waters, and biomass was greater than in more offshore waters (Richardson, 1986). Most copepods are primarily herbivorous, so copepods form an important link between phytoplankton and larger, carnivorous species. Other components of the zooplankton include amphipods, mysids, euphausiids, arrow worms, ostracods, decapods, pteropods, comb jellies, jellyfish, fish larvae, larvaceans, and larval stages of benthic organisms (Johnson, 1956; Hopkins, 1969; Sekerak et al., 1976 and 1979; Horner, 1979; Griffiths and Buchanan, 1982; and Richardson, 1986).

b. Epontic Communities: Epontic communities are composed of those plants and animals living on or in the undersurface of sea ice. Microalgae in the ice consist primarily of pennate diatoms and microflagellates, but centric diatoms and dinoflagellates also may be present, usually in low numbers (Horner and Schrader, 1982). Although approximately 200 diatom species have been identified from arctic sea ice, only a few species predominate. In samples taken by Horner and Schrader (1982), only 6 of the 58 species enumerated accounted for more than 10 percent of the cells counted. Regional differences occur in which species predominates, and changes in community structure have been noted during the development of the spring bloom (Horner and Schrader, 1982).

Microalgae are found in sea ice as it forms in the fall, but the origin of the cells is not known (Horner and Schrader, 1982). One possibility is that those species that eventually thrive in the ice may be present in low numbers in the water column and may be incorporated into the ice as it forms (Horner and Schrader, 1982).

Light appears to be the major factor controlling the distribution, development, and production of the ice-algal assemblage. Although spring blooms of ice algae have been reported by multiple investigators, only recently has a fall bloom also been noted (Schell et al., 1982). Diatom concentrations in Schell's fall samples (taken in 1980) were comparable to the levels found by Horner and Schrader (1982) in the 1980 spring bloom.

In Horner and Schrader's study (1982), primary production by ice algae during the May peak was twice as great as phytoplankton production in the water column. The total amount of epontic algal primary production was estimated by Schell and Horner (1981) to constitute about one-twentieth of the annual total primary production of the nearshore zone. Other sources of primary production include phytoplankton; benthic microalgae; and, in some areas, benthic macroalgae.

Dunton (1984) found that ice algae beneath clear ice contributed about 25 percent of the carbon produced in the area of the Stefansson Sound Boulder Patch. Although the contribution of ice algae to annual productivity may be relatively small, its importance lies in its input during early spring when food is presumably in short supply.

c. Benthic Communities: The benthic communities in the Alaskan Beaufort and Chukchi Seas can contain macrophytic algae (large seaweeds), benthic microalgae and bacteria, and benthic invertebrates.

#### (1) Marine Plants

(a) Macrophytic Algae: Although most substrates in the Beaufort Sea are silty sediments that are generally unsuitable for settlement and growth of large algae, hard substrates in the form of cobbles and boulders occur sporadically. The occurrence of such substrates is not perfectly coincidental with the presence of large seaweeds, since ice gouging can prevent the establishment or growth of algae on suitable substrates. Dunton, Reimnitz, and Schonberg (1982) also have found algae in areas where significant quantities of rock substrata were lacking. But, in general, macrophytes are most likely to occur in areas not subjected to ice gouging or landfast ice, and where hard substrates occur (see Dunton, Reimnitz, and Schonberg, 1982, and the Sale 87 FEIS, USDO, MMS, 1984, for notes about locations of other kelp beds). The largest kelp community thus far described occurs in Stefansson Sound and is appropriately entitled the Boulder Patch (see Dunton and Schonberg, 1981; Dunton, Reimnitz, and Schonberg, 1982; and Dunton, 1984). The locations of other kelp beds in the eastern Beaufort Sea are portrayed in Figure 5 of Dunton, Reimnitz and Schonberg (1982). Basically, these other beds occur near the Stockton Islands, Flaxman Island, and Demarcation Bay. Dunton, Reimnitz, and Schonberg (1982) state that: "In two cases, algae were present in the absence of significant concentrations of rock substrata. However, none of the algal beds were large, not all contained kelp, and none possessed the diverse epilithic fauna that characterizes the Boulder Patch in Stefansson Sound." MacGinitie (1955) noted the occurrence of algal growths (possibly, Laminaria) at Elson Lagoon near Point Barrow. Some kelp and other macroscopic algae also occur somewhat south or southeast of the sale area in the Chukchi Sea (Phillips et al., 1982; Schell, 1985, personal commun.).

The Boulder Patch community, although predominated by the brown alga, Laminaria solidungula, also contains red algae and a diverse assemblage of benthic invertebrates. Approximately 98 percent of the carbon produced annually in the Boulder Patch is derived from kelp and phytoplankton. Laminaria is estimated to contribute 50 to 56 percent of the annual production (134 g C/m<sup>2</sup>/yr to 211 g C/m<sup>2</sup>/yr),

depending on whether the plants are beneath clear or turbid ice (Dunton, 1984). Kelp are responsible for the release of approximately 60 percent of the particulate organic matter found in the environment (Dunton, 1984). This input may be quite important to the numerous filter feeders found in the community.

Much of the linear growth of the kelp takes place in winter, with maximum growth occurring in late winter or early spring (Dunton, Reimnitz, and Schonberg, 1982). The only herbivore that noticeably consumes kelp in the Boulder Patch is the chiton, Amicula vestita. Dunton (1984) estimates the annual ingestion of kelp by A. vestita is approximately 0.8 g C/m<sup>2</sup>.

(b) Benthic Microalgae: Benthic microalgal assemblages, consisting primarily of diatoms, have been studied in the nearshore area off Barrow (Matheke and Horner, 1974), off Narwhal Island (Horner and Schrader, 1982), and in Stefansson Sound (Horner and Schrader, 1982; Dunton, 1984). The relationship of the species found in sediments with those found in the ice-algal assemblage is unclear, although some species occur in both assemblages. Although Matheke and Horner (1974) reported high productivities for benthic microalgae over the summer, Horner and Schrader (1982) and Dunton (1984) reported that benthic microalgae do not contribute significantly to primary production. Dunton (1984) estimates that benthic microalgae contribute about 2 percent of the annual carbon produced in the Stefansson Sound Boulder Patch, with production in the absence of turbid ice figured at about 0.4 g C/m<sup>2</sup>/yr.

(2) Benthic Invertebrates: Benthic invertebrates in the Alaskan Beaufort and Chukchi Seas can generally be divided into two main categories, epifauna and infauna, based on their relationship with the bottom substrate. Infaunal organisms live within the substrate and, as a result, are often sedentary. Epifaunal organisms, on the other hand, generally live on or near the surface of the bottom substrate. The organisms comprising these groups, as well as the general patterns of their distribution and abundance, have been described in the FEIS's for Sales 87, 97, and 109 (USDOI, MMS, 1984, 1987a, and 1987b, respectively). Major studies examining these groups in the Alaskan Beaufort and Chukchi Seas include those of Broad (1979); Broad, Griffiths, and Carey (1981); Carey (1978); Stoker (1981); Frost and Lowry (1983); Griffiths and Dillinger (1981); Craig and Griffiths (1981); Envirosphere (1985); and Moulton, Fawcett, and Carpenter (1985). Wacasey (1975) has described the infauna of the Canadian Beaufort Sea.

Patterns in the distribution and relative abundance of species in the Beaufort Sea appear to be correlated with physical factors. In nearshore waters with depths less than or equal to 2 m, relatively few species are found. Since this is the zone of shorefast ice, the distribution and abundance of most species is probably dependent on annual (or more frequent) colonization. Biomass and diversity in the inshore zone generally increase with depth, except in the shear zone at approximately 15 to 25 m in depth. Intensive ice gouging occurs in this zone between the landfast ice and the moving polar pack ice, which generally disturbs the sediments in which infaunal organisms exist, thereby presumably minimizing their abundance. Ice gouging continues out to about 40 m with decreasing intensity. Diversity and biomass of infauna increase beyond this minimum-abundance zone with distance offshore (Carey, 1978), at least as far as the continental shelf (200 m).

d. Trophic Interactions: In a highly seasonal environment like that of the Beaufort and Chukchi Seas, extremes and patterns in the physical environment affect the interaction of organisms with the environment and interactions among organisms. Physical parameters may limit when and how much primary productivity occurs, thus influencing the availability of food to other organisms. Thus, shifting patterns of physical processes may limit or determine biological processes and resultant interactions among organisms.

In the Alaskan Beaufort and Chukchi Seas, sources of primary production include epontic algae, phytoplankton, benthic microalgae, benthic macroalgae, and peat entering into the system from terrestrial environs. The turbidity of ice and the pattern of ice breakup greatly influence the timing and degree of production by algae. The contribution of ice algae to annual productivity may be relatively small (see earlier discussion), but its importance probably lies in its input during early spring when food is presumably in short supply. Another peak in production by ice algae may occur in the fall (Schell et al., 1982). Open-water phytoplankton generally have the greatest input to primary production (but see comments related to macroscopic algae and peat input), but the contribution varies spatially, increasing in offshore areas except where pack ice is perennial (Schell et al., 1982; Alexander, 1974; Horner, 1981; Apollonio, 1959; English, 1959). Benthic macroscopic algae, although limited in their occurrence in the Beaufort Sea, can provide as much as 56 percent of the annual primary production in an area (Dunton, 1984).

The production or input of carbon into the ecosystem is important, but the methods and degrees to which

these potential food sources are used are also critical and form the basis for further interaction among organisms. Knowledge of trophic interactions is in some respects quite rudimentary; most information revolves around who eats what or whom. Relatively little information exists concerning preferences, feeding behavior, likelihood of choosing alternative prey, etc.

Although terrestrially-derived peat contributes substantially to available carbon in the nearshore marine environment, it is little-used by strictly marine organisms and thus does not enter in large degree into the marine food webs (Schell, 1983). Peat carbon does seem to be important seasonally for freshwater and anadromous arctic fishes and oldsquaw ducks utilizing insect larvae. The insect larvae appear to be the link with peat carbon for these organisms (Schell, 1983). Bacterial production in river plumes based on the use of soluble organic material leaching from vegetation may provide another link between terrestrial vegetation and marine food webs. Marine organisms, however, are basically dependent on food webs based on marine algae (see Fig. III-B-1), although peat and peat detritus have some input.

The food habits of marine invertebrates vary depending on habitat, season, preferences, etc., but in general they may rely on marine plants, other invertebrates, detritus, or carrion. Certain invertebrates--primarily mysids, amphipods, copepods, isopods, and euphausiids--comprise major portions of the diets of some fishes, birds, and marine mammals (Lowry and Frost, 1981b, 1984; Frost and Lowry, 1983, 1984; Craig, 1984a; Craig et al., 1984; Connors, 1984; Divoky, 1984; Moulton, Fawcett, and Carpenter, 1985; and *Envirosphere*, 1985). Other invertebrates, such as bivalves, snails, crabs, and shrimp may comprise the diets of some marine mammals (e.g., walrus and bearded and ringed seals; see Frost and Lowry, 1983a).

Areas with high primary productivity or with concentrations of certain larval forms also may be areas where organisms dependent on that productivity, either directly or indirectly, also concentrate (Johnson, 1956; Schell, 1985, personal commun.). Schell (1985, personal commun.) has found a positive correlation between patterns of high primary productivity in the Alaskan Beaufort Sea and areas where whales historically have been killed. Areas in the eastern Beaufort Sea where bowhead whales feed contain concentrations of their zooplankton prey (Griffiths, Thomson, and Johnson, 1987). Thus, patterns in physical parameters can be linked to patterns of primary and secondary productivity.

2. **Fishes:** This discussion summarizes and incorporates by reference the description of fish resources contained in FEIS's for Sales 87 and 97 (USDOL, MMS, 1984 and 1987a, respectively).

The fishes occurring in the Beaufort Sea fall into three basic categories: (1) freshwater species that make relatively short seaward excursions from coastal rivers, (2) anadromous species that spawn in freshwater and migrate seaward as juveniles and adults, and (3) marine species that complete their entire lifecycle in the marine environment. They are typical of the "Inuit fauna" (McAllister, 1962), a fairly distinct assemblage of marine or anadromous fishes that extends from the central Canadian Arctic through the Chukchi Sea and into Siberian coastal waters. Sixty-two fish species have been reported from the Alaskan Beaufort Sea (Craig, 1984a) and 72 from the northeastern Chukchi Sea (Craig, 1984b). By comparison, over 300 fish species occur in the Bering Sea and Gulf of Alaska. The low variety of fish in the region has been attributed to low temperature, low productivity, and harsh ice conditions that preclude extensive use of shoreline habitats during the winter period.

Of the 62 Alaskan Beaufort species reported, 37 were collected in nearshore, brackish waters and 40 in offshore, marine waters, indicating that some species occur in both habitats. The areas of greatest species diversity tend to be the delta regions of large rivers draining into the Beaufort Sea. Some characteristics of the physical environment greatly influence the distribution and abundance, both spatially and temporally, of Beaufort Sea fishes. In particular, the formation of a narrow band of warm, brackish water nearshore affects the movements and activities of anadromous fishes. The formation of this watermass is described in the Sale 87 FEIS (USDOL, MMS, 1984). This warm, brackish water, with its riverine origin, has its greatest extent off the mouths of rivers, with a plume sometimes extending 20 to 25 km offshore (Craig, 1984a). During winter, most of the nearshore water less than 2 m deep freezes to the bottom.

Aspects of the general biology of freshwater, anadromous, and marine fish species occupying the Alaskan Beaufort Sea follow.

a. **Freshwater Species:** Freshwater fishes that venture into the coastal waters are found almost exclusively in association with fresh or brackish waters extending offshore from major river deltas. Their presence in the marine environment is generally sporadic and brief with a peak occurrence probably

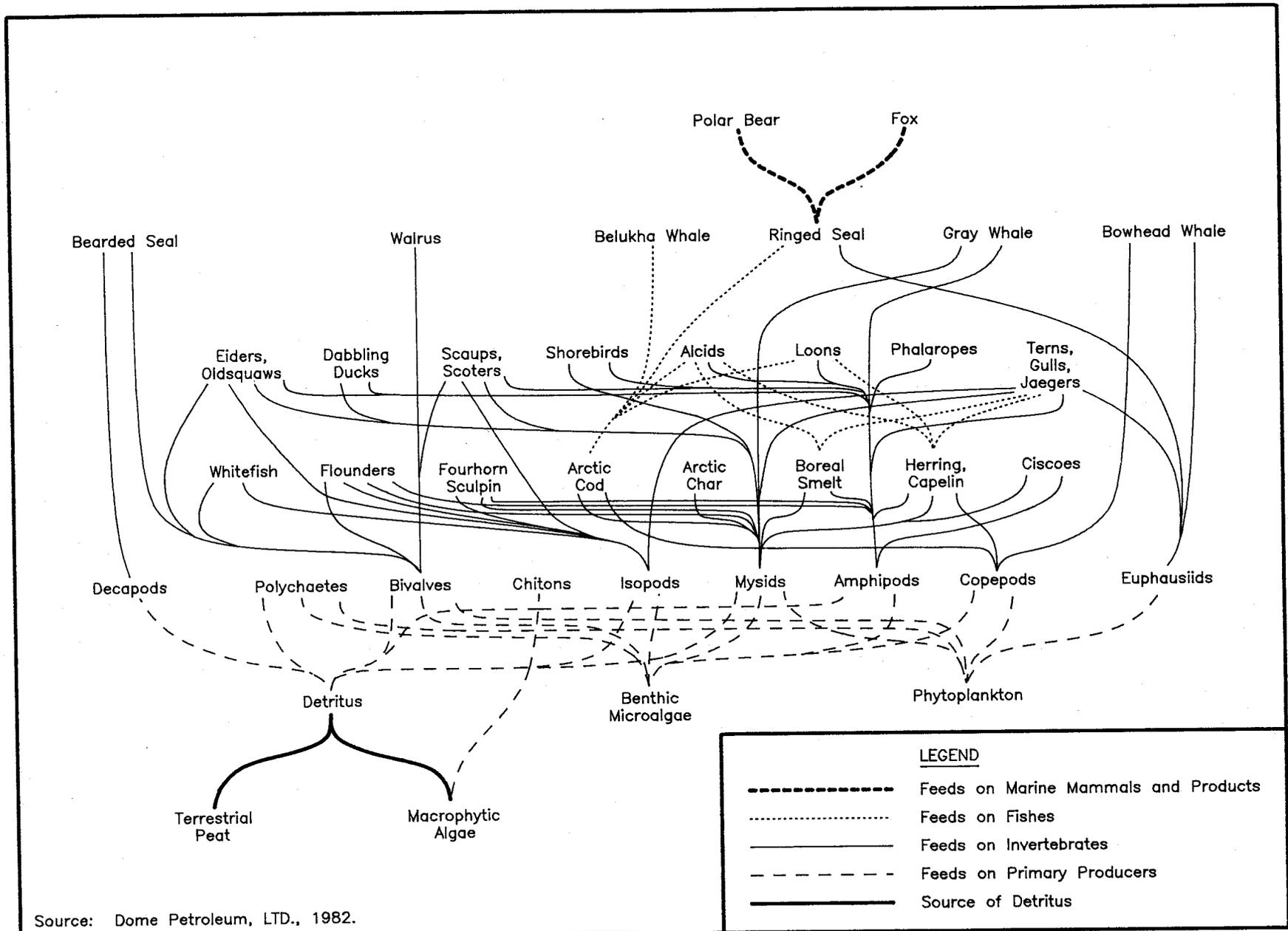


Figure III-B-1. Major Trophic Pathways (Food Web) in the Beaufort and Northeast Chukchi Seas

during or immediately following spring breakup. Such freshwater species include arctic grayling, round whitefish, and burbot.

b. Anadromous Species: Anadromous species found in the nearshore waters of the Beaufort Sea include arctic char, arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, and broad whitefish. Pink and chum salmon have been reported from Simpson Lagoon (Craig and Haldorson, 1981) and along the western Beaufort (Schmidt, McMillan, and Gallaway, 1983); however, their occurrence is thought to be occasional and their abundance relatively low. Other anadromous species recorded from the Alaskan Beaufort include arctic lamprey; chinook, sockeye, and coho salmon; inconnu; and ninespine and threespine stickleback.

The two largest river drainage systems, the Mackenzie and the Colville, contain the most anadromous species. Both rivers have spawning populations of arctic char, ciscoes, whitefishes, and smelt, plus relatively small runs of salmon (Craig, 1984a). Between these two drainage systems are numbers of mountain streams containing perennial springs that are associated with the spawning and overwintering grounds of arctic char (Craig, 1984a).

During the open-water season, anadromous fishes appear to widely use the nearshore, brackish-water habitats as feeding and rearing areas. With the first signs of spring breakup (June 5-20), adult and juvenile fishes move into and disperse through these coastal waters where they feed extensively on an abundant food supply, consisting mainly of epibenthic invertebrates. During the 3- to 4-month open-water season, anadromous fishes accumulate energy reserves used for overwintering and spawning activities that occur later in fresh- or brackish-water habitats.

Anadromous fishes using the Beaufort Sea coastal region as summer-feeding habitat have been hypothesized to prefer the warmer, less-saline waters around river deltas rather than the cooler, more-saline waters offshore or removed from drainages. Support for this hypothesis has come from Craig and Haldorson (1981); Moulton, Tarbox, and Thorne (1980); Griffiths and Gallaway (1982); Critchlow (1983); Dew (1983); Griffiths et al. (1983); Woodward-Clyde Consultants (1983); Moulton and Fawcett (1984); and Moulton, Fawcett, and Carpenter (1985). Moulton, Fawcett, and Carpenter (1985) also have found that the large fish of some anadromous species (char, arctic cisco, and least cisco) are less restricted by low temperature and high salinity than are smaller fish. Among the abundant anadromous fishes found in the nearshore zone, arctic char have the broadest salinity tolerance, followed--in decreasing order--by arctic cisco, least cisco, and broad whitefish.

The concentration of movement and feeding activities of anadromous fishes in the band of warm, brackish water nearshore has been postulated to be related most to (1) temperature and salinity regimes or (2) the concentration of prey in this area. Recent investigations and correlation analysis (Moulton, Fawcett, and Carpenter, 1985) suggest that fish distribution is most strongly correlated with temperature and/or salinity parameters; prey density seems to have little effect. Food does not appear to be a limiting factor for the anadromous fishes studied (Craig and Haldorson, 1981, and Moulton, Fawcett, and Carpenter, 1985, but see comments about arctic cisco). Within the nearshore-brackish zone, fish tend to be concentrated along the mainland and island shorelines rather than in lagoon centers or offshore. The important fishes in nearshore waters, based on numerical abundance or use by humans, are arctic and least cisco, arctic char, arctic cod, and fourhorn sculpin (the latter two are marine species). These species constitute over 90 percent of the fish caught along the Alaskan Beaufort and western Yukon Territory coastlines (Craig, 1984a). Recent catch statistics also indicate that broad whitefish is an important and preferred species in subsistence harvests (George and Nageak, 1986; Moulton, Field, and Brotherton, 1986).

The coastal distribution of some anadromous species (e.g., the broad and humpback whitefishes and arctic char) reflect major geographical differences in the locations of anadromous fish stocks in North Slope rivers (see Fig. III-B-2). Details of distributions of the Alaskan Beaufort anadromous fishes are found in the Sale 87 FEIS (USDOI, MMS, 1984); Morrow (1980); Craig (1984a); and Moulton, Fawcett, and Carpenter (1985). Brief descriptions of the distributions of the four major anadromous fishes in the Alaskan Beaufort Sea follow. Arctic cisco apparently originate from the Mackenzie River in Canada but range as far west as Point Barrow. Arctic char in Alaskan waters are generally found east of the Colville River and are known to spawn and overwinter in mountain streams. Anadromous least cisco are common west of the Colville River (in rivers from near Wainwright to the Colville) and in rivers on the northern coast of the Yukon and Northwest Territories, but are absent in lakes and rivers of the central Beaufort Sea (between the Colville River and the Babbage River in Canada). In the Alaskan Beaufort Sea, broad whitefish occur in association

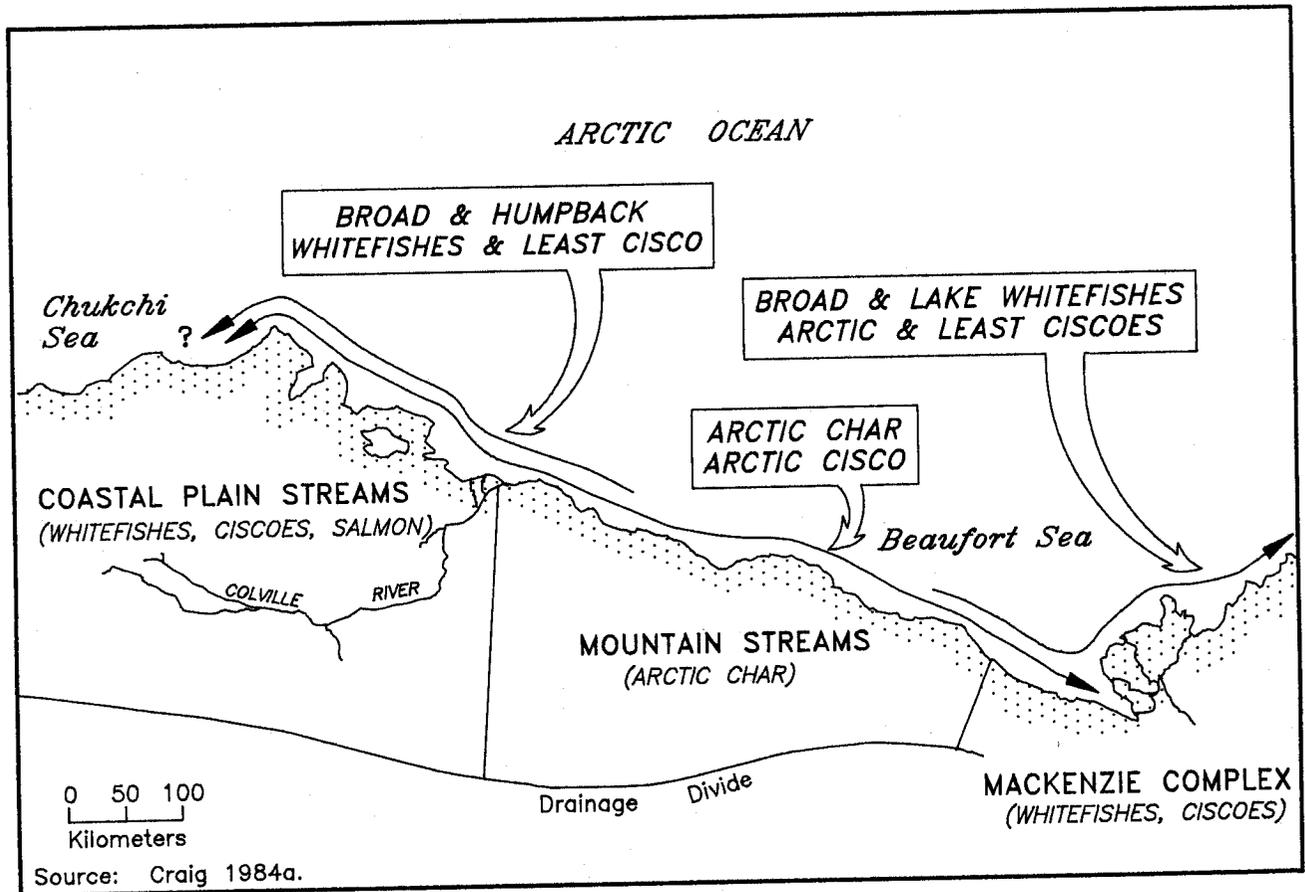


Figure III-B-2. Freshwater Sources and Coastal Dispersal Patterns of the Principal Anadromous Fishes Occurring Along the Beaufort Sea Coast

with the freshwater discharges of larger rivers from Point Barrow east to the Sagavanirkok River Delta and also have been reported from the Canning River.

Because some fishes, notably whitefishes and least ciscoes, do not disperse far from their rivers of origin, they show a somewhat disjunct distribution pattern with greatest abundances near the Mackenzie River and west of the Sagavanirkok River. In contrast, those fishes that disperse widely from their streams of origin (arctic ciscoes and some arctic char) usually are common along the entire Alaskan Beaufort Sea coastline. An extreme example of a fish showing this latter pattern of dispersal is the arctic cisco. Gallaway et al. (1983) suggest that all the arctic cisco in the Alaskan Beaufort Sea are derived from a single stock that reproduces in the Mackenzie River system. Waves of fishes disperse into Alaskan waters at irregular intervals (Gallaway et al., 1983; EnviroSphere, 1985), and juvenile fishes use Alaskan rivers (in particular, the Colville and adjacent environs) and their delta areas as overwintering habitat. Presumably, when they attain sexual maturity, they return to the Mackenzie River to spawn.

Recent genetic studies of arctic char have demonstrated that separate stocks with distinctive genetic makeups occur in different river drainages (Everett and Wilmot, 1987). This suggests that despite what may be wide-ranging movements by adults, char show high fidelity to a particular drainage (Johnson, 1980).

Other distributional patterns also occur. Onshore-offshore distribution or segregation of species varies, presumably due to affinity or tolerance for various salinity-temperature regimes.

Seasonal shifts in distribution take place, with most anadromous species returning to North Slope rivers and lakes in late summer or fall. Some return later, in early winter, while others overwinter in brackish waters off or within the major river deltas (Mackenzie and Colville). One anadromous species, the rainbow smelt, shows a distinctly different pattern by overwintering in marine environments. Large concentrations occur off the mouths of the Mackenzie and Colville Rivers in winter. Then, in spring, the smelt migrate into the rivers to spawn (Haldorson and Craig, 1984).

The nearshore, brackish waters, which are used by these anadromous fishes primarily as a feeding ground, contain an abundant supply of food organisms. The food habits of both anadromous and marine fishes using this zone are quite similar. Epibenthic mysids and amphipods usually constitute over 90 percent of the diets of arctic and least ciscoes, arctic char, and arctic cod (Craig and Haldorson, 1981; Craig et al., 1984). Other fishes also may extensively use these prey while showing preferences for other types of prey. For example, rainbow smelt and sometimes arctic char eat fish; fourhorn sculpin and arctic flounder eat isopods. Infaunal organisms are not abundant in areas where water depths are less than 2 m and are not commonly eaten by nearshore fishes (Craig, 1984a).

Additional diet and selectivity information was gathered by Moulton, Fawcett, and Carpenter (1985). During the period of greatest fish abundance, in early and midsummer, there was little dietary overlap among the fish species taken in Prudhoe Bay. In late summer, as fish declined in abundance and prey increased, significant dietary overlap was noted between arctic and least cisco, arctic cisco and char, and arctic cisco and broad whitefish. The various fish species showed somewhat different sets of preferences for two mysid species, amphipods, isopods, and other prey (Moulton, Fawcett, and Carpenter, 1985). Although most anadromous fishes feed in nearshore waters during the summer, both arctic and least cisco are known to continue feeding through the winter in Colville River Delta habitats (Craig and Haldorson, 1981).

c. Marine Species: Marine species in the Beaufort Sea have been studied much less than anadromous species have been. In general, they appear to be widely distributed but in fairly low densities, with schooling species such as arctic cod displaying a rather patchy distribution. Forty-three marine species have been reported from the Alaskan Beaufort Sea, with some found primarily in the brackish, nearshore waters; others in the marine, offshore waters; and some in both environments (see Craig, 1984a). The most widespread and abundant species are the arctic cod, saffron cod, twohorn and fourhorn sculpins, the Canadian eelpout, and the arctic flounder (Craig, 1984a). Trawl surveys conducted by Frost and Lowry (1983a) in the northeastern Chukchi and western Beaufort Seas, at depths of 40 to 400 m, sampled 19 species of fishes.

Three of these species (arctic cod, Canadian eelpout, and twohorn sculpin) accounted for 65 percent of the catch. Catch rates were low in their trawls. In more-nearshore waters, the fourhorn sculpin also is important numerically. Some marine species, arctic cod and capelin, sporadically enter the nearshore areas to feed on the abundant epibenthic fauna or to spawn. Others, such as fourhorn sculpin and flounder,

remain in coastal waters throughout the ice-free period, then move farther offshore with the development of the shorefast ice during the winter. The arctic cod has been described as a "key species in the ecosystem of the Arctic Ocean" due to its widespread distribution, abundance, and importance in the diets of marine mammals, birds, and other fishes (Andriyashev, 1954; Quast, 1974; Bain and Sekerak, 1978; Craig et al., 1982; Sekerak, 1982; Craig, 1984a). It has been calculated to be the most important consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry, 1983a) and may influence the distribution and movements of marine mammals and seabirds (Craig, 1984a, citing Klumov, 1937; Bradstreet, 1980; Davis, Finley, and Richardson, 1980; and Finley and Gibb, 1982).

Fourhorn sculpins are among the most widespread and numerous species along the Beaufort Sea coastline. This demersal fish is found in virtually all nearshore habitats including deeper waters not frequented by anadromous fishes (Craig and Haldorson, 1981). Saffron cod, arctic flounder, and starry flounder have similar distributions; however, their occurrence is sporadic and variable and in much lower numbers. Snailfish, which appear to be closely associated with hard, rocky substrates or kelp, have been collected in Simpson Lagoon (Craig and Haldorson, 1981) and Prudhoe Bay and have been observed in association with the Stefansson Sound "Boulder Patch" (Dunton, Reimnitz, and Schonberg, 1982).

Canadian eelpout is a benthic fish species that is common on muddy bottoms (Andriyashev, 1954). After arctic cod, it was the most abundant species found by Frost and Lowry (1983a). Twohorn sculpin, an offshore marine fish (Frost and Lowry, 1983a), is abundant but patchy in its distribution. Capelin is a widely distributed species that has been reported in areas west of the Mackenzie River Delta; it usually is not abundant except in August when it spawns in coastal habitats.

Most other marine species spawn during the winter period. Craig and Haldorson (1981) suggest that arctic cod spawn under the ice between November and February, and spawning areas appear to occur both in shallow coastal areas as well as in offshore waters. Fourhorn sculpin spawn on the bottom in nearshore habitats during midwinter. Snailfish also are winter spawners, attaching their adhesive eggs to rock or kelp substrate.

Feeding habits of marine species are similar to those of anadromous species in nearshore waters. Almost all of the marine species discussed rely heavily on epibenthic and planktonic crustacea such as amphipods, mysids, isopods, and copepods. Flounders also feed heavily on bivalve mollusks, while fourhorn sculpins supplement their diets with juvenile arctic cod.

d. Sport and Commercial Use of Fish Resources: Anadromous fishes, particularly ciscoes, whitefishes, and char, are the focal point of several fisheries along the Alaskan Beaufort Sea coastline. Subsistence harvest of fishes is described in Section III.C.3. Fishes also are taken by a commercial fishery in the Colville River Delta and by sport fishing at villages, DEW-line stations, and oil camps.

The only continuous commercial fishing operation on Alaska's North Slope is operated by a single family (Helmericks) during the summer and fall months in the Colville River Delta. Of the four species taken, arctic cisco is the most important fish product. This species, along with broad and humpback whitefish, is sold for human consumption in Fairbanks and Barrow. Least cisco also are taken in large numbers and are sold for dogfood. Average annual catch statistics (1964-1984; State of Alaska, ADF&G, 1984) for these species are as follows:

<u>Species</u>	<u>Number</u>	<u>Percent</u>	<u>Total Weight (lbs.)</u>
Arctic Cisco	30,615	55	30,615
Least Cisco	21,602	39	19,441
Broad Whitefish	2,183	4	11,133
Humpback Whitefish	1,351	2	

It is estimated that about 9 percent of the arctic ciscoes and 5 percent of the least ciscoes are exploited by commercial fisheries every year.

3. Marine and Coastal Birds: The description of marine and coastal birds in the Beaufort Sea Planning Area as contained in Section III.B.3 of the Sale 87 FEIS (USDOJ, MMS, 1984) is incorporated by reference. A summary of this description, augmented by additional material, as cited, follows. Several million birds, consisting of about 150 species--including seabirds, waterfowl, shorebirds, passerines, and raptors--occur on the North Slope and/or within marine habitats within or adjacent to the area of Sale 124 in

the Beaufort Sea. Nearly all of these species are migratory and are found in the Arctic seasonally, from May through September. The most-abundant marine and coastal species include red phalarope, oldsquaw, glaucous gull, and common eider. During the fall--late September to mid-October--20,000 to 40,000 Ross' gulls, representing a large proportion of the world population of this species, occurs within the sale area and adjacent coastal habitats, within which the greatest numbers are found offshore of Point Barrow and eastward to the Plover Islands (Sanger et al., 1988).

Within the proposed sale area, major concentrations of birds occur near shore (in waters less than 20 m in depth) and in coastal areas such as Peard Bay, Plover Islands-Barrow Spit, Pitt Point-Cape Halkett, Fish Creek Delta, Colville River Delta, Simpson Lagoon, Beaufort Lagoon, and Demarcation Bay (Graphic 1). In the far western part of the proposed sale area (Point Barrow area), high densities of birds occur offshore apparently due to increased productivity caused by nutrient intrusion from the Bering Sea. Areas such as Elson Lagoon-Plover Islands, Pitt Point-Cape Halkett, and Simpson Lagoon support 50 to 100 birds per square kilometer (birds/km<sup>2</sup>) in August, with feeding flocks of thousands of birds/km<sup>2</sup> occurring when abundant food sources are available. However, pelagic areas (waters deeper than 20 m and out to the shelf break) offshore of Point Barrow-Plover Islands in the western Beaufort Sea support high average densities (38.1 birds/km<sup>2</sup>) of predominant species during the open-water season.

Shortly after spring migration, most shorebird and waterfowl populations disperse to nesting grounds primarily on moist tundra and marshlands of the arctic slope. The Teshekpuk Lake area, Colville River Delta, Mackenzie River Delta, Canning River Delta, and Herschel Island are very important nesting areas for waterfowl such as Pacific brants, yellow-billed loons, and snow geese, respectively. Other species, such as common eiders, arctic terns, glaucous gulls, and black guillemots, nest on barrier islands (Graphic 1). Timing of breakup of ice surrounding a barrier island is critical for determining the island's importance as a nesting site for marine birds. For this reason, islands near large river deltas such as Thetis and Herschel Islands receive the heaviest use. Other barrier island nesting sites shown on Graphic 1 vary in their importance to nesting birds. In the Plover Islands, islands such as Cooper and Deadman Islands (in the western Beaufort Sea) are important for nesting black guillemots.

Beginning in mid-July, large concentrations of 10,000 or more oldsquaw and eider occur in coastal waters inshore of islands, such as those in Peard Bay (Gill, Handel, and Connors, 1985), and in Simpson and Beaufort Lagoons where the birds intensively feed and molt before fall migration. In late July, large numbers of phalaropes and other shorebird species begin to concentrate along the coast. They feed intensively at coastal beach habitats of barrier islands and spits such as Barrow Spit-Plover Islands and along lagoon coastlines, marshlands, and mudflats. Use of lagoons and other coastal habitats peaks in August to late September before and during fall migration. During migration, tens of thousands of birds may use a local habitat area while passing through. In addition to the above habitats, coastal tundra lakes, ponds, and river deltas are very important for waterfowl and shorebird molting and staging before and during fall migration. Major areas are Teshekpuk Lake, Fish Creek Delta, Colville River Delta, Hulahula River Delta, and coastal tundra areas (for snow geese and tundra swans) on the Arctic National Wildlife Refuge (ANWR).

4. **Pinnipeds, Polar Bears, and Belukha Whales:** The description of these nonendangered marine mammals in the Beaufort Sea Planning Area as contained in Section III.B.4 of the Sale 87 FEIS (USDOI, MMS, 1984) is incorporated by reference. A summary of this description, augmented by additional material, as cited, follows. This account emphasizes species of marine mammals, other than endangered whales, commonly occurring in the Alaskan Beaufort Sea habitats that may be affected by the proposed sale. Species covered include the ringed seal, bearded seal, spotted seal, walrus, polar bear, and belukha whale. The trophic relationships of these species to other organisms of the marine ecosystem are portrayed on Figure III-B-2. Other species that are uncommon or rare in the sale area but that occasionally occur in small numbers include the harbor porpoise, killer whale, narwhal, and hooded seal. Due to the relative numerical insignificance of the latter species in the Beaufort Sea, they are not discussed further.

All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972 (MMPA). In the act, it was the declared intent of Congress that marine mammals "be protected and encouraged to develop to the greatest extent feasible commensurate with sound policies of resource management, and that the primary objective of their management should be to maintain the health and stability of the marine ecosystem." General habitat areas of marine mammals are shown on Graphic 2.

a. Pinnipeds

MINERALS MANAGEMENT SERVICE  
ALASKA OCS REGION

PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 1

MARINE AND COASTAL BIRDS

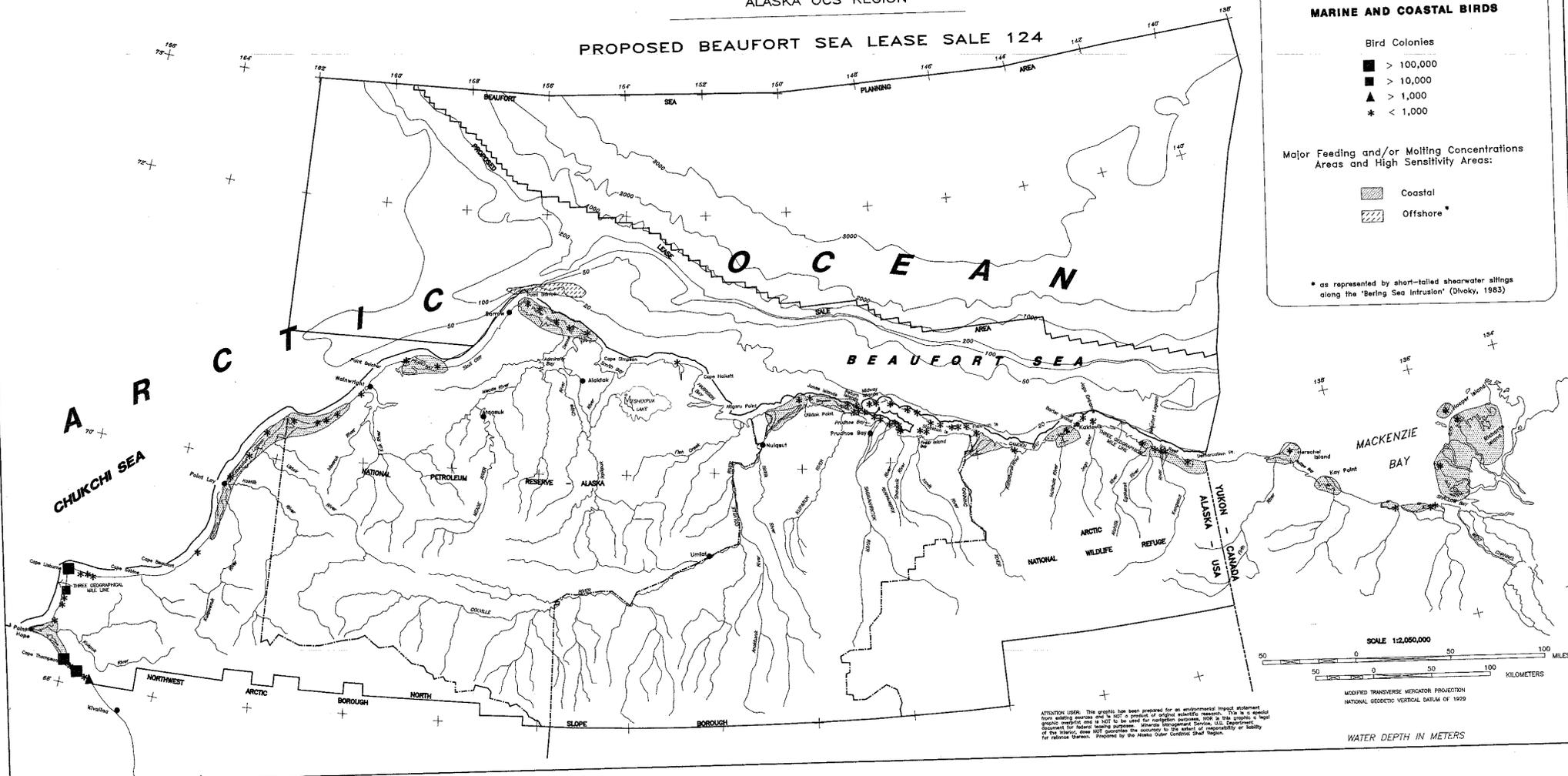
Bird Colonies

- > 100,000
- ▲ > 10,000
- ▲ > 1,000
- \* < 1,000

Major Feeding and/or Molting Concentrations  
Areas and High Sensitivity Areas:

- ▨ Coastal
- ▧ Offshore\*

\* as represented by short-tailed shearwater sightings  
along the 'Bering Sea Intrusion' (Divoky, 1983)



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SCALE 1:2,050,000  
50 0 50 100 MILES  
50 0 50 100 KILOMETERS

MODIFIED TRANSVERSE MERCATOR PROJECTION  
NATIONAL GEODETIC VERTICAL DATUM OF 1929

WATER DEPTH IN METERS



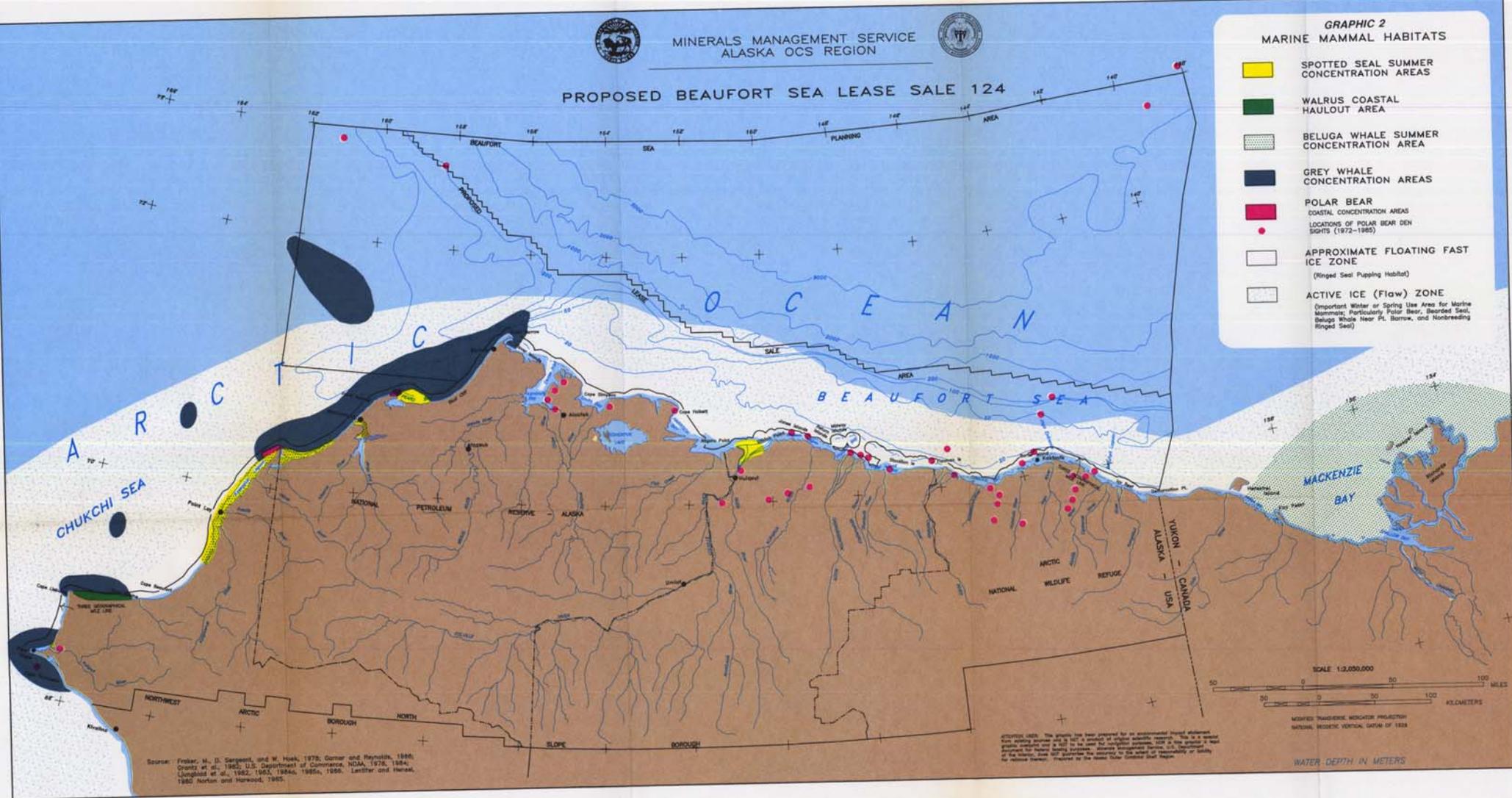
MINERALS MANAGEMENT SERVICE  
ALASKA OCS REGION



PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 2  
MARINE MAMMAL HABITATS

-  SPOTTED SEAL SUMMER CONCENTRATION AREAS
-  WALRUS COASTAL HAULOUT AREA
-  BELUGA WHALE SUMMER CONCENTRATION AREA
-  GREY WHALE CONCENTRATION AREAS
-  POLAR BEAR COASTAL CONCENTRATION AREAS
-  LOCATIONS OF POLAR BEAR DEN SIGHTS (1972-1985)
-  APPROXIMATE FLOATING FAST ICE ZONE (Winged Seal Pupping Habitat)
-  ACTIVE ICE (Flow) ZONE (Important Winter or Spring Use Area for Marine Mammals; Particularly Polar Bear, Bearded Seal, Beluga Whale, Harp Pt. Seal, and Humpbacked Ringed Seal)



Source: Proker, H., D. Sergeant, and W. Hoek, 1978; Gorman and Reynolds, 1980; Counts et al., 1982; U.S. Department of Commerce, NOAA, 1978, 1984; Ljungblad et al., 1982, 1983, 1984a, 1985a, 1985b; Lavett and Haines, 1980; Norton and Harwood, 1985.

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SCALE 1:1,000,000  
0 50 100 150 200 MILES  
0 50 100 150 200 KILOMETERS

MODIFIED TRANSVERSE MERCATOR PROJECTION  
NATIONAL MEGNETIC VERTICAL DATUM OF 1983

WATER DEPTH IN METERS

(1) Ringed Seals: This species is the most abundant seal in the Beaufort Sea. It is widely distributed throughout the Arctic, with an estimated population of 80,000 seals during the summer and 40,000 seals during the winter in the Alaskan Beaufort Sea (Frost and Lowry, 1981). Ringed seal densities within the proposed sale area may depend on a variety of factors such as food availability, proximity to human disturbance, water depth, ice stability, etc. Densities of ringed seals in the floating shorefast-ice zone of the Beaufort Sea generally range from 1.5 to 2.4 seals per square nautical mile (seals/nmi<sup>2</sup>) (Frost, Lowry, and Burns, 1988a). Although ringed seals do not occur in large herds, loose aggregations of tens or hundreds of animals do occur, probably in association with abundant prey.

Probably a polygamous species, ringed seals, when sexually mature, establish territories during the fall that they maintain during the pupping season. Pups are born in late March and April in lairs that are excavated in snowdrifts and pressure ridges. During the pupping and breeding season, adults on shorefast ice (floating fast-ice zone, see Graphic 2) are generally less mobile than individuals in other habitats; they depend on a relatively small number of holes and cracks in the ice for breathing and foraging. During nursing (4-6 weeks), pups are generally confined to the birth lair. This species is a major subsistence resource composing as much as 58 percent of the total seals harvested by subsistence hunters in Alaska (see Sec. III.C.3, Subsistence-Harvest Patterns).

(2) Bearded Seals: This species is found throughout the Arctic and generally prefers areas where seasonal broken sea ice occurs over waters less than 200 m deep. The majority of the bearded seal population in Alaskan OCS areas are in the Bering and Chukchi Seas, where an estimated 300,000 to 450,000 individuals occur. The bearded seal is primarily restricted to the moving ice in the Beaufort Sea. Densities of bearded seals in the western Beaufort Sea and throughout the sale area are greatest during the summer and lowest during the winter. The most important winter and spring habitat area is the active ice zone shown in Graphic 2.

Pupping occurs on top of the ice from late March through May primarily in the Bering and Chukchi Seas, although some pupping occurs in the Beaufort Sea. The nursing period is very short (12-18 days); most pups reach approximately 63 percent of their adult length when they are weaned. These seals do not form herds, although loose aggregations of animals do occur. The bearded seal is a relatively important subsistence species and is preferred by subsistence users.

(3) Spotted Seals: This species is a seasonal visitor to the Beaufort Sea. Spotted seals appear along the coast in July in low numbers (about 1,000 total for the Alaskan Beaufort Sea coast), hauling out on beaches, barrier islands, and remote sandbars on the river deltas. Beaufort Sea coastal haulout and concentration areas include the Colville River Delta, Peard Bay, and Oarlock Island in Dease Inlet/Admiralty Bay adjacent to the proposed sale area (Graphic 2). Recently, these seals also have frequented Smith Bay at the mouth of the Piasuk River. Spotted seals frequently enter estuaries and sometimes ascend rivers, presumably to feed on anadromous fishes. Spotted seals migrate out of the Beaufort Sea in the fall (September to mid-October) as the shorefast ice re-forms and the pack ice advances southward. They spend the winter and spring periods along the ice front throughout the Bering Sea where pupping, breeding, and molting occur.

(4) Walruss: The North Pacific walrus population was estimated at 232,500 animals in 1985 (Gilbert, 1989), comprising about 80 percent of the world population. By 1980, the walrus population was showing density-dependent signs of having reached the carrying capacity of its environment, with significant decline in productivity and calf survival occurring. At the same time, harvest rates by both the Soviet and American walrus hunters have more than doubled, with 10,000 to 15,000 animals (4-6% of the population) killed per year (Fay, Kelly, and Sease, 1989). The latter investigators believe that natural curtailment of the walrus population and the increase in human exploitation of this population may result in a dramatic population decline. An optimistic hypothetical model of the Pacific walrus population, based on recent data and assuming a 10-percent reduction in harvest rates per year, projects that the walrus population will decline to about 175,000 by the early 1990's (Fay, Kelly, and Sease, 1989). In general, most of this population is associated with the moving pack ice year-round. Walrus spend the winter in the Bering Sea; and the majority of the population summers throughout the Chukchi Sea, including the westernmost part of the proposed sale area (Graphic 2). Although a few walrus may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open-water season, the majority of the Pacific population occurs west of 155° W. longitude north and west of Barrow, with the highest seasonal abundance along the pack-ice front (Graphic 2).

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

Walrus calves are born from mid-April to mid-June during the northward migration; mating takes place from January to March. The gross reproductive rate of walrus is considerably lower than that of seals. Prime reproductive females produce one calf every 2 years rather than one every year as do other pinnipeds. Walrus are a very important cultural and subsistence resource. Alaskan annual harvest catches ranged from 3,000 to about 6,000 animals from 1980 to 1985 (Fay, Kelly, and Sease, 1989).

b. Polar Bears: Polar bears are found throughout the Arctic. The Beaufort Sea population (from Point Barrow to Cape Bathurst, Northwest Territories) is estimated to be 1,300 to 2,500 bears, while the total Alaskan population is estimated at 3,000 to 5,000 bears (Amstrup, 1983; Amstrup, Stirling, and Lentfer, 1986). There is substantial annual variation in the seasonal distribution and local abundance of polar bears in the Alaskan Beaufort Sea. Average density appears to be one bear every 30 to 50 mi<sup>2</sup>, with much lower densities occurring farther than 100 mi offshore and higher densities occurring near ice leads where seals are concentrated. The two most important natural factors affecting polar bear distributions are sea ice and food availability.

Drifting pack ice off the coast of the Alaskan Beaufort Sea probably supports greater numbers of polar bears than either shorefast ice or polar pack ice, probably due to the abundance and availability of subadult seals in this habitat. Polar bears prefer rough sea ice over smooth ice for hunting and resting (Martin and Jonkel, 1983). Local concentrations of polar bears may occur along the coast of Alaska when pack ice drifts close to the shoreline and shorefast ice forms early in the fall.

Pregnant and lactating females and newborn cubs are the only polar bears that occupy winter dens for extended periods. Polar bears may concentrate such denning on offshore islands and certain portions of the mainland. Typically, dens are more sparsely distributed in the Alaskan coastal zone than areas receiving consistent use such as Wrangell Island, Hudson Bay, and James Bay. Pregnant females come to coastal areas in late October or early November to construct maternity dens. Most terrestrial dens are located close to the seacoast, usually not more than 8 to 10 km inland, but some dens have been located over 100 mi inland in Canada (Kolenosky and Prevett, 1983). Offspring are born from early December to late January, and females and cubs break out from dens in late March or early April. Polar bear dens have been located along river banks in northeast Alaska and on shorefast ice close to islands east of the mouth of the Colville River. Recently recorded denning areas have been found along the coast of ANWR. These and other recorded den locations from 1972 to 1985 are indicated on Graphic 2. Female polar bears generally do not use the same den-site location (Ramsay and Stirling, 1990; Amstrup and Garner, 1989). Polar bears repeatedly use the same geographic areas for maternity denning (Amstrup and Garner, 1989), but shifts in the distribution of den locations have been reported in Canada and might be related to changes in sea-ice conditions (Ramsay and Stirling, 1990).

Insufficient data exist to accurately quantify polar bear denning along the Alaskan Beaufort Sea coast. However, dens in this area appear to be less concentrated than in many denning areas in Canada and on Wrangell Island and elsewhere in the Arctic. Polar bears have been reported to bear young in maternity dens far offshore on the pack ice (Lentfer and Hensel, 1980; Amstrup, 1985). The majority of polar bear maternity dens located recently (1983-1985) in the Sale 124 area were found on sea ice scattered throughout the planning area (Amstrup, 1985; see Graphic 2).

Besides being covered by the MMPA of 1972, polar bears and their habitats are protected by the International Agreement on the Conservation of Polar Bears of 1976 between Canada, Denmark, Norway, the Union of Soviet Socialist Republics, and the United States. This agreement addresses the protection of "habitat components such as denning and feeding sites and migration patterns."

c. Belukha Whales: The belukha whale, a subarctic and arctic species, is a summer

seasonal visitor throughout offshore habitats of the Alaskan portion of the Beaufort Sea. The Bering-Chukchi-Beaufort population may be in excess of 25,000, while an estimated 11,500 belukha whales migrate to the eastern Beaufort Sea (Frost, Lowry, and Burns, 1988b). Most of the latter population migrate from the Bering Sea into the Beaufort Sea in April or May. However, some whales may pass Point Barrow as early as late March and as late as July (Frost, 1985, personal commun.). The spring-migration routes through ice leads are similar to those of the bowhead whale. A major portion of the Beaufort Sea population concentrates in the Mackenzie River estuary during July and August (Graphic 2). An estimated 2,500 to 3,000 belukhas summer in the northwestern Beaufort and Chukchi Seas, with some utilizing coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost, Lowry, and Burns, 1988b; see Graphic 2).

Fall migration through the western Beaufort Sea and the Sale 124 area is in September or October. Although small numbers of whales have been observed migrating along the coast (Johnson, 1979), surveys of fall distribution strongly indicate that most belukhas migrate offshore along the pack-ice front (Lowry and Burns, 1988). Belukha whales are an important subsistence resource of Inuit Natives in Canada and also are important locally to Inupiat Natives in Alaska (see Sec. III.C.3, Subsistence-Harvest Patterns).

**5. Endangered and Threatened Species:** The description of the endangered and threatened species that occur in the Beaufort Sea Planning Area (including the endangered bowhead and gray whales and the threatened arctic peregrine falcon) as contained in Section III.B.5 of the Sale 97 FEIS (USDOI, MMS, 1987a) is incorporated by reference. A summary of this description, augmented by additional material, as cited, follows.

An endangered species is defined by the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), as a species that is in danger of extinction throughout all or a significant portion of its range. Threatened species are those likely to become endangered within the foreseeable future. Whales protected under the ESA also are protected under the International Convention for the Regulation of Whaling (1946) and the MMPA of 1976. Endangered species likely to occur within the proposed Sale 124 area include bowhead and gray whales, and the threatened arctic peregrine falcon may be present adjacent to the sale area.

a. **Bowhead Whales:** Individuals of the western arctic stock of bowhead whales, estimated to number about 7,800 (Zeh, Reilly, and Sonntag, 1988), migrate through the proposed sale area semiannually as they migrate between summer-feeding grounds located in the Canadian Beaufort Sea and wintering areas in the Bering Sea.

Population estimates have risen dramatically, although the reason behind this increase is more likely better censusing techniques rather than a rapidly increasing population. However, Zeh et al., 1990, using ice-based visual census data, estimated a 3.1-percent rate of increase for the years 1978-1988. The current population estimate may be about 40 percent of the historic population level prior to commercial exploitation (based upon numbers cited by Braham, 1984). The species presently appears to be much more abundant than at the close of the commercial whaling period, just after the turn of the century, when it was estimated that there were probably around 1,000 animals.

After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward in August into Alaskan waters. Generally, few bowheads are seen in Alaskan waters until the major portion of the migration occurs, typically between mid-September and mid-October. Bowheads continue to feed intermittently as they migrate across the Alaskan Beaufort Sea. Conditions can vary during the fall migration from open water to over nine-tenths ice coverage, and the extent of ice cover may influence the timing or duration of the fall migration. The depth regime over which the greatest number of whales appears to migrate is from 10 to 50 m. An analysis of median water depths of bowheads sighted during fall aerial surveys from 1982 through 1988 provides an overall median of 37 m for all years combined. In addition, greater median depths were observed for heavy ice years, especially for the heaviest ice year, 1983, with a median of 347 m (Treacy, 1989).

Data on the bowhead fall migration through the Chukchi Sea is limited; however, it appears that before they move south into the Bering Sea, most bowheads cross the Chukchi Sea in a broad front from Point Barrow to the northern coast of the Chukotsk Peninsula.

The bowheads' northward spring migration appears to be timed with the ice breakup, usually beginning in April. In the Chukchi Sea, they follow leads in the flaw zone from outer Kotzebue Sound to Barrow.

Several studies of acoustical and visual comparisons of bowhead spring migration off Barrow show bowheads migrating under ice. Several observers' data indicate that bowheads migrate underneath ice and break through ice from 14 to 18 cm thick for breathing (George et al., 1989, and Clark et al., 1986). George et al. (1989) suspect that bowheads use ambient-light cues and possibly the echoes of their calls to navigate under ice and to distinguish thin ice from multi-year-ice floes (thick ice). After passing Barrow from April through mid-June, they move through offshore leads in an easterly direction. East of Point Barrow, the lead systems divide into numerous branches that vary in location and extent from year to year. Bowheads arrive on their summer-feeding grounds in the vicinity of Banks Island/Amundsen Gulf about late May to June (Fraker, 1979).

Bowheads apparently feed throughout the water column, and they have been observed feeding in or near the proposed sale area during their spring and fall migrations. Food items most commonly found in the stomachs of harvested bowheads include euphausiids, mysids, copepods, and amphipods. Areas to the east of Barter Island appear to be used by many bowheads for feeding briefly as they migrate slowly westward across the Beaufort Sea (Thomson and Richardson, 1987). In some years, sizable groups of bowheads have been seen feeding east of Point Barrow near the Plover Islands. Carbon isotope analysis of bowhead baleen has indicated that a significant amount of feeding may occur in wintering areas (Schell, Saupe, and Haubenstock, 1987). Bowheads also were observed feeding in the spring in the vicinity of Point Barrow during 1985 and 1986, indicating that bowheads will opportunistically feed in this area when food is available.

Bowhead mating and calving appear to occur during the spring migration. Late winter is the most probable mating season, at the time when most of the population is located in the Bering Sea. However, mating behavior also has been reported north of Point Barrow. The peak of calving probably occurs in May, although the calving season could extend in some years from late March until early August.

b. Gray Whales: The eastern Pacific gray whale stock is estimated to number 21,113 individuals (Breiwick et al., in press). Due to commercial whaling, this stock was severely depleted by the early 1900's. However, under legal protection, the eastern Pacific gray whale stock has recovered to, or now exceeds, its size prior to commercial whaling (Rice, Wolman, and Braham, 1984). In recent years, the population has grown by an estimated 2.5 percent per year.

A relatively low number of gray whales summer within the proposed sale area. Major gray whale summer-feeding areas exist in the northern Bering and southern Chukchi Seas. Smaller numbers of whales summer in the northern Chukchi Sea with a few entering the Beaufort Sea. Gray whales may be present in the proposed sale area from June or more likely July through September and into October before migrating south out of the area.

The gray whale's northward migration begins in February off the Baja California coast. Most of the gray whale population enters the Bering Sea through Unimak Pass from March through June. The whales begin to arrive on summer-feeding grounds near St. Lawrence Island in May and June and subsequently migrate to more northerly feeding areas in the northern Bering and Chukchi Seas.

During summer, gray whales--like the other great whales--build up fat on which they apparently survive during the fall, winter, and spring. Gray whales are primarily bottom feeders, selecting high biomass areas on their northern feeding grounds. Ampeliscid amphipods appear to a primary food resource in a number of feeding areas. Feder et al. (1989) reported that the macrofaunal sampling they had done on the Chukchi Sea continental shelf revealed that the greatest concentrations of benthic invertebrates, including amphipods, occur within the area where gray whales concentrate. In addition to benthic suction feeding, gray whales also are capable of feeding on pelagic prey by skimming and engulfing, as reported by several authors in Nerini (1984). This mode of feeding may be used in areas where mobile scavenging arthropods are present (Nerini, 1984).

c. Arctic Peregrine Falcons: Based on 1988 surveys, the population of arctic peregrine falcons in Alaska now stands at about 80 pairs and 120 young and appears to be increasing (USDOI, FWS, 1989). Peregrine falcons are present in Alaska from about mid-April to mid-September. Egg-laying on the North Slope begins in the middle of May, and the young fledge from about the end of July to mid-August.

There are no known active nest sites along the coast between Barrow and Demarcation Point. Nest sites closest to the coast occur about 25 mi inland. The most frequent sightings of arctic peregrine falcons along the Beaufort Sea coast have occurred east of the mouth of the Colville River where probably immature birds use this area on a transient basis from mid-August to mid-September.

6. **Caribou:** The description of caribou in the Beaufort Sea Planning Area as contained in Section III.B.6 of the Sale 87 FEIS (USDOI, MMS, 1984) is incorporated by reference. A summary of this description, augmented by additional material, as cited, follows. Among the terrestrial mammals that occur along the coast of the Beaufort Sea, barren-ground caribou is the species that could be affected most by proposed OCS oil and gas activities in the Sale 124 area.

Two large caribou herds and two smaller caribou herds use coastal habitats adjacent to the sale area: the Western Arctic, the Porcupine, the Central Arctic, and the Teshekpuk Lake herds (WAH, PCH, CAH, and TLH, respectively). The WAH, estimated to be about 250,000 animals (Larsen and Machida, 1989), ranges over territory in northwestern Alaska that extends approximately from the Colville River to the western coast of Alaska and north from the Kobuk River to the Beaufort Sea. The PCH, estimated to be about 180,000 animals in 1986 (Morgan, 1988), ranges south from the Beaufort Sea coast, from the Canning River of Alaska in the west, eastward through the northern Yukon and portions of the Northwest Territories in Canada, and south to the Brooks Range (Fig. III-B-3). The CAH, estimated at about 18,000 animals (Cameron, Smith, and Fancy, 1989), ranges between the Canning and Itkillik Rivers to the east and west, and from the Beaufort Sea in the north to the crest of the Brooks Range in the south.

The calving and wintering area for the TLH, comprising 4,000 to 5,000 animals (USDOI, BLM, 1983), is around Teshekpuk Lake and near Cape Halkett adjacent to Harrison Bay (see Fig. III-B-3). The WAH's major calving area is inland on the National Petroleum Reserve-Alaska (NPR-A). The PCH calving range encompasses an area along the Beaufort Sea coast from the Canning River in Alaska to the Babbage River in Canada and south to the northern foothills of the Brooks Range. Major concentrations of calving cows occur within this range between the Canning and Sadlerochit Rivers on the west and east, respectively, and between Camden Bay on the north and the Sadlerochit Mountains on the south. Recently, most of the CAH have calved within 30 km of the Beaufort Sea, including the Prudhoe Bay area (see Fig. III-B-3). Calving generally takes place from late May to late June.

During the postcalving period in July through August, caribou generally attain their highest degree of aggregation with continuous masses of animals in excess of 50,000. Cow/calf groups are most sensitive to human disturbance during this period. During the summer months, caribou use various coastal habitats of the Beaufort Sea in Alaska, such as sandbars, spits, river deltas, and some barrier islands, for relief from insect pests.

The need for caribou to migrate appears to be a behavioral adaptation that prevents destruction of forage habitat. If movements are greatly restricted, caribou are likely to overgraze their habitat, leading to perhaps a drastic, long-term population decline. Migrating caribou often follow well-defined routes between winter and summer ranges. The caribou diet shifts from season to season and depends on the availability of forage. The winter diet has been characterized as consisting predominantly of lichens and mosses, with a shift to vascular plants during the spring (Thompson and McCourt, 1981). Eriophorum-tussock-sedge buds appear to be very important in the diet of lactating caribou cows during the calving season (Lent, 1966; Thompson and McCourt, 1981), while orthophyll shrubs (especially willows) are the predominant forage during the postcalving period (Thompson and McCourt, 1981). The availability of sedges during the spring--which apparently depends on temperature and snow cover--probably affects specific calving locations and success.

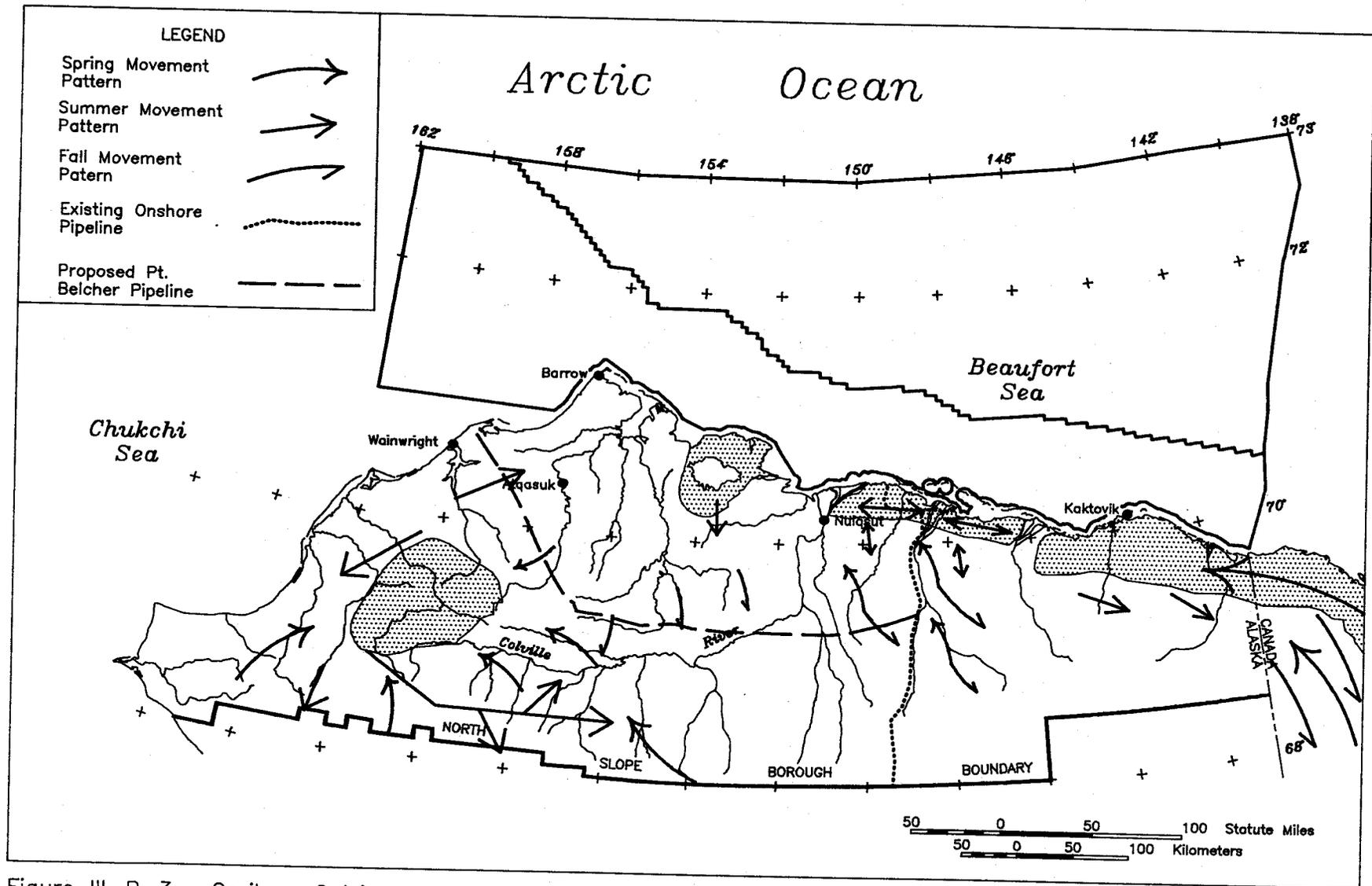


Figure III-B-3. Caribou-Calving Areas and Movement Patterns

### III.C. Social Systems

1. Economy of the North Slope Borough: The direct economic effects of proposed Sale 124 would be restricted almost entirely to the North Slope Borough (NSB). Because almost no direct economic effects are expected to occur outside this region, the economics discussion in the EIS does not describe the Statewide economy or the Statewide economic effects of the proposed sale. The description of the economy of the NSB as contained in Section III.D.1 of the Sale 97 FEIS (USDOJ, MMS, 1987a) is incorporated by reference; a summary of this description, augmented by additional material, as cited, follows.

The NSB includes the entire northern coast of Alaska and encompasses 88,281 mi<sup>2</sup> of territory, equal to 15 percent of the land area of Alaska. The predominately Inupiat residents have traditionally relied on subsistence activities. Sociocultural aspects and subsistence activities of the economy are discussed in Sections III.C.2 and III.C.3, respectively, of this EIS.

Located within the region is a vast petroleum-industry development centered at Prudhoe Bay. The most important economic linkage between petroleum activities and permanent residents of the region is the NSB government. The NSB is collecting very large property-tax revenues from petroleum-industry facilities. These revenues have funded greatly improved educational, health, and other government services and have financed an extensive Capital Improvements Program (CIP), which has created large numbers of construction jobs for permanent residents.

The following updates on NSB revenues and expenditures and employment in the North Slope region under existing conditions are from the Rural Alaska Model as developed by the Institute for Social and Economic Research (ISER) for MMS. There are four key groups of assumptions to which the model is most sensitive or for which there is greater uncertainty as to their true values. These assumptions are (1) future NSB revenues, (2) the relationship between Native migration and unemployment, (3) the share of jobs in each category of employment available to Natives, and (4) the percentage of workers unable to find other jobs in the villages who will seek work in the oil industry.

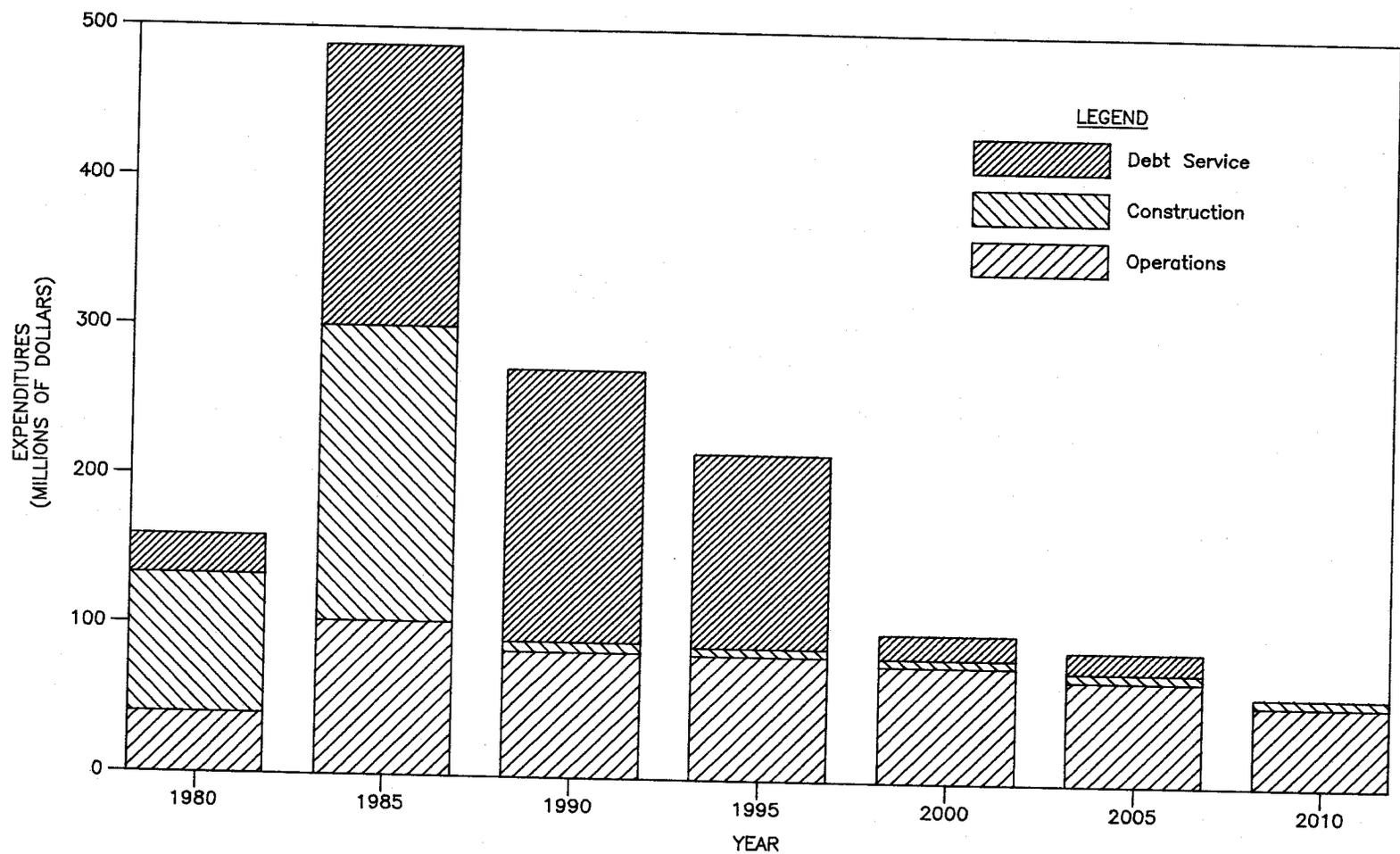
a. NSB Revenues and Expenditures: The tax base that has allowed the recent high levels of local-government expenditures consists primarily (more than 95% in fiscal year [FY] 1984) of the enormously high-valued petroleum-industry-related property in the Prudhoe Bay area. Because of this very valuable property, the NSB's tax base in 1984 was more than triple the base in the Fairbanks North Star Borough and almost equaled the base in the Municipality of Anchorage.

The NSB's total revenues in FY 1989 were estimated at \$317 million. The largest source of these revenues was property taxes (71%). A large share of the general-fund revenues (69.6% in FY 1989) must be used to pay for previous expenditures, primarily the debt on general-obligation bonds that were sold to fund CIP projects.

Total property-tax value is projected to rise until 1990 and decline thereafter. Property values could be higher or lower than those projected, depending on world-energy prices. However, property value is not considered to be the constraining factor for future NSB revenues. Future NSB revenues are likely to be constrained by a number of other factors, including (1) existing and potential State-imposed limits, (2) NSB residents' willingness to assume higher property-tax burdens, and (3) State and Federal revenue-sharing policies.

The FY 1985 mill rate applied by the NSB to assessed property was a record 18.37 mills. This rate is the sum of a rate of 1.78 mills for operations and 16.59 mills for debt service. Due to perceived adverse political and economic consequences, the NSB administration is not expected to increase the total rate any further. Although State statutes limit the mill rate for operations, the NSB's rate is well under the limit and, therefore, the NSB administration is not now facing any legal constraints to raising the rate. However, debt service peaked in 1989 and, as a consequence, the debt-service mill rate will decline. This allows the projected increase in the operations mill rate without increasing the overall mill rate. Total property-tax revenues peaked in 1988 and are now declining.

Figure III-C-1 shows actual and projected expenditures by the NSB from 1980 to 2010. Construction expenditures, primarily CIP, decline dramatically by the year 1990; and operating expenditures decline



Source: University of Alaska, ISER, 1986.

Figure III-C-1. North Slope Borough Expenditures (Actual and Projected) by Category, 1980-2010

significantly by the year 2000. These drastic declines in expenditures will be the most important factors in the projected decline of resident employment discussed in the following section.

b. Employment: Total North Slope (resident and commuter) employment in 1989 was estimated at around 7,000, down from a peak of over 10,300 in 1983. Over 5,000 (72%) of the jobs in 1989 were in the oil industry, down from a peak of almost 7,800 jobs in 1983. Almost all petroleum-industry jobs (over 99%) are held by workers who commute to permanent residences outside the region. Commuters also held an estimated 141 jobs outside of the petroleum industry in 1989. Many of these jobs (30%) were associated with "other" CIP projects (wages not paid directly by the NSB). Other employment filled by commuters was with Federal and State government. The vast majority of the commuters are employed in isolated, self-sufficient industrial enclaves having relatively minor direct economic interaction with the Eskimo communities. Most of these enclaves are related to petroleum production or exploration, although one small enclave is the site of defense-related communications.

Figure III-C-2 provides data on Native and non-Native resident employment since 1980. Total resident employment in the year 1989 was estimated to be about 2,500, with about 60 percent of jobs held by Natives. Table III-C-1 provides a breakdown of employment by category. A primary goal of the NSB has been to create employment opportunities for Native residents, and they have been successful in hiring large numbers of Natives for NSB construction projects and operations. The NSB employment has been both high-paying and very flexible, permitting employees to take time off when they wish to and allowing employees to be rehired after quitting or being fired.

Only a small number of permanent residents hold jobs at the industrial enclaves at Prudhoe Bay. Residents seem to prefer the employment created by the NSB to jobs potentially available in industry. Pay scales offered by the NSB are equal to or better than those in the oil and gas industry, and the working conditions and flexibility offered by the NSB are considered by the Natives to be superior to those prevailing in the oil and gas industry. The report, Description of the Socioeconomics of the North Slope Borough (University of Alaska, ISER, 1983), provides a detailed description of the employment situation and the reasons for the small Native involvement in the oil and gas industry.

Non-Native resident employment more than doubled between the years 1980 and 1985. Most of the employment (66%) was with NSB operations and CIP. These employment opportunities for non-Natives have resulted in the significant increase in the non-Native population that is discussed in Section III.C.1.c of this EIS. Since 1985, non-Native resident employment has declined 14 percent.

Figure III-C-2 presents projections of employment in the region. The biggest reason for the projected decline in resident employment is the projected decline in NSB revenues and expenditures, which results in an expected decline in NSB-funded CIP employment from 402 in 1985 to 10 by 1990. Other CIP employment also is expected to decline from 147 in 1985 to 4 by 1990. As CIP projects are completed, expenditures are shifted to operations. Even with an increased emphasis on operations, however, operating employment is expected to decline slightly, from 1,343 in 1985 to 1,100 by 1990. The share of resident employment held by Natives remains at about 56 percent between the years 1985 to 2010. The unemployment rate for Natives is shown in Figure III-C-3. After falling for several years, the rate is projected to rise beginning in 1986 and to reach 50 percent by 2002. Outmigration of residents is projected to occur to keep the unemployment rate from rising above 50 percent. This outmigration would aggravate the reduction in NSB revenues, since intergovernmental transfers and operation revenues (from property taxes) are proportional to population levels. Employment of Native residents in the petroleum industry has not changed much since 1985, although this may change due to the dramatic decline in CIP employment. Up to 1992, industry employment of Natives is constrained primarily by the Native labor supply (willingness to take advantage of industry-employment opportunities). After 1992, Native employment would be limited by industry's demand for labor (ability and willingness to offer industry-employment opportunities to Natives).

### c. Population

(1) Introduction: The population of the North Slope is divided among eight traditional Inupiat communities and various oil-related work camps. Traditional communities include Point Hope, Point Lay, and Wainwright on the Chukchi Sea; Barrow, Nuiqsut, and Kaktovik on the Beaufort Sea; and Atqasuk and Anaktuvuk Pass, both inland (see Sec. III.C.3, Fig. III-C-6). The traditional communities are predominantly Inupiat, they are situated at long-used villages or subsistence sites, and subsistence resources continue to play an important role in their domestic economies. Although historically these

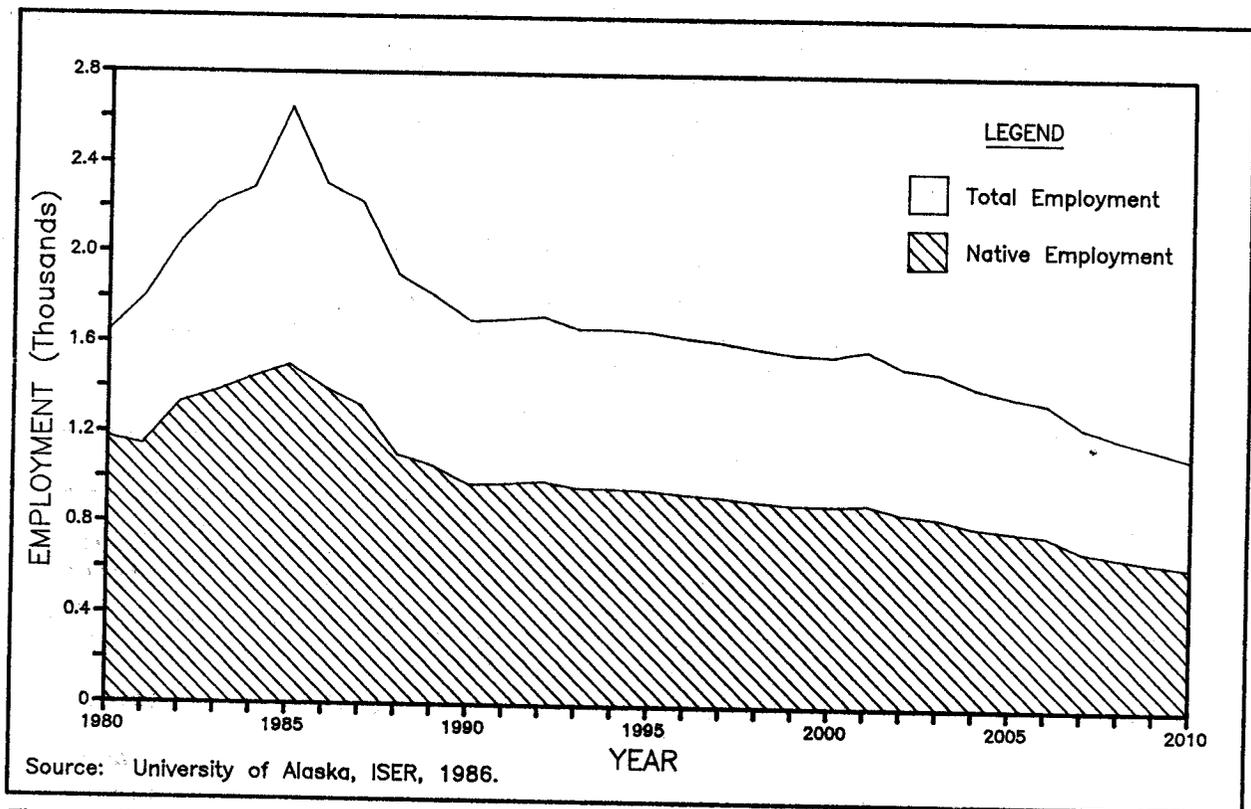


Figure III-C-2. Employment (Actual and Projected) of Native and Total Residents of the North Slope Borough Under Existing Conditions, 1980-2010

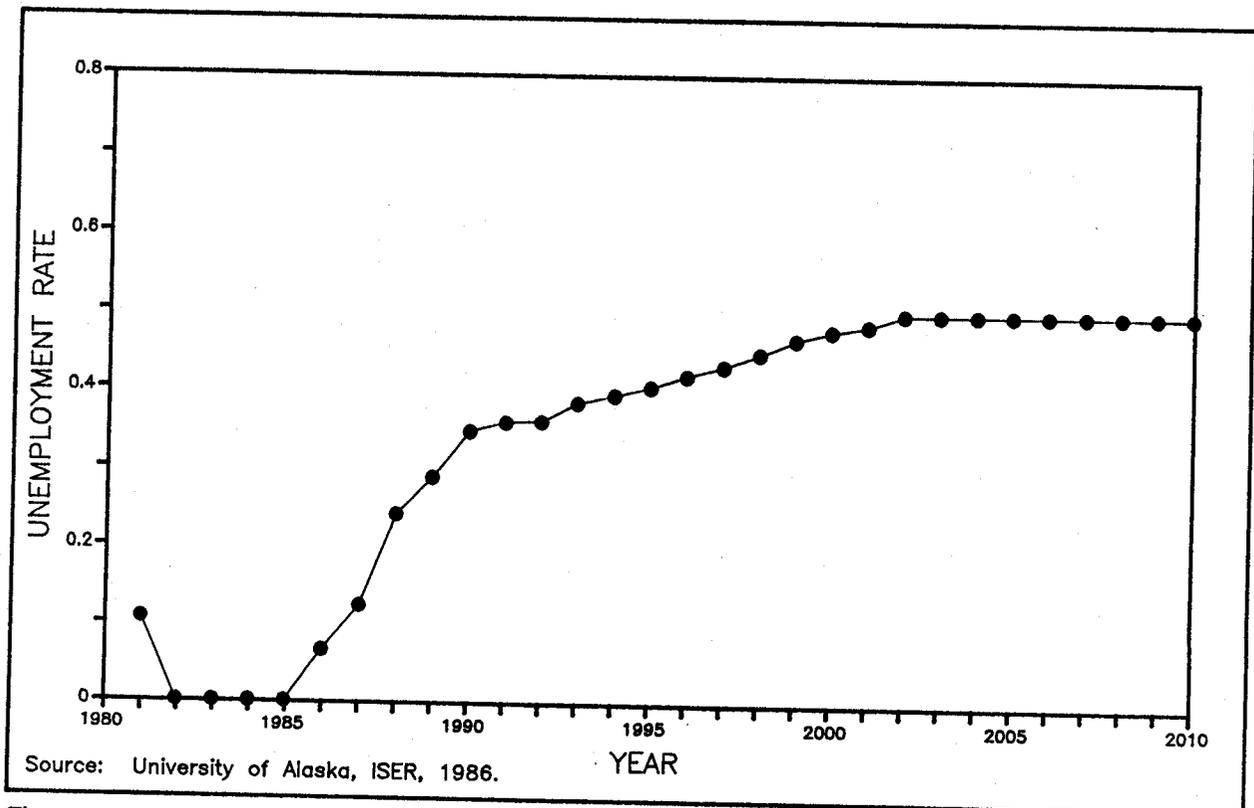


Figure III-C-3. Unemployment Rates (Actual and Projected) for Native Residents of the North Slope Borough after Migration, 1981-2010

Table III-C-1  
 Estimated Native and Non-Native Resident Employment by Category  
 in the North Slope Region in 1985

Employment Category	Residents' Status		
	Native (percent)	Non-Native (percent)	Total (percent)
NSB Operations	681 (45%)	662 (58%)	1,343 (51%)
NSB CIP	302 (20%)	100 (9%)	402 (15%)
Local Support	315 (21%)	317 (28%)	632 (24%)
Other CIP	147 (10%)	0 (0%)	147 (6%)
Federal and State Government	23 (2%)	57 (5%)	80 (3%)
Oil Industry	30 (2%)	0 (0%)	30 (1%)
Totals	1,497 (100%)	1,136 (100%)	2,633 (100%)

Source: University of Alaska, ISER, 1986.

settlements grow and contract, they contain a core of resident households united by long-standing kinship bonds.

Oil-related work camps are comprised primarily of male employees who, when not working, reside in Anchorage, Fairbanks, other parts of Alaska, or out of State. At present, these camps are concentrated in the Kuparuk-Prudhoe Bay area, but their location is tied to the necessities of oil exploration, construction, and production (see Sec. III.C.3, Fig. III-C-6). Naturally, the population of these camps is directly determined by the changes in oil development. Thus far, most North Slope work camps have been developed as industrial enclaves separated by rules and distance from the traditional communities. For this reason, the sociocultural effects of the oil industry remain, in large measure, indirect. Social, economic, and population dynamics of the villages are distinct from those of the work camps.

Table III-C-2 presents 1980 and 1982 population figures (as well as figures for 1985 and 1988-89) for villages and work camps in the region. The 1980 figures are given by village and camp. They are totaled by census subarea, as well as for the entire NSB. While these numbers present an adequate picture of North Slope village population, they do not adequately reflect the population in the work camps. The 1982 figures are broken down only for villages. Totals are given for the traditional villages, for oil-related work camps, and for the NSB as a whole. The work-camp total is from a special census that represents an accurate picture of camp size at one point in time. According to Table III-C-2, of the 11,234 people counted on the North Slope in 1982, 43.9 percent resided in traditional villages and 56.1 percent were found in oil-related work camps.

(2) Traditional Communities: The same census figures for eight of the villages in Table III-C-2 are restated in Table III-C-3, which also includes available census data going back to 1929. Figure III-C-4 depicts this information for total North Slope village population and for Barrow. All villages grew between 1980 and 1982, and these villages increased by a total of 1,101 people--a phenomenal 28.8 percent in 2 years, or a growth rate of 13.5 percent per annum. Wainwright's population increased the least--7.7 percent. The "new" villages of Atqasuk, Nuiqsut, and Point Lay grew most rapidly--96.3, 38.0, and 54.4 percent, respectively. Barrow's population increased rapidly as well. In 2 years, this regional center grew by 675 people, or 14.3 percent per annum. While Barrow's 1982 population reached 2,882, other North Slope villages remained relatively small, with an average of 292 inhabitants. The largest of these contained 11 percent of the total North Slope village population, the smallest only 3 percent. Barrow, on the other hand, represented 58.5 percent of the North Slope total.

The future of this 1980's population explosion must be viewed against long-term trends. Until the early 1970's, North Slope trends conformed roughly to those found generally in Native rural Alaska (Alonso and Rust, 1977). As elsewhere in the State, by the 1950's, smaller North Slope villages were losing people to their regional center, Barrow, as well as to urban Alaska. In spite of high rates of natural increase, Point Hope and Wainwright grew relatively slowly. The smaller settlements of Atqasuk, Nuiqsut, and Point Lay diminished to almost nothing by the 1970's. On the other hand, Barrow--after it emerged as the regional center in the 1940's--grew rapidly with infusions of people from other villages (Milan, 1978). In 1939, Barrow's population comprised 28.9 percent of the North Slope total; by 1970, this figure climbed to 69.4 percent. Much of this drift from smaller to larger settlements was inspired by better economic prospects in the latter (see below).

Between 1929 and 1960, the population of the North Slope grew 2.3 percent annually. Barrow, reflecting its role as a regional center, grew at a 4.6-percent rate during these same years. Fueled by improving economic prospects and health care, the growth rate rose in the 1960's. In this decade, the North Slope added 945 people--3.8 percent per annum. Increasingly, economic prospects centered in Barrow; it grew 4.8 percent per year.

The early 1980's population boom is a unique event in the demographic history of the North Slope. It indicates indirectly the economic and social magnitude of NSB's CIP. During these years, CIP economic infusions created jobs, housing, and infrastructure in all the North Slope villages (see Sec. III.D.1, Sale 87 FEIS [USDOI, MMS, 1984]). In these communities, this led to higher levels of population retention, to the return of people who had previously sought employment elsewhere, and to immigration of individuals--particularly non-Natives--who previously had not resided in the area. The newer villages of Atqasuk, Nuiqsut, and Point Lay grew much faster than Anaktuvik Pass, Kaktovik, Point Hope, and Wainwright, with an annual average growth of 7.1 percent and 2.6 percent, respectively. This growth reflects higher per capita housing construction in the newer settlements. Outside Barrow, housing construction was the driving force in these CIP-fueled economies (Galginaitis, 1984). Barrow's growth boom in the

Table III-G-2  
Population of the North Slope Region  
1980, 1982, 1985, 1988-89

Village	1980 <sup>1/</sup>	1982 <sup>2/</sup>	1985 <sup>3/</sup>	1988-89 <sup>4/</sup>
Anaktuvuk Pass	203	250	234	264
Atqasuk	107	210	214	219
Barrow	2,267	2,882	3,075	3,223
Cape Lisburne	36	---	---	---
Kaktovik	165	214	206	227
Nuiqsut	208	287	337	314
Point Hope	464	544	570	591
Point Lay	68	105	129 <sup>5/</sup>	158
Wainwright	405	436	507	502
<b>SUBTOTAL</b> Traditional Inupiat Villages	<u>3,923</u>	<u>4,928</u>	<u>5,272</u>	<u>5,498</u>
<b>SUBTOTAL</b> Oil-Related Enclaves, Military Stations	276 <sup>6/</sup>	6,306	3,036 <sup>7/</sup>	
<b>TOTAL</b> NORTH SLOPE BOROUGH	4,199	11,234	8,308	

Source: As indicated in the footnotes below.

1/ USDOC, Bureau of the Census, 1981.

2/ Alaska Consultants, Inc., 1984.

3/ FY 1986 Revenue Sharing Program, State of Alaska, Dept. of Regional and Community Affairs.

4/ North Slope Borough Census Preliminary Report on Population Economy, May 1989.

5/ 1984 household census conducted by NSB.

6/ This figure from the 1980 U.S. Census under-represents the actual number of workers employed in petroleum-related enclaves.

7/ This number was calculated by Alaska Consultants, Inc., 1984, using a different methodology from that used in the 1980 Census. In 1982, the military stations contained around 200 people. The remainder of this subtotal consists of 39.1 percent of the latest average annual employment of the Prudhoe Bay, Kuparuk, and pipeline areas.

Table III-C-3  
North Slope Population Trends  
1929 to 1982

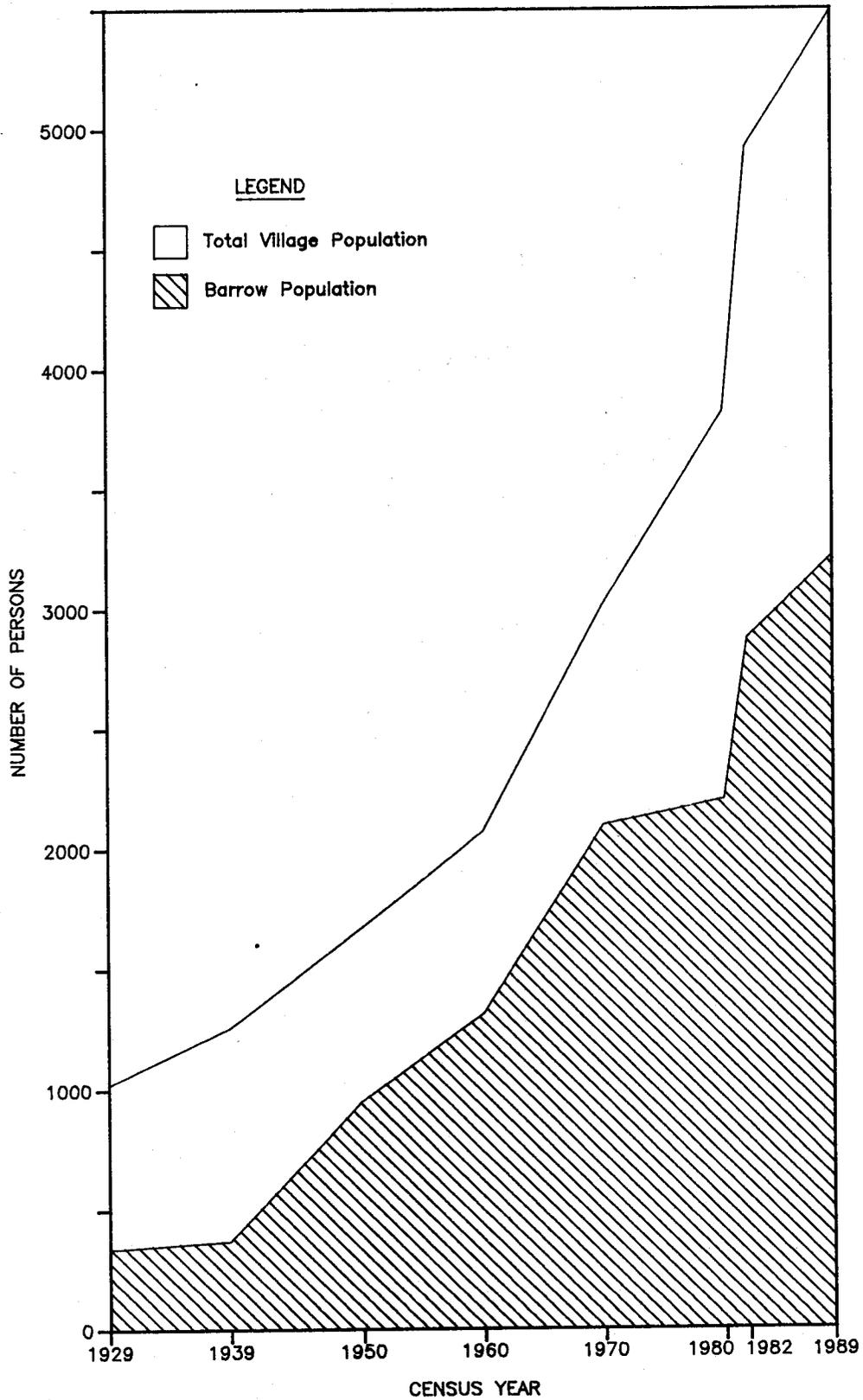
Village	1929	% Total	1939	% Total	1950	% Total	1960	% Total	1970	% Total	1980	% Total	1982	% Total	1988 1989	% Total
Anaktuvuk Pass	<sup>1/</sup>		<sup>1/</sup>		66	3.9	35	1.7	99	3.3	203	5.3	250	5.1	264	4.9
Atqasuk			78	6.2	49	2.9	30	1.4	<sup>2/</sup>		107	2.8	210	4.3	219	4.1
Barrow	330	32.4	363	28.9	951	56.7	1,314	63.3	2,098	69.4	2,207	57.7	2,882	58.5	3,223	58.6
Kaktovik	<sup>3/</sup>		13	1.0	46	2.7	120	5.8	123	4.1	165	4.3	214	4.3	227	4.2
Nuiqsut	<sup>3/</sup>		89	7.1	<sup>2/</sup>		<sup>2/</sup>		<sup>2/</sup>		208	5.4	287	5.8	314	5.7
Point Hope	139	13.7	257	20.4	264	15.7	324	15.6	386	12.8	464	12.1	544	11.0	591	10.5
Point Lay	351	34.5	117	9.3	75	4.5	<sup>2/</sup>		<sup>2/</sup>		68	1.8	105	2.1	158	2.9
Wainwright	197	19.4	341	27.1	227	13.5	253	12.2	315	10.4	405	10.6	436	8.9	502	9.1
<b>TOTALS</b>	<b>1,017</b>		<b>1,258</b>		<b>1,678</b>		<b>2,076</b>		<b>3,021</b>		<b>3,827</b>		<b>4,928</b>		<b>5,498</b>	

Source: USDOC, Bureau of the Census, 1981; Alaska Consultants, Inc., 1981; North Slope Borough Census, Report on Population and Economy, May 1989.

<sup>1/</sup> Anaktuvuk Pass was not a village site in 1929 and 1939. It functioned as a seasonal camp.

<sup>2/</sup> Settlement is abandoned, used as a seasonal camp, or too small to be censused.

<sup>3/</sup> Figures are not available. Size is assumed to be small.



Source: U.S. Dept. of Commerce, 1981; Bureau of the Census, 1981; Alaska Consultants, Inc., 1981.

Figure III-C-4. North Slope Population Trends: 1929-1989 Total Village Population, Barrow

1980's--14.3 percent annually--indicates its role as the political and bureaucratic center for all these activities. Much of this growth has occurred from the immigration of non-Natives. Between 1970 and 1980, this group grew from 9.5 to 22 percent of Barrow's total population. This group is made up primarily of Caucasians but includes Blacks, Filipinos, Koreans, Mexicans, and others (Smythe and Worl, 1985).

Figures for the preceding decade also show the importance of the NSB-CIP program. By the early 1970's, the area's growth rate was slowing. The Alaska Native Claims Settlement Act (ANCSA) settlement in 1971 and NSB incorporation in 1972 opened the way to expanded revenues, as well as to resettlement of Atqasuk, Nuiqsut, and Point Lay. This resettlement, which was financed primarily by the NSB, initially masked the CIP program's role in promoting further centralization in Barrow. By creating construction jobs in the new settlements, other communities--most notably Barrow--lost inhabitants during the initial stages of elevated population growth. For the first time since 1939, Barrow actually lost ground in its share of the total North Slope population.

The effects of the CIP program on composition of North Slope villages can be seen from their non-Native populations. Between 1970 and 1980, the non-Native population grew by 150 percent. This population included teachers and technocrats, with or without their families, as well as skilled laborers required on local CIP projects. It also included other ethnic minorities who moved to Barrow and filled relatively low-paying unskilled and clerical jobs (Smythe and Worl, 1985). In particular, the number of laborers fluctuated rapidly along with construction demands. Nevertheless, in 1980, approximately 30 percent of all village inhabitants were non-Natives. The CIP job-related characteristic of this influx is evident in its distribution among age groups. Only peak working years are well-represented--children are relatively few, the aged almost nonexistent. Figure III-C-5 depicts non-Native village population by percentage of age group. The age-30 to -34 group represents over 40 percent of all village inhabitants of that group. Actually, the percentage of non-Natives in these active years is under-represented by this graph. Since no age information was given for 19 percent of non-Native inhabitants, they were excluded from this tabulation.

The CIP expenditures were \$93 million in 1980 and peaked at \$302 million in 1983. They dropped to \$211 million in 1984 and further to \$199 million in 1985. The CIP projects face further drastic reduction and may drop to 0 by 1990. This reduction is expected whether or not more OCS or onshore oil developments occur on the North Slope (see Sec. III.C.1.a). Because recent population growth has been tied to CIP-related opportunities, similar growth is not expected in the foreseeable future. Various population sectors should be differentially affected. Because non-Native residency is tied most directly to CIP projects, this group faces some reduction. This reduction may be heaviest among people in their 20's and 30's in settlements other than Barrow. It should involve people in construction roles more than those in managerial or technocratic roles.

In recent years, governmental functions have concentrated in Barrow, and its Native residents may be less affected by projected reductions in CIP expenditures than those in the smaller villages. Finally, with the reduction of construction jobs, Native families may rely more on subsistence harvests. Native households with more developed subsistence-harvest and -sharing patterns may be less affected by demographic shifts than households without them. This may be particularly true in settlements other than Barrow.

**2. Sociocultural Systems:** The topic of sociocultural systems encompasses the social organization and cultural values of the society. This section provides a profile of the sociocultural systems that characterize the communities near the Sale 124 area that might be affected by this lease sale: Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik (see Fig. I-2). All of these communities are within the NSB. The ethnic, sociocultural, and socioeconomic makeup of the communities on the North Slope is primarily Inupiat. Sociocultural systems of the North Slope Inupiat are described and discussed in detail in the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a, Sec. III.C.2) and the Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b, Sec. III.C.3), which are incorporated by reference. The following summary is pertinent to Sale 124 and is augmented by additional material, as cited.

**a. Introduction:** The North Slope has a fairly homogeneous population of Inupiat (72.3% Inupiat in 1989). The percentage in 1989 ranged from 93.7 percent Inupiat in Nuiqsut to 61.1 percent Inupiat in Barrow (NSB Census, 1989). In 1989, the populations of each of the communities in the sale area were 3,223 in Barrow; 502 in Wainwright; 219 in Atqasuk; 314 in Nuiqsut; and 227 in Kaktovik (see also Sec. III.C.1).

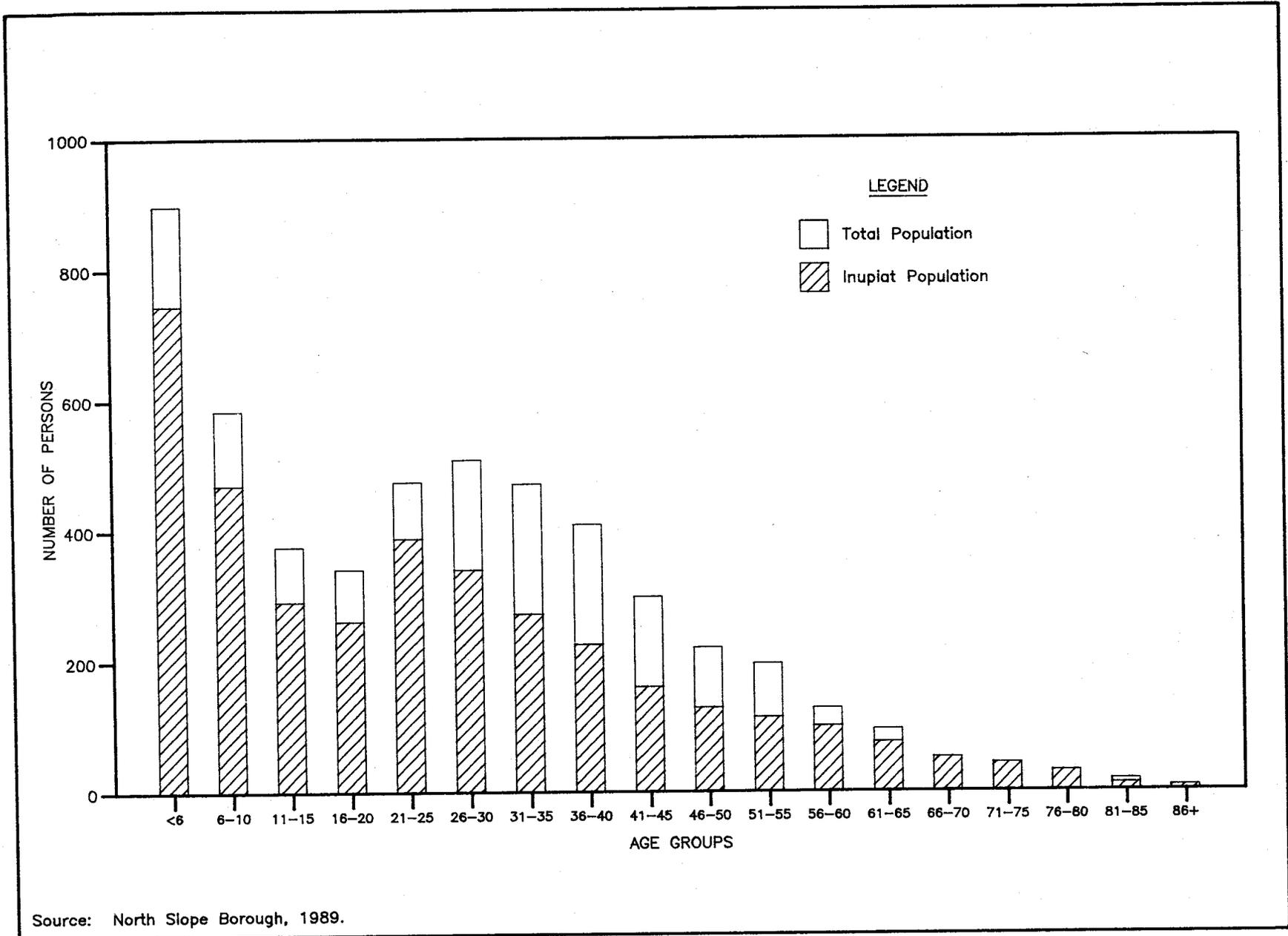


Figure III-C-5. Comparison of Inupiat and Total Population of the North Slope Borough, 1988

North Slope society responded to early contacts with outsiders by successfully changing and adjusting to new demands and opportunities (Burch, 1975; Worl, 1978; NSB Contract Staff, 1979). Since the 1960's, the North Slope has witnessed a period of "super change," a pace of change quickened by the area's oil developments (Lowenstein, 1981). In 1952, the anthropologist Spencer was dependent upon interpreters for his Barrow work (Spencer, 1959). Today, few North Slope residents lack English skills (Klausner and Foulks, 1982:48); and communications with the "outside" are no longer uncertain. All North Slope communities are tied to the larger world via telephone, cable television, and regularly scheduled commercial air transportation. Oil-related work camps have altered the seascape and landscape of the Prudhoe Bay-Kuparuk industrial complex, making some areas off limits to traditional pursuits such as hunting. Large NSB CIP's dramatically changed the physical appearance of the NSB communities. Blocks of modern houses, new schools, water-treatment plants, power plants, and community buildings stand out. Snowmachines, three-wheeled all-terrain vehicles, and--in many communities--cars and pickups abound.

Social services have increased dramatically during the period from 1970 to 1985, with increased NSB budgets and grants acquired by or through the Inupiat Corporation of the Arctic Slope. In 1970 and 1977, residents of North Slope villages were asked about their state of well-being in a survey conducted by the ISER (University of Alaska, ISER: see Kruse, Baring-Gould, and Schneider, 1983). Significant increases in complaints about alcohol and drug use were noted in all villages between 1970 and 1977. Health and social-services programs have attempted to meet the needs of alcohol and drug-related problems with treatment programs and shelters for wives and families of abusive spouses and with greater emphasis on recreational programs and services.

The introduction of modern technology has tied the Inupiat subsistence economy to a cash economy (Kruse, 1982). Nevertheless, oil-supported revenues help support a lifestyle that is still distinctly Inupiat; and the area's people feel that their culture remains intact (Sale 87 FEIS [USDOI, MMS, 1984]); Alaska Consultants, Inc. [ACI]/Braund, 1984, Table 113). Indeed, outside pressures and opportunities have sparked what may be viewed as a cultural revival (Lantis, 1973). North Slope residents exhibit an increasing commitment to areawide political representation, local government, and the cultural preservation of such institutions as whaling crews and dancing organizations. People continue to hunt and fish; but aluminum boats, outboards, and three-wheelers now help blend these pursuits with wage work. Inupiat whaling remains a proud tradition that involves ceremonies, dancing, singing, visiting and cooperation between communities, and the sharing of foods.

The possible effects of the proposed action on whales and whaling is a major scoping issue for residents of the North Slope (Kruse, Baring-Gould, and Schneider, 1983; ACI/Braund, 1984; USDOI, MMS, 1983b, Sale 87 Barrow Public Hearing Transcript). Whaling remains a primary subsistence activity for Wainwright, Barrow, Nuiqsut, and Kaktovik (see Sec. III.C.3)--an activity that has roots in Eskimo prehistory (Giddings, 1967). Whales are not only an important subsistence issue; they are the singlemost important animal to the North Slope sociocultural system, which also has roots in prehistory (Lantis, 1938; Bockstoce et al., 1979; Worl, 1979).

The following sections describe the communities that may be affected by Sale 124. These community-specific descriptions discuss factors relevant to the sociocultural analysis--location of the community in relation to industrial activities, population, and current socioeconomic conditions. Social organization, cultural values, and other issues of all Sale 124 communities are discussed following these descriptions.

(1) Wainwright: Wainwright is the location of one of the assumed air-support bases for exploration during this lease sale and is 20 to 25 km from the pipeline landfall and shore-base site at Point Belcher. Some of Wainwright's subsistence marine resources are harvested in a portion of the proposed lease-sale area.

As in other North Slope communities, the changes in Wainwright from 1975 to 1985--stimulated by the NSB CIP boom--have not been as dramatic as the changes in Barrow. Nonetheless, the CIP has led to retention of the population and the creation of new jobs, housing, and infrastructure. Although there has been an influx of non-Natives into Wainwright, unlike Barrow, most of these non-Natives are transient workers and cannot be considered permanently settled or even long-term residents. In 1989, approximately 8.7 percent of all Wainwright residents were non-Native (North Slope Borough, Dept. of Planning and Community Services, 1989). This was a decrease from 30 percent non-Native in 1983 (Luton, 1985), and most likely a direct result of the end of the NSB CIP boom. Of these approximately 43 residents, only a few would be in Wainwright 6 months to a year later. Even most of the eight Caucasian teaching couples in Wainwright in 1983 (Luton,

1985) had not been in Wainwright more than a year. The Caucasians in Wainwright tend to be nonpermanent, mobile residents who have relatively little interaction with the Native population--which has created a certain degree of racial tension in the community (Luton, 1985).

The Wainwright CIP has not only been central to the local economy, it also has changed the face of the community and affected the quality of life. Residents now live in modern, centrally heated homes with running water, showers, and electricity. New buildings dominate the town, and upgraded roads have encouraged more people to own vehicles. Between July 1982 and October 1983, the number of pickup trucks and automobiles in Wainwright more than tripled (Luton, 1985).

(2) Barrow: Barrow is likely to be one of the air-support bases for exploration. A major part of Barrow's marine subsistence-harvest areas are within the proposed Sale 124 area. Barrow's terrestrial-harvest area includes the pipeline routes from Pt. Belcher and Pitt Point.

Barrow is also the largest community on, and the regional center of, the North Slope. Barrow has already experienced dramatic population changes as a result of increased revenues from onshore oil development and production in Prudhoe Bay and other smaller oil fields; these revenues have stimulated the NSB CIP. In 1970, the Inupiat population of Barrow represented 91 percent of the total population (USDOC, Bureau of the Census, 1971); by 1989, the proportion had dropped to 61.1 percent (North Slope Borough, Dept. of Planning and Community Services, 1989). In 1985, non-Natives outnumbered Natives between the ages of 26 and 59. An increasing number of non-Native families also have established permanent residence in Barrow. Another significant feature of the Barrow population since 1970 is the increase in ethnic diversification. Caucasians comprise 25.2 percent and Filipinos comprise 4.9 percent of the total non-Native population. Other population groups include other Alaska Natives, Blacks, Mexicans, and Koreans (NSB Census, 1989). The influx of non-Natives to Barrow also has brought an increase of mixed households since 1978, with an increasing number of Inupiat women choosing non-Natives as spouses (Worl and Smythe, 1986).

In the period from 1975 to 1985, Barrow experienced extensive social and economic transformations. The NSB CIP stimulated a boom in the Barrow economy and an influx of non-Natives to the community. Inupiat women entered the labor force in the largest numbers ever and achieved positions of political leadership in the newly formed institutions. The proportion of Inupiat women raising families without husbands also increased during this period. The extended family, operating through interrelated households, is salient in community social organization (Worl and Smythe, 1986). During this same period, the social organization of the community became increasingly diversified with the proliferation of formal institutions and the large increase in the number of different ethnic groups. Socioeconomic differentiation is not new in Barrow--during the commercial-whaling period and the reindeer-herding period, there were influxes of outsiders and shifts in the economy. Other fluctuations have occurred during different economic cycles (trapping, U.S. Navy and Arctic Contractors employment, the recent CIP boom, and the periods of downturn in between [Worl and Smythe, 1986]). As a consequence of the changes it has already experienced, it may be more capable of absorbing additional changes as a result of this lease sale than would a smaller, homogeneous Inupiat community.

(3) Atqasuk: Atqasuk is a small (201 residents in 1989 [NSB Census, 1989]), predominantly Inupiat community (90% in 1989 [NSB Census, 1989]) located inland from the Arctic Ocean on the Meade River about 60 mi south of Barrow. Atqasuk is not located in the vicinity of proposed lease-sale activities, nor is it expected to experience any direct additional population growth or employment as a result of Sale 124. Indirect employment opportunities as a result of this sale are not expected to be large and would not have additional effects on the sociocultural systems of these communities. Effects on the sociocultural systems of these communities are only expected to occur as a result of increased NSB revenues and their effects on the subsistence-harvest patterns of these communities.

(4) Nuiqsut: Nuiqsut (population 302 in 1989, 97% Inupiat [NSB Census, 1989]) is located on the west bank of the Nechelik Channel of the Colville River Delta, about 25 mi from the Arctic Ocean and approximately 150 mi southeast of Barrow. Nuiqsut, which was one of three abandoned Inupiat villages in the North Slope region identified in ANCSA, was resettled in 1973 by 27 families from Barrow.

Most of Nuiqsut's marine subsistence-harvest area lies within the proposed Sale 124 lease-sale area; and its terrestrial, fish, and bird subsistence-harvest areas are in the vicinity of possible landfalls at Pitt, Oliktok, and Thomson Points. Additionally, a pipeline from Pt. Belcher would go through Nuiqsut's land subsistence-harvest area; and Nuiqsut also may be used for some air support for lease activities.

(5) Kaktovik: Kaktovik (population 210, 80% Inupiat in 1989 [NSB Census, 1989]), the easternmost village in the North Slope Borough, is located on the north shore of Barter Island, which is between the Okpilak and Jago Rivers on the Beaufort Sea coast. Barter Island is one of the largest of a series of barrier islands along the north coast and is about 300 mi east of Point Barrow. Kaktovik has been an important "place of barter" for centuries. Canadian and Barrow Inupiat stopped on Barter Island to trade. In 1923, a white trader established a permanent village on Barter Island.

Like Nuiqsut, most of Kaktovik's marine subsistence-harvest area is within the proposed Sale 124 lease-sale area; and its terrestrial, fish, and bird subsistence-harvest areas include a possible landfall at Point Thomson. Kaktovik also would be used for some air support for lease activities.

b. Social Organization: The social organization of communities near the Sale 124 area is strongly kinship-oriented. Kinship formed "the axis on which the whole social world turned" (Burch, 1975). Historically, households were composed of large, extended families; and communities were kinship units. Today, there is a trend away from the extended-family household because of an increase in mobility, availability of housing, and changes in traditional kinship patterns. However, kinship ties in Inupiat society continue to be important and a central focus of the social organization.

The social organization of the North Slope Inupiat encompasses not only households and families but wider networks of kinspeople and friends. These various types of networks are related through various overlapping memberships and also are embedded in those groups that are responsible for hunting, distributing, and consuming subsistence resources.

An Inupiat household on the North Slope may contain a single individual or group of individuals who are related by marriage or ancestry. However, other individuals--related by birth, marriage, or friendship--may visit for extended periods and take their meals and sleep in this household. In fact, they may periodically visit a round of households where they stay for limited periods on a regular basis. The members of an Inupiat household are fluid; relatives or friends may drop in and share meals and sleeping facilities for extended periods; and meals, babysitting, and other reciprocal activities regularly take place with other relatives and friends at their residences. The interdependencies that exist among Inupiat households differ markedly from those found in the U.S. as a whole. In the larger non-Inupiat society, the demands of wage work emphasize a mobile and prompt work force. While modern transportation and communication technologies allow for contact between parents, children, brothers, sisters, and other extended-family members, more often than not independent nuclear households (father, mother, and children) or conjugal pairs (childless couples) form independent "production" units that do not depend on extended-family members for the day-to-day support of food, labor, or income. Naturally, many people depend on their families for emotional support via the telephone or--in times of crisis--via air transportation. They also know that their extended-family might provide income for medical emergencies and help with bills during periods of unemployment. However, a key contrast between non-Native and Inupiat cultures occurs in their differing expectations--the Inupiat expect and need support from extended-family members on a day-to-day basis.

Associated with these differences, the Inupiat hold unique norms and expectations about sharing. Households are not necessarily viewed as independent economic units; and giving, especially by successful community members (e.g., hunters), is regarded as an end in itself, although community status and esteem accrue to the generous. Kinship ties are strengthened through sharing and exchange of subsistence resources (Nelson, 1969; Burch, 1971; Worl, 1979; ACI/Braund, 1984; ACI/Courtneage/Braund, 1984; and Luton, 1985). Kinship is also strengthened through cooperation in terms of group efforts and provision of cash and equipment for subsistence activities (ACI/Courtneage/Braund, 1984).

c. Cultural Values: Traditional Inupiat values were centered on the Inupiat's close relationship with natural resources, specifically game animals. The Inupiat also had a close relationship to the supernatural with specific beliefs in animal souls and beings who controlled the movements of animals. Other values included an emphasis on the community and its needs and support of other individuals. The Inupiat respected persons who were generous, cooperative, hospitable, humorous, patient, modest, and/or industrious (Lantis, 1959; Milan, 1964; Chance, 1966). Although there have been substantial social, economic, and technological changes in Inupiat lifestyle, subsistence continues to be the core or central organizing value of Inupiat sociocultural systems in the Sale 124 area. The Inupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1969). This refrain is repeated again and again by the residents of the

North Slope (Kruse, Baring-Gould, and Schneider, 1983; ACI/Braund, 1984). Task groups are still organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an important part of the Inupiat life. Whom one cooperates with is a major component of the definition of significant kin ties (Heinrick, 1963). Since subsistence tasks are, to a large extent, age and sex specific, subsistence task groups are even important to the definition of such relations as the roles of husbands and wives, children and parents, friends, etc. (Wolfe, 1981; Thomas, 1982; Jorgensen, 1984; and Little and Robbins, 1984). In addition, large amounts of subsistence foods are shared within the community. Whom one gives to and receives from also are major components of the definition of significant kin ties (Heinrick, 1963; ACI/Courtage/Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system; the hunt, the sharing of products of the hunt, and the beliefs surrounding the hunt tie families and communities together, connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men. Good hunters are often respected leaders. Good health comes from a diet of products of the hunt. Young hunters still give their first game to the community elders. To be generous brings future success. These are but some of the ways in which subsistence and beliefs about subsistence join with sociocultural systems.

The cultural value placed on kinship and family relationships is apparent in the sharing, cooperation, and subsistence activities that occur in Inupiat society, as discussed above. However, the value also is apparent in the patterns of residence, reciprocal activities, social interaction, adoption, political affiliations (some families will dominate one type of government, e.g., the village corporation), employment, sports activities, and membership in voluntary organizations (Mother's Club, Search and Rescue, etc.) (ACI/Courtage/Braund, 1984).

Bowhead whaling also remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess. The spring whale hunt off the Chukchi Sea lead system ties together these values with feasting and food preferences and symbolizes cultural integrity (see Bockstoce et al., 1979; ACI/Courtage/ Braund, 1984).

The ramifications of the whale hunt are more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and to define community-leadership patterns as well. The structured sharing of the whale helps determine social relations both within and between communities (Worl, 1979; ACI/Courtage/Braund, 1984).

Furthermore, the task-group formation and structured sharing that surround other subsistence pursuits are likewise important to Inupiat society. For example, the organization of summer boat crews for seal, walrus, and bird hunting helps to define kin ties and leadership within communities. The sharing of the proceeds of these hunts establishes meaningful ties between individuals and families. What is said for summer boat hunting holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to the elders does more than feed old people; it bonds giver and receiver together, joins them to a living tradition, and draws them into their community.

Today, this close relationship between the spirit of a people, their social organization, and the cultural value of subsistence hunting may be unparalleled in other American energy-development situations. The Inupiat people's continuing strong dependence on subsistence foods, particularly marine mammals, creates a unique set of potential effects from offshore oil development on the social and cultural system. A recent analysis of the Inupiat concerns about oil development was based on a compilation of approximately 10 years of recorded testimony at North Slope public hearings for State and Federal energy-development projects. The vast majority of concerns centered around the subsistence use of resources, including damage to subsistence species, loss of access to subsistence areas, loss of Native foods, or interruption of subsistence-species migration. These four concerns represent 83 percent of all the testimony taken on the North Slope (University of Alaska, ISER, 1983, Table 16).

d. Other Issues: Other issues important to an analysis of sociocultural systems are those that will affect or are already affecting Inupiat society. Section III.C.2 of the Sale 97 DEIS details issues about fiscal and institutional growth in the NSB, changes in employment, increases in income, decreases in Inupiaq fluency, rising crime rates, and substance abuse; these issues are summarized in this section. Both the Sale 87 FEIS (USDOJ, MMS, 1984, Sec. III.C.2) and the Sale 97 FEIS (USDOJ, MMS, 1987a, Sec. III.C.2) consider the NSB's fiscal and institutional growth; and, in addition, Smythe and Worl (1985) detail

the growth and responsibilities of local governments.

The NSB provides most government services for all five communities that might be affected by Sale 124. These services include public safety, public utilities, fire protection, and some public-health services. The NSB grew steadily in the late 1970's and early 1980's. Further fiscal and institutional growth is expected to be limited in the foreseeable future because of economic constraints in limiting direct Inupiat participation in oil-industry employment and growing Statewide budget constraints (Kruse, Baring-Gould, and Schneider, 1983). A massive NSB CIP in the early 1980's built facilities such as schools, houses, roads, community buildings, fire stations, and health clinics and provided employment for the North Slope residents. The Arctic Slope Regional Corporation, formed under the ANCSA, runs several subsidiaries including Eskimos, Inc. and Tundra Tours. Most of the communities also have an Indian Reorganization Act (IRA) government as well as a city government. The IRA and village-corporation governments have not provided much in the way of services in the NSB.

The NSB CIP has caused the median yearly income of Natives to increase from \$6,923 in 1970 to \$32,515 in 1980 (per capita, not inflation adjusted) (Smythe and Worl, 1985). This increase was almost totally related to increases in Borough-related or Borough-created jobs. However, with decreasing oil revenues in 1985 and 1986, the CIP and other employment opportunities have decreased; and there has been considerable concern on the North Slope about future employment opportunities.

While decreases in Native-language fluency have been noted among younger NSB residents, North Slope Inupiat are still generally bilingual--about 87 percent speak Inupiaq with some fluency and, of those, only about 6 percent either cannot speak English or speak it poorly. Although most people can speak Inupiaq, there seem to be a number of younger Inupiat who speak English exclusively to their children and who question their own fluency in Inupiaq when speaking (Galginaitis, 1985; Luton, 1985).

Recent statistics on homicides, rapes, and wife and child abuse present a sober picture of some aspects of life in NSB communities. Violent deaths account for more than one-third of all deaths on the North Slope. The Alaska Native Health Board (ANHB) notes the "overwhelming involvement of alcohol (and drug) abuse in domestic violence, suicide, child abuse, birth defects, accidents, sexual assaults, homicide and mental illness" (ANHB, 1985). Lack of comparable data makes it impossible to compare levels of abuse and violence between aboriginal (prior to contact with Caucasians), traditional (from the time of commercial whaling through the fur trade), and modern (since World War II) Inupiat populations. Nonetheless, it is apparent from reading earlier accounts of Inupiat society that there has been a drastic increase in these social problems. Recent information from Barrow (Worl and Smythe, 1986) details the important changes in Inupiat society that have occurred during the last decade in response to these problems. Services provided by outside institutions and programs have recently begun to assume some responsibility for functions formerly provided by extended families. Today, there is an array of social services available in Barrow that is more extensive for a community of this size than anywhere in the U.S. (Worl and Smythe, 1986).

The baseline of the present sociocultural system includes change and strain. The very livelihood and culture of North Slope residents come under increasingly close scrutiny and regulation. The physical landmarks and regularities of life, such as homes, schools, and roads, all evidence massive change and growth. In such a situation, the potential for "lost spirit"--losing one's Native identity and "soul"--increases (Vesilind, 1983). This increase in stresses on social well-being and cultural integrity and cohesion comes at a time of economic well-being that is threatened by the decline of CIP projects across the North Slope (University of Alaska, ISER, 1983).

### 3. Subsistence-Harvest Patterns:

a. Introduction: This section describes the subsistence-harvest patterns of the Inupiat (Eskimo) communities closest to the Sale 124 area--Wainwright, Barrow, Atkasuk, Nuiqsut, and Kaktovik. This community-by-community description provides general information on subsistence-harvest patterns, harvest information by resource and community, timing of the subsistence-harvest cycles, and harvest-area concentrations by resource and by community. Subsistence-harvest patterns of several of the communities adjacent to the Beaufort Sea Sale 124 area are described in Section III.C.3 of the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a) and Chukchi Sea Sale 109 FEIS (USDOI, MMS, 1987b) and are incorporated by reference. The following description is augmented by the "Barrow Arch Socioeconomic and Sociocultural Description" (ACI/Courtnage/Braund, 1984), the "Subsistence Study of Alaska Eskimo Whaling Villages" (ACI/Braund, 1984), "Subsistence Fisheries Alaskan Arctic, 1970-1986" (Craig, 1987), and "North Slope

Subsistence Study, Barrow 1987" (Stephen R. Braund and Associates, 1988).

The community residents adjacent to the Sale 124 area participate in a subsistence way of life. While new elements have been added to the way people live, this way of life is a continuation of centuries-old traditional patterns. Until January 1990, Alaska statutes defined "subsistence uses" as: "the non-commercial, customary and traditional uses of wild, renewable resources by a resident domiciled in a rural area of the state for personal or family consumption" (AS Sec. 16.05.940); and subsistence uses were given priority over other uses. In January 1990, as a result of McDowell vs. State of Alaska, this law was declared unconstitutional by the Alaska Supreme Court. However, Federal law (Title VIII of ANILCA) continues to define Alaskan subsistence and grants it priority over other uses as well. The new ruling means Alaska cannot legally (according to State law) establish rural preference for subsistence. The effect of the Alaska Supreme Court's decision was stayed until July 1, 1990. The State had until then to devise a solution to the issues raised in the McDowell decision. The Alaska State Legislature was not able to pass any subsistence legislation despite a special session called for that purpose. On Federal lands in Alaska, Federal laws grant subsistence priority over other uses, and Federal Agencies are now managing these hunts and will continue to do so until State legislation can be enacted.

Subsistence activities, which are assigned the highest cultural value by the Inupiat, provide a sense of identity as well as an important economic activity. The importance of hunting to the maintenance of cultural identity is expected to grow in the near future as social pressures associated with oil development build.

Inupiat scoping concerns regarding oil development for Sale 124 can be divided into four categories: (1) direct damage to subsistence resources and habitats, (2) disruption of subsistence species during migration, (3) disruption of access to subsistence areas, and (4) loss of Native food.

Effects on subsistence could be serious even if the net quantity of available food did not decline. Some species are important for the role they play in the annual cycle of subsistence-resource harvests. However, the consumption of harvestable subsistence resources provides more than dietary benefits; these resources also provide materials for personal and family use. The sharing of harvestable subsistence resources helps maintain traditional family organization. Subsistence resources provide special foods for religious and social occasions such as Christmas, Thanksgiving, and--the most important ceremony in the communities adjacent to the Sale 124 area--Nalukatak, which celebrates the bowhead whale harvest. The sharing, trading, and bartering of harvestable subsistence resources structures relationships among communities adjacent to the Sale 124 area, while the giving of such foods helps maintain ties with family members elsewhere in Alaska. Finally, subsistence provides a link to the cash economy. Households within the communities earn cash from crafting walrus ivory and whale baleen and from harvesting furbearing mammals. As the availability of wage earnings associated with the oil industry and NSB CIP projects declines in future years, this link may be expected to increase in importance in the communities of the sale area. These are examples of possible effects on consumption. The production side of the subsistence system also may be affected. The temporary elimination of a species from a community's subsistence-harvest spectrum could impair the hunt of that species without substantially affecting the overall diet.

b. Community Subsistence-Harvest Patterns: This section provides general information regarding subsistence-harvest patterns in all of the communities close to the Sale 124 area. The extent of the subsistence area used by each community in the sale area is shown in Figure III-C-6. Figures III-C-7 through III-C-12 show the harvest-concentration areas for the various subsistence resources used by the communities of Wainwright, Barrow, Atqasuk, Nuiqsut, and Kaktovik. Specific information regarding the harvest areas, species harvested, and quantities harvested is provided in the following discussion of each community. Under certain conditions, harvest activities may occur anywhere in the sale area; but they tend to be concentrated along rivers and coastlines, near communities, and at particularly productive sites.

While the subsistence areas and activities of all five communities near the sale area would be affected at least indirectly by proposed Sale 124, most of the marine-subsistence-harvest areas of Nuiqsut and Kaktovik lie within the Sale 124 boundary. Parts of Atqasuk's and Barrow's marine-subsistence-harvest areas--especially for bowhead whales and other marine mammals, marine fishes, and migratory waterfowl--lie within this boundary. The caribou-hunting areas of Barrow, Wainwright, Atqasuk, Nuiqsut, and Kaktovik would be most directly affected by pipelines and other onshore facilities associated with the proposed action.

Subsistence harvest of vegetation by communities adjacent to the Sale 124 area is limited, while the harvest of faunal resources such as marine and terrestrial mammals and fishes is heavily emphasized. The spectrum of

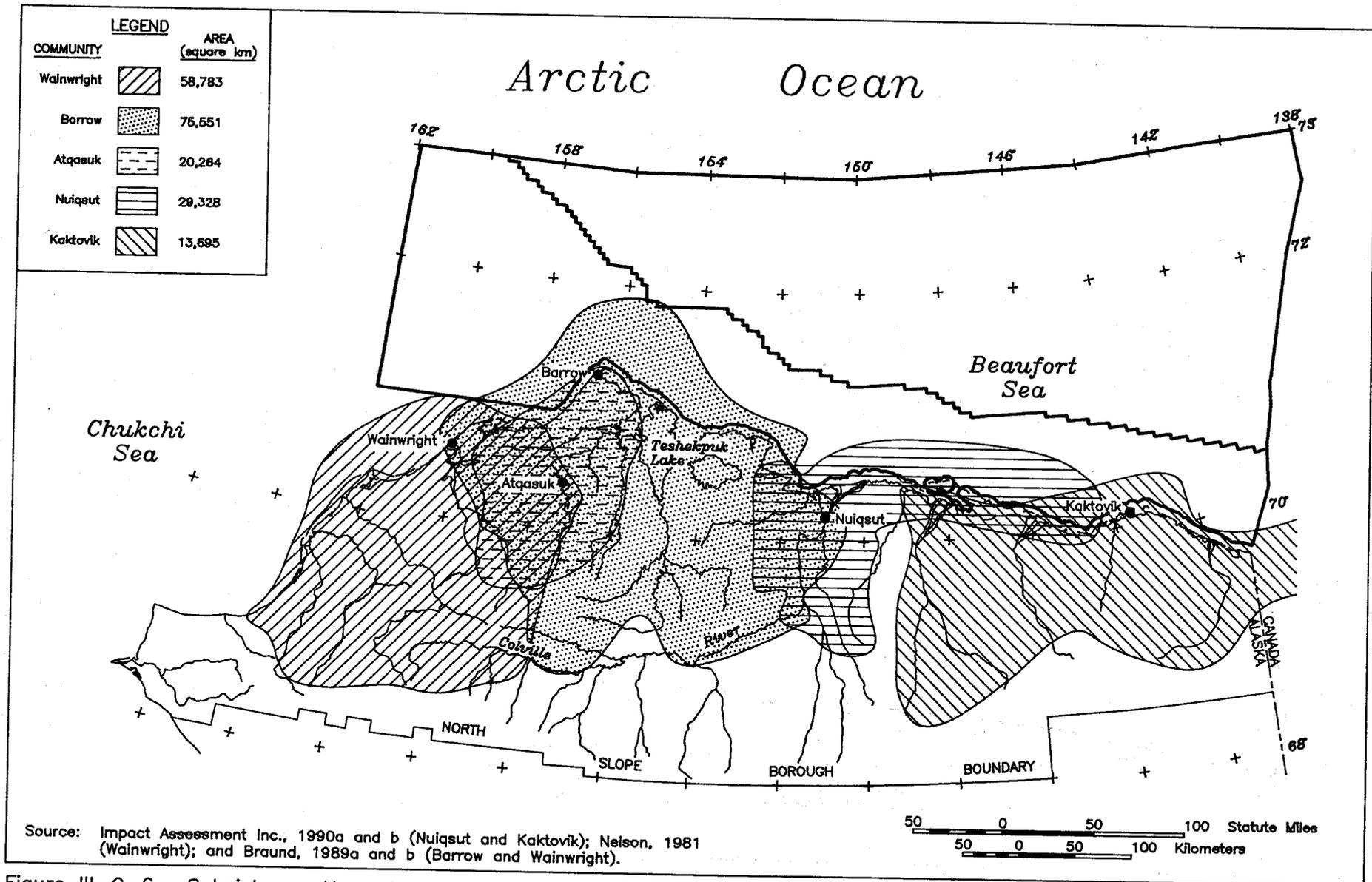


Figure III-C-6. Subsistence-Harvest Areas for Sale 124 Communities

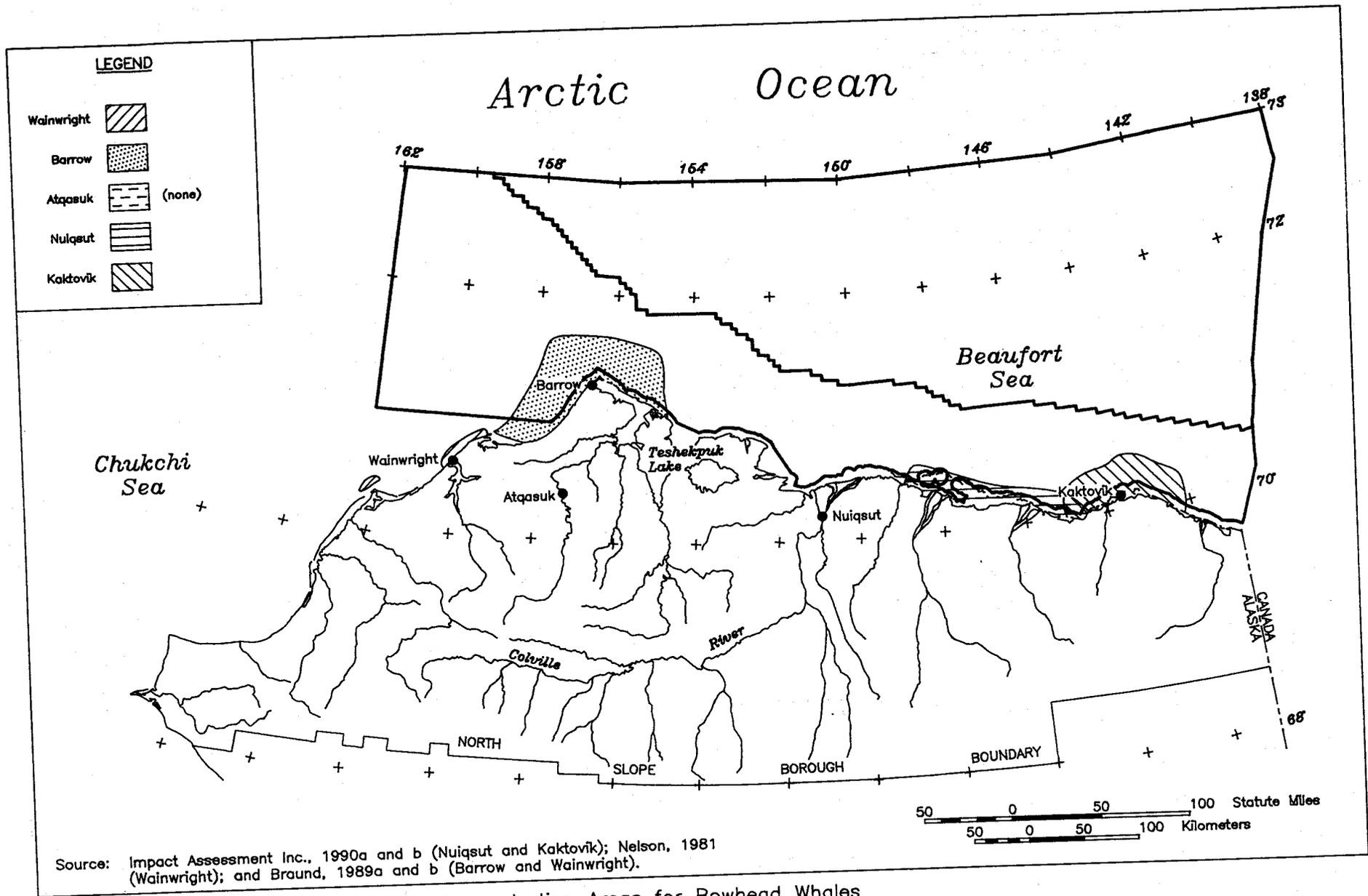


Figure III-C-7. Subsistence-Harvest-Concentration Areas for Bowhead Whales

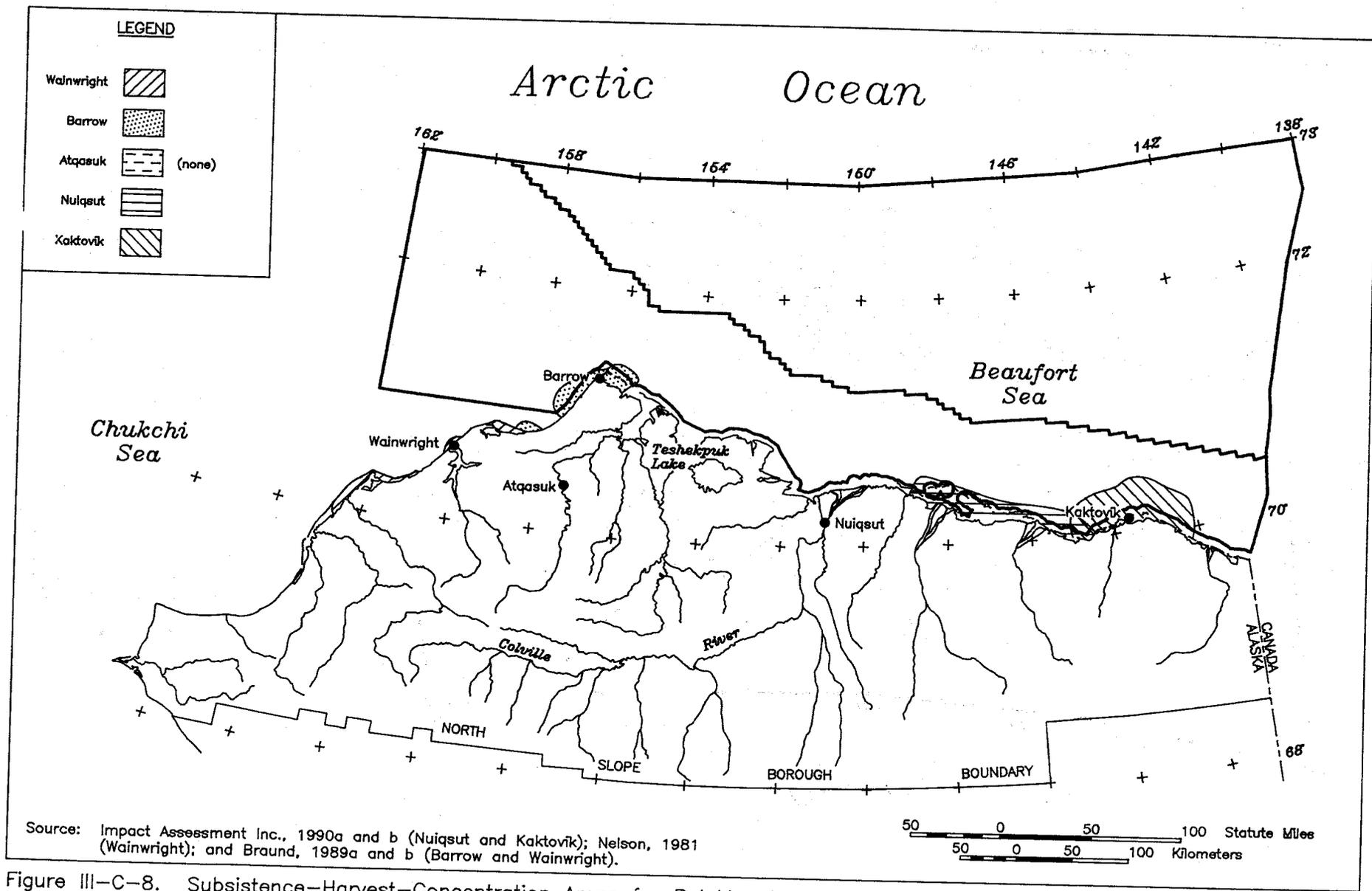


Figure III-C-8. Subsistence-Harvest-Concentration Areas for Belukha Whales

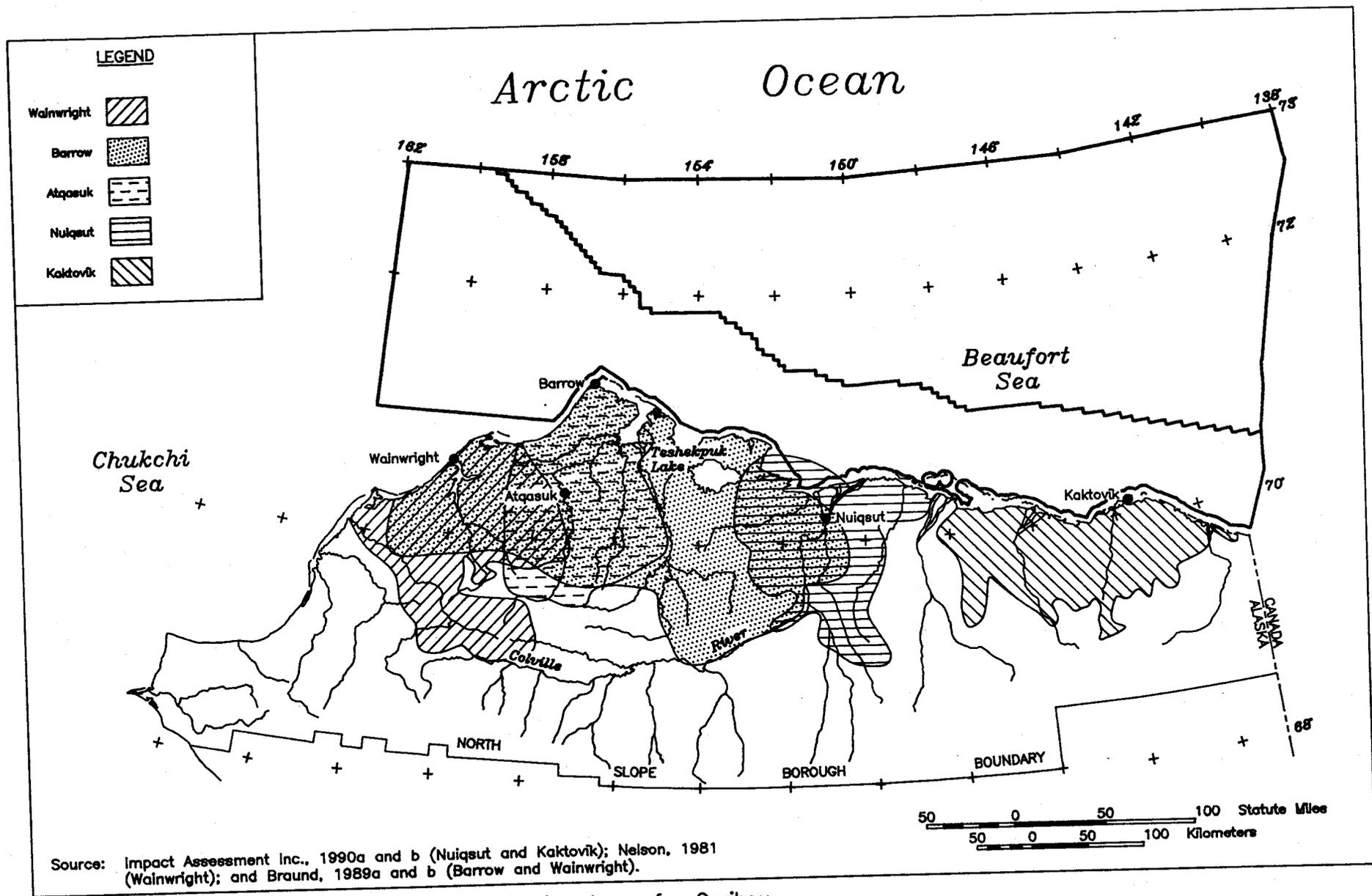


Figure III-C-9. Subsistence-Harvest-Concentration Areas for Caribou

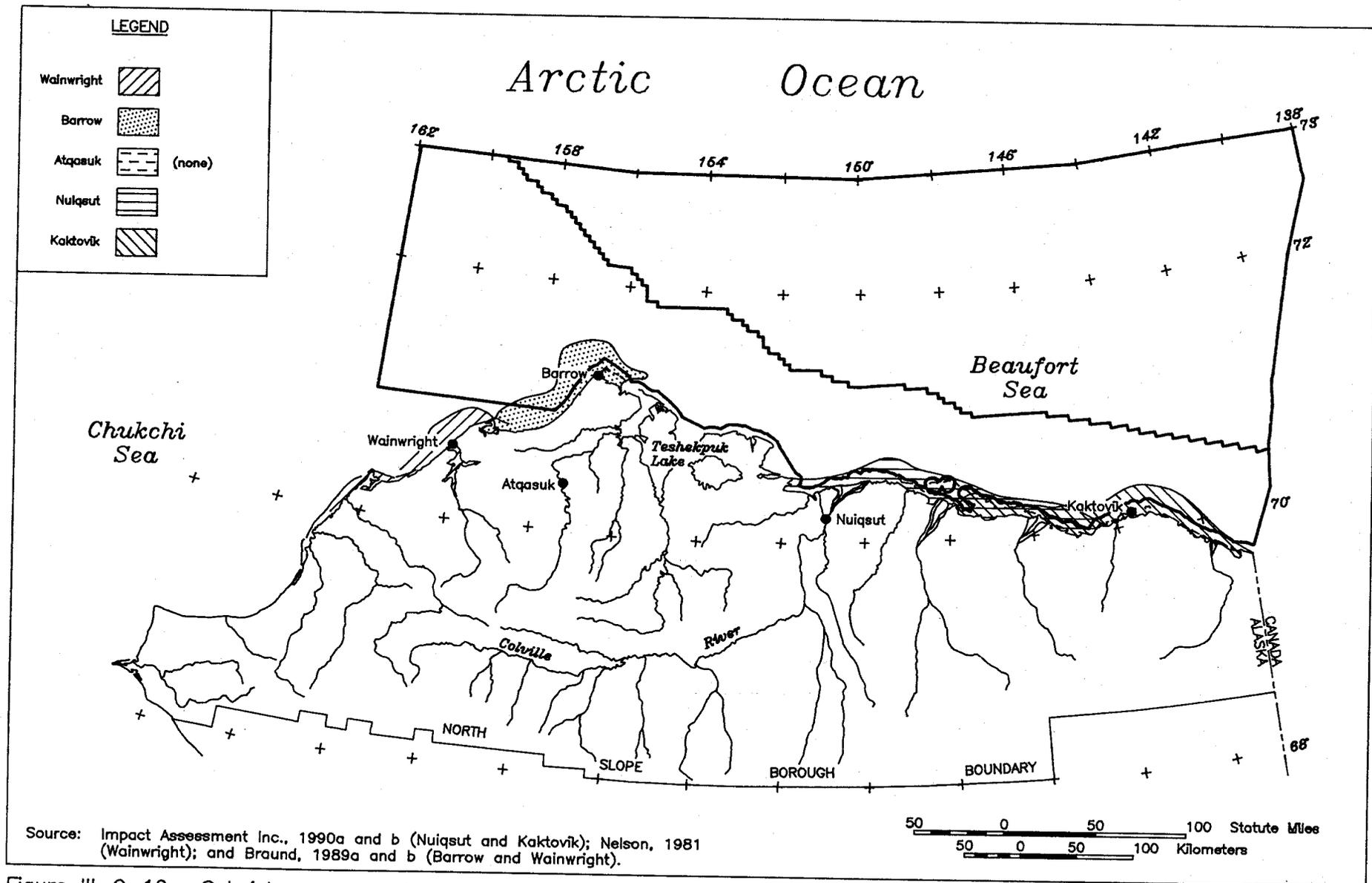


Figure III-C-10. Subsistence-Harvest-Concentration Areas for Seals

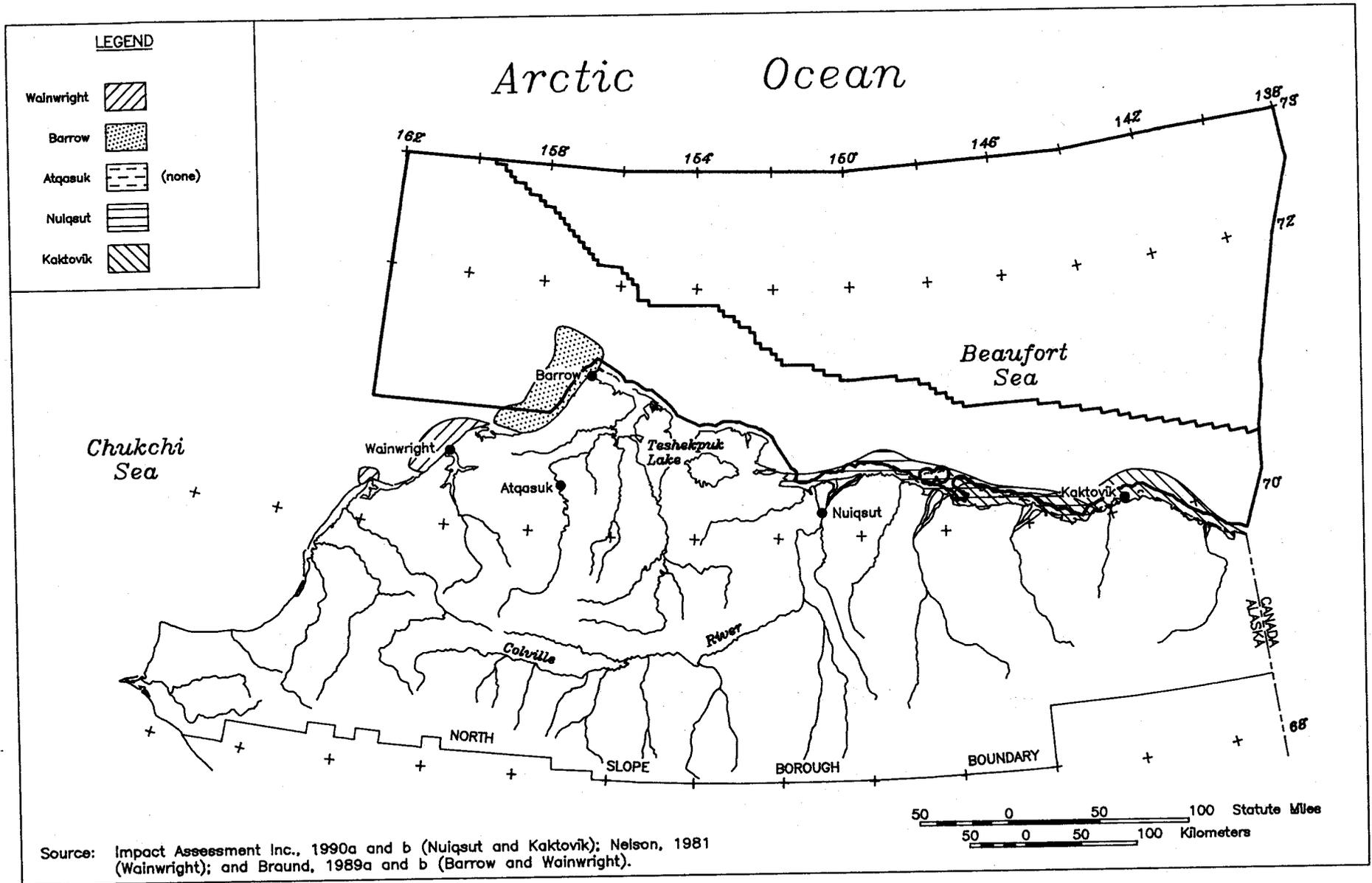


Figure III-C-11. Subsistence-Harvest-Concentration Areas for Walrus

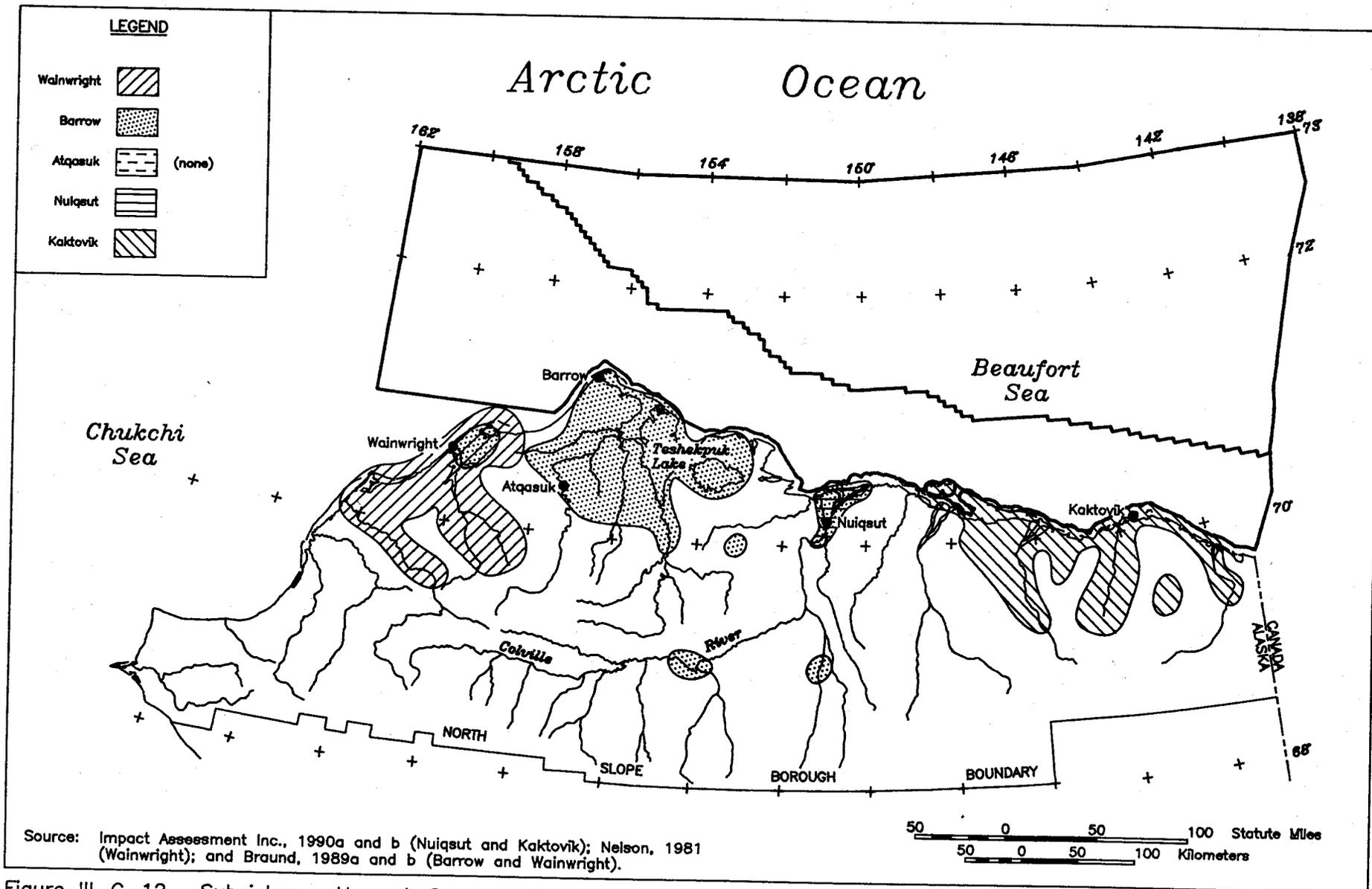


Figure III-C-12. Subsistence-Harvest-Concentration Areas for Fishes

available resources in this region is limited when compared to more southerly regions. Table III-C-4 presents a list of resources harvested by each community in the sale area. Tables III-C-5 through III-C-8 summarize residents' responses to the following categories: (1) subsistence resources most often harvested by communities close to the sale area, (2) resources that provided the largest source of meat, (3) resources that were consumed most often, and (4) resources that were preferred (see the Beaufort Sea Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a] and the Chukchi Sea Sale 109 FEIS [USDOI, MMS, 1987b]). While the responses differed from community to community, the combination of caribou, bowhead whale, and fish was identified by between 75 and 95 percent of all respondents as being the primary group of resources harvested (Tables III-C-5 through III-C-7).

Available data on kilograms of harvested and/or consumed subsistence resources provide a good idea of subsistence levels and dependency (Stoker, 1983, as cited by ACI/Braund, 1984). The caribou is the most important resource in terms of effort spent hunting, quantity of meat hunted, and quantity of meat consumed (effort spent hunting is measured by frequency of hunting trips rather than total kg harvested [Tables III-C-5 through III-C-7]). The bowhead whale is the preferred meat (Table III-C-8) and also is the subsistence resource most important as the basis for sharing and community cooperation--the foundation of the sociocultural system (see the Sale 97 FEIS, Sec. III.C.3). Depending on the community, fish are the second- or third-most-important resource after caribou and bowhead whale (Table III-C-6). The bearded seal and birds also are considered primary subsistence species.

Waterfowl are particularly important during the spring, when they provide variety to the subsistence diet. Seal oil from hair and bearded seals is an important staple and a necessary complement to other subsistence foods. Whaling is a major concern in the Sale 124 area. The subsistence pursuit of bowhead whales occurs at Wainwright, Barrow, Nuiqsut, and Kaktovik. Whaling is the most-valued activity in the subsistence economy of these communities today. This is true in spite of International Whaling Commission (IWC) quotas and relatively plentiful supplies of caribou, fish, and other subsistence foods and a limited supply of retail grocery foods (except in Barrow). Whaling traditions include kinship-based crews, use of skin boats, shoreline preparation for distribution of the meat, and total community participation and sharing. In spite of the rising cash income, these traditions remain as central values and activities for all the Inupiat in these communities (see the Sale 97 FEIS, Sec. III.C.3, for a discussion on the cultural importance of whaling).

Bowhead whaling strengthens family and community ties and the sense of a common Inupiat heritage, culture, and way of life. Thus, whaling activities provide strength, purpose, and unity in the face of rapid change. Barrow is the only community within the area that harvests whales in both the spring and the fall (see Fig. III-C-7). Wainwright residents hunt bowheads only during the spring season, and Nuiqsut and Kaktovik residents hunt bowhead only during the fall season.

Harvest data for Barrow, Wainwright, Nuiqsut, and Kaktovik are only estimates that represent average values. Because of this limitation, resource-harvest data are presented in terms of a 20-year average (from 1962-1982) for selected North Slope communities (Table III-C-9). Table III-C-10, which shows the contribution made by various harvestable subsistence resources to the Native diet, is based on the amount of usable meat and fat contributed to the diet rather than on the number of animals harvested. The 20-year averages do not reflect the important shift in subsistence-harvest patterns that occurred in the late 1960's, when the substitution of snowmachines for dogsleds decreased the importance of ringed seals and walrus (two key dogfoods) and increased the relative importance of waterfowl in the subsistence system. While ringed seals and walrus remain significant human foods and walrus still provide important raw materials for Native handicrafts, this shift illustrates that technological or social change may lead to long-term modifications of the subsistence system. Because of a projected decline in NSB CIP projects, community wage work, and incomes (see Sec. III.C.1), subsistence hunting in general may increase. The hunting of walrus and polar bears, particularly, may increase because of their importance for Native handicrafts. Because of recent changes in technology and subsistence-harvest patterns, the dietary importance of waterfowl also may continue to increase. However, none of these changes would affect the predominant dietary roles of caribou, whales, or fishes--the three resources that play central and specialized roles in the North Slope subsistence system and for which there are no logical substitutes.

(1) Wainwright: Wainwright residents (population 502 in 1989 [NSB, 1989]) enjoy a diverse resource base that includes both terrestrial and marine resources. Wainwright is located on the Chukchi Sea coast about 160 km southwest of Barrow. Marine-subsistence activities are focused on the coastal waters from Icy Cape in the southern range to Point Franklin and Peard Bay in the northern. The Kuk River lagoon system--a major marine estuary--is an important marine and wildlife habitat used by local

Table III-C-4  
Subsistence Resources Harvested by Selected North Slope Communities<sup>1/</sup>

Resource	Barrow C/IN <sup>2/</sup>	Wainwright C/IN	Pt. Lay C/IN	Pt. Hope C/IN	Atkasuk IN	Nuiqsut IN/C
Bowhead Whales	X	X	<sup>3/</sup>	X		X
Caribou	X	X	X	X	X	X
Fishes	X	X	X	X	X	X
Belukha Whales	X	X	<sup>3/</sup>	X		X
Seals	X	X	X	X		X
Bearded Seals	X	X	X	X		X
Walruses	X	X	X	X		X
Polar Bears	X	X	X	X		X
Moose	X	X	X	X	X	X
Sheep				X		
Small Land Mammals	X	X	X	X	X	X
Ducks	X	X	X	X	X	X
Geese <sup>4/</sup>	X	X	X	X	X	X
Murres						
Owls					X	
Ptarmigan	X	X	X	X	X	X
Bird Eggs	X	X	X	X	X	X
TOTAL	14	14	14	16	9	13

Sources: NSB Contract Staff, 1979:10-14; ACI/Braund, 1984, Tables 96, 97, 98, and 108.

<sup>1/</sup> This list of resources is derived from NSB Contract Staff (1979:14). For the purposes of this table, "primary" and "secondary" resources are joined and designated with an "X." Following ACI/Braund (1983, Tables 96, 97, 98, and 108), bowhead whales, caribou, and fishes are listed first to designate their relative importance.

<sup>2/</sup> C = Coastal/Marine; IN = Inland/Freshwater; the code listed first is emphasized.

<sup>3/</sup> Of these three important resources--bowhead whales, caribou, and fishes caribou and fishes are major resources for both inland and coastal settlements. Bowhead whales are an important resource for all coastal North Slope communities except Point Lay, where they are not available. The belukha whale is very important at Point Lay, however, and plays an equivalent role to the bowhead in the Point Lay economy.

<sup>4/</sup> Migratory birds, particularly geese, are of increasing importance to the subsistence system; however, because of their limited mass, they cannot be classed with bowheads, caribou, or fishes.

Table III-C-5  
Subsistence Resources Most Often Harvested in 1981  
by Selected North Slope Communities<sup>1/</sup>  
(Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Kaktovik
Caribou	62.2	33.8	76.7	50.0
Walrus	2.7	5.6	0.0	0.0
Bowhead Whales	21.6	26.8	0.0	15.4
Fishes	10.8	24.0	16.7	19.2
Seals	0.0	1.4	0.0	0.0
Bearded Seals	2.7	4.2	16.7	0.0
Birds	0.0	1.4	3.3	7.7
Other	0.0	2.8	3.3	7.7
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(37)	(32)	(30)	(26)

Source: ACI/Braund, 1984.

<sup>1/</sup> No data are available for Atqasuk.

Table III-C-6  
Largest Sources of Meat Harvested in 1981  
by Selected North Slope Communities<sup>1/</sup>  
(Percentage Distribution of Responses)

Resource	Wainwright	Barrow	Nuiqsut	Kaktovik
Caribou	55.2	64.2	75.9	30.8
Walrus	0.0	4.5	0.0	0.0
Bowhead Whales	20.7	10.4	0.0	34.6
Fishes	10.3	14.9	20.7	23.1
Seals	0.0	0.0	0.0	0.0
Bearded Seals	6.9	1.5	3.4	0.0
Birds	6.9	3.0	0.0	11.5
Other	0.0	1.5	0.0	0.0
Total	100.0	100.0	100.0	100.0
(Number of Respondents)	(29)	(67)	(29)	(26)

Source: ACI/Braund, 1984.

<sup>1/</sup> No data are available for Atqasuk.

**Table III-C-7**  
**Meat Most Often Eaten from**  
**Subsistence Harvests by Selected North Slope Communities<sup>1/</sup>**  
**(Percentage Distribution of Responses)**

Resource	Wainwright	Barrow	Nuiqsut	Kaktovik
Caribou	79.4	71.4	93.4	44.0
Walrus	0.0	0.0	0.0	0.0
Bowhead Whales	17.6	8.6	0.0	40.0
Fishes	0.0	0.0	0.0	8.0
Seals	0.0	0.0	0.0	0.0
Bearded Seals	3.0	1.4	0.0	0.0
Birds	0.0	17.2	3.3	4.0
Other	0.0	1.4	3.3	4.0
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
(Number of Respondents)	(34)	(70)	(30)	(25)

Source: ACI/Braund, 1984.

<sup>1/</sup> No data are available for Atqasuk.

**Table III-C-8**  
**Preferred Meat from Subsistence Harvests**  
**for Selected North Slope Communities<sup>1/</sup>**  
**(Percentage Distribution of Responses)**

Resource	Wainwright	Barrow	Nuiqsut	Kaktovik
Caribou	30.5	17.8	50.0	46.2
Walrus	0.0	1.4	0.0	0.0
Bowhead Whales	66.7	72.6	32.1	38.5
Fishes	0.0	5.5	10.7	0.0
Seals	0.0	2.7	0.0	0.0
Bearded Seals	0.0	0.0	0.0	0.0
Birds	0.0	0.0	0.0	0.0
Sheep	0.0	0.0	0.0	0.0
Other	2.8	0.0	3.6	11.5
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
(Number of Respondents)	(36)	(73)	(28)	(25)

Source: ACI/Braund, 1984.

<sup>1/</sup> No data are available for Atqasuk.

Table III-C-9  
Annual Harvest of Subsistence Resources Averaged for  
the Period 1962-1982 for Selected North Slope Communities<sup>1/</sup>, <sup>2/</sup>, <sup>3/</sup>  
(Percentage Distribution of Responses)

Resource <sup>1/</sup>	Wainwright	Barrow	Nuiqsut	Kaktovik
Bowhead Whales	1.50 13,350 8.2%	10.10 89,890 21.3%	0.30 2,670 8.6%	1.00 8,900 27.5%
Caribou	1,200 84,000 51.6%	3,500 245,000 58.2%	400 28,000 90.2% <sup>4/</sup>	75.00 5,250 16.2%
Walrus	86 30,205 18.5%	55 19,250 4.6%	---	+3.00 1,050 3.2%
Bearded Seals	250 20,000 12.3%	150 12,000 2.9%	---	30.00 2,400 7.4%
Hair Seals	375 7,125 4.4%	955 18,145 4.3%	---	70.00 1,330 4.1%
Belukha Whales	11 4,400 2.7%	5 2,000 0.3%	---	5.00 2,000 6.2%
Polar Bears	7 450 0.3%	7 1,125 0.3%	1 225 0.1%	4.00 900 2.8%
Moose	2 450 0.3%	5 1,125 0.3%	---	5.00 1,125 3.5%
Dall Sheep	0.50 0 0%	0.0 0 0%	---	27.00 1,227 3.8%
Small Land Mammals	---	5/ 455 0.1%	---	4 136 0.4%
Birds	5/ 545 0.3%	5/ 3,636 0.9%	---	4 136 0.4%
Fishes	5/ 1,273 0.8%	5/ 27,955 6.6%	---	4 7,045 21.7%
Vegetation	---	---	---	---
Total Harvest (kg)	162,923	421,031	---	32,408
Per Capita Harvest	439	245	---	219

Source: Stoker, 1983, as cited by ACI/Braund, 1984.

- 1/ For each resource, data are expressed in descending order as follows: number of animals harvested, usable weight (kg), and percentage of average total community harvest. Note that -- denotes no data.
- 2/ The actual per capita harvests may be somewhat higher because of incomplete data and underestimates of some harvests. See also footnotes to Tables III-C-11, -12, and -13.
- 3/ No data are available for Atkasuk.
- 4/ Caribou-harvest statistics were available only for 1976, and harvest levels were not available for most other species. Consequently, the percentages of average total community harvest may not be representative of actual percentages.
- 5/ Data expressed only as usable weight (kg) rather than as number of animals harvested.

Table III-C-10  
 Primary Subsistence Resources Harvested for the Period  
 1962-1982 by Selected North Slope Villages<sup>1/</sup>  
 (Percentage of Average Total Village Harvest)

Village	Bearded Belukha		Bowhead		Dall		Hair		Polar		Other	
	Seals	Whales	Birds	Whales	Caribou	Sheep	Fishes	Seals	Moose	Bears		Walruses
Barrow	2.9	0.5	0.9	21.3	58.2		6.6	4.3			4.6	1.8
Kaktovik	7.4	6.2	3.2	27.5	16.2	3.8	21.7	4.1	3.5	2.8	3.2	0.4
Wainwright	12.3	2.7		8.2	51.6			4.4			18.5	2.3

Source: Stoker, 1983, as cited in ACI/Braund, 1984.

<sup>1/</sup> No data are available for Atqausk and Nuiqsut.

hunters. Wainwright is situated near the northeastern end of a long bight that affects sea-ice conditions as well as marine-resource concentrations. Although Wainwright's subsistence-harvest area is outside of the proposed lease-sale area, Wainwright is the location of one of the assumed air-support bases for exploration during this lease sale and is 20 to 25 km from the pipeline landfall and shore-base site at Point Belcher (within Wainwright's subsistence-harvest area).

(a) Bowhead Whales: Bowhead whales are Wainwright's most important marine resource; they are available in the Wainwright area beginning in late April (Fig. III-C-13). Wainwright is not as ideally situated for bowhead whaling as are Point Hope and Barrow. Ice leads often break far from shore and are often wider than those near Barrow or Point Hope, and multiple leads are common. Skin boats are used early in the season, when the leads are narrower (ACI/Courtnage/Braund, 1984). Because of the wider leads that occur later in the season, Wainwright whalers are likely to use aluminum boats to pursue bowheads farther offshore. There are approximately eight whaling camps along the edge of the landfast ice (ACI/Braund, 1984). In some years, these camps are 16 to 24 km offshore. The bowhead whale-harvest area delineated in Figure III-C-7 indicates the harvest-concentration areas over the past few years. The harvest areas vary from year to year, depending on where the open leads form; and the distance of the leads from shore varies from year to year (ACI/Courtnage/Braund, 1984). The bowhead accounted for 8.2 percent of the total annual subsistence harvest (an average of 1.5 whales taken each year from 1962-82) (Table III-C-9). The annual bowhead harvest has not varied as much as the harvest of other subsistence resources; over the past 20 years, the number taken has varied only from zero to three (Table III-C-11). In a subsistence study conducted in Wainwright in 1988 to 1989 (Stephen R. Braund and Associates, 1989a), bowhead whales (four whales harvested) comprised 42.3 percent of total edible pounds harvested and marine mammals comprised 70 percent of the total edible pounds harvested (see Tables III-C-11a and b).

(b) Belukha Whales: Belukha whales are available to Wainwright hunters during the spring bowhead-whaling season (late April to early June); however, pursuing belukhas during this time jeopardizes the bowhead whale hunt and therefore occurs only if no bowheads are in the area. Belukhas also are available later in the summer (July through late August) in the lagoon systems along the coast (Figs. III-C-8 and III-C-13). The reluctance of Wainwright residents to harvest belukhas during the bowhead-whaling season means that they must rely on the unpredictable summer harvest for the major volume of this resource. Consequently, the relative importance of the belukha whale varies from year to year (Nelson, 1981; ACI/Courtnage/Braund, 1984). The annual average harvest of belukhas (over 20 years from 1962-1982) is estimated at 11, or 2.7 percent of the total annual subsistence harvest (Table III-C-9). In Braund's (1989a) study, belukha whale harvests made up 1.1 percent of Wainwright's harvest (see Table III-C-11a).

(c) Caribou: Caribou are the primary source of meat for Wainwright residents. Prior to freezeup, caribou hunting is conducted along the inland waterways, particularly along the Kuk River system. During the winter months, most of the herd moves inland into the Brooks Range and then south of the North Slope; but some caribou remain near the coast. During the spring, the herd returns and concentrates near the Utukok and Colville River headwaters. In June, the herd follows major stream and river drainages toward the coast (Nelson, 1981). Wainwright's caribou harvest area is shown in Figure III-C-9. An annual average (over 20 years from 1962-1982) of 1,200 caribou is harvested (Table III-C-9) for 51.6 percent of the total annual subsistence harvest. Caribou are available throughout the year, with a peak harvest period from August to October (Fig. III-C-13). In Braund's (1989a) study in Wainwright, caribou comprised 23.1 percent of the total harvest (Table III-C-11b).

(d) Walrus: Walrus are present only seasonally in Wainwright, with the exception of a few that overwinter in the area. The peak hunting period occurs from July to August (Fig. III-C-13) as the southern edge of the pack ice retreats. In late August and early September, Wainwright hunters occasionally harvest walrus that are hauled out on beaches. The focal area for hunting walrus is from Milliktagvik north to Point Franklin, although hunters prefer to harvest them south of the communities (Fig. III-C-11) so that the northward-moving pack ice can carry the hunters back toward home while they butcher their catch on the ice. This northward-moving current also helps the hunters return home in their heavily loaded boats (Nelson, 1981). The estimated annual harvest ranges from 20 to 257 animals (Table III-C-11). The annual average (over 20 years from 1962-82) is estimated at 86 walrus, or 18.5 percent of the total annual subsistence harvest (Table III-C-9). In Braund's study (1989a), walrus comprised 17.6 percent of the total harvest (Table III-C-11a).

(e) Seals: Wainwright residents hunt four seal species--ringed, spotted, ribbon (all hair seals), and bearded seals. Ringed seals (the most common species) are generally available throughout the ice-locked months.

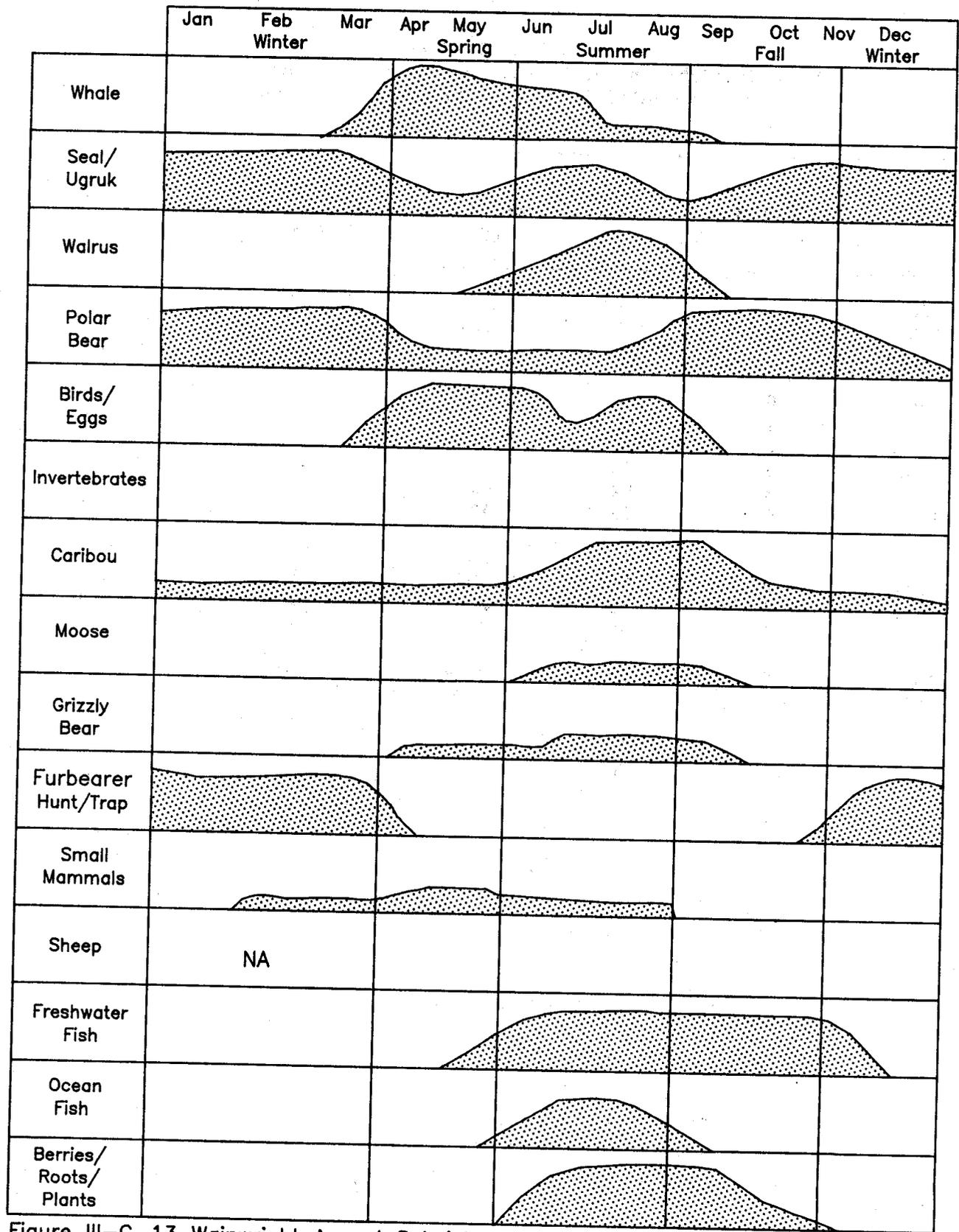


Figure III-C-13. Wainwright Annual Subsistence Cycle\*

Source: North Slope Borough Contract Staff, 1979.

\* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

Table III-C-11  
Wainwright Annual Harvest of Subsistence Resources  
for Which Sufficient Data Are Available, 1962-1982

Year	Bowhead Whales (No.)	Walruses (No.)	Hair Seals <sup>1/</sup> (No.)	Polar Bears (No.)	Total Harvest <sup>2/</sup> (Kg)
1962	1	--	328	- <sup>3/</sup>	157,580
1963	2	132	573	- <sup>3/</sup>	187,130
1964	1	225	--	- <sup>3/</sup>	207,018
1965	0	194	345	- <sup>3/</sup>	186,698
1966	1	140	69	- <sup>3/</sup>	171,454
1967	0	47	277	- <sup>3/</sup>	133,956
1968	2	85	40	- <sup>3/</sup>	160,553
1969	3	92	450	- <sup>3/</sup>	179,693
1970	0	89	480	- <sup>3/</sup>	152,513
1971	2	23	250	- <sup>3/</sup>	142,843
1972	2	56	1,600	3	179,143
1973	3	31	250+	4	153,968+
1974	1	38	250+	5	138,843+
1975	0	65	250+	4	139,168+
1976	3	257	250+	10	234,318+
1977	2	24	250+	9	143,643+
1978	2	20	--	7	144,265+
1979	1	36	--	0	139,293
1980	1	--	--	9 <sup>4/</sup>	158,923
1981	3	--	--	10 <sup>4/</sup>	177,623
1982	2	--	--	17 <sup>4/</sup>	167,571.33
Annual Average	1.5	86	375	7	164,571.33

Source: Stoker, 1983, as cited by AGI/Braund, 1984.

- <sup>1/</sup> Seal-harvest figures are estimates only and are probably on the low side.
- <sup>2/</sup> Estimated kilograms, includes all species.
- <sup>3/</sup> Data not available by community, only for the entire State (Schliebe, oral commun., 1987).
- <sup>4/</sup> Schliebe (1985, Tables 8, 9, and 10). In 1983 and 1984, Wainwright harvested 23 and 26 polar bears, respectively (Schliebe, 1985, Tables 10, 11, and 12).

-- means no data are available.

Table III-C-11a  
Wainwright 1988 to 1989  
Harvest Estimates for Marine Mammals

Resource	Conversion Factor <sup>1/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Marine Mammals	n/a	n/a	179,574	1395.9	358.1	70.1%	40.4%
Belukha whale	1,400.0	2	2,800	24.6	6.3	1.1%	0.9%
Bowhead whale <sup>4/</sup>	27,104.0	4	108,416	847.0	217.2	42.3%	78.9%
Walrus	272.0	58	45,038	346.5	89.0	17.6%	18.4%
Bearded seal	176.0	97	16,991	124.8	32.1	6.6%	33.3%
Polar bear	496.0	7	3,472	30.5	7.8	1.4%	4.4%
Total Ringed & Spotted Seals	42.0	68	2,856	22.5	5.8	1.1%	23.7%
Ringed seal	42.0	63	2,646	20.6	5.3	1.9%	11.8%
Spotted seal	42.0	5	210	1.8	0.5	0.1%	5.3%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
2/ Community totals are based on harvest amounts reported by all Wainwright households for all species except the bowhead (see note 4).  
3/ Per household and per capita means are based only on the 114 full-year households for all species except the bowhead (see note 4).  
4/ Edible pounds harvested for bowhead whale were derived from a pounds-per-foot-length ratio, which includes all edible portions of the whale. Average pounds per household and per capita were derived from the total edible whale amount rather than from the number of shares households reported receiving. Thus, these figures are higher than the actual amounts households received.  
n/a means not applicable.

Table III-C-11b  
Wainwright 1988 to 1989  
Harvest Estimates for Terrestrial Mammals

Resource	Conversion Factor <sup>1/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Terrestrial Mammals	n/a	n/a	60,696	500.6	128.5	23.7%	54.4%
Caribou	117.0	505	59,094	486.6	124.9	23.1%	53.5%
Moose	500.0	3	1,500	13.2	3.4	0.6%	2.6%
Brown bear	100.0	1	100	0.9	0.2	*	0.9%
Ground squirrel	0.4	3	1	**	**	*	0.9%
Arctic fox (blue)	n/a	60	n/a	n/a	n/a	n/a	5.3%
Red fox (cross, silver)	n/a	27	n/a	n/a	n/a	n/a	7.0%
Wolverine	n/a	20	n/a	n/a	n/a	n/a	5.3%
Wolf	n/a	10	n/a	n/a	n/a	n/a	3.5%
Ermine	n/a	2	n/a	n/a	n/a	n/a	0.9%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
2/ Community totals are based on harvest amounts reported by all Wainwright households for all species.  
3/ Per household and per capita means are based only on the 114 full-year households for all species.  
\* represents less than .1 percent.  
\*\* represents less than .1 pound.  
n/a means not applicable.

Table III-C-11c  
Wainwright 1988 to 1989  
Harvest Estimates for Birds

Resource	Conversion Factor <sup>1/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Birds	n/a	n/a	6,161	51.04	13.1	2.4%	50.9%
Total Geese		1,342	5,181	43.76	11.2	2.0%	40.4%
White-fronted goose	4.5	607	2,732	23.45	6.0	1.1%	19.3%
Brant	3.0	572	1,716	14.18	3.6	0.7%	26.3%
Goose (nonspecified)	4.5	129	581	4.86	1.2	0.2%	9.6%
Lesser snow goose	4.5	29	131	1.07	0.3	0.1%	29.8%
Canada goose	4.5	5	23	0.20	0.1	*	16.7%
Total Eiders		560	839	6.08	1.6	0.3%	5.3%
Eiders (nonspecified)	1.5	337	505	3.14	0.8	0.2%	10.5%
Common eider	1.5	57	86	0.75	0.2	*	5.3%
King eider	1.5	100	150	1.32	0.3	0.1%	10.5%
Spectacled eider	1.5	64	96	0.84	0.2	**	7.0%
Stellar's eider	1.5	2	3	0.03	*	**	0.9%
Ptarmigan	1.5	135	95	0.79	0.2	**	13.2%
Other ducks	0.7	31	47	0.41	0.1	**	7.0%
Pintail duck	1.5	18	27	0.24	0.1	**	5.3%
Duck (nonspecified)	1.5	12	18	0.16	*	**	2.6%
Mallard duck	1.5	1	2	0.01	*	**	0.9%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
 2/ Community totals are based on harvest amounts reported by all Wainwright households for all species.  
 3/ Per household and per capita means are based only on the 114 full-year households for all species.  
 \* represents less than .1 pound.  
 \*\* represents less than .1 percent.  
 n/a means not applicable.

Table III-C-11d  
Wainwright 1988 to 1989  
Harvest Estimates for Fish

Resource	Conversion Factor <sup>1/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Fish	n/a	n/a	9,895	83.46	21.4	3.9%	64.0%
Total Whitefish		4,888	4,892	42.92	11.0	1.9%	19.3%
Whitefish (nonspecified)	2.0	4	8	0.07	*	**	0.9%
Round whitefish	1.0	400	400	3.51	0.9	0.2%	3.5%
Least cisco	1.0	4,473	4,473	39.24	10.1	1.7%	16.7%
Bering, Arctic cisco	1.0	11	11	0.10	*	0.9%	0.9%
Total Other Freshwater Fish		2,911	2,351	20.54	5.3	0.9%	20.2%
Arctic grayling	0.8	2,904	2,323	20.29	5.2	**	19.3%
Burbot (Ling cod)	4.0	6	24	0.21	0.1	**	2.6%
Lake trout	4.0	1	4	0.04	*	**	0.9%
Total Salmon		11	49	0.43	0.1	**	1.8%
Salmon (nonspecified)	6.1	2	12	0.11	*	**	0.9%
Chum (Dog) salmon	6.1	3	18	0.16	*	**	1.8%
Pink (Humpback) salmon	3.1	6	19	0.16	*	**	0.9%
Total Other Coastal Fish		19,877	2,603	19.57	5.0	**	52.6%
Rainbow smelt	0.12	19,479	2,337	17.68	4.5	**	50.9%
Tomcod (Saffron cod)	1.0	230	230	1.58	0.4	0.1%	1.8%
Arctic cod	0.2	164	33	0.29	0.1	**	0.9%
Sculpin	0.6	4	2	0.02	*	**	0.9%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
 2/ Community totals are based on harvest amounts reported by all Wainwright households for all species.  
 3/ Per household and per capita means are based only on the 114 full-year households for all species.  
 \* represents less than .1 pound.  
 \*\* represents less than .1 percent.  
 n/a means not applicable.

Table III-C-11e  
Barrow 1988 to 1989  
Harvest Estimates for Marine Mammals<sup>1/</sup>

Resource	Conversion Factor <sup>2/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Marine Mammals	n/a	n/a	337,225	359.9	111.8	754.2%	40.7%
Bowhead whale <sup>3/4/</sup>	11,612.0	9	209,015	223.1	69.3	33.6%	32.4%
Walrus	772.0	88	67,623	72.2	22.4	10.9%	9.0%
Bearded seal	176.0	213	37,467	40.0	12.4	6.0%	16.9%
Polar bear	496.0	11	5,600	6.0	1.9	0.9%	1.3%
Total Ringed & Spotted Seals							
Ringed seal	42.0	417	17,519	18.7	5.8	2.8%	12.2%
Spotted seal	42.0	414	17,396	18.6	5.8	2.8%	12.2%
	42.0	3	123	0.1	*	**	0.2%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ Estimated sampling errors do not include errors in reporting, recording, and converting to usable weight.  
2/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
3/ Bowhead harvest does not contribute to the sampling error for marine mammals since the bowhead harvest is based on a complete count.  
4/ The percent of Barrow households harvesting bowhead represents the percent of Barrow households receiving crew-member shares at the whale-harvest site, as extrapolated from the sample households.  
\* represents less than .1 pound.  
\*\* represents less than .1 percent.  
n/a means not applicable.

Table III-C-11f  
Barrow 1988 to 1989  
Harvest Estimates for Terrestrial Mammals<sup>1/</sup>

Resource	Conversion Factor <sup>2/</sup> Edible Weight Per Resource in Pounds	Community Totals		Average Pounds Harvested <sup>2/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Terrestrial Mammals	n/a	n/a	204,558	218.3	67.8	32.9%	27.3%
Caribou	17.0	1,523	178,195	190.2	59.1	8.6%	5.0%
Moose	500.0	50	25,163	26.9	8.3	4.0%	4.8%
Dall sheep	99.0	11	1,052	1.1	0.3	0.2%	0.6%
Brown bear	100.0	1	117	0.1	*	**	0.6%
Other Terrestrial Mammals							
Porcupine	10.0	14	31	0.03	*	**	0.5%
Ground squirrel	0.4	3	26	0.03	*	**	0.5%
Wolverine	n/a	12	5	0.01	*	**	0.1%
Arctic fox (blue)	n/a	3	n/a	n/a	n/a	n/a	0.3%
Red fox (Cross, Silver)	n/a	160	n/a	n/a	n/a	n/a	1.4%
	n/a	6	n/a	n/a	n/a	n/a	0.1%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ Estimated sampling errors do not include errors in reporting, recording, and converting to usable weight.  
2/ See Braund, 1989a, Table A-4, for sources of conversion factors.  
\* represents less than .1 pound.  
\*\* represents less than .1 percent.  
n/a means not applicable.

Table III-C-11g  
Barrow 1988 to 1989  
Harvest Estimates for Birds

Resource	Conversion Factor <sup>1/</sup> Edible Weight Per Resource in Pounds	Community Totals <sup>2/</sup>		Average Pounds Harvested <sup>3/</sup>		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Birds	n/a	n/a	21,519	22.97	7.1	3.5%	32.8%
Total Geese		2,959	13,062	13.94	4.3	2.1%	18.2%
Goose (nonspecified)	4.5	197	886	0.95	0.3	0.1%	1.5%
Brant	3.0	166	499	0.53	0.2	0.1%	3.5%
White-fronted goose	4.5	2,591	11,656	12.44	*	**	16.3%
Snow goose	4.5	4	17	0.02	*	**	10.3%
Canada goose	4.5	1	3	0.00	*	**	10.0%
Total Eiders		4,764	7,145	7.63	2.4	1.1%	9.7%
Eiders (nonspecified)	1.5	4,686	7,030	7.50	2.3	1.1%	9.7%
Common eider	1.5	19	29	0.03	*	**	0.4%
King eider	1.5	57	86	0.09	*	**	7.7%
Spectacled eider	1.5	1	2	0.00	*	**	6.0%
Ptarmigan	0.7	1,792	1,254	1.34	0.4	0.2%	12.1%
Other Ducks	1.5	39	58	0.06	*	**	1.5%

Source: Stephen R. Braund & Associates, 1989a.

- 1/ Estimated sampling errors do not include errors in reporting, recording, and converting to usable weight.  
 2/ See Braund, 1989b, Table A-4, for sources of conversion factors.  
 \* represents less than .1 pound.  
 \*\* represents less than .1 percent.  
 n/a means not applicable.

Table III-C-11h  
Barrow 1988 to 1989  
Harvest Estimates for Fish<sup>1/</sup>

Resource	Conversion Factor <sup>2/</sup> Edible Weight Per Resource in Pounds	Community Totals		Average Pounds Harvested		Percent of Total Edible Pounds Harvested	Percent of all Wainwright Households Harvesting Resource
		Edible Number Harvested	Pounds Harvested	Per Household	Per Capita		
Total Fish	n/a	n/a	58,825	62.78	19.5	9.5%	25.1%
Total Whitefish		23,797	45,604	48.67	15.1	7.3%	16.7%
Whitefish (nonspecified)	2.0	2,663	5,326	5.69	1.8	0.9%	2.0%
Round whitefish	1.0	1,392	1,392	1.49	0.5	0.2%	9.0%
Broad whitefish (river)	2.5	9,674	24,184	25.81	8.0	3.9%	6.0%
Broad whitefish (lake)	3.4	1,059	3,599	3.84	1.2	0.6%	2.8%
Humpback whitefish	2.5	1,395	3,488	3.72	1.2	0.6%	5.4%
Least cisco	1.0	6,905	6,905	7.37	2.3	1.1%	2.5%
Bering, Arctic cisco	1.0	710	710	0.76	0.2	0.1%	6.8%
Total Other Freshwater Fish		10,797	11,259	12.02	3.7	1.8%	12.9%
Arctic grayling	0.8	9,953	7,964	8.50	2.6	1.3%	7.1%
Arctic char	2.8	59	166	0.18	*	**	4.4%
Burbot (Ling cod)	4.0	695	2,781	2.97	0.9	0.4%	3.9%
Northern pike	2.3	1	3	0.00	*	**	0.5%
Lake trout	4.0	87	346	0.37	0.1	0.1%	0.5%
Total Salmon		124	752	0.80	0.2	0.1%	1.2%
Salmon (nonspecified)	6.1	34	206	0.22	0.1	**	0.5%
Chum (Dog) salmon	6.1	5	30	0.03	*	**	0.3%
Pink (Humpback) salmon	3.1	9	28	0.03	*	**	1.3%
Silver (Coho) salmon	6.0	74	446	0.48	0.1	0.1%	0.3%
King (Chinook) salmon	18.0	2	42	0.05	*	**	4.0%
Total Other Coastal Fish		5,709	1,210	1.29	*	**	3.4%
Capelin	0.2	1,676	335	0.36	*	**	0.1%
Rainbow smelt	0.2	71	14	0.02	*	**	0.2%
Arctic cod	0.2	3,877	775	0.83	0.3	0.1%	0.2%
Tomcod	1.0	85	85	0.09	*	**	0.6%

Source: Stephen R. Braund & Associates, 1989b.

- 1/ Estimated sampling errors do not include errors in reporting, recording, and converting to usable weight.  
 2/ See Braund, 1989b, Table A-4, for sources of conversion factors.  
 \* represents less than .1 pound.  
 \*\* represents less than .1 percent.  
 n/a means not applicable.

Bearded seals are available during the same period, but they are not as plentiful. Although they are harvested less frequently, spotted seals are common in the coastal lagoons during the summer; most are taken in Kuk Lagoon. Ribbon seals occasionally are available during the spring and summer months. Ringed and bearded seals are harvested most intensely from May through July (ACI/ Courtnage/Braund, 1984). Most ringed seals are harvested along the coast from Milliktagvik to Point Franklin, with concentration areas along the shore from Kuk Inlet southward to Milliktagvik and from Nunagiaq to Point Franklin. Migrating seals are most concentrated at Qipuqlaich, just south of Kuk Inlet (Fig. III-C-10) (Nelson, 1981). The harvest of bearded seals is an important subsistence activity in Wainwright because it is a preferred food and the skins are used as covers for the whaling boats (ACI/Courtnage/Braund, 1984). The best harvest areas for bearded seals are on the flat ice south of Wainwright, off Qilamittagvik and Milliktagvik, and beyond towards Icy Cape (Fig. III-C-10) (Nelson, 1981). Although no annual harvest data were available for bearded seals in the 1962 to 1982 20-year-average computation, the annual average subsistence harvest (over 20 years from 1962-1982) is estimated at 250 seals, or about 12.3 percent of the total annual subsistence harvest (Table III-C-9). In 1988, Braund (1989a) documented 97 bearded seals harvested (6.6 percent of the marine-mammal harvest). One hair seal harvest during the past 20 years is estimated at between 250 and 1,600 seals. In recent years, approximately 250 hair seals have been harvested each year (Table III-C-11). The average annual harvest (over 20 years) is estimated at 375, or 4.4 percent of the total annual subsistence harvest (Table III-C-9). In Braund's study (1989a), only 68 hair seals (ringed and spotted) were recorded, comprising 1.1 percent of the total marine-mammal harvest (Table III-C-11a).

(f) Fishes: Wainwright residents harvest a variety of fishes in most marine and freshwater habitats along the coast and in lagoons, estuaries, and rivers. The most important local fish harvest occurs from September through November (Fig. III-C-13) in the freshwater areas of the Kuk, Kugrua, Utukok, and other river drainages (Craig, 1987) (Fig. III-C-12). Ice fishing for smelt and tomcod (saffron cod) occurs near the community primarily during January, February, and March. In the summer months, Wainwright residents harvest arctic char, chum and pink salmon, Bering cisco (whitefish), and sculpin along the coast and along the lower portions of Kuk Lagoon (Nelson, 1981; ACI/ Courtnage/Braund, 1984). The most common species harvested in the Kuk River system are Bering and least ciscoes, grayling, ling cod, burbot, and rainbow smelt. Other species harvested less frequently along the coast--in some cases, in estuaries or freshwater--include rainbow smelt, flounder, cisco, saffron cod, arctic cod, trout, capelin, and grayling (Nelson, 1981; Craig, 1987). Marine fishing is conducted from Peard Bay to Icy Cape and in Kuk Lagoon.

During the period 1969 to 1973, the annual fish harvest was about 1,727 kg. The annual per capita fish catch was 4 kg. (The ADF&G cautions that these data were not systematically collected or verified [Craig, 1987].) Stoker (1983, as cited by ACI/Braund, 1984) uses these data and lists fish as a minor resource in the total harvest of Wainwright subsistence resources (approximately 0.8% of the annual harvest averaged over 20 years [Table III-C-9]); fish were the third-largest source of subsistence foods (Table III-C-6) and the third-most important species harvested (Table III-C-5) in Wainwright in 1981. In Braund's (1989a) study, fish made up 3.9 percent of the total harvest with whitefish and least cisco the most important (Table III-C-11d). This difference can be attributed to (1) the increase in the importance of fish as a subsistence resource because of the introduction of snowmachines and motorized skiffs that have made distant fish camps more accessible and (2) a value change that has stimulated the residents' interest in fishing and camping away from the community (Nelson, 1981). The fish harvest plays an important role in strengthening kinship ties in the community (Nelson, 1981; ACI/Courtnage/Braund, 1984). In addition, fish are a crucial resource when other resources are less abundant or unavailable; over time, fish are a more reliable and more stable resource (Nelson, 1981).

(g) Migratory Birds: The migration of ducks, murres, geese, and cranes begins in May and continues through June. The harvest of waterfowl is initiated in May at whaling camps and continues through June (Fig. III-C-13). Hunting decreases as the bird populations disperse to their summer ranges. During the fall migration southward, the range is dispersed over a wide area (Fig. III-C-11); and hunting success is limited except at Icy Cape (ACI/Courtnage/Braund, 1984). Wainwright residents annually harvest an estimated 545 kg of birds (averaged over 20 years from 1962-1982), or about only 0.3 percent of the total annual subsistence harvest (Table III-C-9). Braund's study (1989) documented that birds were 2.4 percent of the total harvest and geese were 2.0 percent (Table III-C-11c). Although the volume of waterfowl meat is a relatively small portion of the total subsistence harvest, waterfowl hunting is a key element in Wainwright's subsistence routine. Like fishing, bird hunting is highly valued in social and cultural terms (see the Sale 97 FEIS, Sec. III.C.3 [USDOI, MMS, 1987a]). Waterfowl dishes are an essential part of community feasts prepared for holidays such as Thanksgiving and Christmas (Nelson, 1981).

(h) Polar Bears: Polar bears are generally harvested along the coastal area in the Wainwright region, around Icy Cape, at the headland from Point Belcher to Point Franklin, and at Seahorse Island (Nelson, 1981). Wainwright residents hunt polar bears primarily in the fall and winter, less frequently in the spring, and rarely during the summer (Fig. III-C-13). Polar bears comprise a small portion of the Wainwright subsistence harvest, with an annual average (over 20 years) of seven harvested, or only 1.0 percent of the annual subsistence harvest (Table III-C-9). In Braund's study (1989), polar bears comprised 1.4 percent of the total harvest (Table III-C-11b). Since 1972, the prohibition of the commercial sale of polar bear hides has diminished the intensity of the harvest. Even so, the pursuit of polar bears continues to be an important manifestation of Inupiat traditional skills and an expression of manhood in a society that places an extremely high value on hunting as a way of life (Nelson, 1981).

(2) Barrow: As with other communities adjacent to the Sale 124 area, Barrow residents (population 3,223 in 1989 [NSB, 1989]) enjoy a diverse resource base that includes both marine and terrestrial animals. Barrow's location is unique among the communities in the sale area--the community is a few miles southwest of Point Barrow, the demarcation point between the Chukchi and Beaufort Seas. This location offers superb opportunities for hunting a diversity of marine and terrestrial mammals and fishes. Barrow is likely to be one of the air-support bases for exploration. A major part of Barrow's marine subsistence-harvest area includes the assumed pipeline routes from Pt. Belcher and Pitt Point.

(a) Bowhead Whales: Unlike residents of other communities close to the Sale 124 area, Barrow residents hunt the bowhead whale during both spring and fall; however, more whales are harvested during the spring whale hunt, which is the major whaling season. In 1977, the IWC established a quota for subsistence hunting of the bowhead whale by Alaskan Inupiat. The quota is currently regulated by the Alaska Eskimo Whaling Commission, which annually decides how many bowheads each community may take; this number depends on the overall quota set by the IWC. Barrow whalers hunt in the fall only if they do not get their quota during the previous spring hunt. There are approximately 30 whaling camps along the edge of the landfast ice. The location of the camps depends on ice conditions and currents. Strong currents and many leads near Point Barrow prohibit crews from camping near the point. Most whaling camps are located south of Barrow, as far south as Walakpa Bay. The bowhead is hunted in two different areas, depending on the season. In the spring (from early April until the first week of June [Fig. III-C-14]), the bowheads are hunted from leads that open when the pack-ice conditions deteriorate. Bowhead whales are harvested along the coast from Point Barrow to the Skull Cliff area (Fig. III-C-7). The distance of the leads from shore varies from year to year. The leads generally are parallel and quite close to shore, but they occasionally break directly from Point Barrow to Point Franklin and force Barrow whalers to travel over the ice as much as 16 km offshore to the open leads. The lead is normally open from Point Barrow to the coast, and the hunters are able to whale only 2 to 5 km from shore. A stricken whale can be chased in either direction in the lead. Spring whaling in Barrow is conducted almost entirely with skin boats because the narrow leads prohibit the use of aluminum skiffs, which are more difficult to maneuver than the traditional boats (ACI/Courtnege/Braund, 1984). Fall whaling occurs outside of the Sale 124 area east of Point Barrow (Fig. III-C-7) from the Barrow vicinity in the Beaufort Sea to Cape Simpson in the Beaufort Sea. Hunters use aluminum skiffs with outboard motors to chase the whales during the fall migration, which takes place in open water up to 48 km offshore.

No other marine mammal is harvested with the intensity and concentration of effort that is expended on the bowhead whale. Bowheads are very important in the subsistence economy, and they account for 21.3 percent (an average of 10.10 whales per year) of the annual subsistence harvest from 1962 to 1982 (Table III-C-9). In 1988 and 1989, a 2-year subsistence study was conducted in Barrow (Braund, 1989b). In this 2-year period, 40.7 percent of the total harvest was marine mammals, and 33.6 of the total harvest was bowhead whales (Table III-C-11e). As with all species, the harvest of bowheads varies from year to year; over the past 20 years, the number taken each year has varied from 0 to 23 (Table III-C-12). In the memory of community residents, 1982 is the only year in which a bowhead whale was not harvested (ACI/Courtnege/Braund, 1984).

(b) Belukha Whales: Belukha whales are available from the beginning of whaling season through June and occasionally in July and August (Fig. III-C-14) in ice-free waters. Barrow hunters do not like to hunt belukha whales during the bowhead hunt for fear of scaring the bowheads. The hunters harvest belukhas after the spring bowhead season ends, which depends on when the bowhead quota is achieved. Belukhas are harvested in the leads between Point Barrow and Skull Cliff (Fig. III-C-8). Later in summer, belukhas are occasionally harvested on both sides of the barrier islands of Elson Lagoon. Because the lagoon has numerous passes, it is not possible to herd the belukhas as is done in Point Lay (ACI/Courtnege/Braund, 1984). The annual average belukha harvest over 20 years (from 1962-1982) is estimated at 5, or 0.5 percent

Table III-C-12  
Barrow Annual Harvest of Subsistence Resources  
for Which Sufficient Data Are Available, 1962-1982

Year	Bowhead Whales (No.)	Walruses (No.)	Hair Seals <sup>1/</sup> (No.)	Polar Bears (No.)	Total Harvest <sup>2/</sup> (Kg)
1962	5	--	450	- <sup>3/</sup>	366,046
1963	5	165	412	- <sup>3/</sup>	403,824
1964	11	10	--	- <sup>3/</sup>	413,291
1965	4	57	114	- <sup>3/</sup>	351,462
1966	7	12	63	- <sup>3/</sup>	361,443
1967	3	55	31	- <sup>3/</sup>	390,284
1968	10	16	102	- <sup>3/</sup>	433,996
1969	11	7	2,100	- <sup>3/</sup>	478,896
1970	15	39	2,000	- <sup>3/</sup>	461,496
1971	13	51	1,800	- <sup>3/</sup>	547,421
1972	19	150	1,700	6	480,196
1973	17	20	1,500	5	405,196
1974	9	35	1,000	7	407,671
1975	10	15	1,000	10	565,496
1976	23	136	1,000	9	514,346
1977	20	62	1,000	15	348,741
1978	3	30	--	5	347,741
1979	3	30	--	1	411,891
1980	9	--	--	9 <sup>4/</sup>	365,766
1981	4	--	--	5 <sup>4/</sup>	412,131
1982	0	--	--	7 <sup>4/</sup>	--
Annual Average	10.1	55	955	7	424,716

Source: Stoker, 1983, as cited by ACI/Braund, 1984.

- <sup>1/</sup> Seal-harvest figures are estimates only and are probably on the low side.
- <sup>2/</sup> Estimated kilograms, includes all species.
- <sup>3/</sup> Data are not available by community, only for the entire State (Schliebe, 1987, oral commun.).
- <sup>4/</sup> Schliebe (1985, Tables 8, 9, and 10). In 1983 and 1984, Barrow residents harvested 11 and 35 polar bears, respectively (Schliebe, 1985, Tables 10, 11, and 12).
- means no data are available.

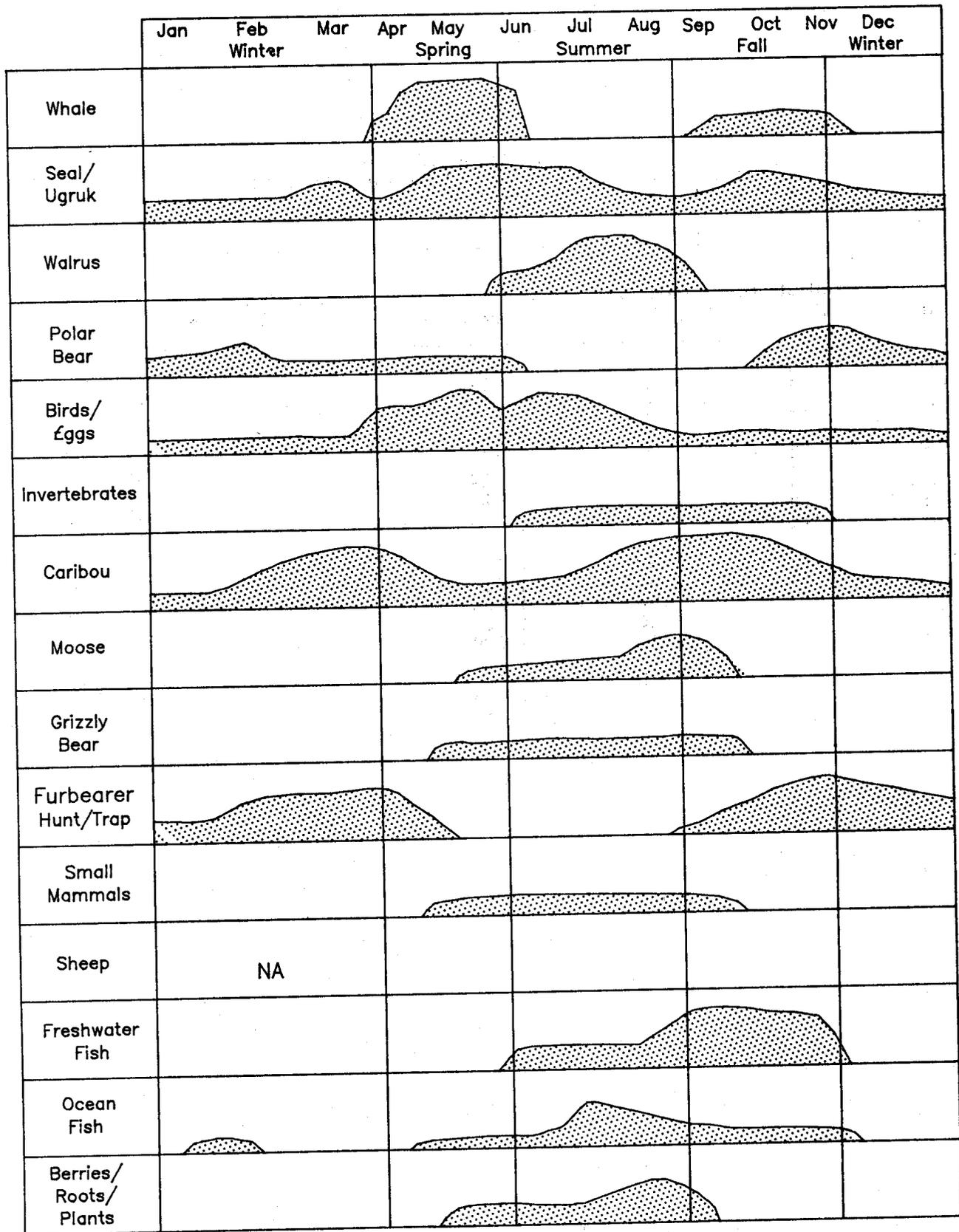


Figure III-C-14. Barrow Annual Subsistence Cycle\*

Source: North Slope Borough Contract Staff, 1979.

\* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

of the total annual subsistence harvest (Table III-C-9). In Braund's (1989b) study, there were no harvests of belukha whales in the 2-year period of data collection.

(c) Caribou: Caribou, the primary source of meat for Barrow residents, are available throughout the year, with peak-harvest periods from February through early April and from late June through late October (Fig. III-C-14). (Specific harvest-area locations for caribou are shown in Fig. III-C-9.) Residents harvest an annual average (over 20 years from 1962-1982) of 3,500 caribou (Table III-C-9), which accounts for 58.2 percent of the total annual subsistence harvest. In Braund's study (1989b), caribou provided 28.6 percent of the total edible pounds harvested (Table III-C-11h).

(d) Seals: Hair seals are available from October through June; however, because of the availability of bowheads, bearded seals, and caribou during various times of the year, seals are harvested primarily during the winter months, especially during February through March (Fig. III-C-14). Ringed seals are the most common hair seal species harvested. Spotted seals are harvested only in the ice-free summer months. Ringed seal hunting is concentrated in the Beaufort Sea, although some hunting occurs off Point Barrow and along the barrier islands that form Elson Lagoon (Fig. III-C-10). During the winter, leads in the area immediately adjacent to Barrow and north toward the point make this area an advantageous spot for sealing. Spotted seals also are occasionally harvested off Point Barrow and the barrier islands of Elson Lagoon. Oarlock Island in Admiralty Bay is a favorite place for hunting spotted seals (ACI/Courtnage/Braund, 1984). From 1962 to 1982, hair seal harvests were estimated at between 31 and 2,100 seals a year (Table III-C-12). The average annual harvest from 1962 to 1982 is estimated at 955 seals, or 4.3 percent of the total annual subsistence harvest (Table III-C-9). Hair seals--ringed only--provided 2.8 percent (417 seals) of the edible pounds harvested from 1987 to 1989 (Braund, 1989b).

The hunting of bearded seals is an important subsistence activity in Barrow because the bearded seal is a preferred food, and its skin is used to cover the whaling boats--six to nine skins are needed to cover a boat. Bearded seals are harvested more than the smaller hair seals because of their larger size and use for skin-boat covers. They are hunted from spring camps in the Beaufort Sea and from open water during concurrent pursuit of other marine mammals. The majority are harvested during the spring and summer months. Bearded seals occasionally are available in Dease Inlet and Admiralty Bay (Fig. III-C-10) (ACI/Courtnage/Braund, 1984). No harvest data were available earlier for the number of bearded seals harvested annually; thus, the annual subsistence harvest averaged over 20 years from 1962 to 1982 was 150 seals, or about 2.9 percent of the total annual subsistence harvest (Table III-C-9). Harvests in 1987 to 1989 were documented at 213 seals, providing 6.0 percent of the total edible pounds harvested (Table III-C-11e).

(e) Fishes: Barrow residents harvest marine and riverine fishes, but their dependency on fish varies according to the availability of other resources. Capelin, char, cod, grayling, salmon, sculpin, trout, and whitefish are harvested (ACI/Courtnage/Braund, 1984). Fishing occurs primarily in the summer and fall months and peaks in September and October (Fig. III-C-14). Fishing also occurs concurrently with caribou hunting in the fall. From December through March, communities fish for tomcod through the ice. The subsistence-harvest area for fish is extensive, primarily because Barrow residents supplement their camp food with fish whenever they are hunting. From Peard Bay west of Barrow to east of Pitt Point on the Beaufort Sea coast, marine fishing occurs in the summer in conjunction with the pursuit of other subsistence resources (Fig. III-C-12). Most fishing occurs closer to Barrow in three areas: (1) along the Beaufort Sea coastline from Point Barrow to Walikpa Bay, (2) inside Elson Lagoon near Barrow, and (3) along the barrier islands of Elson Lagoon (Craig, 1987). From Barrow to Peard Bay, fishing occurs primarily during the spring and summer hunts for waterfowl and marine mammals. Intensive marine fishing takes place in the area of the Beaufort Sea just west of the point immediately adjacent to Barrow. In Elson Lagoon and along the Beaufort Sea coast and in Dease Inlet and Admiralty Bay, fishing occurs during the summer and fall from caribou hunting camps, fall-whaling stations, and other camps. Marine fishing is conducted with gill nets and by jigging. Species harvested include whitefishes, least cisco, grayling, and a few burbot and salmon (Craig, 1987).

Fish camps have been established at traditional family sites along the coast. These camps are generally on points of land, at the mouths of rivers, and at other strategic locations. While coastal fishing can be an important source of fish, most of the fishing occurs at inland fish camps, particularly in lakes and rivers that flow into the southern end of Dease Inlet (Craig, 1987). Inland fish camps are found in the Inaru, Meade, Topogoruk, and Chipp River drainages. These camps provide good fishing opportunities as well as access to inland caribou and birds (ACI/Courtnage/Braund, 1984). During 1969 to 1973, the average annual harvest of fishes was about 37,727 kg (Craig, 1987); from 1962 to 1982, the estimated annual average was 27,955 kg,

which accounts for 6.6 percent of the total annual subsistence harvest (Table III-C-9). In a 1986 partial estimate of fish harvests for the Barrow fall fishery in the Inaru River, the catch composition was least cisco (45%), broad whitefish (36%), humpback whitefish (16%), arctic cisco (1%), fourhorn sculpin (1%), and burbot (0.5%) (Craig, 1987). In Braund's (1989b) study, 1987 to 1989 fish harvests provided 9.5 percent of the total edible subsistence harvest (Table III-C-11h).

(f) Walruss: Walrus are harvested during the spring marine-mammal hunt west of Point Barrow and southwest to Peard Bay (Fig. III-C-11). Most hunters will travel no more than 24 to 32 km to hunt walrus. The major walrus-hunting effort occurs from late June through mid-September, with the peak season in August (Fig. III-C-14). The annual average harvest from 1970 through 1979 is estimated at 57 (Table III-C-12). The annual average harvest over 20 years from 1962 to 1982 is estimated at 55 walrus, or 4.6 percent of the total annual subsistence harvest (Table III-C-9). In Braund's 1987 to 1989 study (1989b), walrus provided 10.9 (88 walrus) percent of the total edible pounds harvested (Table III-C-11e).

(g) Migratory Birds: Migratory birds, particularly eider ducks and geese, provide an important food source for Barrow residents--not because of the quantity of meat harvested or the time spent hunting them, but because of their dietary importance during spring and summer. Geese are harvested more often inland along rivers, while most eider and other ducks are harvested along the coast. Once harvested extensively, snowy owls are no longer taken regularly. Eggs are still gathered occasionally, especially on the offshore islands where foxes and other predators are less common. Waterfowl--hunted during the whaling season (beginning in late April or early May) as they fly along the open leads--provide a fresh-meat source for whaling camps. Later in the spring, Barrow residents harvest many geese and ducks; the harvest peaks in May and early June and continues until the end of June (Fig. III-C-14). Birds may be harvested throughout the summer, but only incidentally to other subsistence activities. In late August and early September, with a peak in the first 2 weeks of September, ducks and geese migrate south and are again hunted by Barrow residents. Birds, primarily eiders and other ducks, are hunted along the coast from Point Franklin to Admiralty Bay and Dease Inlet. Concentrated hunting areas are located along the shores of the major barrier islands of Elson Lagoon.

After spring whaling, geese are hunted inland. A favorite spot for hunting birds is the "shooting station" at the narrowest point of the barrier spit that forms Point Barrow and separates the Beaufort Sea from Elson Lagoon. This area, a highly successful hunting spot during the spring and fall bird migrations, is easily accessible to Barrow residents (ACI/Courtnage/Braund, 1984). Barrow residents harvested an estimated annual average (over 20 years) from 1962 to 1982 of 3,636 kg of birds, which accounts for about 0.9 percent of the total annual subsistence harvest (Table III-C-9).

(h) Polar Bears: Barrow residents hunt polar bears from October to June (Fig. III-C-14). Polar bears comprise a small portion of the Barrow subsistence harvest, with an annual average of seven bears harvested from 1971 to 1981 (Table III-C-12), or only 0.4 percent of the annual subsistence harvest (Table III-C-9). In 1987 to 1989 (Braund, 1989b), 11 polar bears were harvested, providing 0.9 percent of the total edible pounds harvested.

(3) Atqasuk: Atqasuk (population 219 in 1989 [NSB, 1989]) is the only inland community close to the Sale 124 area. The marine-resource areas used by Atqasuk residents are inclusive of those used by Barrow residents and thus are discussed in Section III.C.3.b(2). Only a small portion of the marine resources used by Atqasuk residents is acquired on coastal hunting trips initiated in Atqasuk; the majority of the marine resources are acquired on hunting trips initiated in Barrow with Barrow relatives or friends (ACI/ Courtnage/Braund, 1984). However, Atqasuk hunters harvest fish, migratory birds, and caribou in completely different areas from those of Barrow.

(a) Caribou: Caribou are the most important resource harvested by Atqasuk residents. (Atqasuk's caribou harvest area is shown in Fig. III-C-9.) Although the fall harvest is the most important, caribou also are harvested throughout the winter and in early spring (Fig. III-C-15). Migration patterns and limited access to caribou prohibit hunting in the late spring and summer.

In recent years, the caribou population has been high; and Atqasuk residents have not had to travel far to harvest caribou (distances are not available). Caribou camps often also are used for fishing along the Meade, Inaru, Topogoruk, and Chipp River drainages (ACI/Courtnage/Braund, 1984).

(b) Fishes: Fish is a preferred food in Atqasuk, although in an ACI/Courtnage/Braund, 1984, study,

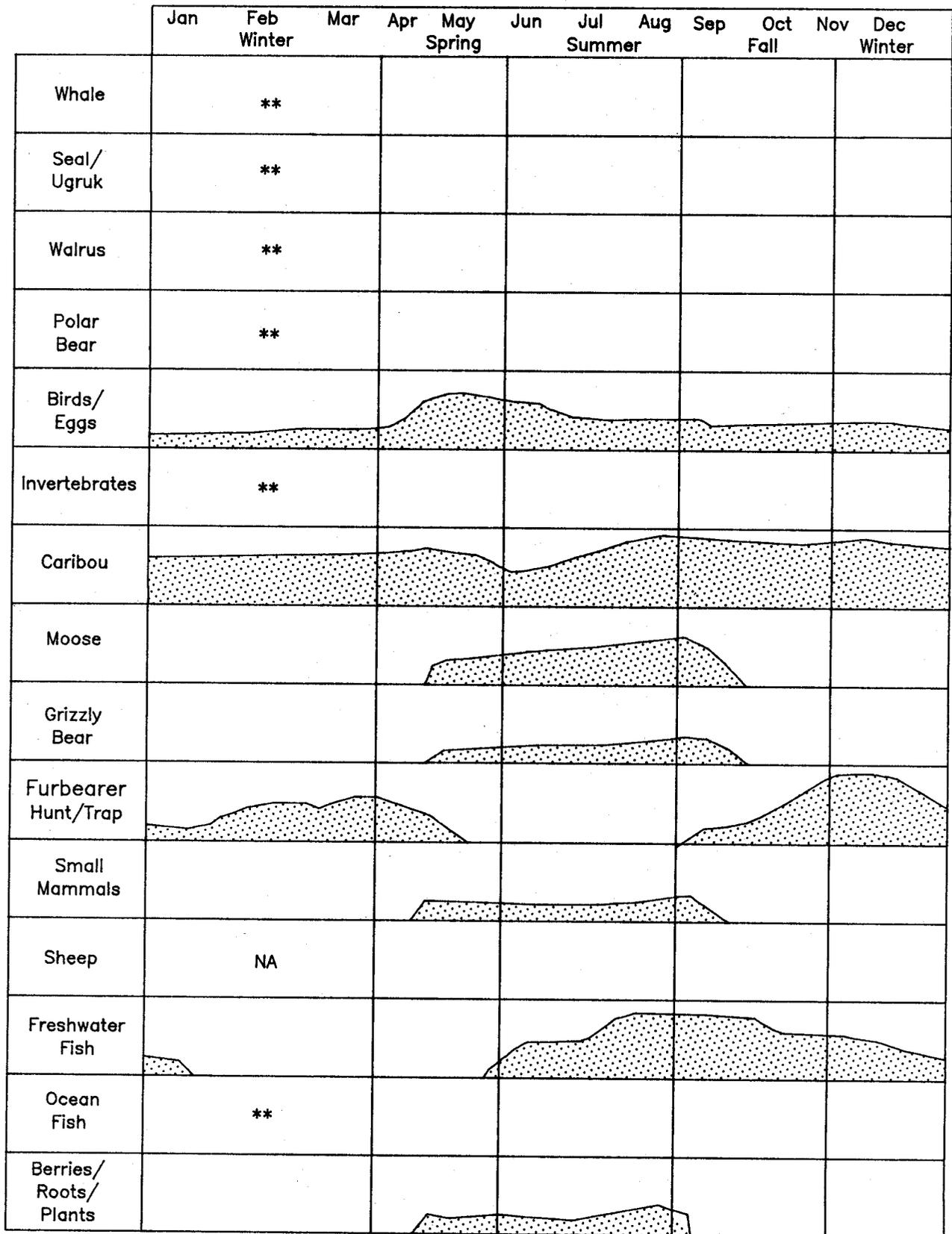


Figure III-C-15. Atkasuk Annual Subsistence Cycle\*

Source: North Slope Borough Contract Staff, 1979.

\* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of subsistence resources.

\*\* These species are harvested only out of hunts originating in Barrow.

respondents said that fish is the secondary resource in quantity harvested. Most fishing occurs along the Meade River. Fish camps also are located on two nearby streams (Usuktuk and Nigisaktuvik Rivers) and downstream on the Meade River, near the Okpiksak River (Craig, 1987). Humpback whitefish, least cisco, grayling, broad whitefish, burbot, and chum salmon (Craig, 1987) are fished with gill nets and baited hooks and by jigging. The most successful fishing months are July and August (Fig. III-C-15), when water levels drop in the Meade River and the river is clearer. Nets are most commonly set in close proximity to the community. During the fall and winter, fishing continues under the ice in the Meade River and in nearby lakes (ACI/Courtneage/Braund, 1984).

Humpback whitefish and least cisco accounted for 96 percent of the summer catch in 1983 (the only year of harvest data). The summer gillnet fishery in the Meade and Usuktuk Rivers caught approximately 3,840 kg of fish. With other gear (harvest of 500 kg) and winter catches (harvest of 1,227 kg), the total harvest was approximately 5,568 kg. The annual per capita catch was about 19.5 kg (Craig, 1987).

(c) Migratory Birds: Atqasuk residents harvest migratory birds from late April through June and again from late August through September on numerous lakes and ponds as well as on the Meade River and its tributaries (Fig. III-C-15). Eggs are gathered in the immediate vicinity of the community for a short period during June (ACI/Courtneage/Braund, 1984).

(4) Nuiqsut: Nuiqsut (population 314 in 1989 [NSB, 1989]) is situated near the mouth of the Colville River, which drains into the Beaufort Sea. For Nuiqsut, the subsistence resources that might be affected by Sale 124 include bowhead and belukha whales, seals, walruses, polar bears, caribou, fishes, and marine and coastal birds. The intensity of effort and preferred harvest periods are indicated in Figure III-C-16. Most of Nuiqsut's marine subsistence-harvest area lies within the proposed Sale 124 lease-sale area; and its terrestrial mammal, fish, and bird subsistence-harvest areas are in the vicinity of possible landfalls at Pitt, Oliktok, and Thomson Points. Additionally, a pipeline from Pt. Belcher would go through Nuiqsut's land subsistence-harvest area; and Nuiqsut also may be used for some air support for lease activities.

(a) Bowhead Whales: Even though Nuiqsut is not located on the coast, marine mammals are a major subsistence resource. Nuiqsut hunters sometimes harvest bowhead whales with Kaktovik hunters. Bowhead whaling usually occurs between late August and early October; the exact timing depends on ice and weather conditions. Also depending on these conditions, the season may last more than 2 months or less than 2 weeks (Fig. III-C-16). Unlike spring-whaling communities, which hunt the bowhead from the edge of ice leads, Nuiqsut whalers hunt bowheads in aluminum skiffs with outboard motors in open water. Generally, they hunt bowheads within 10 mi of shore, but they may travel 20 mi or more from shore. Bowhead whales are commonly harvested by Nuiqsut residents off of Flaxman Island, but the entire coastal area from Nuiqsut to Kaktovik also may be used (Fig. III-C-7). Nuiqsut has not in the past harvested many bowhead whales (four whales since 1972); however, in the past few years their success has improved with harvests in 1986 through 1988. As in other communities, although bowheads are not the main subsistence resource, they are culturally important to Nuiqsut residents. The bowhead is shared extensively with other North Slope communities and as far away as Fairbanks and Anchorage. Its baleen is bartered in traditional networks and is used in the manufacture of traditional arts and crafts.

(b) Belukha Whales: Belukha whales may be harvested throughout the open-water season (Fig. III-C-16) and taken incidentally to the bowhead harvest (Fig. III-C-8). Harvest information is not available for Nuiqsut harvests of belukha whales. While belukhas do not have the same religious significance as do bowheads, the distribution of belukha whales may have a special, traditional form that involves many non-kin. Belukha teeth may be used in the production of arts and crafts.

(c) Seals: Seals are hunted year-round (Fig. III-C-16), but the bulk of their harvest occurs during the open-water season. Breakup usually occurs in June. During the winter, these harvests consist almost exclusively of ringed seals taken along open leads in the ocean ice. In the summer, boat crews harvest ringed, bearded, and spotted seals. Seal hunting occurs along the entire Beaufort Sea coast from Cape Halkett to Anderson Point (Fig. III-C-10). While seal meat is eaten, the dietary significance of seals primarily comes from seal oil, served with almost every meal that includes subsistence foods. Seal oil also is used as a preservative for meats, greens, and berries. Seal skins are important in the manufacture of clothing. Because of their beauty, spotted seal skins are often preferred for making boots, slippers, mitts, and parka trim; however, ringed seal skins are used more often because they are more abundant. Bearded seal hides also are necessary for the manufacture of boot soles. Such products as boots, slippers, mitts, and

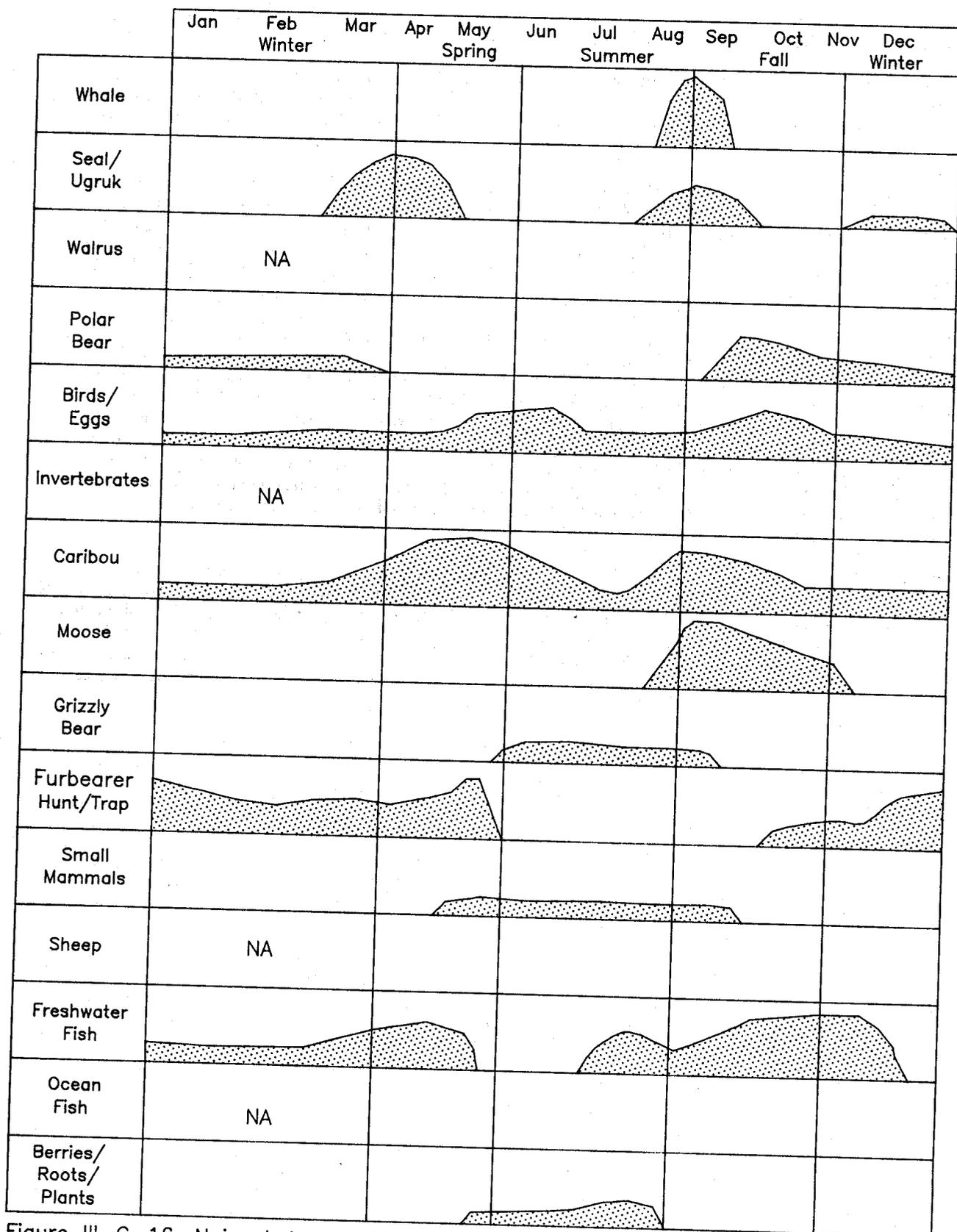


Figure III-C-16. Nuiqsut Annual Subsistence Cycle\*

Source: North Slope Borough Contract Staff, 1979.

\* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

parkas may be sold, given as gifts to relatives and friends, or bartered.

(d) Walrus: Walrus also may be occasionally harvested during the open-water season from June through early October (Fig. III-C-16). Walrus hunting occurs along the entire Beaufort Sea coast from Cape Halkett to Anderson Point (Fig. III-C-10). Walrus meat may be eaten and its ivory used in the manufacture of traditional arts and crafts.

(e) Polar Bears: The harvest of polar bears by Nuiqsut hunters begins in mid-September and extends into the winter (Fig. III-C-16). Polar bear meat is often consumed, although no harvest data are available. The distribution of polar bear meat may have a special, traditional form, which involves non-kin, and also may play a special role during Christmas festivities. The polar bear also is important for its fur, which is used to manufacture cold-weather gear such as boots, mitts, and coats. These items are often sold, given as gifts to relatives and friends, or bartered.

(f) Caribou: Nuiqsut harvests several large land mammals including caribou, moose, and brown bear. Of these, caribou is the most important and is of concern under the proposed action. Caribou, Nuiqsut's primary source of meat, provide an estimated 76 percent of the total subsistence harvest (Table III-C-6). (Nuiqsut's caribou harvest area is shown in Fig. III-C-9.) Caribou are harvested throughout the year, with peak harvests from April through June and in September and October (Fig. III-C-16). Caribou-harvest statistics are available only for 1976, when 400 caribou provided approximately 28,000 kg of meat (Stoker, 1983, as cited by ACI/Braund, 1984). Because of the unpredictable movements of the Western Arctic, Central Arctic, and Porcupine herds and because of the ice and weather-dependent hunting techniques, Nuiqsut's annual caribou harvest fluctuates markedly. When available and weather permits, caribou are harvested almost year-round.

Hunting is often most intense in April, May, August, and September. Caribou--a staple food--may be the most preferred mammal in Nuiqsut's diet. During periods of high availability, caribou can provide a source of fresh meat throughout the year. Caribou may often be shared with kinsmen, friends, and elders within the community; it may be sent to relatives as far away as Anchorage; and occasionally it may be bartered. Caribou plays an important part in holiday feasts. The skins of caribou taken in July and August are used to manufacture such garments as parkas, boot soles, mitts, and mukluk tops. The skins of caribou taken in October and November are used as blankets and sleeping pads.

(g) Fishes: Anadromous fishes provide an important subsistence resource at Nuiqsut. The harvests of most subsistence resources, such as caribou, fluctuate widely from year to year because of variable migration patterns and because harvesting techniques are extremely dependent on ice and weather conditions. The harvest of fishes is an exception to this rule, which adds to the importance of fishes in Nuiqsut's subsistence system. Nuiqsut has the largest documented subsistence harvest on the U.S. Beaufort Sea coast (Moulton, Field, and Brotherton, 1986). Moreover, in October and November, fishes may provide the only source of fresh subsistence foods. Nuiqsut residents harvest fishes from January through May and from late July through mid-December, with the peak harvest apparently occurring in November and early December (Fig. III-C-16).

Fishing is an important activity for Nuiqsut residents due to its proximity to the Colville River with its large resident fish populations. The river supports 20 species of fishes; approximately half of these are taken by Nuiqsut residents (George and Nageak, 1986). Local residents harvest fishes primarily during the summer and fall. The summer, open-water harvest lasts from breakup to freezeup (early June to mid-September). The summer harvest covers a greater area and is longer than the fall/winter harvest in duration, and a greater number of species are caught (see Figs. III-C-16 and III-C-12). Broad whitefish is the primary species harvested during the summer and is the only anadromous species harvested in July in the Nechelik Channel. In July, lake trout, northern pike, broad whitefish, humpback whitefish, and arctic char are harvested in the Main Channel south of Nuiqsut. Salmon species reportedly have been caught in August, but not in large numbers. All five species of Pacific salmon have been reported in the Colville; pink and chum salmon are the most commonly caught, although there reportedly has not been a great interest in harvesting these species (George and Nageak, 1986). Although arctic char is found in the Main Channel of the Colville River (Entrix, Inc., 1986), there is little mention of char as a subsistence species in subsistence studies (George and Nageak, 1986; George and Kovalsky, 1986). Char is apparently liked but is not abundantly caught because the timing is critical (Moulton, 1986, oral commun.).

The fall/winter under-ice harvest begins after freezeup, when the ice is safe for travel by snowmachine.

Local families fish for approximately 1 month or less after freezeup. The Kupigruak Channel is the most important fall-fishing area in the Colville region. The primary species harvested are arctic and least cisco, harvested primarily in the Kupigruak Channel; other fishing for arctic and least cisco also occurs in the Nechelik and Main Channels of the Colville River. Arctic and least cisco composed 88 and 99 percent of the harvest in 1984 and 1985, respectively; however, this varied greatly depending on the net-mesh size. Humpback and broad whitefish, sculpin, and some large rainbow smelt also are harvested, but in low numbers (George and Kovalsky, 1986; George and Nageak, 1986). A fish identified as "spotted least cisco" also has been harvested--this fish is not identified by Morrow (1980) but may be a resident form of least cisco (George and Kovalsky, 1986). Weekend fishing for burbot and grayling also occurs at Itkillikpaat, 10 km from Nuiqsut, even though the success rate for grayling is quite low (George and Nageak, 1986).

The summer catch in 1985 totaled about 8,755 kg of mostly broadfish. In the fall, approximately 27,682 kg of fish were caught, totaling 36,436 kg--an annual per capita catch of 109 kg (however, some of this catch was shipped to Barrow). In 1986, there was a reduced fishing effort in Nuiqsut; and the fall harvest was only 59 percent of that taken in 1985 (Craig, 1987).

Fishes are eaten fresh or frozen; salmon also may be split and dried. Because of their important role as a large and stable food source, and as a fresh-food source during the midwinter months, fish may be shared at Thanksgiving and Christmas feasts and given to relatives, friends, and community elders. Fish also may appear in traditional sharing and bartering networks that exist among North Slope communities. Fishing serves as a strong social function in the community because it often involves the entire family. Most (20-25) Nuiqsut families participate in some fishing activity; however, the bulk of the fishing appears to be done by less than 12 families (George and Nageak, 1986).

(h) Marine and Coastal Birds: Waterfowl and coastal birds are a subsistence resource that has been growing in importance since the mid-1960's. Birds are harvested year-round, with peak harvests in May to June and September to October (Fig. III-C-16). The most important of these birds at Nuiqsut may be the white-fronted goose, Canada goose, Pacific brant, oldsquaw, eider, snow goose, and pintail duck, although other birds--such as loons--may be occasionally harvested. Waterfowl hunting occurs mostly in the spring, beginning in June, and continues throughout the summer and probably into September. In the summer and early fall, such hunting usually occurs as an adjunct to other subsistence activities, such as checking nets. Nuiqsut hunters may harvest Pacific brant intensely in August and early September.

(i) Moose: Moose is harvested from September through mid-December (Fig. III-C-16). There is no available information on the quantities harvested, their relative subsistence importance, or harvest areas at this time.

(5) Kaktovik: Kaktovik is situated on Barter Island off the Beaufort Sea coast (population 227 in 1989 [NSB, 1989]). For Kaktovik, the subsistence resources that might be affected by Sale 124 are bowhead and belukha whales, seals, walruses, polar bears, caribou, fishes, and marine and coastal birds. The intensity of effort and preferred harvest periods are indicated by Figure III-C-17; harvest data summarized by Stoker (1983, as cited in ACI-Braund, 1984) appear in Table III-C-13. Like Nuiqsut, most of Kaktovik's marine subsistence-harvest area is within the proposed Sale 124 lease-sale area; and its terrestrial mammal, fish, and bird subsistence-harvest areas includes a possible landfall at Point Thomson. One of the platforms for the proposed scenario is assumed to be 35 mi (56 km) northeast of Kaktovik. Kaktovik also would be used for some air support for lease activities.

(a) Bowhead Whales: Bowhead whaling occurs between late August and early October (Fig. III-C-17); the exact timing depends on ice and weather conditions. Also depending on these conditions, the season may last more than 1 month or less than 2 weeks. As in Nuiqsut, Kaktovik whalers hunt the bowhead in aluminum skiffs in open water rather than from the edge of ice leads. Whaling crews generally hunt bowheads within 10 mi of shore, although they may occasionally hunt as much as 20 mi from the coast (Fig. III-C-7). Bowhead whales provide a fairly large proportion of Kaktovik's subsistence harvest; with the exception of 1979, from 0 to 4 bowheads have been landed each year since 1962 (Table III-C-13). Bowheads provide a large source of meat and maktak, an especially preferred food. The sharing of the bowhead is a central aspect of Kaktovik's Thanksgiving and Christmas feasts and the focus of the community's Nalukataq (whale feast). As in other North Slope communities, the bowhead is shared extensively. Its baleen is bartered in traditional networks and is used in the manufacture of traditional arts and crafts.

(b) Belukha Whales: Belukha whales usually are harvested in August through November (Fig. III-C-17),

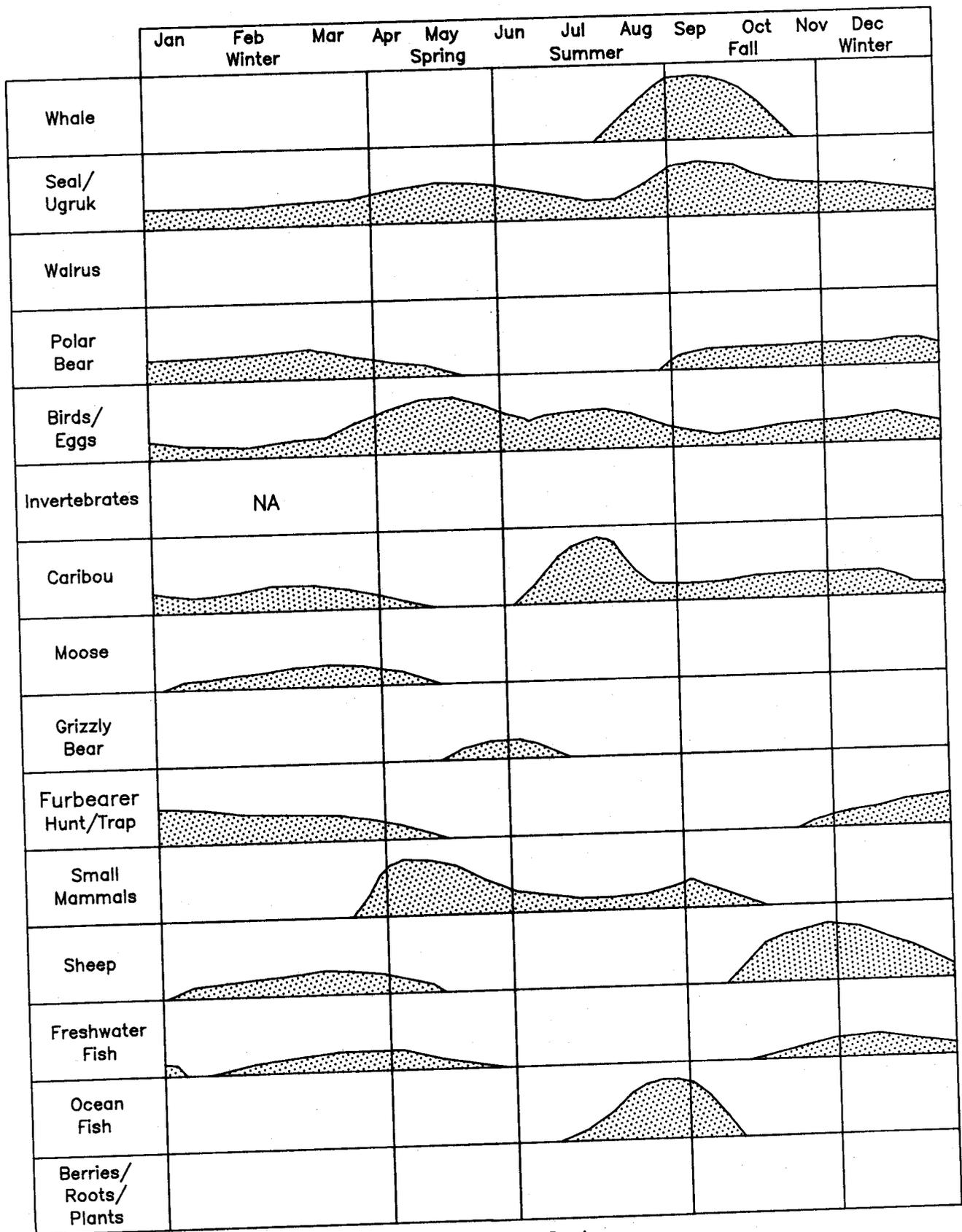


Figure III-C-17. Kaktovik Annual Subsistence Cycle\*  
 Source: North Slope Borough Contract Staff, 1979.

\* Patterns indicate desired periods for pursuit of each species based upon the relationship of abundance, hunter access, seasonal needs, and desirability. Peaks represent optimal periods of pursuit of subsistence resources.

Table III-C-13  
 Kaktovik Annual Harvest of Subsistence Resources  
 for Which Sufficient Data Are Available, 1962-1982

Year	Bowhead Whale	Polar Bear <sup>1/</sup>
1962	0	-
1963	0	-
1964	2	-
1965	0	-
1966	0	-
1967	0	-
1968	0	-
1969	0	-
1970	0	-
1971	0	-
1972	0	5
1973	3	0
1974	2	1
1975	0	1
1976	2	1
1977	2	4
1978	2	0
1979	5	0
1980	1	22
1981	3	1
1982	0	-

Source: Stoker, 1983, as cited by ACI/Braund, 1984.

<sup>1/</sup> No subsistence-harvest data are available for the years 1962-1971, 1982, and 1984 through 1988.

incidental to the bowhead harvest (Fig. III-C-8). However, belukhas sometimes are taken earlier in the open-water season when boating and camping groups are concentrating on the harvest of seals, caribou, or fish. Kaktovik's subsistence system probably is like that found in Barrow and to the west, in which case the distribution of belukha whales has a special, traditional form, which involves many non-kin.

(c) Seals: Seals are hunted year-round, but the bulk of their harvest occurs during the open-water season from July to September (Fig. III-C-17). During the winter, these harvests consist almost exclusively of ringed seals taken along open leads in the ocean ice. These leads are often found many miles offshore. Summer harvests are made by boat crews and consist of ringed, bearded, and spotted seals (Fig. III-C-10). Seal meat is eaten; bearded seal meat is most preferred. However, the dietary significance of seals comes from seal oil, which is served with almost every meal that includes subsistence foods and is used as a preservative for meats, greens, and berries. Seal skins are important in the manufacture of clothing. Because of their beauty, spotted seal skins are often preferred for making boots, slippers, mitts, and parka trim; but ringed seal skins also are important, and bearded seal hides are necessary for the manufacture of boot soles. Such products as boots, slippers, mitts, and parkas are often sold, given as gifts to relatives and friends, or bartered.

(d) Walruss: Because Kaktovik lies east of Point Barrow, walrus are harvested much less frequently than are seals. Walrus are harvested opportunistically, by boat crews hunting other species, in July or August (Fig. III-C-17). Harvests occur in open water along the coast in conjunction with seal hunting (Fig. III-C-11). When harvested, walrus meat may be eaten and its ivory used in the manufacture of traditional arts and crafts.

(e) Polar Bears: Polar bears are harvested during the winter months (Fig. III-C-17) on ocean ice and along ocean leads. When discovered, these bears may be pursued seaward of the barrier islands for 10 mi or more. Polar bear meat is often consumed. If Kaktovik's subsistence system is like that found in the western portion of the North Slope, the distribution of polar bear meat has a special, traditional form, which involves non-kin, and may also play a special role during Christmas festivities. However, the polar bear is primarily important for its fur, which is used to manufacture cold-weather gear such as boots, mitts, and coats. These items are often sold, given as gifts to relatives and friends, or bartered.

(f) Caribou: Kaktovik harvests several large land mammals including caribou, Dall sheep, moose, and brown bear. Of these, only caribou is of concern under the proposed action. Because of the unpredictable movements of the Porcupine and Central Arctic herds and because of the ice and weather-dependent hunting technology, Kaktovik's annual caribou harvest fluctuates widely. When available and weather permits, caribou are harvested almost year-round (Fig. III-C-17). With open water, which usually occurs in July, Kaktovik boat crews hunt caribou along the coast (Fig. III-C-9). Such hunting usually lasts until mid-August, when the caribou move inland and are no longer available. The open-water season is a period of intense caribou harvesting. Approximately 70 percent of all caribou harvests take place on the coastal plain near the coast, and most harvesting is accomplished by boat crews. Usually in late October, snow buildup allows hunters access to inland caribou (Fig. III-C-9). From then until the onset of breakup, which usually occurs sometime in May, Kaktovik hunters take caribou by snowmachine in inland mountains and valleys and, to a lesser extent, on the coastal plain.

Caribou--a staple food that is eaten fresh, frozen, and dried--is the most preferred land mammal in Kaktovik's diet. During periods of high availability, caribou can provide a source of fresh meat throughout the year. Caribou is often shared with kinsmen, friends, and elders within the community; it is often sent to relatives as far away as Anchorage; and it is occasionally bartered. Caribou plays an important part in holiday feasts. The skins of caribou taken in July and August are used to manufacture such garments as parkas, boot soles, mitts, and mukluk tops. The skins of caribou taken in October and November are used as blankets and sleeping pads.

In a recent 3-year study (1981-1983) of Kaktovik's caribou hunting, Pedersen and Coffing (1985) found that the general caribou-hunting range covered about 7,600 mi<sup>2</sup> and that the intensely used area covered about 2,900 mi<sup>2</sup>. This latter figure is a short-term measure of intensity. Because the distribution and availability of caribou fluctuate over a period of years, the size and location of the intensely used area also would change. As expected from earlier research (see NSB Contract Staff, 1979), harvest levels were highly variable. In the 1981 to 1982 season, 43 caribou were taken; in the 1982 to 1983 season, 110 were taken. The annual average harvest was 71.5, approximately .4 caribou per capita. This indicates that the estimated 100 to 300 caribou harvested per year by Kaktovik hunters (U.S. Department of State, 1980) may be high. The figures

presented by Pedersen and Coffing (1985) are comparable to other estimates. ACI/Braund (1984) estimated that an annual average of 75 caribou were taken by Kaktovik hunters between 1962 and 1983; Jacobson and Wentworth (1982) estimated that 80 were taken in 1980. While Jacobson and Wentworth found high-yield areas in both coastal and inland habitats, 70 percent of all caribou harvests took place on the coastal plain near the coast. Most of these were accomplished by boat crews. These figures cannot be extrapolated to other North Slope communities because the species availability and use varies among settlements (see above; see also NSB Contract Staff, 1979). For example, Kaktovik hunts Dall sheep, a big-game species unavailable to other North Slope communities. Kaktovik also is more heavily dependent on fish than most communities (Jacobson and Wentworth, 1982). Moreover, these figures cannot be assumed to reflect the long-term per capita harvests made by Kaktovik hunters. Pederson and Coffing conducted their work in the early 1980's, the period of most intense CIP construction. Reports from other communities indicated that subsistence hunting may have dropped slightly during this period but has increased again since the drop in availability of wage work. Pedersen and Coffing (1985) also found that Kaktovik's hunting patterns already may have been affected by the area's industrialization. They write:

A sizable portion of the general caribou hunting range, as well as a portion of the intensively used area, have been identified as lying within a rapidly industrializing portion of the east-central North Slope. However, very little caribou hunting activity has been conducted in the area recently by Kaktovik residents. No caribou have been reported taken from the area since 1981. . . . It was suggested that unclear harvesting regulations as well as industrialization may have led to avoidance of this region by Kaktovik caribou hunters.

(g) Fishes: Fishes provide an important subsistence resource at Kaktovik. The community's harvests of most subsistence resources fluctuate widely from year to year because of variable migration patterns and because harvesting technologies are extremely dependent on ice and weather conditions. The harvest of fishes is an exception to this rule, which adds to their importance in Kaktovik's subsistence system (see Fig. III-C-12 for harvest areas). Moreover, in January and February, fishes may provide the only source of fresh subsistence foods (Fig. III-C-17).

In the summer, Kaktovik residents primarily harvest arctic char. Sea-run char are caught all along the coast, around the barrier islands, and up the navigable portions of the river deltas. Char are the first fishes to appear after the ice is gone in early July and are caught until late August. Arctic ciscoes are harvested in the ocean after the arctic char run peaks, beginning about the first of August through early September. Grayling also is a major subsistence fish taken in the Hulahula River, and many of the area's rivers and river deltas. Late summer, after freezeup, and then again in the spring, are the most likely times to catch grayling. Least cisco is taken in the lagoons, river deltas, and particularly the small lakes and streams of the river drainages. Broad whitefish is harvested in the deeper lakes and channels of the Canning River Delta from July through September. Less commonly harvested are round whitefish, also harvested in the Canning River. Pink and chum salmon are occasionally taken in July and August near Barter Island (Jacobsen and Wentworth, 1982).

Arctic flounder and fourhorn sculpin are occasionally taken during summer ocean fishing off Manning Point or Drum Island, Arey Spit, and in Kaktovik Lagoon between Manning Point and the mainland. Sculpin is usually not eaten because it is too bony. Pike (in Inupiaq, Paigluk), which has not been positively identified, is caught in the Hulahula River, and occasionally is also caught in other rivers. Arctic cod or tomcod and smelt are caught in the summer along the Beaufort Sea coast, sometimes near the spits off Barter Island. Blackfish is harvested in the spring on the Canning, Hulahula, Kongakut, and especially in the Aichilik, Rivers (Jacobsen and Wentworth, 1982).

During the fall/winter fish harvest, freshwater arctic char is taken inland on the rivers by fishing through holes in the ice. Broad whitefish is occasionally taken in the winter at fishing holes farther inland on the Canning River. Small numbers of ling cod are sometimes taken inland on the Canning River during the snow season. They are harvested only on the inland portions of rivers, at least 10 mi from the coast. During the snow season, lake trout is caught in the Neruokpuk Lakes of the Brooks Range. Arctic cod or tomcod and smelt are sometimes jigged in October and November north of Barter Island and Iglukpaluk. Blackfish is harvested in the winter on the Canning, Hulahula, Kongakut, and especially the Aichilik, Rivers (Jacobsen and Wentworth, 1982).

Because of their important role as a large and stable food source and as a fresh-food source during

midwinter months, fishes may be shared at Thanksgiving and Christmas feasts and given to relatives, friends, and village elders. Kaktovik traditional subsistence uses are probably similar to those found elsewhere on the North Slope, in which case fishes also may appear in traditional sharing and bartering networks that exist among North Slope communities.

(h) Marine and Coastal Birds: Waterfowl and coastal birds are a subsistence resource that has been growing in importance since the mid-1960's. The most important of these birds at Kaktovik are black brants, oldsquaws, eiders, snow geese, Canada geese, and pintail ducks, although other birds--such as loons--may be occasionally harvested. Waterfowl hunting occurs mostly in the spring, from May through early July (Fig. III-C-17). However, less intensive harvesting continues throughout the summer and into September. During the spring, birds are hunted by groups that camp along the ocean's coast; spits and points of land often provide the best hunting locations. In the summer and early fall, bird hunting occurs as an adjunct to other subsistence activities, such as checking nets.

Virtually the entire community of Kaktovik participates in the spring bird hunt. Since it occurs at the end of the school year, it is a major family activity. Because waterfowl is a highly preferred food, it is shared extensively within the community. Birds are often given to relatives, friends, and village elders. While most birds are eaten fresh, usually in soup, some are stored for the winter. Birds are often served for special occasions and holiday feasts such as Nalukataq and Thanksgiving. Occasionally, birds may be bartered.

4. Archaeological Resources: Archaeological resources may be any objects or features older than 50 years that are manmade or modified by human activity. The two major time sequences of archaeological resources of the Beaufort Sea Sale 124 area are prehistoric and historic. Significant archaeological resources are either historic or prehistoric and, as defined by 36 CFR 60.4, generally include properties greater than 50 years old that are associated with events that have made a significant contribution to the broad patterns of our history; are associated with the lives of persons significant in the past; embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic values; represent a significant and distinguishable entity whose components may lack individual distinction; or have yielded, or may be likely to yield, information important in history or prehistory.

The description of the archaeological resources in the Beaufort Sea and shore, as contained in Section III.D.3 of the Sale 97 FEIS (USDOI, MMS, 1987a), is incorporated by reference. A summary of this description, augmented by additional material, as cited, follows. These resources represent the remains of the material culture of past generations of the region's prehistoric and historic inhabitants. They are basic to our understanding of the knowledge, beliefs, art, customs, property systems, and other aspects of the nonmaterial culture. The three major categories of prehistoric and historic archaeological resources identified in the Sale 97 area are (1) onshore sites, (2) offshore sites, and (3) shipwrecks.

a. Onshore Sites: The predominant types of prehistoric resources found on the shores near the proposed Sale 124 area are housepits containing the household and subsistence artifacts of early people (stone lamps, carved ivory, harpoons, etc.). (Refer to the EIS's for Sales 71 [USDOI, BLM, 1982], 87 [USDOI, MMS, 1984], and 97 [USDOI, MMS, 1987a] for National Register site locations, other archaeological resources, historic sites, buildings, and shipwrecks after 1741. Also refer to Fig. III-C-18 for significance of resources for OSRA land segments.) The Leffingwell Camp National Historic Landmark (NHL) and the Birnirk NHL will need special attention that avoids adverse disturbance during the Sale 124 exploration and development activities.

b. Offshore Sites: The MMS archaeological analysis, Prehistoric Resource Analysis, Proposed Sale 124 Beaufort Sea (see Appendix I of this EIS) has been updated for possible archaeological landforms on the Bering Land Bridge. This analysis uses new information, and the report states that no blocks (1) have the potential for prehistoric sites, (2) contain landforms significant for human habitation, and (3) have enough Holocene sediments for site protection and preservation. The analysis states further that "Since prehistoric sites generally occur in predictable geographic areas, it has been proposed in various studies that the same areas where sites of a given period occur on land will be the same areas where sites will occur on the now submerged shelf. These geographic areas with high probability for associated prehistoric sites are listed in Table 1." (See Table 1, Appendix I, this EIS.) Man has occupied the Beaufort Sea shelf area during the past 18,000 years. Although there is only a low probability that a prehistoric site could have survived, it is still possible that early-man-habitation sites would have survived the tremendous

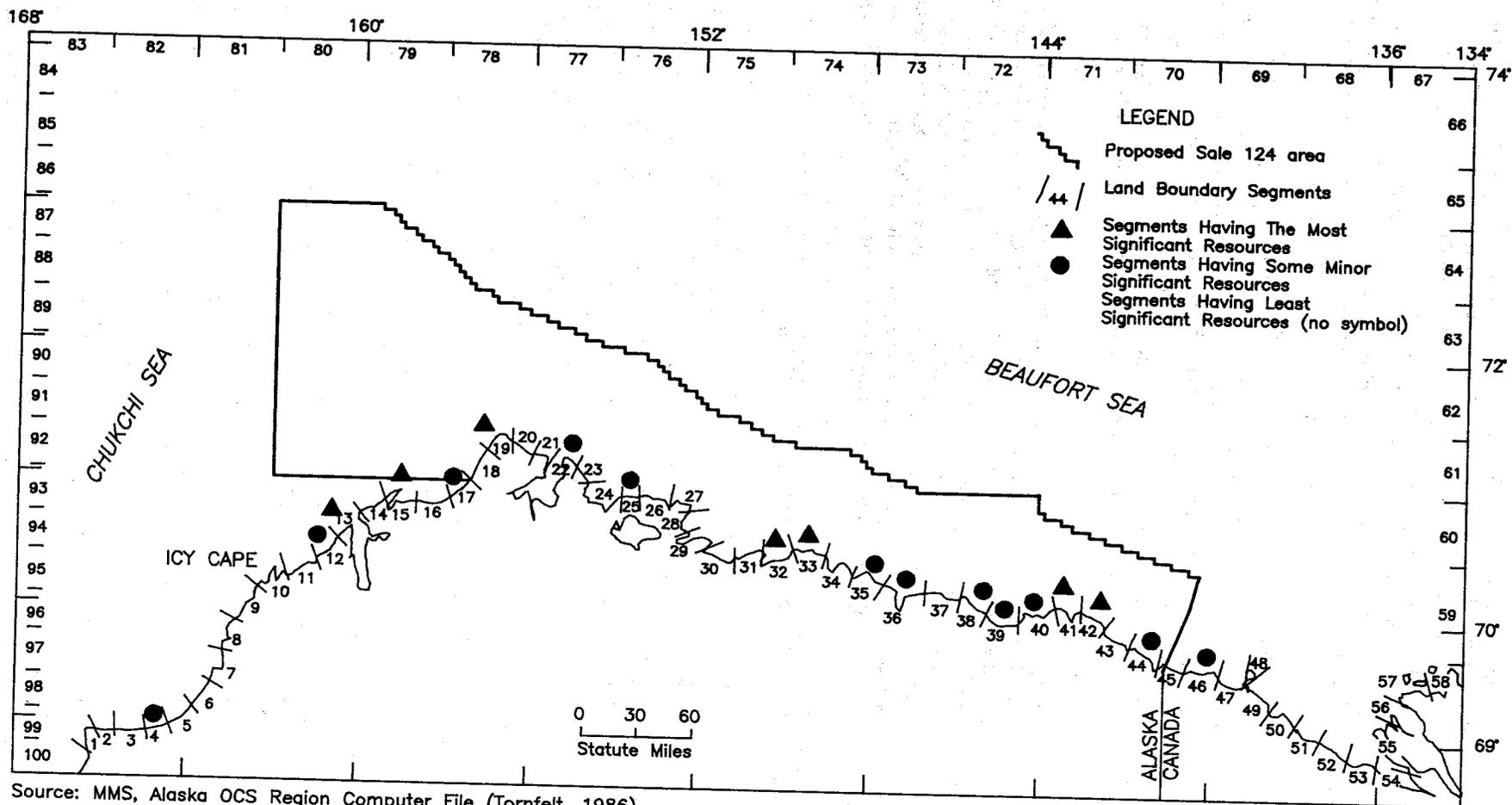


Figure III-C-18. Shipwrecks and Archaeological Resources

amount of ice gouging that has occurred. If a prehistoric site did survive, it is unlikely that it could be detected by present seismic-reflection methods, because the subsurface sediments are so jumbled and homogenized that they do not give good returns on the records. It appears uncertain whether ice gouging and scouring of the sea bottom would preclude survival of a prehistoric site anywhere in the Sale 124 area. No new evidence of such survival is provided with surveys done since this MMS report. Surveys with closer line spacing and/or finer resolution are necessary to say that cultural resources have or have not survived. On the basis of this report, the possibility of the survivability of offshore archaeological resources other than shipwrecks would be small.

c. Shipwrecks: Between 1868 and 1914, 28 shipwrecks have occurred a few miles north and east of Barrow, and 33 have occurred a few miles north and west of Point Belcher (see Tornfelt, in prep., for details on shipwrecks). No surveys for locations of these shipwrecks have been made. Neither have any of the shipwrecks been accidentally or deliberately discovered; therefore, no exact locations are known. (See Reassessment of Shipwreck Potential and Archaeological Survey Recommendations for Sale 109 Leases, Chukchi Sea, Alaska, in Appendix I.) As near as can be determined, shipwrecks that might be located and would be protected by Stipulation No. 1, Protection of Archaeological Resources (see Sec. II.G.2.a), are listed in Appendix I.

Although some remains of shipwrecks do exist in shallow water and on beach edges after 100 years of storm and ice, it is unlikely but still possible that shipwrecks would have survived ice gouging and related ice forces in the Sale 124 area if they occurred shoreward of the 25-m isobath. Beyond the 25-m isobath, the chances of a wreck surviving increase with the distance from the stamuki zone. There are no known offshore wrecks associated with this lease sale (Appendix I). Any such wrecks, if they exist, still would be exposed and detectable by sidescan sonar or equivalent instrument employed in a geohazards survey. Due to uncertainties in the location of a wreck, all such geohazard surveys must be examined carefully by an archaeologist and geophysicist before drilling takes place and any anomalies reported (see Stipulation No. 1, Sec. II.G.2.a).

## 5. Land Use Plans and Coastal Management Programs

a. Land Status and Use: Most land in the NSB is held by a few major landowners. The predominant landowner within the NSB is the Federal Government. Of the approximately 20 million ha in the region north of 68° N. latitude, over one-half is contained in the NPR-A and ANWR. Other major landholders include the State of Alaska (1.4 million ha) and the eight Native village corporations and the Arctic Slope Regional Corporation (1.9 million ha). Complexity in land-ownership patterns is a result of the ANCSA provisions that only surface-estate rights are to be conveyed to Native village corporations; subsurface-estate rights can be conveyed to Native regional corporations. Moreover, in selected Federal holdings, such as ANWR and NPR-A, selection was restricted to surface estate for village corporations. The subsurface estate was reserved for the Federal Government; ASRC was required to select its subsurface estate outside these boundaries.

Major land uses on the North Slope are divided between traditional subsistence uses of the land and hydrocarbon-development operations. The traditional settlement patterns and subsistence uses of land are discussed in Section III.C.3. The extent and location of hydrocarbon exploration and development and production operations on the North Slope and offshore areas are discussed in the description of projects included for the cumulative case, Appendix E.

b. Land Use Planning Documents: Documents addressing land use in the NSB include the ANWR Report and Recommendation to Congress, the NSB Comprehensive Plan and Land Management Regulations, and the NSB Coastal Management Program (CMP). The NSB CMP and the Statewide Standards of the Alaska Coastal Management Program (ACMP) are described in the following section. This section describes the ANWR recommendation and summarizes and incorporates by reference the descriptions of the Comprehensive Plan and Land Management Regulations that are in Section III.D.3.c of the Beaufort Sea Sale 87 FEIS (USDOI, MMS, 1984) and Section III.D.3 of the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a).

(1) Arctic National Wildlife Refuge: The FWS, in cooperation with the U.S. Geological Survey and the Bureau of Land Management, prepared a resource assessment and legislative environmental impact statement to provide Congress with a recommendation on future management of the coastal plain. The report analyzed five management alternatives ranging from opening the entire coastal

plain for leasing for oil and gas development to designating the entire area a wilderness. The alternative recommended to Congress by the Secretary of the Interior as preferred was that which opened the entire coastal plain to oil and gas leasing.

Congressional action is necessary before any of the area can be leased for oil and gas exploration and development. Several bills have been introduced into Congress to authorize such development; however, passage of a bill authorizing activity on the coastal plain is not expected during the 101st session of Congress.

(2) NSB Comprehensive Plan and Land Management Regulations: The North Slope Borough Comprehensive Plan and Land Management Regulations (LMR's) were adopted initially in December 1982. The LMR's were revised on April 12, 1990. The following description is based on the new regulations. The revisions simplified the regulatory process but did not alter the basic premise of the comprehensive plan--to preserve and protect the land and water habitat essential to subsistence living and the Inupiat character of life.

The new LMR's have five zoning districts--Village, Barrow, Conservation, Resource Development, and Transportation Corridor. All areas within the Borough are in the Conservation District unless specifically designated as within the limited boundaries of the villages or Barrow, as a unitized oil field within the Resource Development District, or along the TransAlaska Pipeline corridor within the Transportation Corridor. Therefore, new large scale development most likely would occur within the Conservation District. In that event, a Master Plan for the development must be submitted to the NSB and adopted by the NSB Assembly as an amendment to the Comprehensive Plan, and the land must be rezoned from Conservation District to Resource Development District. During the process for rezoning for the Endicott development, several stipulations were attached to the Master Plan to mitigate adverse effects and to encourage beneficial effects.

In the new regulations, uses are no longer categorized as (1) uses-by-right, (2) prohibited uses, and (3) conditional uses (those that were neither prohibited nor allowed by "right"). Rather, the process identifies (1) uses that can be administratively approved without public review, (2) uses that require a development permit and must have public review before they can be administratively approved, and (3) uses that are considered conditional development that must be approved by the Planning Commission.

Policy revisions in the LMR's incorporated the NSB Coastal Management Policies and supplemented these with several additional policy categories--Village Policies, Economic Development Policies, Offshore Development Policies, and Transportation Corridor Policies. Offshore policies are specifically limited to development and uses in the portion of the Beaufort Sea that is within the NSB boundary. All the policies address offshore drilling.

An automated Geographic Information System (GIS) is integrated into the NSB land use program. At a scale of 1:250,000, the GIS provides information on surface hydrology; political and administrative units; infrastructure; settlements and special features; energy and mineral resources; elevation provinces; historical and archaeological sites; NSB planning maps; regional subsistence-land use; and a composite of vegetation, soils, geology, slope, and land use features (called integrated terrain units [ITU's]). Limited areas, such as the Prudhoe Bay Unit, Endicott Unit, and portions of the Kuparuk Unit, are mapped at the 1:63,360 scale. Information on these areas includes ITU's, surface hydrology, infrastructure, political and administrative units, and habitats (adapted from the NSB planning maps). Data for the Dalton Highway corridor are mapped at the scale of 1:63,360 and are restricted to manmade changes along the corridor.

c. Coastal Management: The Federal Coastal Zone Management Act (CZMA) and the Alaska Coastal Management Act (ACMA) were enacted in 1972 and 1977, respectively. Through these acts, development and land use in coastal areas are managed to provide a balance between the use of coastal areas and the protection of valuable coastal resources. The provisions and policies of both the Federal and State CMP's are described in MMS Reference Paper 83-1 (McCrea, 1983), which is summarized in the following paragraphs and incorporated by reference in this EIS. Statewide standards of the ACMP may be refined through local coastal programs prepared by coastal districts. Coastal districts are encouraged to prepare local CMP's to supplement the Statewide standards in their district. District programs must be approved by the Alaska Coastal Policy Council (CPC) and the Secretary of the U.S. Department of Commerce through the Office of Ocean and Coastal Resource Management (OCRM) before they are fully incorporated into the ACMP. The NSB is the only coastal district in proximity to the sale area; its CMP has been fully incorporated into the ACMP. A description of the NSB CMP follows that of the Statewide

standards of the ACMP.

(1) **Statewide Coastal Management Standards:** The ACMP, as initially approved by OCRM, includes the ACMA, guidelines and standards developed by the CPC, a series of maps depicting the interim boundaries of the State coastal zone, and an EIS prepared by OCRM. The Statewide standards that may be relevant to activities hypothesized in this EIS are summarized in the following paragraphs under three headings: coastal habitats, coastal resources, and uses and activities.

(a) **Coastal Habitats:** Eight coastal habitats were identified in the standards (offshore; estuaries; wetlands and tidelands; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important uplands). Each habitat has a policy specific to maintaining or enhancing the attributes that contribute to its capacity to support living resources (6 Alaska Administrative Code [AAC] 80.130[b] and [c]).

Activities and uses that do not conform to the standards may be permitted if there is a significant public need, no feasible prudent alternatives to meet that need, and all feasible and prudent mitigation measures are incorporated to maximize conformance. Habitat policies frequently are cited in State consistency reviews.

(b) **Coastal Resources:** Two policy areas come under the heading of coastal resources: (1) air, land, and water quality and (2) historic, prehistoric, and archaeological resources. In the first instance, the ACMP defers to the mandates and expertise of the Alaska Department of Environmental Conservation (DEC). The standards incorporate by reference all the statutes, regulations, and procedures of the DEC that pertain to protecting air, land, and water quality (6 AAC 80.140). Concerns for air and water quality are cited frequently during State reviews for consistency.

The policy addressing historic, prehistoric, and archaeological resources requires only identification of the "areas of the coast which are important to the study, understanding, or illustration of national, state, or local history or prehistory" (6 AAC 80.150).

(c) **Uses and Activities:** Nine topics are addressed under this heading: coastal development, geophysical-hazard areas, recreation, energy-facility siting, transportation and utilities, fish and seafood processing, timber harvesting and processing, mining and mineral processing, and subsistence. Uses and activities of particular relevance to the activities hypothesized for this OCS lease sale include coastal development, energy-facility siting, transportation and utilities, and subsistence.

Both the Federal CZMA and the ACMP require that uses of State and Federal concern be addressed (CZMA Sec. 303[2][C], AS 46.40.060, and AS 46.40.070). The ACMA further stipulates that local districts may not arbitrarily or unreasonably restrict or exclude such uses in their CMP's. Among the uses of State concern is the siting of major energy facilities.

(2) **NSB District CMP:** The NSB CMP was adopted by the Borough in 1984. Following several revisions, the NSB CMP was approved by the Alaska CPC in April 1985 and OCRM in May 1988. The coastal management boundary adopted for the NSB CMP varies slightly from the interim boundary of the ACMP. In the mid-Beaufort sector, the boundary was extended inland on several waterways to include anadromous-fish-spawning and -overwintering habitats. Along the Chukchi Sea coast, it was extended inland to include the Kukpuk River and a 1.6-km corridor along each bank.

The NSB CMP was developed to balance exploration, development, and extraction of nonliving natural resources and maintenance of and access to the living resources upon which the Inupiat traditional cultural values and way of life are based. The NSB CMP contains four categories of policies: (1) standards for development, (2) required features for applicable development, (3) best-efforts policies that include both allowable developments and required features, and (4) minimization-of-negative-impacts policies.

Standards for development prohibit severe harm to subsistence resources or activities or disturb cultural and historic sites. Required features address reasonable use of vehicles, vessels, and aircraft; engineering criteria for offshore structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways; residential development associated with resource development; and air quality, water quality, and solid-waste disposal.

Best-efforts policies allow for exceptions if (1) there is "a significant public need for the proposed use and activity" and (2) developers have "rigorously explored and objectively evaluated all feasible and prudent

alternatives . . . ." and briefly documented why the alternatives have been eliminated from consideration. If an exception to a best-efforts policy is granted, the developer must take "all feasible and prudent steps to avoid the adverse impacts the policy was intended to prevent."

Best-efforts policies allow development if all feasible and prudent steps are taken "to avoid the adverse impacts the policy was intended to prevent." Policies in this category address developments that could cause significantly decreased productivity of subsistence resources or ecosystems, displace belukha whales in Kasegaluk Lagoon, or restrict access of subsistence users to a subsistence resource. They also create restrictions on various modes of transportation, mining of beaches, or construction in certain floodplains and geologic-hazard areas.

Best-efforts policies also address features that are required by "applicable development except where the development has met the [two criteria identified above] and the developer has taken all feasible and prudent steps to maximize conformance with the policy." Developments and activities regulated under these policies include coastal mining, support facilities, gravel extraction in floodplains, new subdivisions, and transportation facilities. Siting policies include the State habitat policies and noninterference with important cultural sites or essential routes for transportation to subsistence resources.

All applicable developments must minimize "negative impacts." Regulated developments include recreational uses, transportation and utility facilities, and seismic exploration. Protected features include permafrost, subsistence activities, important habitat, migrating fish, and wildlife. Geologic hazards must be considered in site selection, design, and construction.

Two "areas meriting special attention" (AMSA's) were identified in the CMP--Point Thomson and Kasegaluk Lagoon. Upon further examination, Point Thomson was dropped and the Colville River Delta was added. Planning for the Kasegaluk Lagoon AMSA and the Colville River Delta AMSA is proceeding.

The NSB has adopted administrative procedures for implementing these policies based on the permit process established under Title 19 of the Borough's Land Use Regulations and the consistency-review process of Title 46 of the Alaska Statutes.

## **SECTION IV**

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# **ENVIRONMENTAL CONSEQUENCES**

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## IV. ENVIRONMENTAL CONSEQUENCES

### A. Basic Assumptions for Effects Assessment

The effects of the proposed Beaufort Sea Oil and Gas Lease Sale 124 are assessed in Section IV. Many of the basic resource and scenario assumptions used for effects assessment are discussed in Sections II.A through F and summarized in Table II-A-1. The Section IV assessment includes the analyses of the effects of Alternative I (low, base, and high cases); Alternative II, No Lease Sale; Alternative III, Delay the Sale; Alternative IV, Barrow Deferral Alternative; Alternative V, Barter Island Deferral Alternative; cumulative case; natural gas development and production; and a low-probability, high-effect very large oil-spill event.

For Alternative I, it is assumed the low, base, and high cases represent the potential range of resources, scenarios, and effects that might be possible given the uncertainties associated with estimating resources in a frontier area such as the Beaufort Sea Planning Area. The limits of the range of oil resources are assumed to be the low-case (270 MMbbl) and high-case (2,600 MMbbl) estimates. Within this range is a base-case estimate (900 MMbbl) of oil that is believed likely to be leased and developed. These estimates are used to develop the exploration, development and production, and transportation scenarios used to analyze the potential effects of the proposed sale. (As noted in Appendix A, the low-, base-, and high-case estimates are determined by multiplying the 95th percentile, mean, and 5th percentile conditional estimates, respectively, by a factor representing the fraction of unleased oil in the planning area that is estimated to be leased and, for the base and high cases, economically developed; for Sale 124, the Minerals Management Service [MMS] estimates this fraction to be 0.62.)

The low case is used where there is a high probability that commercially exploitable resources do not exist and development and production activities may not occur as a result of leasing. Thus, the low-case analyses represent the effects associated only with exploratory activities--Section IV.B.

The base-case estimate is presumed to be the likely result if hydrocarbons are present in the sale area in commercial quantities and if the lease sale occurs as proposed. The base case includes (1) the undiscovered resources estimated to be leased, developed, and produced and (2) an estimate of the exploration, development and production, and transportation activities appropriate to that level of resources. The principal analyses of the effects of the proposed sale are performed for the base case--the presumed result if the proposed lease sale is held--Section IV.C.

The high case includes estimates of (1) a higher level of resource recovery that represents the maximum amount of resources if hydrocarbons are present and (2) exploration, development and production, and transportation activities that might result from leasing more acreage than might occur for the base case or discovering larger accumulations of oil--Section IV.D.

The potential effects of a proposed sale based on alternative sale-area configurations are analyzed for two deferral alternatives--the Barrow Deferral Alternative (Alternative IV, Sec. IV.G) and the Barter Island Deferral Alternative (Alternative V, Sec. IV.H). The configuration of the sale area for each of these two alternatives was defined by deleting from the Alternative I area blocks that contain, at various times, significant biological resources and hold important cultural values for the Natives who inhabit the nearby areas; the deleted blocks comprise the deferred area for each alternative. As noted in Section II.E.1 and II.F.1, MMS estimates the probability of a major discovery of hydrocarbons in the deleted blocks to be quite low. Therefore, the amount of oil estimated to be leased, discovered, and produced in the areas defined by either the Barrow Deferral Alternative or the Barter Island Deferral Alternative is 900 MMbbl--the same as for the base case for Alternative I. Because of the low potential for economic development of petroleum resources in either of the proposed deferred areas, the types, levels, and schedule of exploration, development and production, and transportation activities estimated for Alternatives IV (Appendix B, Table 4) or V (Appendix B, Table 5) are assumed to be the same as they are for the base case for Alternative I.

The analyses of the potential effects of the cumulative case for Sale 124 (Sec. IV.I) are based on (1) exploration, development and production, and transportation activities in the three Outer Continental Shelf (OCS) planning areas of the arctic region (Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas [Figure I-1]) and (2) the major projects listed in Table IV-A-4-1 and described in Appendix E--locations are

shown in Graphic 3. The total amount of oil estimated to be present in the three OCS arctic region planning areas is about 5,480 MMbbl (Appendices A and B). The major projects considered in the cumulative effects analyses for Sale 124 include past and future State of Alaska (SOA) and OCS oil and gas lease sales, North Slope Borough (NSB) capital improvement projects, onshore mineral development, and Canadian arctic oil and gas development.

Natural gas also may be discovered in the Sale 124 area during exploration drilling. Although gas resources are not considered economic to exploit at this time, they may be exploited in the future. Thus, leases containing natural gas that may be recoverable in the future probably will be retained by the leaseholder. Hence, the effects of potential natural gas exploitation that are in addition to the effects associated with oil development are analyzed in Section IV.M.

To analyze the potential effects of a low-probability, high-effect, very large oil-spill event, it is assumed that a spill of 160,000 bbl from a pipeline in the Beaufort Sea Planning Area will occur--Section IV.N.

The assumptions and the processes for performing the oil-spill-risk analysis and for calculating the probabilities of oil spills occurring and contacting environmental resources and coastal areas are described briefly in Section IV.A.1; a detailed description is given in Appendix G. Aspects of spilled oil, including (1) its fate and behavior, (2) persistence along shorelines, (3) oil-spill-contingency measures, and (4) toxicity in the marine environment, are discussed in Section IV.A.2.

In analyzing the potential environmental effects of Sale 124, it is assumed that all activities associated with exploration, development and production, and transportation of petroleum will be performed in accordance with all pertinent laws of the United States and Federal regulations. Compliance with pertinent laws and regulations could mitigate some of the effects associated with petroleum exploitation.

Potentially affected communities should not use the Environmental Impact Statement (EIS) as a "local planning document." Site-specific planning cannot yet be done; it might be several years after the lease sale before any specific projections could be made. The exploration, development and production, and transportation scenarios described in this document represent only some of the possible types of activities that might be used to exploit the petroleum resources of the Beaufort Sea Planning Area. These scenarios are used to identify characteristic activities and areas where these activities may occur. They do not represent a recommendation, preference, or endorsement by the U.S. Department of the Interior (USDOI).

1. **Oil-Spill-Risk Analysis:** Oil spills from offshore oil activities can pose significant risks to the environment. Over the last decade, an oil-spill-risk-analysis (OSRA) model has been developed to quantify oil-spill risks to environmental resources and coastal (land/boundary) segments (LaBelle, 1986; LaBelle and Anderson, 1985; Amstutz and Samuels, 1984; Samuels, LaBelle, and Amstutz, 1982-3; Smith et al., 1982; Samuels, Huang, and Amstutz, 1982; Lanfear, Smith, and Slack, 1979). This section briefly describes the process for performing the OSRA and for calculating estimates of probabilities of oil spills occurring and contacting environmental resources and coastal land segments; a detailed description is found in Appendix G.

a. **Overview of the OSRA Model:** This subsection provides a brief introduction to the OSRA. Details of the analysis are provided in Appendix G and in references provided therein. The study area encompassed by the oil-spill-trajectory model for this proposed lease sale is the Beaufort Sea and northeastern Chukchi Sea (Fig. IV-A-1-1). No trajectory analysis is provided for the cumulative case, nor for any case along the tanker route out of Valdez. The EIS treats these components of the overall risk by separately projecting the total oil spillage in the cumulative case and spillage along the Valdez tanker route.

Within the spill-trajectory study area, the likelihoods of oil-spill contacts are calculated for 100 land/boundary segments, 32 environmental-resource areas during open water, and 31 environmental-resource areas during winter (Appendix G). Risks during open water occur from summer spills and also from spills that overwinter within the ice until meltout the following summer.

The hypothetical spill sites (L-1 to L-17 and L-26 to L-33 in Fig. IV-A-1-1) used in this OSRA to represent potential platform and pipeline locations are the same as those used in the Sale 97 final EIS (FEIS) (USDOI, MMS, 1987a). By assuming that an oil spill occurs at a spill site--and by modeling possible spill trajectories under multiple, statistically realistic, modeled weather and oceanic conditions--probabilities of contact are generated for environmental-resource areas and land/boundary segments. Such probabilities are

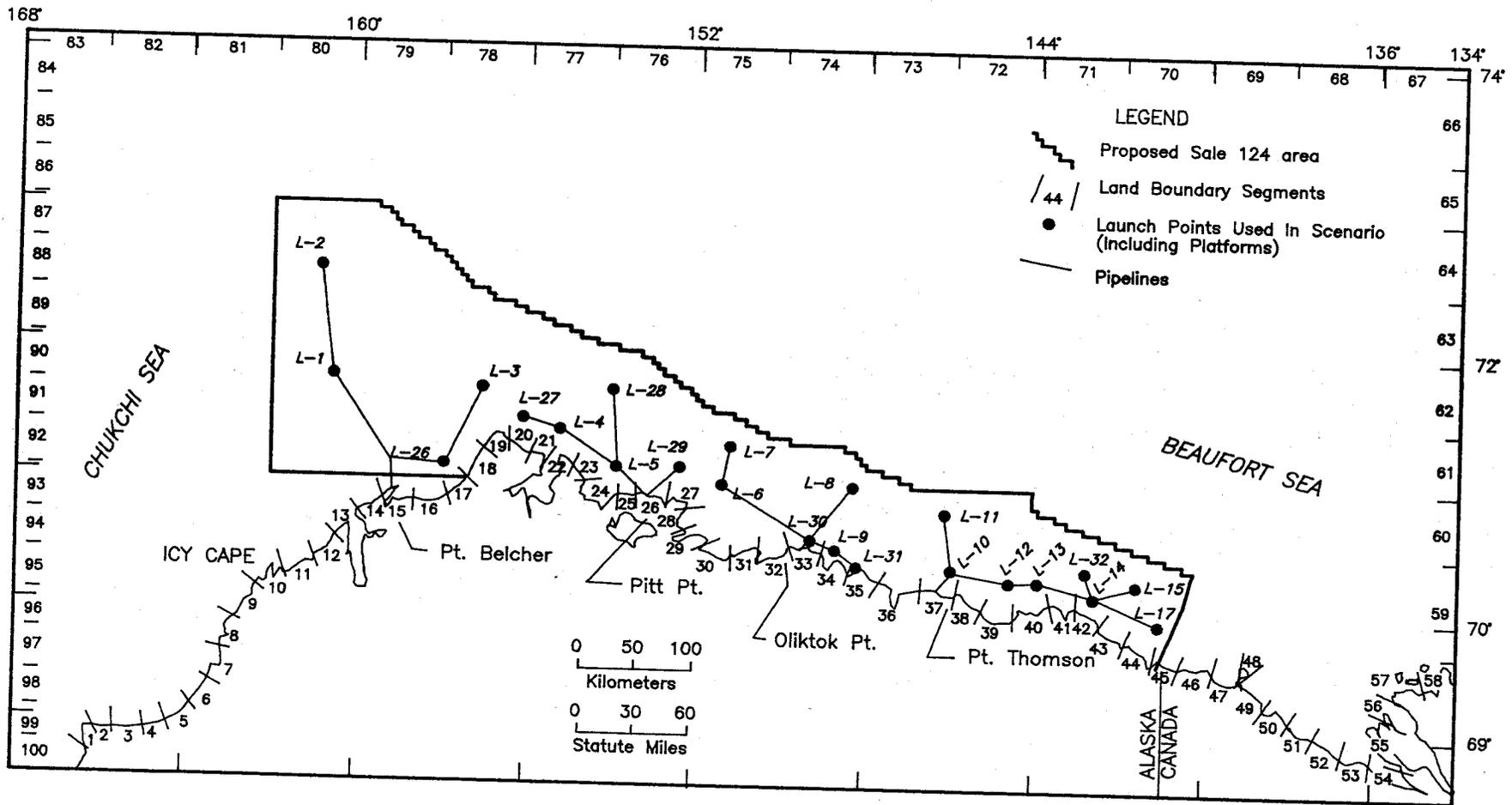


Figure IV-A-1-1. Study Area, Land and Boundary Segments, Pipeline Routes, and Spill Points Hypothesized in the Oil-Spill-Risk Analysis of the Base and High Case

calculated from each spill site and are called "conditional" probabilities, being based on the condition that a spill occurs.

The likelihood of this condition--that a spill occurs--is then internally calculated within the OSRA model for each spill site from (1) proprietary information and assumptions regarding the fractional, Sale 124 resource potential in the vicinity of that spill site; (2) assumed pipeline scenario to shore landfalls (Fig. IV-A-1-1); and (3) estimated spill-rate constants based on historical OCS trends for spillage per volume of oil produced and piped. The probability, summed over all sale-area spill sites, of one or more spills both occurring and contacting a specific land/boundary segment or environmental-resource area is then called a combined probability.

The combined probability represents an estimate of the overall probability of oil-spill contact to specific Sale 124 resources, taking into account 23 (quasi-random) locations (= hypothetical spill sites), the projected amount of oil to be produced and transported, and assumptions about where oil would be found. An oil resource is assigned only to those spill sites associated with the most prospective oil structures in the sale area. In this EIS, the oil resource is projected to be produced from four platforms and, therefore, from no more than four structures in the base case and from seven platforms and no more than seven structures in the high case. The additional production platforms in the high case may represent multiple platforms on the same structures rather than additional oil fields. The exact numbers of structures assumed in the construction of the resource estimates, structure locations, and the amount of oil resource assigned to each spill site are based on proprietary information and are not disclosed even to writers of this EIS.

The structures in the sale area that are assumed to contain the oil resource are those considered most attractive from the PRESTO database (Appendix A, Section III): "These prospects usually have high industry interest and are the most likely to yield the highest rate of financial return by reason of size, distance from shore, proximity to transportation, water depth, etc., and are thus the most likely to be leased as a result of the sale." Spill sites away from these most prospective structures are arbitrarily assumed to contain a nominal amount of oil (0.001 MMbbl) each. Note that this assignment of only negligible oil to spill sites away from the chosen structures implies only that these areas are less prospective and not that they necessarily have negligible oil potential.

Both the four pipeline landfalls assumed in the oil-spill-risk analysis and general platform locations plus four pipeline landfalls assumed elsewhere in this EIS, as summarized in Section II scenarios, are based on nonproprietary data only and do not reflect the proprietary knowledge that went into assigning oil resource to individual spill sites in the oil-spill-risk analysis.

In Appendix G, both combined and conditional probabilities are reported for 3, 10, and 30 days after a summer spill and/or meltout of an overwintering spill during the open-water season and for 3 and 10 days and all winter for spills during the winter season. There is an additional caveat regarding the winter combined probabilities. These were calculated from winter conditional probabilities and total (= 12 months a year), not winter (= 9.5 months a year), oil production and transportation. The number of spill contacts is thus overestimated in winter by 26 percent (12/9.5). The resulting combined probabilities calculated from the Poisson distribution for winter contacts are overestimated by a variable factor of up to 26 percent. Combined probabilities for the open-water season are based on spills that originate at any time of the year and contain no similar overestimate of risk.

The OSRA also projects the total number of spills of at least 1,000 bbl that could occur under the proposed action, the deferral alternatives, and the cumulative case. Within the arctic region, these estimates are calculated from projected oil resource and reserve volumes, assumed transportation modes, and historical trends in OCS spillage (spills per volume produced and piped). Because it is assumed in this EIS that oil is not produced in the low case, spills of at least 1,000 bbl are assumed not to occur in the low case.

b. How the Oil-Spill-Risk Analysis Is Used

(1) Projected Spillage and Probability of One or More Spills: The estimated mean number of spills of at least 1,000 bbl and the probability of one or more such spills is provided for Alternative I (base and high cases), Alternatives IV and V, and the cumulative case (Table IV-A-1-1). The most likely number of spills of at least 1,000 bbl for the base case and each deferral alternative is one. For the purposes of analysis, one spill has been assumed for the base case and each deferral alternative in the Beaufort Sea. For the high case, three spills have been assumed in the Beaufort Sea. Note that all spill

Table IV-A-1-1  
Oil-Spill-Occurrence Estimates and Probabilities for Spills Greater  
Than or Equal to 1,000 Barrels Resulting Over the Assumed  
Production Life of the Proposed Beaufort Sea Lease Sale 124

Source	Reserve Volume Produced (Bbbl)	Resource Volume Produced (Bbbl)	Estimated Mean Number of Spills, Arctic Ocean	Estimated Mean Number of Spills, PWS/GOA	Estimated Mean Number of Spills, Total	Probability of 1 or More Spills, Arctic Ocean (%)	Probability of 1 or More Spills, PWS/ GOA Tankers (%)	Probability of 1 or More Spills, Total (%)
ALTERNATIVE I: <sup>1/</sup>								
Low Case		0	0	0	0	0	0	0
Base Case		0.90	1.14	0.59	1.73	68	45	82
High Case		2.60	3.30	1.69	4.99	96	82	99
ALTERNATIVE IV		0.90	1.14	0.59	1.73	68	45	82
ALTERNATIVE V		0.90	1.14	0.59	1.73	68	45	82
CUMULATIVE CASE:								
Offshore:								
U.S. Arctic OCS		5.48	6.96	3.56	10.52	99	97	>99
Endicott Field	0.31		0.39	0.20	0.60	33	18	45
Pt. Thomson	0.35		0.44	0.22	0.67	36	20	49
Seal/North Star	0.30		0.38	0.20	0.58	32	18	44
Niakuk	0.06		0.07	0.04	0.11	7	4	11
Tern, Hammerhead, & Sandpiper OCS Prospects	--							
Canadian Beaufort Sea	1.74		2.21	0	2.21	89	0	89
Onshore:								
Prudhoe Bay	3.29		0	2.14	2.14	0	88	88
Kuparuk River	0.94		0	0.61	0.61	0	46	46
Lisburne Field	0.16		0	0.10	0.10	0	10	10
West Sak	4		0	2.60	2.60	0	93	93
Ugnu	2.7		0	1.76	1.76	0	83	83
Point McIntre	0.3		0	0.20	0.20	0	18	18
Milne Point	0.05		0	0.03	0.03	0	3	3
Colville River	--							
ANWR		4.4	0	2.86	2.86	0	83	83
NPR-A		1.85	0	1.20	1.20	0	70	70
Total	14.20	11.73	10.46	15.72	26.18	>99	>99	>99

Source: USDOJ, MMS, Alaska OCS Region.

<sup>1/</sup> The low case is based on an exploration-only scenario; spills are assumed not to occur. The base case is based on the estimated resources likely to be leased, discovered, and produced as the result of Beaufort Sea Lease Sale 124 and assumes the existence of economically recoverable hydrocarbons in the Sale 124 Planning Area. There is an estimated 14% probability that such hydrocarbons exist and can be produced economically. The high case is based on the estimated resources that are significantly higher than the base case.

-- means no available estimate.  
PWS/GOA means Prince William Sound and Gulf of Alaska

probabilities are based on the true, fractional mean number of spills and not on the assumed number. The term "mean number" represents a statistical value that almost always is not a whole number.

(2) Combined Probabilities: The combined probabilities are the most extensively used product of the OSRA. These probabilities (Tables G-15 to G-18 for the base case and the high case in Appendix G) are estimates of the likelihood of spill contacts if oil is discovered, produced, and transported in the assumed quantities and locations. Combined probabilities are tabulated in Appendix G only for the base and high cases. The combined probabilities are of limited value in distinguishing the merits of deferral alternatives for Sale 124. Combined probabilities for both deferral alternatives are identical to those for the base case because of the negligible assumed oil resource within the areas to be deferred in the oil-spill-risk analysis and the resulting, almost identical oil-resource distribution in the base case and the deferral alternatives. This similarity among oil-resource distribution for the base case and the deferral alternatives indicates that the most prospective structures are not within the areas proposed to be deferred but does not necessarily indicate that these areas are considered devoid of oil potential by MMS.

(3) Conditional Probabilities: These probabilities (Tables G-1 to G-12 in Appendix G) assume that a spill has occurred at a specific site and are used in Section IV to clarify which hypothetical spill sites pose risk to which environmental resources or shoreline. In particular, EIS analysts use conditional probabilities in discussions of deferral alternatives to evaluate whether oil development within the postulated deferred area would pose oil-spill risk to their environmental resource.

In using both the combined and conditional probabilities, the EIS analysts use 3-, 10-, and 30-day periods as a rule of thumb for oil-spill fate and behavior. The 3-day trajectories are taken to indicate the period over which a crude spill would be unweathered and most (chemically) toxic. Most crude spills of less than 10,000 bbl do not persist as a discrete slick past 10 days, and most spills of 10,000 to 100,000 bbl do not persist as a discrete slick past 30 days. Winter spills in the Arctic provide an exception to this rule of thumb: such spills would quickly freeze unweathered into the ice cover and would melt out in the open-water season as if they were fresh spills. Note that the OSRA does not depict the entire period over which an oil spill would affect the environment. Tarballs would form as the slick breaks up and would persist and disperse downcurrent, on the water surface and within the water column, for 1 or more years after the slick broke up.

c. Additional Assumptions in This EIS Regarding Oil Spills: The OSRA provides only numbers and frequencies of spills of at least 1,000 bbl. Additional assumptions in the EIS are needed regarding volume distribution of these large spills and also regarding the number and volume of those smaller spills not addressed by the OSRA. The number of spills and volumes assumed spilled in this EIS are summarized in Table II-A-1; the derivations of these assumed values are discussed below.

(1) Assumed Size of a 1,000-Bbl-or-Greater Spill: A 1,000-bbl spill is the minimum-sized spill in this category and is much smaller than the typical 1,000-bbl-or-greater spill. The average sizes of a spill of at least 1,000 bbl are 18,000 bbl for OCS platform spills, 25,000 bbl for OCS pipeline spills, and 110,000 bbl for tanker spills (Anderson and LaBelle, 1990; MMS, BEM files). Median spill sizes for spills of at least 1,000 bbl are 7,000 bbl for platforms, 6,000 bbl for pipelines, and 15,000 bbl for tankers. For the scenarios for Alternative I (base and high cases) and the deferral alternatives, the source-weighted (frequency-weighted) average spill size for a spill of at least 1,000 bbl within the Beaufort Sea would be 22,000 bbl and the median size would be 6,500 bbl. Along the tanker route (Prince William Sound and the Gulf of Alaska), an average-size spill would be 110,000 bbl and a median-size spill would be 15,000 bbl. The assumptions regarding the actual volumes for spills of at least 1,000 bbl used in this EIS are based on conservation of both the number and total volume (average size times the number of spills) of spills of at least 1,000 bbl. In this EIS, the assumed spills of at least 1,000 bbl in the Beaufort Sea for the base case (one spill) and high case (three spills) are additionally assumed to be 22,000 bbl each. The average tanker spill in Prince William Sound or the Gulf of Alaska in both the base and high cases would be 110,000 bbl.

Ten spills of at least 1,000 bbl in the Hope Basin, Chukchi Sea, and Beaufort Sea Planning Areas are estimated in the cumulative case. Again, the average size of these pipeline and platforms spills would be 22,000 bbl; the total spillage would be ten times this 22,000-bbl average, or 220,000 bbl. With the 10 spills, it is unlikely that each spill would be the average 22,000 bbl. Based on the statistical size distribution of OCS spills, half of the spills should be less than one-third of the average size, and at least one spill should be considerably greater than the average size. This EIS assumes five spills of median size (6,500 bbl), four spills of average size (22,000 bbl), and one spill of 100,000 bbl in these coastal arctic waters. Note that the combined volumes of these eight assumed spills totals to the earlier estimate of 220,000 bbl of spilled oil.

In the cumulative case, 15 tanker spills greater than 1,000 bbl are estimated to occur along the tanker route in Prince William Sound and the Gulf of Alaska. Because the average tanker spill greater than 1,000 bbl is 110,000 bbl in size, total spillage along the tanker route is estimated to be 1.65 MMbbl. Again, the observed distribution of spill sizes (as for OCS pipeline and platform spills) indicates that about half of the 15 spills should be much smaller than 110,000 bbl and a few spills should be much larger than 110,000 bbl. For Prince William Sound and the Gulf of Alaska, this could, for example, amount to seven tanker spills of 5,000 bbl each, one spill of the median 15,000 bbl, three spills of the average 110,000 bbl, three spills of 260,000 bbl (Exxon Valdez size), and one spill of 520,000 bbl (twice the Exxon Valdez size). These distributions maintain the statistical average and median spill sizes and also the total volume of estimated spillage.

(2) Spills of Less than 1,000 Bbl: Most OCS spills of less than 1,000 bbl are much less than 1,000 bbl, usually less than 50 bbl. Worldwide, oil spills of 50 bbl or less from platforms contribute 0.02 to 0.03 MMbbl annually to a total oceanic release from offshore petroleum production of 0.3 to 0.5 MMbbl (National Research Council [NRC], 1985). Therefore, small spills of 50 bbl or less constitute only 4 to 10 percent of the total industry discharge and are not usually a major concern relative to losses in larger spills or in deliberate discharges.

During exploration in Alaskan OCS waters from 1982 to early 1989, 47 exploration wells were drilled, with five spills greater than 1 bbl and with a total spillage of 45 bbl. This is equivalent to a spill rate of 11 spills per 100 wells drilled, with an average volume of 9 bbl per spill. Based on these data, no small spills would be expected during drilling of four exploration wells in the low case. For the base case and each deferral alternative, two exploration spills are projected, with total spillage of 18 bbl during exploration and delineation. For the high case, four exploration spills are projected, with total spillage of 36 bbl during exploration and delineation. For the cumulative case in the coastal Arctic Ocean, about 11 exploration spills totaling 100 bbl are projected.

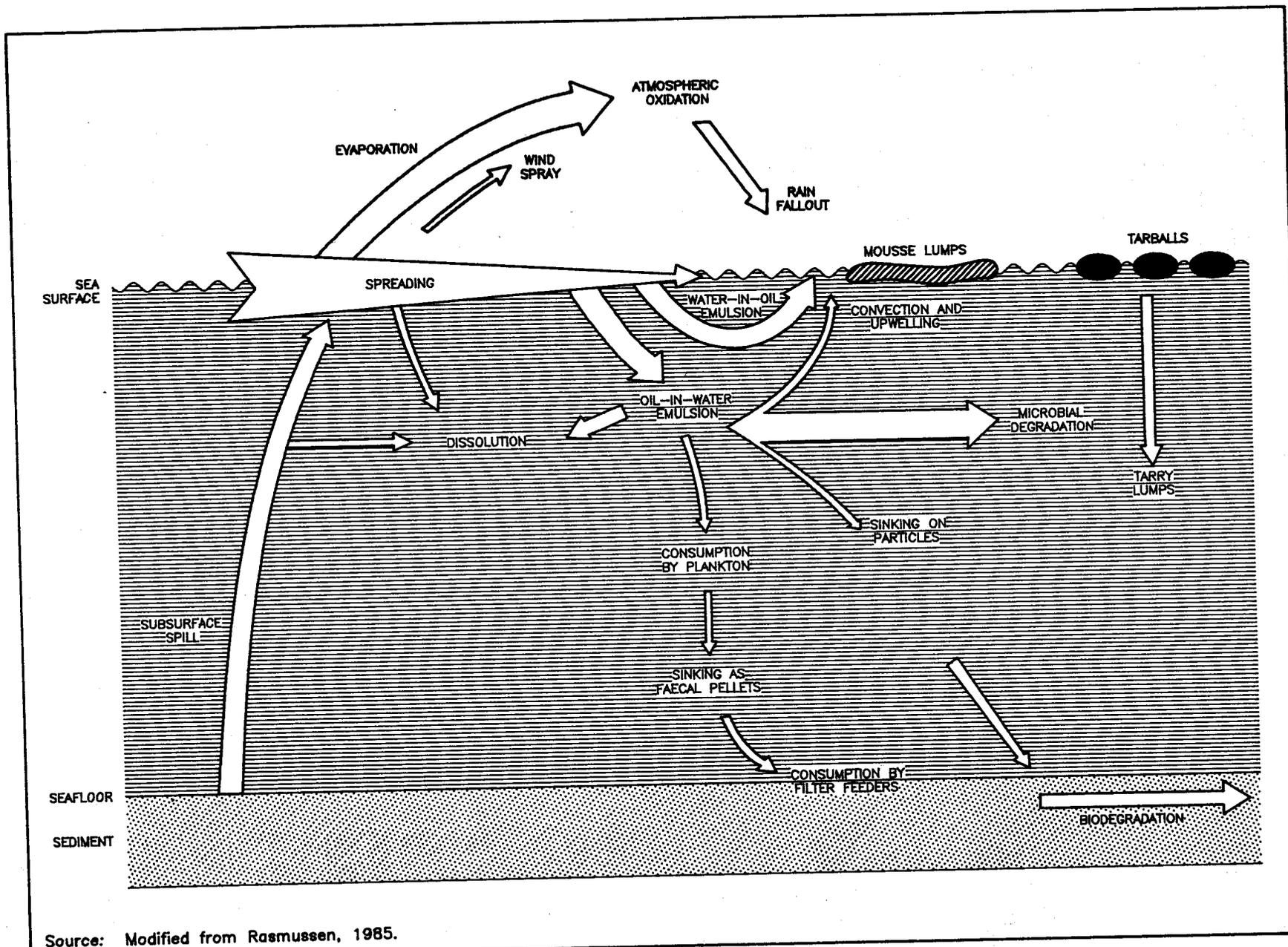
Spills of less than 1,000 bbl would be more frequent during the years of production, but the anticipated volumes of such spills still would be very small. Between 1971 and 1980, the offshore-oil industry in Cook Inlet experienced spills at a rate of 265 spills per Bbbl produced and transported. None of the reported sizes of these spills has been as large as 1,000 bbl, and the average size has been 4.4 bbl (Sale 97 FEIS, USDO, MMS, 1987a). In OCS producing areas from 1964 to 1987, the offshore-oil industry spilled 23,688 bbl in 1,752 small spills (of at least 1 bbl but less than 1,000 bbl) while producing 7.5 MMbbl of crude and condensate. These data provide an OCS production-spillage estimate of 234 spills between 1 and 999 bbl in size per Bbbl produced, with an average spill size of 14 bbl. Thus, the OCS record indicates about a threefold higher volume loss of oil in small spills (less than 1,000 bbl) on the OCS than in Cook Inlet State waters.

Based on the OCS data for production spills, small-spill projections have been made for production in the base case of 211 small spills totaling 3,000 bbl; in the high-case 608 small spills totaling 8,500 bbl; in each deferral alternative, 208 small spills totaling 2,900 bbl; and in the cumulative case in the coastal Arctic Ocean, about 1,900 small spills totaling 27,000 bbl.

Combining spills during exploration and production provides the following overall estimates for small spills of at least 1 bbl but less than 1,000 bbl: (1) low case, no spills; (2) base case, 213 spills totaling 3,000 bbl; (3) high case, 612 spills totaling 8,500 bbl; (4) each deferral alternative, 213 spills totaling 3,000 bbl; and (5) the cumulative case in the coastal Arctic Ocean, about 1,900 spills totaling 27,000 bbl.

2. Aspects of Spilled Oil: Detailed descriptions of the behavior and fate of spilled oil, extent and persistence of oiled shoreline, and oil-spill-contingency measures are contained in Appendix M of this EIS. A summary of these descriptions follows.

a. Fate and Behavior of Spilled Oil: Surface spills and subsurface spills both form surface slicks and similarly weather. A spill of 22,000 bbl in open water of the Beaufort Sea could physically cover 3 to 5 km<sup>2</sup>, and a spill of 100,000 bbl could cover on the order of 8 to 14 km<sup>2</sup>. Winds, movement of the slick, and other forces would tend to spread the oil discontinuously over an area 20- to 200-fold greater than this actual area of oiled surface. Dissolution would account for only about 5 percent of slick mass; most spilled oil evaporates, grounds on the shoreline, or eventually forms tarballs or pancakes (Fig. IV-A-2-1). The presence of broken ice would (1) retard spreading and (2) promote both of the competing processes of dispersion and mousse formation.



Source: Modified from Rasmussen, 1985.

Figure IV-A-2-1. Fate of Oil Spills in the Ocean

Oil spilled under winter ice would pool and freeze to the underside of the ice. The multiyear ice that covers most of the sale area in winter can store 1.8 MMbbl/km<sup>2</sup> in under-ice relief. Thus, oil would not spread appreciably along the underside of the ice before being frozen into the ice. The spill would then move as part of the ice pack. Oil would melt out from multiyear ice more slowly than it would from first-year ice. Most oil would be released through the first summer following the spill, but some oil would not be released until the subsequent summer(s).

b. Likelihood, Extent, and Persistence of Oiled Shoreline: If an oil spill occurs, three important but nonbiological questions arise: (1) will the oil reach the shore; (2) if so, how much shoreline will be contaminated; and (3) how long will the contamination persist? In winter, landfast ice along the shorelines of the Beaufort and Chukchi Seas would keep spills offshore, away from the shoreline; and any oil that did reach shore would not penetrate into the frozen beach. For these shorelines, the relevance of these three questions is much greater for spill contacts during the open-water season than for spill contacts during winter. The following discussion, therefore, emphasizes spills that occur at any time of the year but contact land during the open-water season.

(1) Likelihood of Land Contact if a Spill Occurs: The conditional probabilities that oil spills at specific locations would contact land are summarized in Figure IV-A-2-2 for summer spills and for open-water spills (summer plus overwintering spills). The probability that a spill in winter would persist into summer and then contact land in the model area is considerably less than the probability that a spill in summer would contact land. There is almost no chance that a spill in the Chukchi Sea portion of the proposed Sale 124 area would contact land within 30 days of a spill. However, a spill in the Beaufort Sea portion of the proposed sale area could contact land. The likelihood of contact with land increases rapidly the closer to shore that a spill is assumed to occur. A spill within the area to be deferred in the Barrow Deferral Alternative (Spill Sites L26 and L27) has a chance of contacting land only from Peard Bay to the Plover Islands--the Barrow area (Land Segments 15, 16, 19, and 20). A spill within the area to be deferred in the Barter Island Deferral Alternative (Spill Sites L14 and L32) could contact land from Kaktovik to Harrison Bay, but especially the Kaktovik area (Land Segments 41 and 42).

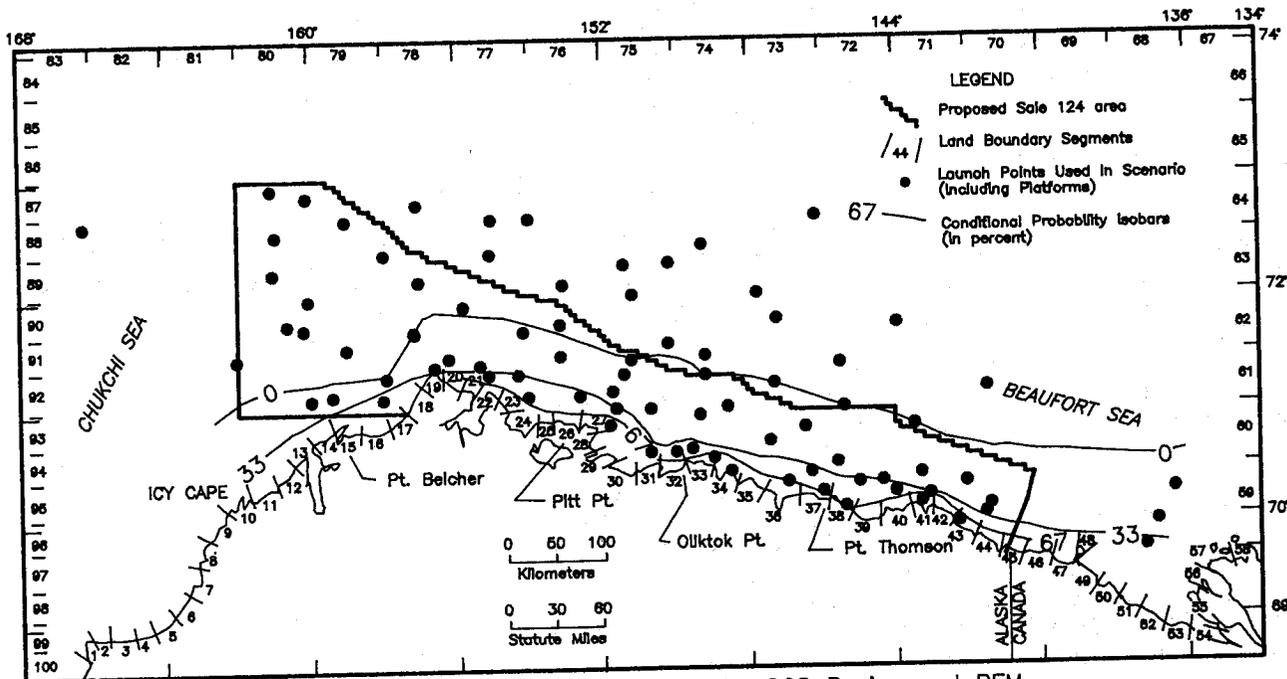
(2) Likelihood of Spills Occurring and Contacting Land:

(a) Base Case: In the base case, the combined probabilities that one or more spills of 1,000 bbl or more would occur and contact the shores of the study area are low, both for the open-water season (5%, 30-day trajectories) and (all) winter (9%, Table IV-A-2-1). Spills are more likely to occur in the western portion of the sale area and head offshore rather than contact land, as evidenced by the higher combined probabilities of spills occurring and contacting the spill-model boundary in the northwest Beaufort and northern Chukchi Seas (Figs. IV-A-2-3 and IV-A-2-4). The odds are that a spill of 1,000 bbl or more would not occur and contact land. Land Segments 20, 21, and 23 near Barrow are the only shorelines at risk from spills of 1,000 bbl or greater as a result of the base case during either the open-water season or winter. No land segment has a greater than 2-percent chance of contact in the open-water season or a greater than 4-percent chance in winter.

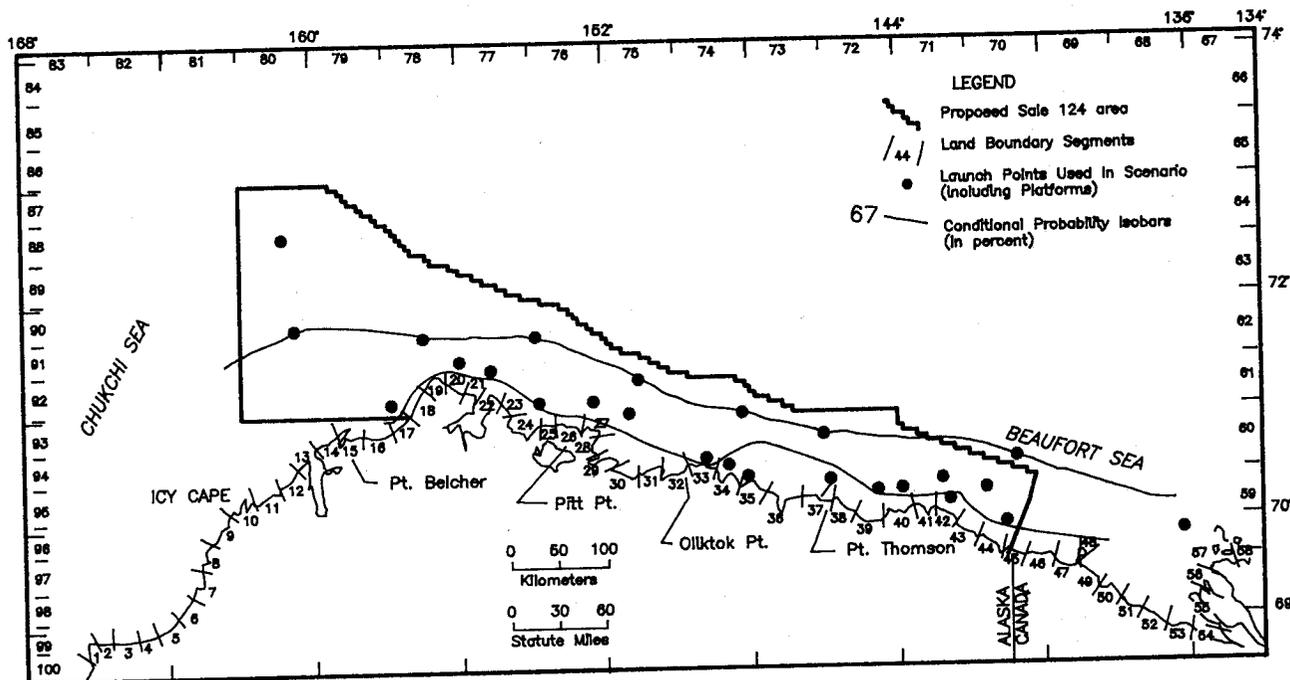
(b) High Case: In the high case, the combined probabilities that one or more spills of 1,000 bbl or more would occur and contact the shores of the study area are still relatively low, about a one-in-three chance over both the open-water season (13%, 30-day trajectories) and (all) winter (23%). This low probability again is because of the greater likelihood that spills would occur in the western portion of the sale area and move offshore to the northwest. The odds are that a spill of 1,000 bbl or greater would not occur and contact land. Land Segments 16 and 20-24 near Barrow are the only shorelines at risk from spills of 1,000 bbl or greater as a result of the base case during either the open-water season or winter. The greatest combined probability of contact with one or more spills of at least 1,000 bbl is for Land Segment 20 at 5 percent during the open-water season and at 12 percent in winter (Figs. IV-A-2-3 and IV-A-2-4).

(c) Alternative IV (the Barrow Deferral Alternative): This alternative would not significantly reduce (combined) probabilities of one or more spills occurring and contacting land because of the negligible oil resource assumed to be in the deferred area.

(d) Alternative V (the Barter Island Deferral Alternative): This alternative would not significantly reduce (combined) probabilities of one or more spills occurring and contacting land because of the negligible oil resource assumed to be in the deferred area.



Source: Samuals, Banks, and Hopkins, 1983; MMS, Alaska OCS Region and BEM.



Source: Table G-9.

Figure IV-A-2-2. Conditional Probabilities that (a) if a Spill Occurred in Summer it Would Contact Land Within 30 days and (b) if a Spill Occurred it Would Contact Land in the Open-Water Season Within 30 days of Spillage or Meltout of a Winter Spill

Table IV-A-2-1  
 Combined Probabilities (Percentage Chance) that One or More Oil  
 Spills of At Least 1,000 Barrels Would Occur and Contact Land  
 During the Open-Water Season or Winter Over the Production  
 Life of the Field<sup>1/</sup>

	3 Days		10 Days		30 Days	
	Open Water	Winter	Open Water	Winter	Open Water	All Winter
<b>Alternative I</b>						
Low Case	0	0	0	0	0	0
Base Case	2	6	5	9	5	9
High Case	5	16	13	23	13	23
<b>Alternative IV</b>						
Barrow Deferral	2	6	5	9	5	9
<b>Alternative V</b>						
Barter Island Deferral	2	6	5	9	5	9

Source: Tables G-15 and G-17 of this EIS.

<sup>1/</sup> The number of days corresponds to the number of days after a summer spill or meltout of a winter spill. Winter probabilities are based on the assumption that the total base and high-case oil resources are produced and transported in winter.

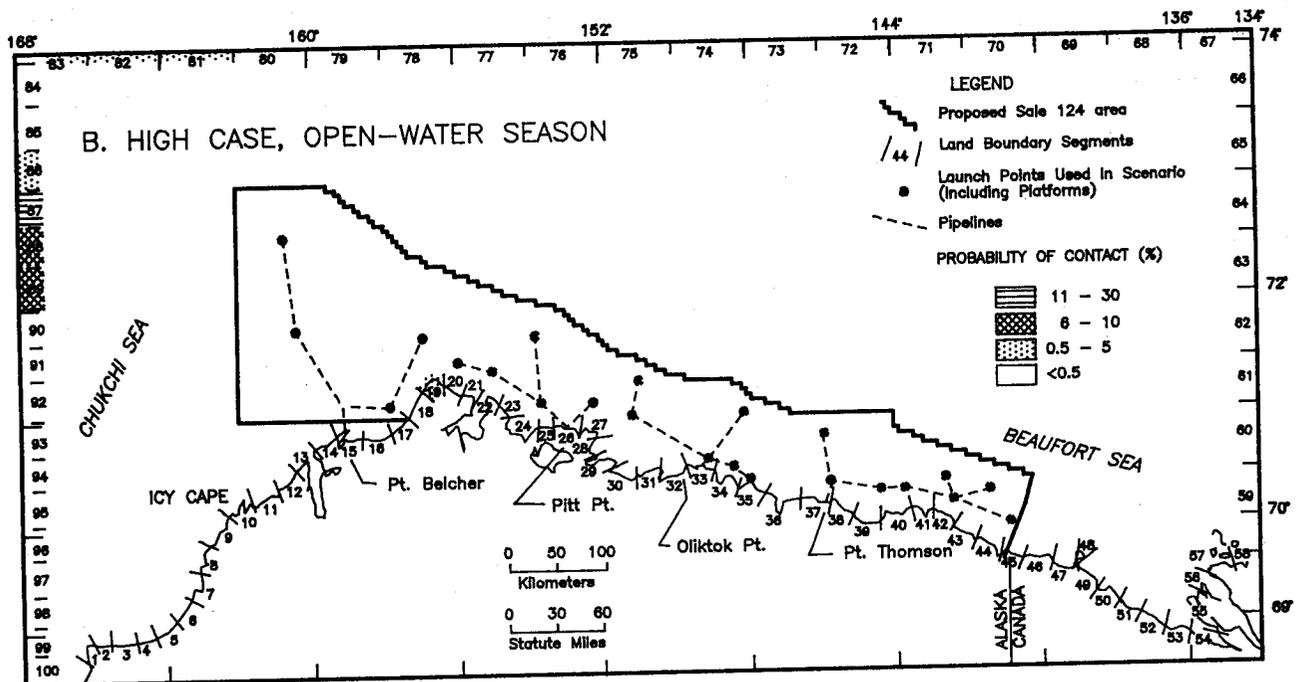
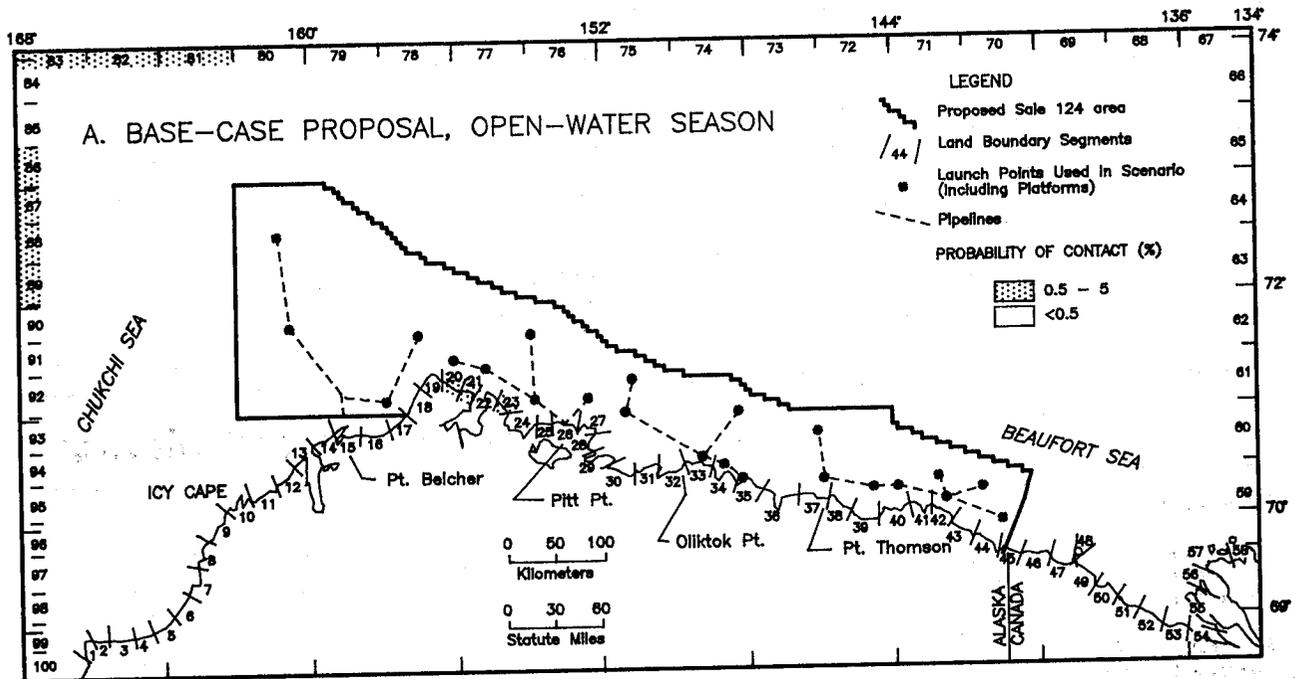


Figure IV-A-2-3. Combined Probabilities for Contact of Land/Boundary Segments By At Least One Oil Spill of 1,000 Barrels or Greater Within 30 Days of Summer Spillage or Melt out of an Overwintering Spill

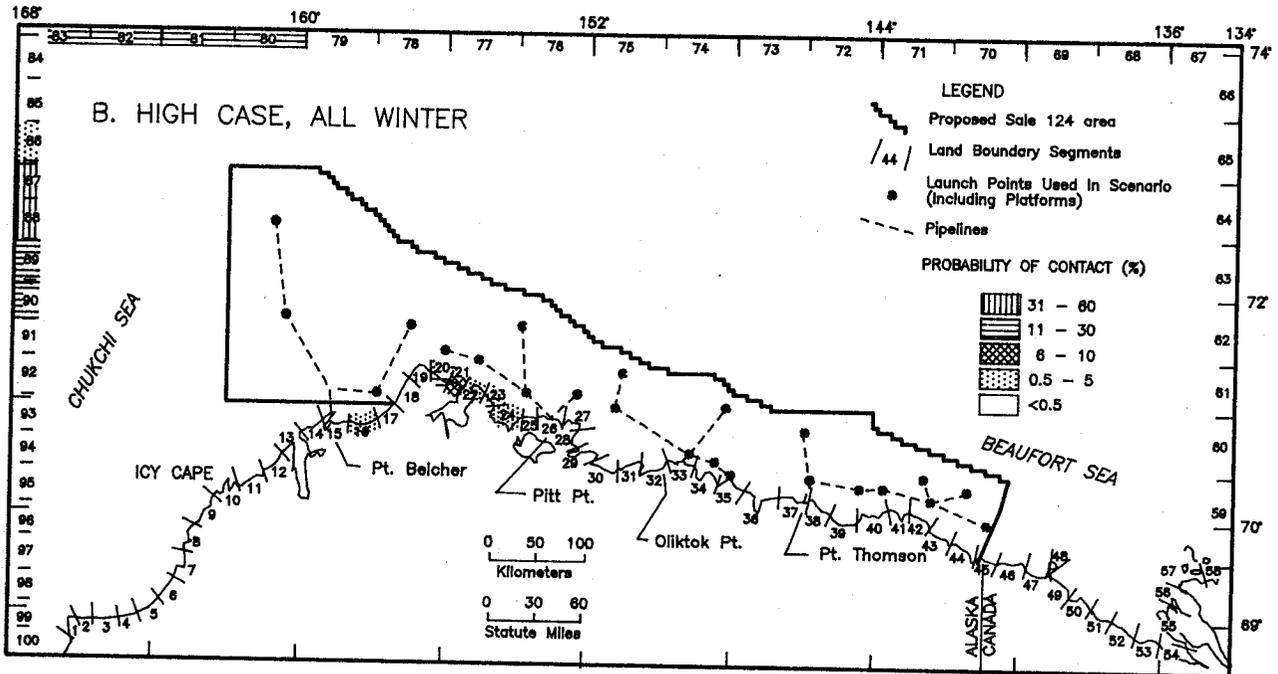
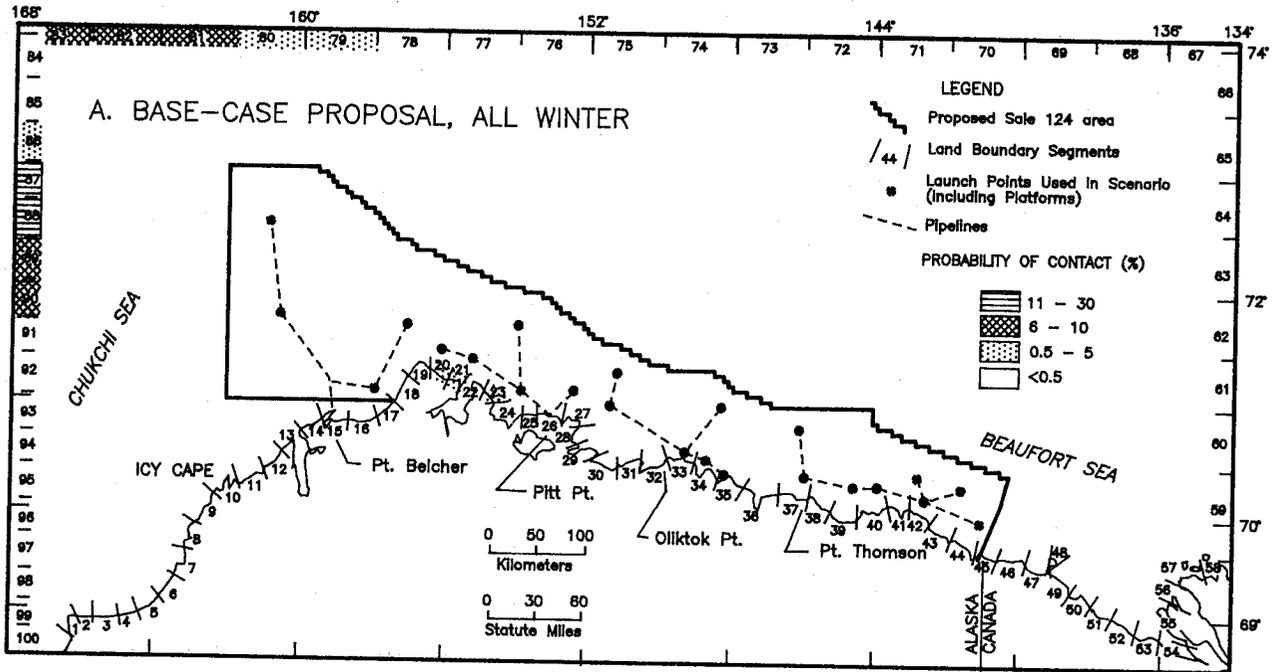


Figure IV-A-2-4. Combined Probabilities for Contact of Land/Boundary Segments By At Least One Oil Spill of 1,000 Barrels or Greater During Winter.

(3) Extent of a Shoreline Spill: An offshore spill that reaches shore is not likely to reach the shoreline in its entirety. Contact could occur with the shoreline in several locations, or the spill could be "smeared" along a single location, depending on the nature of winds and longshore current. In general, if a spill of 22,000 bbl occurred and contacted land, about 50 km of shoreline could be expected to be oiled. For a spill of 100,000 bbl, expected oiling would be on the order of 90 km if the spill occurred and reached land. However, it would be possible for a spill to contact severalfold longer or shorter stretches of coastline than these averages or, alternatively, not contact any shoreline at all.

For the purposes of this EIS, we assume that spills of the size of interest--1,000 bbl or greater--are capable of contacting portions of vast segments of coastline greater than 50 km, or roughly the effective width of two to three land segments. (The actual number of kilometers of shoreline composing an individual land segment is usually much greater than the effective width of that land segment because of shoreline complexity; that is, the presence of lagoons, bays, islands, and headlands--see Fig. IV-A-1-1). Because the trajectory model tracks only the center of mass of the spill, we account for spreading or smearing of the spill along the coast by assuming that the entire land segment and possibly its closest neighbors could have been contacted.

Spills greater than 10,000 bbl and, in particular, long-duration spills are depicted less precisely in the oil-spill-risk analysis than are instantaneous spills. The oil-spill-risk analysis still can be used to represent the risk from such spills. For these spills, the center of mass of the spill still is depicted accurately. However, the spreading of the oil over different trajectories through time and space results in more frequent contacts of oil with land, but each contact involves only a fraction of the total spill. For such spills, the conditional probabilities of contact from an individual hypothetical spill site represent the fraction of the total spill that would contact that target or land segment, disregarding weathering and cleanup. Such spill/model trajectory behavior was demonstrated by both the Santa Barbara spill of 1969 (Amstutz and Samuels, 1984) and the Exxon Valdez spill of 1989 (Jayko and Spaulding, 1989). (The conditional probability would normally represent the likelihood that the target or land segment was contacted by the entire spill.)

(4) Persistence of Stranded Oil: Most of the Beaufort Sea coast is considered to have moderate to high retention potential, with less than half of the coast in the high category. Stranded oil, if not cleaned up and in a zone of high oil-retention capacity, could persist for decades along at least part of the oiled shoreline. In many locations, persistence would be less because of the rapid rate of retreat of much of the Beaufort Sea coast; stranded oil would be eroded along with the shoreline.

(5) Summary: For the base case, the OSRA projects a 5-percent chance that one or more spills of 1,000 bbl or more would occur and, during the open-water season, contact land within 30 days of summer spills and/or meltout of overwintering spills. About 50 km of shoreline could be oiled by such a spill, but effects would very likely be limited to a narrow wave/tidal band unless the spill coincided with extreme wave and/or storm-surge event. Because much of the shoreline is rated moderate to high in oil-spill persistence, oil that is not cleaned up could take decades to naturally cleanse or erode away.

For the high case, the OSRA projects a 13-percent chance that one or more spills of 1,000 bbl or more would occur and, during the open-water season, contact land within 30 days of summer spills and/or meltout of overwintering spills. About 50 km of shoreline could be oiled by a single spill, but effects would very likely be limited to a narrow wave/tidal band unless the spill coincided with extreme wave and/or storm-surge event. Because much of the shoreline is rated moderate to high in oil-spill persistence, oil that is not cleaned up could take decades to naturally cleanse or erode away.

Alternative IV (the Barrow Deferral Alternative) would not decrease the likelihood of a spill occurring and contacting the shoreline. A spill within the area to be deferred in the Barrow Deferral Alternative (Spill Sites L26 and L27) would have a chance of contacting land only from Peard Bay to the Plover Islands--the Barrow area (Land Segments 15, 16, 19, and 20). About 50 km of shoreline could be oiled by a single spill, but effects very likely would be limited to a narrow wave/tidal band unless the spill coincided with extreme wave and/or storm-surge event. Because much of the shoreline is rated moderate to high in oil-spill persistence, oil that is not cleaned up could take decades to naturally cleanse or erode away.

Alternative V (the Barter Island Deferral Alternative) would provide slight additional protection to eastern shorelines, which are already at low risk. A spill within an area to be deferred in the Barter Island Deferral Alternative (Spill Sites L14 and L32) could contact land from Kaktovik to Harrison Bay, but especially the Kaktovik area (Land Segments 41 and 42). About 50 km of shoreline could be oiled by a single spill, but

effects very likely would be limited to a narrow wave/tidal band unless the spill coincided with extreme wave and/or storm-surge event. Because much of the shoreline is rated moderate to high in oil-spill persistence, oil that is not cleaned up could take decades to naturally cleanse or erode away.

c. Oil-Spill-Contingency Measures: The responsibility for cleaning up OCS spills is that of the spiller. The Federal Government will step in as a last resort, only if the Government considers the spiller's response to be inadequate. The basic philosophy of both the Government and the oil and gas industry is to prevent spills before they happen. Considerable attention is given to preventive measures such as better technology and better training.

(1) Contingency Plans: The U.S. and Canada have developed the Joint Canada-U.S. Marine Contingency Plan to respond to oil spills that could cross the border between the two countries. The plan was developed in 1974 and amended in 1983. Annex four of the plan applies to waters off of the arctic coast of Canada, and the U.S. coordination and control of Federal/National spill response are directed by a Joint Response Team (JRT) through the On-Scene Coordinator (OSC). The JRT is composed of officials from the Canadian Coast Guard and the U.S. Coast Guard (USCG) and also from other National/Federal and Provincial/State organizations. The primary function of the JRT is to provide assistance and advice to the OSC, who is responsible for cleanup activities at the spill site. The OSC is designated from the country in which the pollution incident occurs. A deputy OSC is designated from the adjoining country.

The industry spill-response cooperative, the Alaska Beaufort Sea Oilspill Response Body (ABSORB), is expected to expand its coverage to include any leases from the proposed sale area prior to exploration, as has been the case elsewhere along the Alaskan Beaufort Sea coast. The ABSORB is part of the umbrella organization, Alaska Clean Seas (ACS), which is a Statewide cooperative. The ACS, including ABSORB, is in the process of converting from an equipment-warehousing cooperative to a supply and response cooperative.

The ABSORB area of interest is currently defined to include the OCS, beaches, harbors, inland waterways, and offshore islands and waters along the coast of the State of Alaska, within the area bounded on the east by the Canadian border, on the west by 156 degrees W. longitude, and on the south by the mainland shoreline of the State of Alaska.

A second North Slope cooperative also under ACS has as an area of interest the North Slope producing onshore oil lands north of 68° N.

Lessees are required to develop oil-spill-contingency plans as part of their exploration plans prior to drilling. More than a dozen oil-spill-contingency plans have been submitted and approved to date for exploration of existing leases in the Beaufort Sea Planning Area. By having on hand prior knowledge of the nature of the spilled material, slick dynamics, and the characteristics of the threatened environment, plus available equipment and manpower, the responsible party can order and evaluate selected actions.

Responses to spills from OCS activities are approached by arranging and ranking lines of defense to prevent spilled oil from affecting identified vulnerable environment. The first line of defense is always offshore containment. Open-water collection of spilled oil (without containment) is usually not successful (see Effectiveness of Oil-Spill Cleanup at Sea below).

Containment is useful in stopping the spreading of the oil and in providing extra time for deployment of more equipment and manpower. In the presence of sea ice--which can act as a natural containment barrier--in situ burning may be an effective treatment. For a blowout, well ignition is a drastic but potentially effective contingency measure. If conventional cleanup equipment cannot recover the oil before spill contact with important resources is likely to occur, it may be appropriate to use chemical agents to disperse the slick--if permission for their use can be obtained. The Regional Response Team in Alaska, chaired by the USCG and the Environmental Protection Agency (EPA), is trying to streamline guidelines and gain partial preapproval for using dispersants in some Alaskan waters.

(2) Applicability of Oil-Spill-Response Techniques in the Proposed Sale Area: Figure IV-A-2-5 summarizes techniques and equipment and the ice conditions under which they could be used in the Sale 124 area. "Good" applicability does not necessarily imply effective recovery or removal of spilled oil. Effectiveness of spill response is discussed at a later point.

		GOOD		FAIR/LIMITED				HAS POTENTIAL				
ICE CONDITIONS	Period	Breakup						Open Water			Freezeup	Winter
	Type of Ice	DECAYING ICE		BROKEN ICE				WIDELY SCATTERED ICE			NEW THIN, BROKEN, SLUSH ICE	
	Ice Coverage											
	Typical Duration	< 20m water	6 wks.	2 wks.	1 wk.	3 wks.	7 wks.	4 wks.	29 wks.			
20-40m water	6 wks.	4 wks.	2 wks.	3 wks.	4 wks.	4 wks.	29 wks.					
>= 40m water	8 wks.	7 wks.	4 wks.	2 wks.	negligible	4 wks.	29 wks.					
TECHNIQUES	Containment	Natural (Incl. Ice & Snow Barriers)	[Hatched pattern]									
		Conventional Booming	[Hatched pattern]									
		Fire Containment Boom	[Hatched pattern]									
	Recovery	Portable Rope Mops	[Hatched pattern]									
		ARCAT Skimmer	[Hatched pattern]									
		Vessel Skimmers	[Hatched pattern]									
		Other Small Skimmers	[Hatched pattern]									
	Manual Removal		[Hatched pattern]									
			[Hatched pattern]									
	Disposal	In-Situ Burning	[Hatched pattern]									
Incineration On Site		[Hatched pattern]										
Logistics	Dispersants	[Hatched pattern]										
	Vehicles: Amphib. & ACV	[Hatched pattern]										
	Vehicles: Wheel & Track	[Hatched pattern]										
	Tugs & Barges	[Hatched pattern]										
Response	Icebreaker	[Hatched pattern]										
	Aircraft	[Hatched pattern]										
	Primary Response Techniques & Logistics	Burning with natural ice containment. Igniters released from helicopters.		Burning with fire containment booming. Booms deployed with amphibious/air cushion vehicles, tugs & aircraft. Igniters released from surface & from helicopters.				Burning with fire containment booming. ARCAT skimmer with collection booming. Portable skimmers & manual removal from amphibious/air cushion vehicles, tugs, barges and small boats. Towable bladders & incineration.			In-situ burning w/igniters. Use amphibious, ACVs & helicopters.	Manual removal, In-situ burn, incineration. Use all vehicles and aircraft.
	Additional Response Techniques & Logistics	Rope mop skimmers and manual removal from amphibious/air cushion vehicles and from tugs and barges. Storage and incineration on barges.		ARCAT skimmer. Rope mop skimmers and manual removal from amphibious/air cushion vehicles and tugs & barges. Storage & incineration on barges.				Conventional sweep booming (avoiding ice). Backup self-propelled skimmers (avoiding ice). Dispersants (with low ice concentration and good mixing energy).			ARCAT Skimmer, small skimmers w/ vessels. Mark area and wait for solid ice.	Slots & auger; use small skimmers direct suction. Wait to surface in spring.

Source: MMS, Alaska OCS Region; modified from Alaska Clean Seas, 1984, and Labelle et al., 1983

Figure IV-A-2-5. Applicability of Oil-Spill Response Techniques in the Proposed Sale Area

(3) Locally Available Spill-Cleanup Equipment: The MMS, Alaska OCS Region, requires a lessee who wishes to drill to have an initial spill-response capability of 1,000 bbl per day. To date, during drilling of exploration wells in the Beaufort Sea, this requirement has been met with equipment warehoused at Deadhorse by ABSORB and with equipment positioned onsite by individual lessees.

(4) Mobilization Time: The MMS, Alaska OCS Region, requires that initial mobilization and deployment of response equipment be undertaken within 6 to 12 hours of a spill, geography permitting. However, the spiller must be prepared to respond before the spill reaches shore (in less than 6 hours, if necessary). Only onsite equipment and that which could be transported from Deadhorse by helicopter could meet this guideline for deployment for most of the sale area. The limited geographic and temporal presence of open water and slow vessel speeds in broken ice would preclude timely transport of spill equipment by sea. For large spills--those that could exceed the local cleanup-response capability--the MMS, Alaska OCS Region, requires that additional equipment be made available onsite within 48 hours. Additional response equipment to handle a large spill would be available from a multitude of sources.

Equipment stored at Deadhorse or airlifted to Deadhorse would be capable of meeting the criteria of the 48-hour-response time set by MMS. Additional, slower arriving equipment would still be useful in case of a major spill; but MMS would not consider such equipment in judging whether oil-spill-contingency plans met the MMS 48-hour-response criteria. Once spill-cleanup equipment reaches Deadhorse or Prudhoe Bay, it could be transported relatively quickly to the spill site only if it could be carried by helicopter and then only if weather permitted. A helicopter could reach any point in the sale area within 3 hours.

(5) Effectiveness of Oil-Spill Cleanup At Sea: The 6-to-12-hour and 48-hour response times required of drilling lessees by the MMS, Alaska OCS Region, are mobilization and deployment requirements. Cleanup would continue as long as necessary, without any timeframe or deadline. For example, a winter spill in pack ice might require initial onsite response followed by further cleanup of oil melting out and pooling on top of the ice in late spring or summer.

Mechanical cleanup at sea is usually much more effective on low-viscosity or medium-viscosity oils than on high-viscosity oils. A low-viscosity oil could be a diesel or a fresh, light crude. A medium-viscosity oil could be a lubricating oil or a light, flowing emulsion. A high-viscosity oil would be a weathered crude, bunker oil, or thick emulsion. An oil such as Prudhoe Bay crude would initially have low viscosity but would quickly weather and form a high-viscosity emulsion.

Because of natural dispersion, oil slicks in the open ocean are seldom tracked for more than about 10 days before the oil becomes too dispersed to locate or identify as a slick (USDOJ, MMS, Gulf of Mexico [GOM] OCS Region, 1983). Out of necessity or otherwise, natural dispersion has frequently been the chosen response technique in Alaskan waters.

Uncontained burning also is a possible spill remedy. Experiments suggest that burn efficiencies on the order of 50 to 60 percent may be possible if the spill can be immediately set on fire (Laperriere, 1984). However, any delay in ignition would decrease combustion efficiency. The effectiveness of mechanical recovery and in situ burning of spilled oil at sea decreases rapidly with increasing sea state (roughness of the sea), while the effectiveness of dispersants and natural dispersion increases. Mechanical cleanup becomes nonfunctional between International Sea States 3 and 4.

During the months of July through September in the small fraction of the Beaufort Sea Planning Area with open water, sea states of 3 or greater occur from 13 to 30 percent of the time, and sea states of 4 or greater occur 9 to 18 percent of the time. Ice cover the remainder of the year would eliminate both high sea states and standard uses of most mechanical-cleanup equipment.

The review of the historical record of oil-spill cleanup at sea as contained in Section IV.B.5 of the Final Regional EIS (USDOJ, MMS, GOM OCS Region, 1983) is incorporated by reference; a summary of this review follows. Offshore containment and cleanup are major tasks. Weather, sea conditions, and crew fatigue become critical factors; and cleanup at sea is generally only marginally effective. Recovery of oil usually ranges between 5 percent and 15 percent of that spilled. For example, in the Exxon Valdez oil spill, at-sea recovery of oil was estimated by Exxon at 0.01 percent through the first 2 weeks and 7 percent through the first 3 weeks (Oil Spill Intelligence Report, 1989a,b). Inshore (harbor) containment and cleanup operations generally occur in calmer waters and closer to logistical bases. Inshore operations are, therefore, more effective, with recovery of spilled oil on the order of 20 to 50 percent.

Historical demonstrations of the effectiveness by actual spill-response efforts in the Beaufort Sea are few and disappointing. Crowley Barge Tanker 570 spilled 1,600 barrels of heating fuel near Flaxman Island on August 20, 1988, apparently after ice ruptured one tank on the barge, with the leak not being immediately detected. Oil-spill-response equipment was mobilized from Barrow and Deadhorse, but an overflight was unable to locate any spilled fuel and none was recovered. In September 1985, an exploration spill of 2,440 bbl of diesel occurred from the Minuk I-53 artificial island in the Canadian Beaufort Sea during an intense storm (Birchard and Nancarrow, 1986). Plans were made only to apply dispersants and only if the slick approached shore. The slick did not approach shore, and 4 days after the storm ceased the slick had disappeared through natural dispersion and evaporation. No fuel was recovered. Canadian researchers released a total of 63 bbl of crude in field dispersant tests in the Canadian Beaufort Sea in August 1986 (Swiss and Vanderkooy, 1988). Application of even extremely high, up to a 1:2 dispersant-to-oil ratio, did not increase the rate of dissipation of the crude over that caused by natural dispersion on an untreated control slick.

(6) Effectiveness of Oil-Spill Cleanup in Ice: When a spill is dispersed far from its source or when ice is moving, containment and cleanup are more difficult. Planning of effective surface response with mechanical equipment to spills in pack ice has generally required that an icebreaker (or icebreaking-supply ship) be locally stationed in summer as a dedicated oil-recovery vessel (see Appendix M). An on-station icebreaker also would be necessary in winter.

In situ burning of spilled oil during heavy ice periods may be a more promising approach. Exposed oil would be ignited whenever possible. Existing response capabilities are more effective on landfast ice than on broken or pack ice. Spills in the latter two sorts of ice would be easiest to burn if the spill were contained within a small area close to its source. The ice itself can be useful in restricting the spreading of the oil, keeping the oil thicker and more amenable to burning. Experiments conducted to date indicate that in situ burning should be a more effective technique for spill response in the Arctic than is mechanical recovery in more temperate climates.

The presence of landfast ice may actually improve response effectiveness by limiting the movement and spread of the oil and by providing a safe work platform for the cleanup. The only documented success story for offshore spill response in the Beaufort Sea was a planned experimental spill under landfast ice in the Canadian Beaufort Sea (Buiet, Pistruzak, and Dickins, 1981). In this exercise, a total of 119 bbl of crude were spilled under landfast ice three times during the winter to simulate undersea oil blowouts. The following spring, 79 percent of the residual weathered (unevaporated) oil was manually recovered or burned as the oil surfaced on the ice prior to breakup. In winter 1977, 140 bbl of No. 2 diesel were spilled from an onshore tank at Nome, saturating adjacent snow and soil, with some diesel penetrating the ice cover of the Snake River (Allen, 1978). One-third of the spill was recovered, half of this amount by rope mops extended below the ice cover on the Snake River.

Spill-response efforts in the pack ice zone covering 90 percent of the sale area are undocumented and more problematic, particularly in winter. The January 1984 Cepheus spill of aviation fuel into broken ice in Anchorage harbor illustrates one problem with spill response in broken ice (USDOL, MMS, Alaska OCS Region, 1985a). The Coast Guard attempted to monitor movement of 5,000 bbl of spilled fuel by several techniques, only to conclude that none of the available state-of-the-art techniques could distinguish spilled aviation fuel from broken ice. None of the fuel was recovered.

Subarctic Prince William Sound is much more logistically accessible and protected than the open pack-ice zone in the Beaufort Sea Planning Area; yet even shoreline cleanup operations for the Exxon Valdez spill were stopped in mid-September 1989 out of concern for worker safety during the cold and dark winter.

In the Bering Sea, the F/V Milos Reefer grounded on St. Matthew Island in November 1989, spilling at least 5,600 bbl of its 9,000 bbl of mostly bunker and diesel fuel (Akre, 1989a,b,c). Poor weather and logistics ended up prohibiting a response, even though response vessels did reach the site. The initial response vessel, the USCG cutter Midgett, took 6 days to get to the site; the second response vessel, the Fireball, coming from Kodiak with the bulk of the response equipment, arrived onsite 11 days after the spill. No cleanup or offloading of the still-leaking ship was attempted in 1989 because of the severe weather and approach of winter, and any further efforts have been deferred until summer 1990, following the retreat of the Bering Sea seasonal ice pack.

d. Toxicity of Oil in the Marine Environment: In general, the determination of the ultimate effect and the recovery of an ecosystem from petroleum contamination depends on the physical and chemical form of the oil and the state of the ecosystem at the specific time of the oil spill. The dispersion of oil in water, its movements, chemical modifications, effects on aquatic organisms, and persistence in the sea are all influenced by: (1) type and characteristics of the oil (for example, viscosity and percent aromatics); (2) amount and duration of oil spilled; (3) state of the sea, in particular the tidal cycle and wave activity; (4) location of the spill, including the physiography of the area and the distance from shore; (5) the geographical and topological configuration of the affected coast, including textural characteristics of shore sediments; (6) climatic conditions, in particular temperature, wind, and solar radiation; (7) biota of the area; (8) season of the spill; (9) previous exposure of the area to oil; (10) exposure to other pollutants; and (11) effectiveness of mitigating measures taken by appropriate Federal and State agencies.

(1) Crude Oil Characteristics: The toxicity of petroleum on marine organisms depends on the concentration and composition of its individual hydrocarbons at the time of contact. The relative effect of the oil will shift as spilled oil weathers due to the change in its chemical composition.

Crude oil is a complex mixture of alkanes (aliphatic), naphthenes (cyclo paraffinic), aromatics, and asphaltics (asphaltenic and heterocyclic compounds containing oxygen, sulfur, or nitrogen). The low-molecular-weight compounds are more toxic, although they may have an anesthetic or narcotic effect if concentrations are great enough.

In general, the relative toxicity of an oil is proportional to its aromatic content. Studies have shown lower-molecular-weight aromatic hydrocarbons (benzenes and toluenes) to be moderately toxic to a variety of animals. Intermediate-molecular-weight aromatic hydrocarbons (naphthalenes) have been found toxic to phytoplankton and many species of aquatic animals. Laboratory studies have shown that chronic exposure to hydrocarbon fractions can produce mutagenic and carcinogenic effects. However, in the field, the benzenes and naphthalenes are quickly lost to the atmosphere or diluted into the water column.

(2) Comparative Toxicity of Different Oil Forms in Water: Although laboratory toxicity tests show that the deleterious effects of oil are related to its chemical compounds, the form of oil at sea is just as, if not more, important in determining toxicity. That portion of the oil that dissolves, the water-soluble fraction (WSF), appears to be the most likely to be toxic to organisms, possibly due to the easier uptake of oil in this form (Ottway, 1976; Winters and Parker, 1977). Water-in-oil emulsions of spilled oil are likely to cause biological damage due to physical effects, while oil-in-water emulsions probably cause more biological damage due to toxic effects. Oil in dispersed droplets exhibits slightly less toxicity than the WSF's.

(3) Comparative Toxicity of Oil Types: Toxicities vary between oil types because the concentration and composition of individual hydrocarbons within the oil vary. In general: (1) refined oils are considered more toxic than crude oils due to their high aromatic hydrocarbon concentrations and their greater ability to mix into the water column as a result of their less viscous nature and (2) spills of crude oil, residual fuel, and lubricating oil are more likely to cause biological damage by virtue of their viscous physical properties when considered over a length of time, while spills of refined oil, including gasoline and kerosene, are likely to cause biological damage by virtue of their toxic nature over a relatively short period of time (Ottway, 1976).

(4) Biological Differences: The severity of oil pollution on different organisms in various habitats varies from no effect to responses of avoidance, decreased activity, physiological stress, and death. Different species react differently, and different lifestages of an organism will show different sensitivities to petroleum hydrocarbons. Lethal effects of the soluble aromatic hydrocarbons from bioassays range from 1 to 100 parts per million (ppm) for most adult marine organisms and from 0.1 to 1 ppm for the sensitive larval and juvenile lifestages. Sublethal effects may occur from soluble aromatic concentrations ranging from 1 to 100 parts per billion. Major sublethal effects from exposure to petroleum hydrocarbons are reduced growth rates, reproductive maturation, and the reproductive potential or fecundity of an organism. The ecological significance of these responses is important at the population and community levels. A species may be proven sensitive to oil in the laboratory, but in the natural environment, due to such factors as effective reproduction and dispersal strategies and immigration, an entire population may recover rapidly. Conversely, although an individual organism may show high tolerance to oil contamination in the laboratory, recovery of that population under natural conditions may be delayed due to such factors as competition for food and space or dependence on a specific food source. See Section IV.B for more specific discussions of toxicity as it relates to biological resources found in the proposed sale area.

3. **Constraints and Technology:** This section discusses those environmental features that are considered hazards to petroleum exploitation in the Beaufort Sea Planning Area and the strategies and technologies used to mitigate their effects. The environmental features identified as potential hazards include sea ice, permafrost, waves and currents--especially during storm surges--faults and earthquakes, unstable surface sediments, natural gas hydrates, shallow gases, and erosion. These features are part of the physical environment described in Section III.A of this EIS. The discussion in this section summarizes and incorporates by reference the description of constraints and technologies contained in the Sale 87 FEIS (USDOI, MMS, 1984) and Sale 97 FEIS (USDOI, MMS, 1987a); a summary of this discussion, augmented by additional material, as cited, follows.

a. **Sea Ice:** Sea ice is the principal environmental factor affecting the offshore development of petroleum resources in the planning area. The large, lateral forces that can be exerted by moving icefloes and sheets, ridges, floebergs, and ice islands are a major concern in the design and operation of offshore facilities associated with petroleum exploration and production. The force that moving sea ice exerts on a structure is limited by the strength, size, and shape of the ice and the magnitude of the driving forces. Sea ice is a heterogeneous substance with many small- and large-scale variations. These variations are likely to cause stress concentrations and local failures well before the theoretical ice loads are reached. Other concerns associated with sea ice include rideup, pileup, override, and seafloor gouging.

The strategies used to mitigate the effects of sea ice are discussed in relation to the technologies and activities associated with exploration, development and production, and transportation of oil.

(1) **Exploration:** The drilling units that have been used to drill exploration wells in the Beaufort Sea include (1) artificial islands, (2) caisson-retained islands, (3) ice islands, (4) bottom-founded mobile drilling units such as the Single-Steel Drilling Caisson and the Concrete Island Drilling System, and (5) floating units such as the ice-strengthened drillships and the Conical Drilling Unit. Sea-ice forecasting has developed as a strategy to maximize drilling time and to reduce the risks presented by moving sea ice. Ice observations are used to produce maps showing the various ice types, ages, concentrations, and directions of movement. The ice information is combined with weather forecasts and historical ice-movement, wind, and current data to predict sea-ice motion. These forecasts allow time for the well to be shut-in safely if weather and sea-ice conditions become severe enough to threaten the operation.

To reduce the threat that sea ice poses to the floating drilling units, icebreakers and icebreaking supply boats perform ice-management tasks that include breaking up ice around the drillship and breaking, towing, or pushing large floes so that their drift trajectories miss the drillship. In heavy ice, the support vessels continuously steam around the drillship to keep the ice sufficiently broken so that it produces only minimal lateral forces on the drillship. Sea-ice forecasts also allow for the efficient deployment of the icebreaking vessels.

To protect the equipment installed at the wellhead on the seafloor from collisions with the keels of drifting ice masses, MMS requires placement of the subsea blowout preventor (BOP) stacks that are used in areas subject to ice gouging in excavations (glory holes) deep enough so that the top of the stack is below the deepest probable gouge depth (USDOI, MMS, 1982). The BOP is designed to close the top of the well, control the release of fluids, permit pumping fluids into the hole, and allow movement of the drill pipe.

(2) **Development and Production:** If economically recoverable petroleum resources are discovered, structures designed for the recovery of oil will be placed in the lease-sale area. The experiences gained from exploration units will contribute to the design and construction of these production platforms. Production platforms will be larger than exploration units because space must be provided for (1) drilling a number of production and service wells; (2) locating facilities to separate oil, gas, and water that is produced from the wells; and (3) locating the equipment and wells that may be needed to inject gas and water. Production platforms may be larger versions of the units used for exploratory drilling.

Structures contemplated for year-round use in the stamukhi and pack-ice zones would have to resist the forces exerted by thick, first-year and multiyear ice-floes and sheets, ridges, and ice islands. Placement of an offshore structure that could survive the impact of a large ice island may not be likely. However, if the probability of an event is very low and a spill could be avoided, a production platform could be designed and installed in the pack-ice zone.

Concepts also are being developed for arctic production platforms that are monolithic, multisided concrete or steel structures or large monopod/monocone-type structures. A variety of steels are available for construction use in low-temperature environments; and concrete has been used to construct many different types of structures that resist seawater, ice, and freeze-thaw cycles.

(3) Transportation: Transportation of oil from the production sites to refineries may be by pipeline, tankers, or a combination of the two systems. A considerable amount of experience has been derived from these systems in many other offshore areas. As with other techniques, some of this experience will be used to design, construct, and operate petroleum-transportation systems in the planning area. Experience with arctic petroleum-transportation systems is very limited and, thus, a number of new problems will have to be solved.

(a) Offshore Pipelines: The threat that sea ice poses to a marine-pipeline system in the Sale 124 area is indicated by the presence of ice gouges. The area of most intense gouging is the stamukhi zone; the frequency of ice gouging decreases shoreward and seaward of this zone. Burial of the pipeline beneath gouge depth will afford protection from moving ice.

Offshore pipelines can be laid during the open-water period by a variety of existing pipelaying techniques. These methods include laying pipe from a conventional lay or reel barge or by bottom or surface tows. Only the ice in the landfast zone may be thick and stable enough to support the equipment used to lay pipe in the winter. Short pipelines and shallow-water sections of longer pipelines will probably be installed by the bottom-pull method. Longer pipelines will probably be installed by a vessel that can lay pipe at a rate of about 2 km per day.

Pipeline-burial depth will depend on the deepest gouge that is expected to be cut into the seafloor during the operational life of the pipeline. As with many other sea-ice phenomenon, it is difficult to predict maximum gouge events that will occur within some time interval for specific segments of the seafloor.

Those segments of offshore pipelines that cross the shoreline also must be protected from such sea-ice hazards as gouging, pileups, or rideups. Three of the methods that might be used are burial of the pipeline (1) beneath the offshore sediments and onshore soils, (2) in a causeway, or (3) in a frozen berm. Continuous, solid-fill causeways will alter the nearshore circulation and sediment-transport patterns and, if located near river mouths, affect the distribution of the freshwater that floods the nearshore ice during spring runoff. The nature of the changes will be site specific and depend on the length and orientation of the causeway.

(b) Marine-Transportation System: A marine-transportation system is a possible alternative to a pipeline system for the transportation of oil from production sites to refineries. This system would include icebreaking tankers, offshore storage and loading terminals, and icebreaking support vessels. These components are discussed briefly in the following paragraphs to indicate some of the planning, testing, and operating experiences that have gone into developing marine-transportation systems for the Arctic.

Tankers: The most economic-size crude-oil tanker for a particular trade route depends on a number of factors that include time in port, cruising speed in open waters and various concentrations and thicknesses of ice, the amount of oil loaded into the tanker, physical restrictions along the trade route, and terminal limitations (Han-Padron, 1985). It is assumed that the icebreaking tankers could transport the crude oil to an ice-free transshipment terminal on the Alaska Peninsula. Conventional tankers would then be used to carry the oil to refineries outside Alaska.

Based on the average sea-ice conditions in the Beaufort and Chukchi Seas, it is assumed that the tanker's power and structural specifications will be equivalent to Canadian Arctic Shipping Pollution Prevention Regulations Ice Class 8. The maximum tanker size considered is 250,000 deadweight tonnage. A tanker of this size would have a draft of about 24 m, an overall length of 390 m, and a beam of 55 m. (An Ice Class 8 vessel would have sufficient hull strength and propulsion power to maintain a steady speed of 3 kn in 8 ft [2.4 m] of level ice.)

Offshore Storage and Loading Facilities: In the Beaufort Sea Planning Area, the structures used for storage and loading would be gravity- or pile-founded units; and they would have to resist the same ice forces as the production platforms. Although a single structure that combines the storage and loading functions may be used, separation of the crude-oil-storage and mooring/loading facility may consist of a large concrete/steel

caisson-type structure that is divided into compartments for oil storage, seawater or sediment ballast, and operating equipment. The mooring/loading facility would incorporate some means of mooring the tankers, and a loading crane or arm supports the hoses carrying oil to the tankers. Open-water mooring and loading systems are common in other offshore areas; but in the Arctic, winter loading may have to be accomplished in moving ice fields.

Production platforms also may serve as offshore-loading terminals. The use of the production platform for offshore loading must provide the following: (1) a loading system that will permit the moored tankers to weathervane, (2) sufficient fendering to prevent a catastrophic collision between an approaching tanker and the platform, and (3) a means of clearing ice rubble in shallow water.

Icebreaking Support Vessels: Icebreakers and work/supply boats with icebreaking capabilities would be required to support tanker operations. From time to time, these vessels may be needed to assist tankers transiting the northern part of the Bering, Chukchi, and Beaufort Seas. Also, icebreaking vessels should be available to assist the tankers during mooring and for ice-management duties during loading. Icebreaking support vessels would probably need to be Ice Class 8 or greater.

#### b. Other Constraints

(1) Permafrost: The geotechnical effects that must be considered in the design of structures that are to be placed in areas underlain by subsea or subterranean permafrost are, in many respects, similar. However, studies to date indicate that the subsea permafrost is usually warmer and more saline than the subterranean permafrost and is, thus, more easily disturbed by thermal disruptions. Potential hazards associated with the presence of permafrost include thaw subsidence and frost heave.

Thaw subsidence may be caused by those activities that disrupt the thermal balance of the permafrost. These activities include: (1) drilling wells through existing permafrost layers, (2) laying and maintaining crude-oil pipelines, (3) placement and operation of bottom-founded gravity structures, and (4) constructing artificial islands and berms.

The most common cause of thaw subsidence may be associated with the production of crude oil. The flow of oil from multiple wells that are relatively close together in the permafrost zone may lead to greater settlement. As a result of the permafrost thawing, the well casing may be subjected to increased loads as the pore pressure and the stiffness of the surrounding sediments are reduced.

However, if the well is shut in and the flow of hot oil stops, the pore water in the surrounding sediments may refreeze. The freezeback expansion of the refrozen pore water may cause large radial pressures against the well casing. By adapting drilling-mud composition and hydraulics, drilling rates, cementing techniques, and casing designs to arctic conditions, wells that pass through permafrost zones are being successfully drilled, completed, and produced.

Pipelines may cause thaw subsidence if they are located in regions where ice-bonded permafrost is near the surface of the seafloor. Some thawing of the permafrost is acceptable if it does not result in excessive deformation of the pipe. Submarine pipelines have substantial buckling resistance and can tolerate more deformation than terrestrial pipelines. Methods to prevent thaw subsidence during the life of the pipeline include insulation, refrigeration, and overexcavation and backfill. Pipeline parameters that can be adjusted to reduce thawing include (1) increasing the thickness of insulation or pipeline separation (if more than one line) and (2) decreasing pipeline temperature, pipe diameter, or depth of cover.

Pipeline routes may be selected to avoid areas of thaw-unstable permafrost near the surface. A relatively thick layer of unfrozen soil provides a thermal and mechanical buffer between the pipeline and ice-bonded permafrost. Artificial islands and causeways will be subject to seasonal freezing and permafrost formation as are the natural geomorphological features of the arctic environment.

(2) Natural Gas Hydrates: Natural gas hydrates have been encountered in boreholes drilled not only in the arctic offshore and onshore environments but also in holes drilled in the seafloor in many other areas throughout the world in recent years. During drilling, the rapid decomposition of the hydrates may cause a rapid increase in pressure in the wellbore, gasification of the drilling mud, and the possible loss of well control. If the release of the hydrate gas is too rapid, a blowout may occur and there is the potential danger that the escaping gas may be ignited.

However, the hydrate zone can be detected by continuously monitoring the drilling muds for gas increases. Also, the rate of hydrate decomposition can be reduced by (1) lowering the temperature or controlling the density of the drilling mud, (2) drilling at controlled penetration rates, or (3) using insulated high-strength casing opposite the hydrate-bearing formation. Hydrate zones also may be detected by seismic surveys prior to drilling.

In addition to permafrost thaw, the flow of hot petroleum hydrocarbons past a hydrate layer will result in hydrate decomposition around the wellbore and the loss of strength of the affected sediments. Also, the freezeback of a well during shut-in periods may cause reformation of the hydrates and induce high pressures on the casing string.

(3) Waves, Currents, and Storm Surges--Flooding and Erosion: There is a considerable amount of coastal and offshore engineering experience from other areas that can be adapted to the arctic marine environment. Excluding storms, available information indicates that waves and currents should not be a major problem affecting offshore operations. In the absence of long-term measurements, it is possible to statistically hindcast the characteristics of wind-driven waves, currents, and storm surges at potential operating sites. The hindcast results are used as input for statistical extrapolation procedures to determine wave heights and periods, storm-surge heights, and current velocities that could interact with structures of a given site during the operational life. Through careful analyses of regional and site-specific environmental data, protective measures can be taken to reduce the effects of moving water.

(4) Faults and Earthquakes: Faults and earthquakes are considered to be a high hazard for all the facilities that rest on the seafloor. Such movement could, if it is severe enough, damage part or all of an entire bottom-founded structure. Movement along fault surfaces may destroy the integrity of producing wells located within or near the fault zone and could produce a seep if the fault extends to the surface or a blowout if the rupture is at or near the surface.

Because fault surfaces can be detected by seismic surveys, facilities can be located away from potentially active faults or fault systems. The risk of locating facilities near faults is greatly reduced if they are no longer active. The determination of active faults or fault systems would have to be made, at least in part, by correlating faults with known earthquake epicenters.

As noted in Section III.A.1.b, seismic activity in the Sale 124 area occurs mainly off Camden Bay. Data indicate that the magnitude of the seismic events in this area may not be sufficient to cause structural failure of properly designed platforms or pipelines buried in the seafloor sediments.

Structures must be designed to withstand the upper limit of ground motion associated with seismic activity; and there is considerable experience associated with the design, construction, and operation of offshore facilities in areas of more intense seismic activity (e.g., southern California and Cook Inlet, Alaska).

(5) Unstable Sediments: The ability of the seafloor sediments to support the weight of the heavy, bottom-founded structures and to resist sliding when sea ice interacts with the structure are important considerations. The geotechnical properties of the sediments that support the structures must be determined to understand how the sediments will react under static or cyclic vertical and lateral loads. There is considerable engineering experience associated with offshore foundations that can be used in the Arctic.

Sediment instability and mass movement are related to relatively high seafloor gradients, low sediment strength in fine-grained sediment that retains high amounts of water, sediment loading from waves during the passage of storms, and ground motion during earthquakes. On the continental shelf inshore of the 50-m isobath, the slope of the seafloor is generally very low, except in the vicinity of the Barrow Sea Valley. Except in the vicinity of Camden Bay, ground motions associated with earthquakes are generally low. Thus, mass movement in waters less than 50 m is generally not a hazard that would significantly affect offshore operations. Hazards associated with mass movement are most likely to be found (1) in the Camden Bay area during an earthquake; (2) in the deeper parts of the lease-sale area, particularly in the vicinity of the shelf break; and (3) possibly in the vicinity of the Barrow Sea Valley.

Pipelines are susceptible to creep, slides, flowage, and subsidence. Methods used to minimize potential damage to pipelines include (1) routing a pipeline so that it follows the contour of a mudslide lobe, (2) crossing a flow in the general direction of the flow movement, and (3) laying pipelines in mudslide areas that

show signs of less disturbance. Recent engineering adaptations to mudslide problems include using flexible joints, which allow some movement, and safety couples, which activate immediate shut off of the line flow if the line is moved.

(6) **Shallow-Gas Deposits:** Sediments in which gas has accumulated are a potential hazard if they underlie manmade structures or are penetrated during drilling. The presence of gas may lower the shear strength of the sediments and reduce their ability to support structures. If the pressure is high enough, the gas may cause a blowout during drilling. The presence of shallow gas in the sediments of the continental shelf can be determined from seismic profiles. Measures can be taken to reduce the threat that low-shear-strength sediments may have to the integrity of manmade structures and that gas may have to drilling operations.

**Summary:** The environmental hazards that affect petroleum exploration in the Beaufort Sea Planning Area are related to sea ice, permafrost, storm surges, faults and earthquakes, hydrate and shallow gases, and factors affecting the geotechnical characteristics of the seafloor sediments; sea ice is the hazard of major concern. However, the potential severity of the hazard varies with each activity, and measures can be taken to lessen its effects. These measures include (1) scheduling activities to minimize exposure to a hazard, (2) conducting surveys to locate potentially hazardous areas and locating facilities away from known hazards, and (3) designing facilities to withstand a range of environmental forces. The use of these strategies necessitates being able to (1) identify the hazards, (2) locate or predict where and when they will occur, and (3) estimate their effects.

4. **Major Projects Considered in the Cumulative-Case Analysis:** The cumulative-case analysis includes the potential effects associated with (1) exploitation of the resources estimated for the cumulative case--OCS lease sales (Appendices A and B); exploitation of known or estimated resources from offshore or onshore private, State, or other Federal leases; and (3) major development of construction projects. Information on the projects considered in the cumulative-case analysis is summarized in Table IV-A-4-1 and described in Appendix E. The location of these projects is shown in Graphic 3.

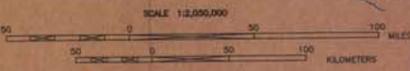
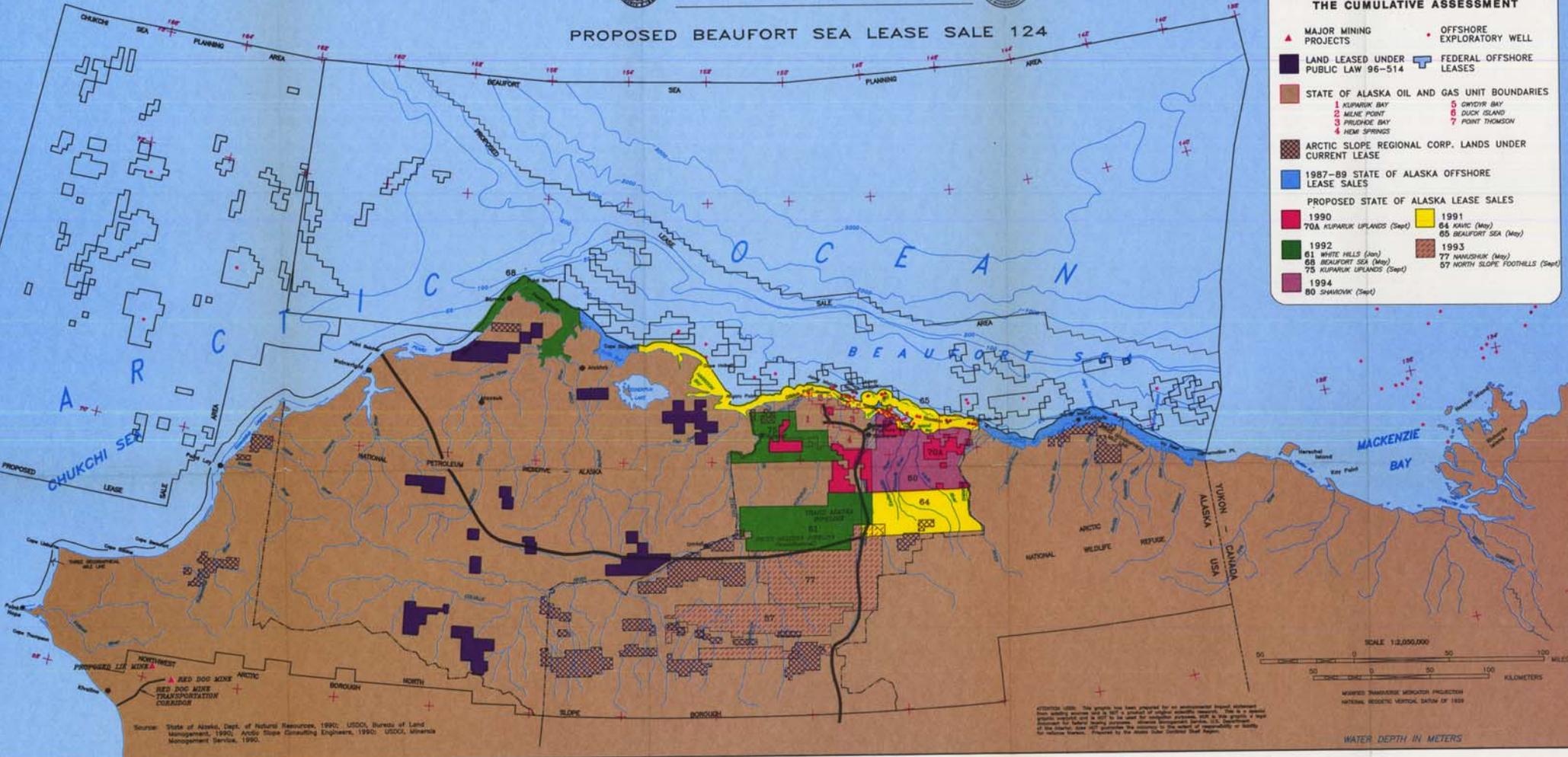


PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 3

MAJOR PROJECTS INCLUDED IN THE CUMULATIVE ASSESSMENT

- ▲ MAJOR MINING PROJECTS
- OFFSHORE EXPLORATORY WELL
- LAND LEASED UNDER PUBLIC LAW 96-514
- FEDERAL OFFSHORE LEASES
- STATE OF ALASKA OIL AND GAS UNIT BOUNDARIES
- 1 KUPARUK BAY
- 2 MILNE POINT
- 3 PRUDHOE BAY
- 4 NEM SPRINGS
- 5 OWOYUR BAY
- 6 DUCK ISLAND
- 7 POINT THOMSON
- ARCTIC SLOPE REGIONAL CORP. LANDS UNDER CURRENT LEASE
- 1987-89 STATE OF ALASKA OFFSHORE LEASE SALES
- PROPOSED STATE OF ALASKA LEASE SALES
- 1990
- 70A KUPARUK UPLANDS (Sept)
- 1991
- 64 KAVIC (May)
- 65 BEAUFORT SEA (May)
- 1992
- 61 WHITE HILLS (Jan)
- 66 BEAUFORT SEA (May)
- 75 KUPARUK UPLANDS (Sept)
- 1993
- 77 NANKUSIUK (May)
- 57 NORTH SLOPE FOOTHILLS (Sept)
- 1994
- 80 SHARONK (Sept)



ATTENTION: This graphic has been prepared for an environmental impact statement from existing sources and is not a product of original scientific research. This is a general graphic representation and is not to be used for navigation purposes. All data are from the best available information and do not constitute the authority of responsibility or liability for various sources. Prepared by the Alaska State Geologist's Office.

Source: State of Alaska, Dept. of Natural Resources, 1990; USDO, Bureau of Land Management, 1990; Arctic Slope Consulting Engineers, 1990; USDO, Minerals Management Service, 1990.

WATER DEPTH IN METERS

Table IV-A-4-1  
Major Projects Considered in Cumulative-Effects Assessment

Project Name <sup>1/</sup>	General Location	Resource Estimate <sup>2/</sup>	Exploration	Developmental Timeframe <sup>3/</sup>		Current Status 1989
				Development Construction	Peak Daily Production <sup>4/</sup>	
<u>Chukchi Sea Region</u>						
North Slope Borough Capital Improvements Program (CIP) (2)	North Slope Borough	Not relevant	Not relevant	1983-1985+	Operation: 1983-1985+	Includes projects at villages, Prudhoe Bay, and Kuparuk.
Red Dog Mine (9)	145 km north of Kotzebue and 114 km east of Kivalina	77 million metric tons, primarily of zinc/lead reserves	Complete	1986-1989	*/	Construction of the port facility began in the summer of 1986.
National Petroleum Reserve-Alaska (NPR-A) (11)	Northwest Alaska, west of Colville River	1.85 (oil) 3.26 (gas)	1944-1989	--	--	No commercial reserves have been discovered. In 1985, drilling began on areas leased under the USDOI program. Annual lease sales are scheduled.
Arctic Slope Regional Corporation (ASRC) (15)	Primarily north-western Alaska, south and west of NPR-A	--	1973 and thereafter	--	--	Low-level exploration ongoing; no discoveries. Drilling up to three wells in ANWR.
Discovered Resources (Oil Fields, Gas Fields, and Mining) (9)	Generally in the De Long Mountain area	--	--	--	--	With the development of the port facilities for the Red Dog deposit, other zinc/lead deposits--such as the Lik--may become commercial. Coal resources are present along the Chukchi Sea coast.
Future OCS Leasing (18)						
a. Chukchi Sea	Offshore Chukchi Sea	2.7 (oil)	1990 and thereafter	--	--	See Sale 109 FEIS for information on the Chukchi Sea resources.
b. Hope Basin	Kotzebue Sound and Chukchi Sea	0.17 (oil)	1991 and thereafter	--	--	OCS Sale 133 is a frontier-exploration sale proposed for 1992.
<u>Mid-Beaufort Sea Region</u>						
Trans-Alaska Pipeline (TAP) (1)	Prudhoe Bay to Valdez	Not relevant	Not relevant	1973-1977	Design capacity: 2.0 MMbbl/day	The 1,288-km pipeline and related facilities occupy 42.4 km <sup>2</sup> . Current flow rate is 2.05 MMbbl/day.
Prudhoe Bay unit (PBU) Oil Production (3)	Prudhoe Bay onshore	9.6 (oil)	1965-1969	1969-1985	1977-2006 1.5 Mbbbl/day	Peak production to decline in 1990 and continue thereafter. New satellite field, Point McIntire, will produce from a 300-MMbbl reservoir in the early 1990's.

Table IV-A-4-1  
Major Projects Considered in Cumulative-Effects Assessment  
(Continued)

Project Name <sup>1/</sup>	General Location	Resource Estimate <sup>2/</sup>	Exploration	Developmental Development Construction	Timeframe <sup>1/</sup> Peak Daily Production <sup>4/</sup>	Current Status 1989
Lisburne Field (4)	PBU	0.35-0.45 (oil)	1968-1983	1984-1987	1987-2017 100,000 bbl/day	Wells on five onshore sites. Offshore well site dropped. Production in 1989 reached 36,000 bbl/day.
Kuparuk River Unit (5)	Approx 25 mi west of Prudhoe Bay, onshore	0.4-1.3 (oil)	1970-1979	1981-19__	1982-2002 300-320,000 bbl/day	Phase I production commenced in December 1981. Full field water flooding began in 1986.
West Sak (6)	Within Kuparuk River Unit	2.0-4.0 (oil)	1970-1975	1984 post-1986	1985-2015+ 200,000 bbl/day if developed; 2,500 bbl/day during pilot project	Pilot project is completed. Development will not occur until oil prices improve and become more stable.
Duck Island Unit (7)	19.3 km east of Prudhoe Bay	0.3-0.98 (oil)	1977-1982	1985-1987	1988-2000+ 100,000 bbl/day	The Duck Island unit has produced 1,000 bbl/day as of the end of 1988. A waterflood project had begun to maintain unit formation pressure.
Milne Point (8)	North of Kuparuk River Unit	0.03-.08 (oil)	1970-1984	1984-1985	1986-2000+ 25,000 bbl/day	Production began in 1985, was suspended in 1986, and restarted in 1988.
Niakuk Field	Offshore north-east of the Prudhoe Bay Field	Approx. 58 MMbbl reserves	1987-1988	1989-1991		Drilling will begin in 1991 and extend over a 13-month period. Production is scheduled to occur in the 4th quarter of 1991.
Discovered Resources (Oil Fields and Gas Fields) (9)	Mid-Beaufort Sea	--	--	--	--	Until gas infrastructure is available, gas fields such as Point Thomson and Gubik won't be developed. Others such as Gwyder Bay, Ugnu Sands, and Simpson Lagoon need either technological advances or increases in oil prices before they can be developed.
Seal Island	Beaufort Sea	0.3 (oil)	1981-1986	1987-1990	1989-2014 5,000 bbl/day	Additional wells are planned.
Previous Federal Offshore Lease Sales (14)	Barrow to Canada within 200-m isobath	0.6 (oil)	1981-1992	1992-1995	1995-2014	Exploration drilling is under way.

Table IV-A-4-1  
Major Projects Considered in Cumulative-Effects Assessment  
(Continued)

Project Name <sup>1/</sup>	General Location	Resource Estimate <sup>2/</sup>	Exploration	Developmental Timeframe <sup>3/</sup>		Current Status 1989
				Development Construction	Peak Daily Production <sup>4/</sup>	
Future OCS Leasing Beaufort Sea	Offshore Beaufort Sea	0.53	1990 and thereafter	1995 and thereafter	1996-2014+ 150,000 bbl/day	Information for Sale 124 applies to future Beaufort Sea sales.
Future State of Alaska Leasing (17)	Offshore Beaufort Sea, onshore east and south of PBU	Moderate to high petroleum potential	1989 and thereafter	--	--	According to the State's 5-year leasing program (as of 1989), between Barrow and the Canning River, in excess of 4 million acres will be offered by 1993.
<u>Eastern Beaufort Sea Region</u>						
Arctic National Wildlife Refuge (ANWR) (12)	North of Brooks Range, east of Canning River	--	1983 and thereafter	Prohibited	Prohibited	ANILCA prohibits development or additional exploratory drilling until authorized by Congress.
Canadian Beaufort Sea (ESSO, Dome, Gulf acreage) (16)	Offshore Mackenzie Bay, Canada	7.0 (oil)	1973-1990	1982-2000+ and thereafter	1990-? in excess of 180,000 MMbbl	Delta gas project operators ESSO/Shell have applied for a permit to export gas. Offshore Amauligiak oil field being delineated.

Source: MMS, Alaska OCS Region.

- 1/ The numbering in parentheses following the projects in this table corresponds with the listing and further description of projects in Appendix G of this EIS.
- 2/ Resource estimates for oil are expressed in billions of barrels of recoverable oil; gas estimates are expressed in trillions of cubic feet.
- 3/ Developmental timeframes are approximate. Dates are fixed with timing of first commercial field development. Timeframes for subsequent fields are not indicated.
- 4/ Production estimates, when available, are expressed in barrels of oil per day (MMbbl = million barrels) and cubic feet of gas per day (MMcf = million cubic feet).
- 5/ 636,364 metric tons per year of concentrates will be shipped.
- 6/ Discovered resources, 17.4 bbl of oil and 11.7 Tcf of gas.

## Definitions Assumed for Effects Assessment

The definitions shown in Table S-2 (ref.) at the beginning of this EIS were developed to help determine the relative extent of effects. The words VERY LOW, LOW, MODERATE, HIGH, and VERY HIGH defined in the table appear in capital letters in Section IV only to ensure a common understanding of the terms and not to emphasize the level of effect.

### IV.B. Alternative I--Low Case

Alternative I would offer for leasing about 4,095 blocks of the Beaufort Sea Planning Area (Fig. IV-B-1), and the low case represents the minimum amount of industry activity that is expected to occur as a result of the lease sale. The MMS estimates the oil resources to be about 270 MMbbl for the low case, and this estimate represents a quantity of oil that is less than an estimated minimum amount that would have to be discovered before development and production could occur (see Appendices A and B). Four exploration wells would be drilled during a 2-year period (1992 and 1993). After testing, the wells would be plugged and abandoned and industry activity resulting from the sale would cease. For a discussion of the types and levels of exploration activities associated with the low case, see Section II.B.1.a.

This section presents the analyses of the potential effects that the low case for Alternative I might have on the physical and biological resources, sociocultural systems, and programs in and adjacent to the planning area.

1. Effects on Water Quality: For the low case, the only agent likely to affect water quality in the Beaufort Sea Sale Area would be deliberate discharges from exploration platforms. Oil spills and construction activities are assumed not to occur.

Deliberate Discharges During Exploration: Exploratory vessels would discharge drilling fluids in bulk quantities (Table II-A-1), along with sanitary wastes from wastewater-discharge sources. Discharges of drilling muds and drill cuttings for exploration are projected from the development scenario in Section II.B.1.a; they would occur over a 2-year period. Discharges during exploration would occur in 1992 and 1993 at 1,100 metric tons (1,260 English short tons) of drilling muds per year and 1,500 metric tons (1,640 English short tons) of drill cuttings per year.

Drilling muds used offshore of Alaska are of relatively low toxicity and are limited to this low level of toxicity in permits for their discharge granted by EPA. During exploration, only barium concentrations in discharged muds are expected to be always more than a hundredfold greater than concentrations in nearby sediments (Table IV-B-1-1). Concentrations of cadmium, lead, mercury, and zinc in discharged muds, however, may be more than a hundredfold greater than concentrations in nearby sediments.

Based on the above and additional information presented in Appendix L, EPA has determined that exploratory discharges are not likely to exceed applicable water-quality criteria outside of a 100-m radius, or 0.03 km<sup>2</sup> around each discharge site. With only two exploratory platforms present, water quality in an area no more than 0.03 km<sup>2</sup> around each platform, for a total of 0.06 km<sup>2</sup> at any one time or 0.12 km<sup>2</sup> during all of exploration could be temporarily degraded during active discharge of drilling muds and cuttings. Therefore, the effect of exploration discharges on water quality would persist for a few hours over a fraction of a square kilometer--a VERY LOW effect.

CONCLUSION: For the low case, the effects on both LOCAL and REGIONAL water quality are expected to be VERY LOW.

2. Effects on Lower-Trophic-Level Organisms: For the low case, no oil spills are assumed to occur. The effects of seismic exploration on marine plants are expected to be VERY LOW. In general, even high explosives (e.g., dynamite) have relatively little effect on marine invertebrates, presumably due to

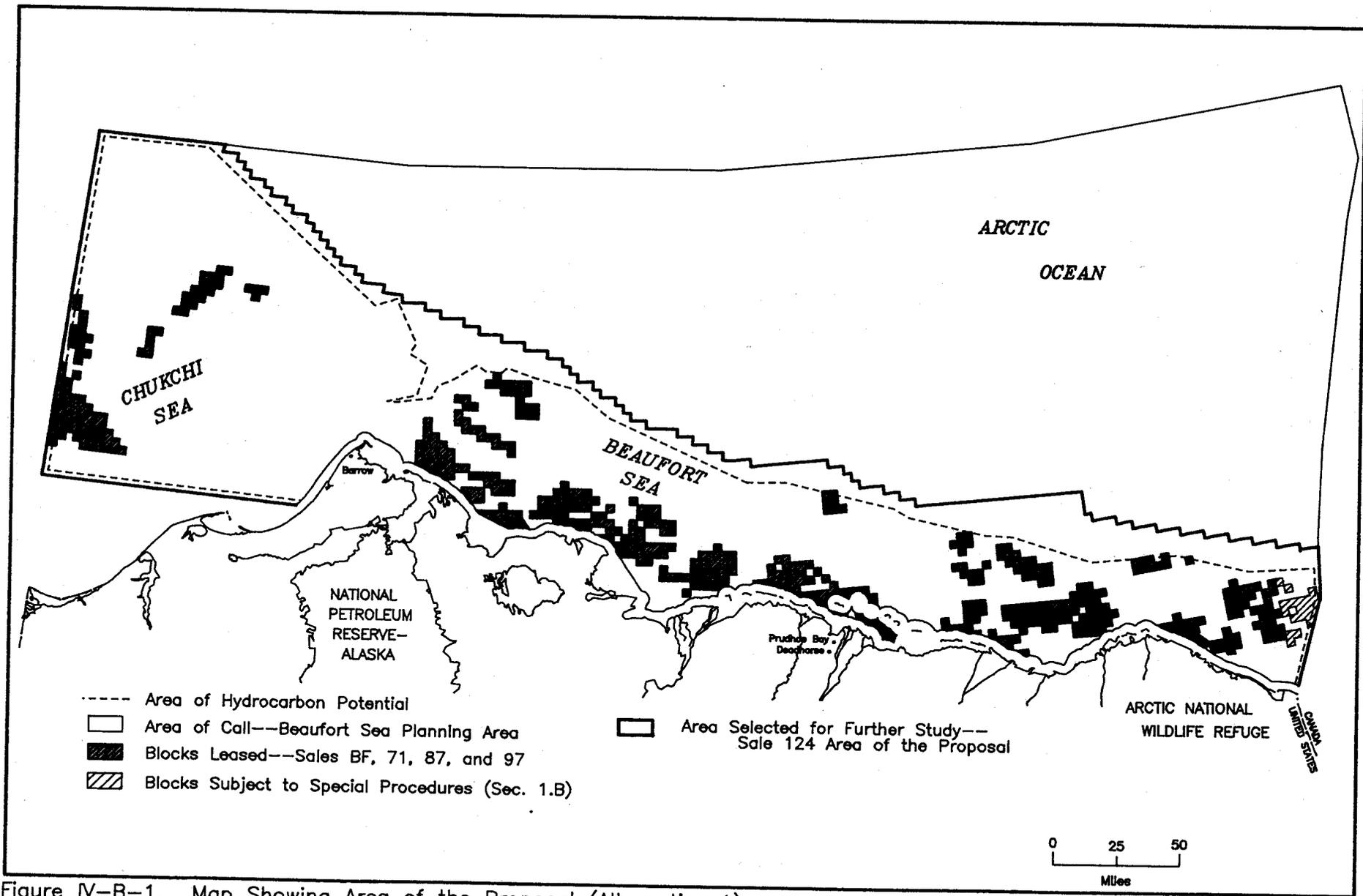


Figure IV-B-1. Map Showing Area of the Proposal (Alternative 1)

Table IV-B-1-1  
 Expected Trace-Metal Concentrations and Enrichment Factors  
 (Over Existing Shelf Concentrations in the Beaufort Sea Planning Area)  
 for Drilling Muds Discharged in the Beaufort Sea

Metal	Maximum Concentrations Measured in Drilling Muds (parts per million)	Enrichment Factor Over:		
		Suspended Sediments	Shelf- Bottom Sediments	Nearshore- Bottom Sediments
Arsenic	17.2	--- <sup>1/</sup>	0.7-1.1	---
Barium	398,800	---	530-2,000 <sup>2/</sup>	530-2,200
Cadmium	4.2	---	21	14-110
Chromium	1,300	9-12	15	14-76
Copper	88	1-18	1.5	2-18
Lead	1,270	---	420	64-330
Mercury	3.7	---	23-120	41-190
Nickel	88	0.9-62	1.9	2.7
Vanadium	235	0.8-120	1.7	2-7
Zinc	3,420	15-430	35	29-180

Source: Table III-A-2 of this EIS and Appendix I of the Sale 109 FEIS (USDOI, MMS, 1987b).

<sup>1/</sup> --- Denotes no data.

<sup>2/</sup> Calculated using nearshore-sediment concentrations.

lack of air-containing chambers, such as the swim bladder of fish (Falk and Lawrence, 1973). Airguns, which are much more innocuous for fish than explosives, were shown to have no effect on caged oysters placed close to the airgun (Gaidry, unpublished, cited by Falk and Lawrence, 1973). Effects of waterguns on marine organisms have not, to our knowledge, been assessed, but their effects are expected to be as low or lower than those of airguns because a lesser amount of energy is involved. Due to the prevalent use of airguns and waterguns in Alaskan OCS waters, seismic surveys are expected to have VERY LOW effects on invertebrates as well as on marine plants.

The "Fate and Effects of Exploratory Phase Oil and Gas Drilling Discharges in the Beaufort Sea Planning Area, Lease Sale 124" have been analyzed by EPA in Appendix L. Probable effects on phytoplankton, zooplankton, and benthic communities are discussed in that appendix and in Section IV.C.B.2.c. Due to the general low toxicities of such discharges and the small area ( $0.03 \text{ km}^2$  /drilling unit during operation) affected, effects to phytoplankton and zooplankton are expected to be LOW. Benthic communities are also expected to incur a LOW effect; however, effects are expected to be longer lasting but localized due to the deposition of drilling muds and cuttings.

In the low case, it is assumed that a total of four wells will be drilled from a combination of one bottom-founded mobile drilling unit and three floating drilling units over a 2-year period. Installation of a bottom-founded unit will cause localized death to benthic invertebrates and plants covered, but these effects are expected to be extremely localized, a LOW effect. Each year, 1,100 metric tons (1,260 English short tons) of drilling muds and 1,500 metric tons (1,640 English short tons) of drill cuttings will be discharged (Table IV-B-1-1). For phytoplankton and zooplankton, the effect of discharging drilling muds and cuttings is expected to be LOW, primarily because of the low levels of toxicity demonstrated and the small area ( $0.06 \text{ km}^2$  during each of the 2 years of exploration drilling) that should be affected. Benthic communities also are expected to incur a LOW effect; however, effects probably will be longer lasting (but localized) due to the deposition of drilling muds and cuttings.

**CONCLUSION:** The effects of the low case on lower-trophic-level organisms are expected to be LOW.

3. **Effects on Fishes:** For the low case, no oil spills are assumed to occur. Within the Sale 124 area, only airguns and waterguns will be used for seismic surveys. Falk and Lawrence (1973) have compiled a review of several types of seismic surveys and their effects on fish. High explosives can be quite lethal to fish, but they will not be used in the Beaufort Sea. Experiments testing the effects of airguns on caged coho salmon smolts found no harmful effects (Weaver and Wienhold, 1972, cited by Falk and Lawrence, 1973). Kostyuchenko (1973) examined the effect of airguns (as well as electric-pulse generators and TNT charges) on fish eggs and larvae in the Black Sea. Airguns had little effect on even the most sensitive fish eggs at distances of 5 m from the discharge source. Even at a distance of 0.5 m from the source, the survival rate of eggs was 75.4 percent compared to the control's rate of 92.3 percent. Airguns were not observed to have any effect on larvae; however, only limited numbers of larvae were examined. Airguns have been found to have few harmful effects, especially as compared to high explosives. Waterguns, which use the rapid release of water to generate a seismic pulse, release less energy than airguns. Effects of waterguns on marine organisms have not, to our knowledge, been assessed, but effects are expected to be as low or lower than those of airguns. Due to the expected prevalent use of airguns and waterguns for seismic surveys in the Sale 124 area, LOW effects on fish are anticipated.

The general types of effects that discharged drilling fluids and cuttings could produce are reviewed and discussed in Appendix L of this document. This referenced material discusses effects that are lethal--as well as chronic or sublethal--and effects on populations and communities.

Only 12 fish species have been tested for acute lethal concentrations of drilling fluids (see Table 19, NRC, 1983). In general, fish appear less sensitive to drilling fluids than invertebrates, but this may reflect the fewer number of tests done with fish and a lesser examination of effects on different lifestages.

Pink salmon fry were found to be moderately sensitive to drilling fluids, exhibiting 96-hour  $LC_{50}$  values of 3,000 to 29,000 ppm (Dames and Moore, 1978). ( $LC_{50}$  values indicate the concentration of test substance that caused 50-percent mortality of the experimental organisms.) Toxicity increased when experimental solutions were well stirred. The increased toxicity observed might relate to gill damage (whole muds were used in the acute lethal bioassay test); gill histopathology was observed in pink salmon fry exposed to a 30,000-ppm suspension of used high-weight chromium lignosulfonate from Cook Inlet (Houghton, Beyer, and Thielk, 1980). Tests with coho salmon have resulted in 96-hour  $LC_{50}$  values of 15,000 to 190,000 ppm for

whole-mud suspensions (Monaghan, McAuliffe, and Weiss, 1977).

A few studies on certain tissues suggest that fish do not accumulate trace metals in their tissues (Payne et al., 1982; Tillery and Thomas, 1980). Other tissues than those tested, however, may be more likely to accumulate trace metals.

An area of special vulnerability that should be kept free of discharged material is the Boulder Patch. Fishes that depend on or are largely restricted to this habitat may be vulnerable to effects from discharged material, as would be demersal fish eggs laid within the Boulder Patch. Fish could die, or could suffer gill damage or other sublethal effects, while eggs could be smothered or otherwise be damaged. Effects to this community from drilling-fluid discharge are highly unlikely, because available lease tracts are situated far from the Boulder Patch; and the EPA Beaufort Sea National Pollution Discharge Elimination System (NPDES) Permit does not allow discharges within 1,000 m of the Boulder Patch.

In the low case, a total of four exploration and delineation wells are expected to be drilled from a number of different locations over a 2-year period. Each year, 1,100 metric tons (1,260 English short tons) of drilling muds and 1,500 metric tons (1,640 English short tons) of drill cuttings would be released (Table IV-B-1-1). Effects should be very localized. Details of extent and timing of water-quality effects are presented in Section IV.B.1, Effects on Water Quality.

The amounts of drilling muds and cuttings expected to be released are small relative to the natural suspended-sediment load of the Sale 124 area. (See Sec. III.D.6 in the Sale 87 FEIS, USDOJ, MMS, 1984, and Sec. IV.B.1, Effects on Water Quality, of this EIS.) Sediments are contributed by rivers, coastal erosion, runoff from breakup, and mixing of inshore waters. Most fishes (except for demersal eggs and planktonic forms) should be able to avoid areas of active discharge. Demersal eggs in those areas could be buried by discharged material (see Appendix L and Jones and Stokes, 1983).

The overall effects of drilling discharges on the fish fauna of the Sale 124 area are expected to be LOW because (1) fish are mobile; (2) in general, fish do not seem to be very sensitive to discharged drilling fluids and cuttings; and (3) the area projected to be affected will be so small (0.06 km<sup>2</sup> for each of the 2 years of exploration drilling; see Sec. IV.B.1, Effects on Water Quality).

Activities relating to installation of a bottom-founded drilling unit are expected to be very localized. In general, demersal fishes would be expected to move during installation activities but to reutilize their habitat on completion of the installation if substrate type were not altered and the habitat were recolonized by their prey. However, demersal fishes are not expected to recolonize those areas where gravel replaces soft sediments. Due to the small number of drilling units (one) expected to be installed, the presumably broad distributions of most adult and larval marine fishes in the Beaufort Sea, and the ability of fish to move from an area of disturbance, regional populations are not expected to be affected. Therefore, the installation of exploration units is expected to have a LOW effect on fishes.

**SUMMARY:** For the low case, the effects from seismic exploration, discharges of drilling fluids, and drilling-unit installation should be very localized. The effects of these activities on fishes are expected to be LOW.

**CONCLUSION:** The effects of the low case on fishes are expected to be LOW.

4. **Effects on Marine and Coastal Birds:** Several million migratory birds of about 150 species occur on marine, coastal, and tundra habitats within or adjacent to the proposed Sale 124 area. Oldsquaw, red phalarope, glaucous gull, and common eider are among the most abundant species present. Important coastal habitats are shown in Graphic 1. The primary adverse effects from low-case OCS exploration activities in the proposed sale area on marine and coastal birds could come from noise and disturbance associated with air and vessel traffic in support of exploration activities. No oil spills are assumed to occur under the low case.

**Site-Specific Noise and Disturbance Effects:** Primary sources of noise and disturbance to marine and coastal birds would come from air (180 flights/year for 2 years) and marine (25 boat trips/drilling season for 2 years) traffic to and from the two exploration platforms (operating/yr). Air support is assumed to be centered out of Deadhorse at Prudhoe Bay, Camp Lonely, or Barter Island with 2 helicopter round trips per day for the two exploration-drilling units and a total of 180 helicopter trips per year (out to the two units and

back to Deadhorse or another onshore base). If there are drilling operations during the open-water season, MMS requires the operator to maintain an emergency-standby vessel within the immediate vicinity of the drilling units. Depending on ice conditions, two or more icebreaking vessels may be required to perform ice-management tasks for the floating units.

The greatest disturbance is likely to come from aircraft traffic flying near barrier-island bird colonies and to a lesser degree from aircraft and boats passing near lagoon concentrations of feeding and molting waterfowl and shorebirds. Aircraft flying between the exploration platforms and support facilities at Deadhorse, Camp Lonely, or Barter Island that take a route along the coast adjacent to the sale area during the nesting season are more likely to temporarily disturb thousands of birds than aircraft that fly directly from Deadhorse, Camp Lonely, or Barter Island airport to the offshore platforms. Occasionally, these direct offshore flights may briefly disturb foraging flocks of seabirds with little or no lasting effects; however, aircraft disturbance to local feeding or molting concentrations of waterfowl and shorebirds in the lagoon areas during the fall may reduce the ability of migratory birds to acquire the energy (fat-lipid reserves) necessary for successful migration. If such disturbance occurred frequently, migration mortality might increase and winter survival of other affected birds might be reduced; but the amount of air traffic (one or two flights/day/platform during drilling of the four exploration wells) is not likely to disturb more than a few feeding and molting flocks of birds near the coast or near the drill platforms on occasion. Noise and disturbance effects on birds from aircraft traffic are not expected to be more than LOW.

The noise associated with drilling operations and the movement of barges and supply vessels (25 boat trips/year) could disturb foraging seabirds near drilling sites. However, the low-frequency sounds emitted from drilling operations have not been shown to continually displace foraging seabirds from active oil-development areas along the California coast or in Cook Inlet. Expected Sale 124 vessel traffic of about 25 boat trips to and from the two platforms per year during the 2 years of exploration could temporarily disturb marine and coastal birds. As the vessels pass near the birds, short-term diving or flight responses may result. Unless industry uses small boats or hovercraft capable of moving through very shallow water and boat operators deliberately pass through the coastal lagoons and river deltas, vessel-traffic disturbance of birds is likely to be very brief and is expected to have a VERY LOW effect. It is very unlikely that industry operations under the proposed marine-support and transportation scenarios would have any reason for moving boats through the shallow lagoons adjacent to the sale area. However, if industry boat traffic were to pass through the lagoons, disturbance effects on birds would be similar to those of low-flying aircraft. The overall effects of noise and disturbance from aircraft, boat traffic, and drilling activities on marine and coastal birds are expected to be LOW.

**CONCLUSION:** For the low case, the effects on marine and coastal birds (waterfowl, seabirds, and shorebirds) are expected to be LOW.

**5. Effects on Pinnipeds, Polar Bears, and Belukha Whales:** Six species of nonendangered marine mammals--numbering over 100,000 ringed, spotted, and bearded seals; 3,000 to 5,000 polar bears; 250,000 walruses; and about 12,000 belukha whales--commonly occur year-round or seasonally in a portion of or throughout the Beaufort Sea Planning Area and are very likely to be exposed to OCS-exploration activities. Noise and disturbance could adversely affect marine-mammal populations found in the proposed Sale 124 area. No oil spills are assumed to occur under the low case.

a. **Site-Specific Noise and Disturbance Effects:** The primary sources of noise and disturbance of ringed, bearded, and spotted seals; walruses; polar bears; and belukha whales would come from the air and marine traffic associated with the low case and more specifically from the supply boat traffic (25 trips/year), icebreakers, and helicopters (180 flights/year) associated with the assumed two exploration-drilling units. Aircraft traffic centered out of Deadhorse, Barter Island, Lonely, Barrow, or other locations traveling to and from drilling platforms could be a primary-disturbance source to spotted seals hauled out on the beaches along the Colville River Delta and to walruses and bearded and ringed seals hauled out on the ice. Seismic boats assumed for the low case also would be primary-noise sources (see Sec. II.B.1.a). Secondary-disturbance sources would be low-frequency noises from drilling operations on the two exploration platforms. Exploration drilling would take place from bottom-founded mobile and floating drilling units; depending on ice conditions, the floating units would be supported by one or more vessels with icebreaking capabilities.

Exploration drilling from drillships in the deeper water tracts may coincide with the belukha whale fall migration through the offshore areas along the pack-ice front. Icebreaker traffic has been demonstrated to

disturb the belukha whales within 35 to 50 km of the vessel (Finley and Davis, 1984). Other than flight responses, the meaning or importance of behavioral changes correlated with the sound and presence of boats is uncertain. Icebreaker traffic could briefly interrupt marine-mammal migration when the vessels are near marine-mammal concentrations within a lead system; and it temporarily may interrupt the movements of belukha whales, seals, and walruses or displace some animals when the vessels pass through the area. However, there is no evidence to indicate that vessel traffic would block or significantly delay marine-mammal migrations. In fact, severe ice conditions are likely to have a far greater influence on spring and fall migrations than vessel traffic associated with low-case activities. Such traffic is not likely to have more than LOW effects on pinniped, polar bear, and belukha whale movements or distributions; but the displacement of pinnipeds, polar bears, and belukha whales could affect the availability of these animals to subsistence hunters for that season. Icebreaker activity also may physically alter some ice habitats and destroy some ringed seal lairs in pack-ice areas, perhaps crushing or displacing some ringed seal pups and perhaps displacing a few denning polar bears (a LOW effect).

Exploratory drilling during the winter season--when natural leads are often frozen over--would result in formation leads and cracks in the ice on the leeward sides of the two drill rigs (operating/yr); such local changes in ice habitat would attract seals, which in turn could attract polar bears (Stirling, 1988). Some polar bears could be unavoidably killed to protect oil workers when the bears were attracted to the drill rigs due to food odors and curiosity. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation with the U.S. Fish and Wildlife Service (FWS) on this matter is expected to result in the use of nonlethal means in most cases to protect the safety of the rig workers from polar bear encounters. The number of bears lost as a result of such encounters is expected to be low.

Some of the air traffic to and from exploration-drilling units (180 helicopter trips/year) could greatly disturb hauled-out seals and walruses, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing walruses and seals hauled out on the ice. If walrus-nursery herds hauled out on the ice in the far western part of the sale area (see Graphic 2) during the summer-through-fall period (July through September) were greatly disturbed by low-flying aircraft, injury or death to young calves could result from the stampede of cows into the water. Disturbance of walrus-nursery herds also might cause abandonment of calves by walrus cows. Although air-traffic disturbance would be very brief, the effect on individual walruses, particularly calves, could be severe. The number of walruses and seals affected would depend on the number of disturbance incidents (one or two aircraft flights/day to two platforms). The walrus-nursery herds are widely distributed along the ice front and along lead systems during spring migration; thus, aircraft traffic to and from the drill platforms is not likely to disturb a major portion of the calving population. However, a LOW effect on a portion of the walrus-calf population is expected. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast or disturbance of bearded seals hauled out offshore near the two drill platforms is not likely to result in the death or injury of any seals, although increases in physiological stress caused by the disturbance may reduce the longevity of some seals if disturbances were frequent (a LOW effect).

b. Effects of Geophysical Seismic Activities: Approximately 500 to 17,000 mi of geophysical seismic surveys using about two vessels per year have been conducted annually over a 10-year period in the Beaufort Sea Planning Area during the open-water season, and 0 to 3,700 mi of over-ice surveys were conducted during the winter season (USDOI, MMS, 1987a).

Ringed seals pupping in shorefast-ice habitats within about 150 m of the on-ice shot lines are likely to be disturbed by on-ice seismic exploration (Burns and Kelly, 1982). However, the number of ringed seal pups that possibly could be killed as a result of this level of disturbance is likely to be less than a few hundred, considering the sparse distribution (1-2 seal dens/nmi<sup>2</sup>) of breeding seals in the Beaufort Sea. This is expected to have no more than a LOW effect on the population (40,000 seals), with recovery taking place within one year.

An estimated 36 mi<sup>2</sup> of open-water seismic surveys at several survey sites, using perhaps two seismic boats for 8 days, could disturb pinnipeds, polar bears, and belukha whales during the 1 to 2 weeks of survey activity (Sec. II.B.1.a). Similar to other boat traffic, open-water, active seismic activities are likely to result in startle responses by ringed, bearded, and spotted seals; walruses; polar bears; and belukha whales near the sound source. As with other vessel traffic, this disturbance response is likely to be brief; and the affected animals are likely to return to normal behavior patterns within a short period of time after a seismic vessel has left the area. Noise and disturbance from seismic boats and other vessels could be a problem if boat traffic

moved near marine-mammal-haulout areas or interfered with spotted seal and walrus movements. However, this effect is not likely, given the expected amount of vessel traffic associated with the low case. If the presence of noise from industrial activity occurred very near coastal subsistence areas and reduced or delayed the use of these habitats by marine mammals, the availability of these subsistence resources to villagers could be adversely affected (see Sec. IV.C.10.a, Effects on Subsistence). Overall, noise and disturbance from air and marine traffic associated with the low case are expected to have LOW or short-term, localized effects on these marine-mammal populations.

c. Effects of Offshore Platform Installation: For the low case, one to two exploration-drilling units per year are to be used in the sale area. Site preparation for bottom-founded drilling units could temporarily--one season--affect marine mammals through noise and disturbances. Some pinnipeds, polar bears, and belukha whales temporarily could be displaced within approximately 1 to 3 mi of the two platforms by noise and disturbance from platform installation and marine-vessel and air-support traffic. Local displacement for less than one season could occur within 1 to 3 mi of the activity site (a LOW effect).

SUMMARY: For the low case, noise and disturbance due to air and vessel traffic, seismic shallow-hazard surveys, and drilling-unit installations and operations could have some adverse effects on pinnipeds, polar bears, and belukha whales found in the lease-sale area. Noise associated with seismic activities and air and vessel traffic could cause brief startle, annoyance, and/or flight responses of pinnipeds, polar bears, and belukha whales. Helicopter trips and boat traffic to and from the two exploration-drilling units could disturb hauled-out ringed, bearded, and spotted seals and walruses, causing them to charge in panic into the water and result perhaps in the injury or death of a few seal pups and walrus calves (a LOW effect). Because the walrus-nursery herds and nursing seals and pups are widely distributed along the ice front, aircraft moving to and from drill platforms are likely to temporarily disturb only a small portion of the walrus and seal populations. Thus, aircraft-disturbance effects are expected to be LOW.

Vessel traffic supporting the drilling units and seismic vessels operating during the open-water season temporarily could displace or interfere with some marine-mammal movements and distribution for a few hours to a few days. Such short-duration displacement is expected to have a LOW effect on pinnipeds, polar bears, and belukha whales.

CONCLUSION: The overall effect of the low case is expected to be LOW on pinnipeds (ringed, bearded, and spotted seals and walruses), LOW on polar bears, and LOW on belukha whales.

6. Effects on Endangered and Threatened Species: Endangered and threatened species could be affected by the exploration activities noted in Section II.B.1.a. This discussion of the effect of the Sale 124 low case on endangered and threatened species reviews pertinent Endangered Species Act (ESA) consultations and examines the potential effects of oil and gas exploration on the bowhead and gray whales and the arctic peregrine falcon, listed species likely to be present in or near the sale area. Information contained in this section is summarized and updated from the Beaufort Sea Sale 97 FEIS (USDOI, MMS, 1987a), which is incorporated by reference.

a. Endangered Species Act Consultations: Pursuant to requirements under the ESA of 1973, as amended, the Alaska OCS Region, MMS (formerly the Alaska OCS office, Bureau of Land Management), has consulted with the FWS and National Marine Fisheries Service (NMFS) on previous Beaufort Sea lease sales (BF, 71, 87, and 97) and with NMFS on OCS leasing and exploration activities in the arctic region. In the most recent biological opinions, Sale 97 (May 20, 1987), the Arctic Region (November 23, 1988), NMFS concluded that leasing and exploration activities would likely not jeopardize bowhead or gray whales. However, it was their view that development and production activities located in the spring-lead systems used by bowhead whales for their migration would be likely to jeopardize the population. In addition, these opinions did not address any exploration activities within the spring-lead system. Reasonable and prudent alternatives were included with these opinions that could be adopted to avoid this potential jeopardy situation. Consultations with FWS on previous lease sales have resulted in nonjeopardy opinions with regard to the arctic peregrine falcon.

In accordance with the ESA Section 7 regulations governing interagency cooperation, MMS notified NMFS and FWS on March 3, 1989, of the endangered and threatened species that would be included in a biological evaluation for Section 7 consultation. Both agencies responded confirming the species to include in the biological evaluation. The biological evaluation was completed and, in accordance with Section 7(a) of the ESA, as amended, consultations on the proposed Beaufort Sea Sale 124 were initiated with NMFS and FWS

in November 1989. A March 9, 1990, biological opinion for Sale 124 was received from NMFS, which reaffirmed the November 23, 1988, Arctic Region biological opinion as "applicable to the proposed Lease Sale 124." The FWS completed their formal consultation review with a May 17, 1990, nonjeopardy biological opinion for the arctic peregrine falcon. Both agencies provided recommendations to protect threatened and endangered species. Various mitigating measures were developed (See Sec. II.G.) to reflect the recommendations. Both NMFS and FWS were notified by June 4, 1990, correspondence on the updating of Sale 124 information since their respective biological opinions were issued. Both agencies agreed that the new information would not change their opinions (FWS June 11, 1990, memorandum; NMFS August 8, 1990, letter). On August 7, 1990, NMFS notified MMS that it had amended their biological opinion to include an Incidental Take Statement. This statement allows a take of bowhead and gray whales (by harassment) incidental to oil and gas exploration in the Beaufort and Chukchi Seas for the next 5 years. (See Appendix K for the biological evaluation, biological opinions, and other documentation of the Section 7 consultation process.)

b. Effects on Bowhead Whales: Exploration noise would be the major effect-producing agent associated with the low case that might influence the behavior of bowhead whales. There would be no adverse effects from major oil spills, because it is assumed that economically producible hydrocarbon resources would not be discovered for this case. There could be a number of minor alterations in bowhead habitat as a result of Sale 124. Bottom-founded drilling units may cover small areas of benthic habitat, and muds and cuttings from drilling may bury portions of the seafloor that support benthic invertebrates used for food by bowhead whales; however, the effects are expected to be minimal because bowheads feed primarily on pelagic zooplankton, and the areas of sea bottom that are affected would be very small in relation to the available habitat.

Noise and disturbance for the low case would occur from drilling four exploration wells, 360 helicopter flights, and 36 mi<sup>2</sup> of shallow-hazards seismic surveys within 3 years of the lease sale. Noise-producing activities most likely to affect bowhead whales would include aircraft traffic, icebreaking or other vessel traffic, geophysical-seismic surveys, and exploratory drilling. Bowheads are unlikely to react significantly to occasional single passes by helicopters ferrying personnel and equipment to offshore operations. Helicopter trips for Sale 124 exploration-well drilling are estimated to average one round trip per day per site. If bowheads are overflown, some probably would dive quickly in response to the aircraft noise; but this noise generally is audible for only a brief time (less than 90 seconds), and the whales should, within minutes, resume their normal activities.

Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. In the Canadian Beaufort Sea, bowheads observed in vessel-disturbance experiments began to orient away from an oncoming vessel at a range of up to 2.5 mi (4 km) and to move away at increased speeds when approached closer than 1.2 mi (2 km). Vessel disturbance under experimental conditions caused a temporary disruption of activities and sometimes disrupted social groups when groups of whales scattered as a vessel approached. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering persisted for a longer period.

Generally, vessel traffic associated with Sale 124 would be limited to routes between the exploratory-drilling units and the shore base. Each drilling unit probably would have one emergency-standby vessel and one supply vessel per week. Depending on ice conditions, floating drilling units may have two or more icebreaking vessels standing by to perform ice-management tasks.

Bowhead whales probably would encounter a few vessels associated with Sale 124 activities during their fall migration or while feeding in the eastern Alaskan Beaufort Sea. Spring-migrating bowheads (April to June) are expected to encounter few, if any, vessels along their migration route because ice at this time of year would typically be too thick and concentrated for the operation of drillships and supply vessels. It is likely that vessels actively involved in ice management or moving from one site to another would be more disturbing to whales than vessels idling or maintaining their position. In either case, bowheads probably would adjust their individual swimming paths to avoid approaching within several kilometers of vessels attending a drilling unit and probably would move away from vessels that approached within a few kilometers. Vessel activities associated with the sale are not expected to disrupt the bowhead migration, and small deflections in individual bowhead-swimming paths and a reduction in use of one to several small areas of bowhead-feeding habitat near exploration units should not result in significant adverse effects on the species.

There has been some concern for the potential of vessels striking and injuring bowheads. George et al., 1990, reported a 1- to 2-percent frequency of scars reflecting ship collisions on bowheads landed by subsistence whaling. Several studies of the North Atlantic populations of the northern right whale, *Eubalaena glacialis*, indicate that ship collisions, especially when whales are socializing near the surface, are considered an effect on the population (Goodyear, 1989; USDOC, NOAA, 1990). Considering the limited amount of vessel traffic associated with Sale 124, its limitation to open-water conditions, and the response of bowheads to approaching vessels (as described above), it is unlikely that bowheads would be involved in collisions with industry vessels.

Sound from seismic exploration is another potential source of noise disturbance to bowhead whales. Seismic surveys, which produce loud sounds that can propagate long distances from their source, are of two types: low-resolution, deep-seismic and high-resolution, shallow-seismic surveys. After a sale, lessees normally conduct the quieter, high-resolution seismic surveys on their leases to evaluate potential shallow hazards to drilling. Nearly all seismic systems used for these surveys have sound-source levels below 167 dB relative to 1 microPascal at 1 m. Shallow-hazards seismic surveys for exploration-well sites would be conducted during the ice-free season.

Bowheads appear to display normal behavior in the presence of high-resolution seismic surveys at distances greater than 2.8 mi (4.5 km) but orient away from nearby seismic operations. In those cases where bowhead disturbance by nearby seismic surveys has been observed, the whales' surface-respiration-dive characteristics appeared to recover 30 to 60 minutes following the cessation of the seismic disturbance. Direct injury (physical impairment of hearing) even at close range is unlikely (California State Land Commission, 1982).

Because of the small amount of the relatively quiet, high-resolution seismic surveys likely to result from Sale 124, these activities are not likely to have significant effects on endangered whales. Bowheads will likely temporarily change their individual swimming paths as they approach or are closely approached by seismic vessels. These short-term responses are not likely to preclude a successful migration or to significantly disrupt feeding activities. Seismic surveys are not expected to be conducted in or near the spring-lead system through which bowheads migrate because (1) degraded ice conditions would not allow on-ice surveys and (2) insufficient open water is present for open-water seismic surveys.

Another source of noise would be from drilling units. Stationary sources of offshore noise (such as drilling and dredging) appear less disruptive to bowhead whales than moving sound sources (such as vessels). Bowhead whales exhibiting normal behavior while on their summer-feeding grounds have been observed on several occasions within a few kilometers of operating drillships, well within the zone where drillship noise is clearly detectable. In playback experiments, some bowheads showed a weak tendency to move away from the sound source at a level of drillship noise comparable to that which would be present several kilometers from an actual drillship. Reactions to drilling sound from artificial islands and caisson-retained islands have yet to be observed, but underwater-sound levels at various distances from a caisson-retained island (with support vessels nearby) in the Canadian Beaufort Sea were similar to those produced by a drillship. In general, bowhead avoidance is less around an unattended structure than one attended by support vessels.

Although it is not anticipated (see Sec. II.A.2) and highly unlikely due to heavy ice conditions, spring-migrating bowheads could be exposed to drilling noise from one or possibly two drilling operations from bottom-founded drilling units. Fall-migrating bowheads could be exposed to a maximum of two drilling operations resulting from Sale 124. Bowheads would be expected to respond to noise from drilling units by slightly changing their migration speed and swimming direction to avoid closely approaching these noise sources. Under open-water, mean, ambient-noise conditions, it has been estimated that bowheads might respond to drilling noise at 0.62 to 5.0 mi (1.0-8.0 km) from a drillship but only 0.12 to 1.12 mi (0.2-1.8 km) from an artificial-island drilling site (Miles, Malme, and Richardson, 1987). Summer studies (1982-84) in the Canadian Beaufort (Richardson, Wursig, and Greene, 1990) revealed that sensitivity to drillship and dredge noises differed among bowhead whales. Approximately half of the whales observed responded at noise levels about 115 dB, which occurred at 3 to 11 km from a drillship and dredge. If the drillships are attended by icebreakers, as is typically the case during the fall in the U.S. Beaufort Sea, the drillship noise may frequently be masked by icebreaker noise, which is often louder. Bowhead whales would then likely respond to the sound of the attending icebreakers at distances of 1.24 to 15.53 mi (2-25 km) from the icebreakers (Miles, Malme, and Richardson, 1987). Elaborate models, incorporating various study data and assumptions, predicted that icebreakers to have the largest estimated zone of influence in an analysis of four OCS planning areas (North Aleutian, Chukchi, Norton, and Shumagin). The North Aleutian had the largest zone of influence at 35 km to 40 km and Chukchi the smallest at 4.3 km to 11.7 km (Malme et al., 1989). Overall,

response distances would vary depending on icebreaker activities and sound-propagation conditions.

Bowhead reactions to dredge noise have been observed to be similar to their reactions to drilling noise. Whales were seen on a number of occasions less than 3.11 mi (5 km) from active dredging operations on their summer-feeding grounds well within the ensonified area. However, in playback experiments, some whales 0.62 to 1.40 mi (0.1-2.25 km) from the sound source responded to the onset of strong dredge noise by moving away from the sound source. Bowheads seen in the vicinity of actual dredging operations may have habituated to the activity, or there may be variation among bowheads in the degree of sensitivity toward noise disturbance, so that bowheads seen in the vicinity of dredging operations may have been the more tolerant individuals.

Concerns also have been raised in regard to the effects of noise from OCS operations in the spring-lead system and the potential for this noise to delay or block the bowhead spring migration. The OCS-related noise would occur mainly from bottom-founded drilling units. To date, there have been no drilling or production operations in the vicinity of the spring-lead system during the bowhead migration and none is anticipated for Sale 124 (see Sec. II.A.2); consequently, the following discussion is necessarily speculative.

The MMS has funded a study (spring of 1989 and 1990) on the effects of production activities on the bowhead whale, and a portion of that study will include observations of bowhead whale behavior in the presence of recorded noise from production operations (drilling or production platform, icebreaker, and helicopter) played back as whales migrate through the spring-lead system. Richardson (1990) reported that preliminary analysis of spring 1989 data showed bowheads approaching within 120 m on 2 days and within 1 km on another day to playback sounds of drilling on an ice platform. However, he noted "some individuals may have been more sensitive and may have showed avoidance at greater ranges" and "additional data are needed before conclusions can be drawn." When the study has been completed, we should have a better idea of how whales would react to noise in the lead system. We can, however, project--based on noise conditions in the lead system and whale behavior in general in the presence of exploration units--how bowheads might react to exploration noise in or near the lead system. The following information is summarized from pages IV-B-80 through 82 of the FEIS for the Chukchi Sea Oil and Gas Lease Sale 109 (USDOI, MMS, 1987b), which is incorporated by reference.

One factor to consider in assessing the possible effects of exploration noise in the lead system is that exploration units are stationary, whereas the lead system is not. Consequently, a platform that is present within or near a lead one day may be well outside the lead the next day--possibly an obstacle on one day and not on the next. High ambient-noise levels have been measured at the boundary between open water and pack ice; consequently, ambient noise could be high in the area of the spring lead. If this is the case, ambient noise would tend to mask distant industry noise, making it less audible and probably less disturbing to the bowheads. Bowheads may use their reflected calls to navigate through heavy ice and to locate thin ice, leads, and cracks for breathing (George et al., 1989). Noise from drilling activities may interfere with this process. However, with the ambient-noise masking discussed above and the possible use of ambient light by bowheads to locate "safe" ice conditions (George et al., 1989), the entrapment or disorientation of bowheads is doubtful.

Gray whales, which appear to react to noise disturbance at levels fairly similar to bowheads, show little avoidance of production- or drilling-platform noise. Experimental evidence using playback noise indicated that 50 percent of migrating gray whales would avoid drilling-platform noise at 40 m. Consequently, if migrating bowheads in the Chukchi and Beaufort Seas react to platforms as described for gray whales, there should be little avoidance of platforms or drilling units located in or near the spring-lead system, and adverse effects on the migration should be minimal.

**SUMMARY:** Bowhead behavior can be affected markedly but temporarily by the close approach of ships and less consistently by aircraft. Bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident, and their activities do not seem to be interrupted for long. Occasional brief interruption of feeding by a passing boat or aircraft is probably not of major significance. Similarly, the energetic cost to bowheads of travelling a few extra miles to avoid a noise source is very small in comparison with the energetic cost of migrating from the central Bering Sea to the eastern Beaufort Sea and back. Bowhead reactions to industrial activities that continue for hours or days, such as distant seismic exploration, drilling, and dredging are not as well known. Behavioral studies have suggested that bowheads habituate to noise from distant ongoing drilling, dredging, or seismic operations (Richardson, Wells, and Wursig, 1985; Richardson et al., 1985; Richardson, Wursig, and Greene, 1990), but there is still some apparent localized

avoidance. For example, data on reactions to a drillship and support vessels suggest that some of the migrating (fall) bowhead whales exhibited avoidance at 10 to 25 km (Davis, 1987). There has been no documented evidence that noise from OCS operations would serve as a barrier to migration. As a result, the effect of acoustic disturbance from operations associated with the Sale 124 low case is expected to be VERY LOW.

**CONCLUSION (Effects on Bowhead Whales):** The overall effects on bowhead whales of activities associated with the low case are expected to be VERY LOW.

c. **Effects on Gray Whales:** Exploration noise would be the major effect-producing agent associated with the low case that might influence the behavior of gray whales. There would be no adverse effects from oil spills, because it is assumed that economically producible hydrocarbon resources would not be discovered under this case.

It is assumed that two drilling units per year will be used for exploration. These units could temporarily occupy several acres of habitat and, if located in a gray whale-feeding area, could possibly displace a few whales from several hundred yards to a few miles from the drilling unit for one season. Discharges of fluids from drilling units are not expected to significantly reduce gray whale-food resources.

Noise-producing activities most likely to affect gray whales would include aircraft and vessel traffic, geophysical-seismic surveys, and drilling operations. Most observations of gray whale behavior in the presence of disturbance factors have occurred along the whales' migration route or on their wintering grounds rather than on summer-feeding areas within Alaskan waters.

Effects of sale-related aircraft and vessel traffic on gray whales are likely to be very minor, but the degree of effect may depend on well location. During the period July through September, when exploratory drilling is likely to occur, gray whales are generally found in low numbers in the Chukchi Sea portion of the sale area. Aerial- and vessel-support activity associated with drilling units located east of Barrow may disturb small numbers of gray whales. Gray whales overflown by aircraft at altitudes less than 1,500 ft (450 m) may dive in response to the noise and visual stimulus of the aircraft. However, if the aircraft remained on a direct course, the whales should continue with their normal activities. Vessels that approach no closer than several miles to gray whales should not disturb the whales. Likewise, vessels that maintain a constant speed and course probably would cause little disturbance to gray whales. In the most likely case, a low number of whales would be exposed to aircraft or vessel traffic on the order of once per day. This disturbance might cause them to briefly cease feeding, but they should resume their normal behavior in less than an hour.

Areas in which high-resolution seismic activity associated with Sale 124 will take place will depend on where exploration units are proposed to be located. Gray whales are expected to be present in the northern Chukchi Sea throughout the ice-free season when seismic-survey activity may occur; so surveys west of Point Barrow would have the greatest potential for disturbing gray whales. Gray whales appear to display a high degree of tolerance to distant seismic noise. In experiments conducted along the California coast during the gray whale migration, whale groups consistently showed no avoidance response to the airgun-array vessel at distances greater than about 1.2 mi (2 km). Comparable results were achieved in seismic experiments with feeding gray whales off Saint Lawrence Island, Alaska (Malme et al., 1986). Consequently, it could be expected that only those whales that are approached closely would avoid the seismic-survey vessels; avoidance responses should be brief and are not expected to seriously disrupt feeding activities.

Stationary offshore-noise sources such as drilling and dredging appear to be potentially less disruptive to gray whales than moving sound sources. Gray whales have been observed to migrate normally past a drillship and drilling units along the California coast. Stationary sound sources associated with Sale 124 low-case activities would have very minor effects on gray whales because in any one year, only up to two exploration-drilling units are expected as a result of the sale. As a result of the noise produced by drilling units, gray whales might avoid feeding within several hundred yards of these units.

Considering the combined factors of seismic noise, aircraft and vessel traffic, and noise from drilling units, the effects of the low case on gray whales are expected to be VERY LOW.

**CONCLUSION (Effects on Gray Whales):** The effects on gray whales for the low case are expected to be VERY LOW.

d. Effects on Arctic Peregrine Falcons: The major effect-producing agent associated with the low case that might influence arctic peregrine falcons would be noise from support activities. There would be no adverse effects from oil spills, since it is assumed that economically producible hydrocarbon resources would not be discovered under this case. Nesting peregrines could, on rare occasions, be disturbed by aircraft overflights related to the proposed sale that may occur inland from the coast. Nesting sites such as those near Ocean Point on the Colville River, about 25 mi inland, and along the coast south of Barrow may be vulnerable to such occasional disturbance. The extent of such disturbance would depend on future locations of support facilities. Aircraft based in Deadhorse or Barrow would not typically fly over these areas. Thus, significant disturbance of peregrine falcons associated with the exploration phase is unlikely. Gravel mining for any artificial islands associated with Sale 124 also is unlikely to affect the peregrine because extraction is expected to occur near the Beaufort Sea coast, and peregrines are not known to nest in this area.

CONCLUSION (Effects on Arctic Peregrine Falcons): For the low case, effects on arctic peregrine falcons are expected to be VERY LOW.

7. Effects on Caribou:

a. Effects of the Low Case: Among the terrestrial mammal populations that could be affected by activities associated with the low case are the more than 448,000 caribou of the Western Arctic, Central Arctic, Teshekpuk Lake, and Porcupine caribou herds occurring along the coast adjacent to the Beaufort Sea Planning Area. The primary potential effects on caribou from OCS exploration activities under the low case would come from helicopter traffic (disturbance) to and from offshore drilling units. No oil spills are assumed to occur for the low case.

b. Sale-Specific Disturbance Effects Associated With Oil and Gas Exploration: Disturbance of caribou associated with exploration activities would come primarily from helicopter traffic (180 flights/year or 1 trip/day/platform for 2 years) to and from Deadhorse, Camp Lonely, Barter Island, or other onshore facilities and the two offshore-exploration platforms. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at 60-m elevations or less and exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 500 to 1,000 ft (Calef, DeBock, and Lortie, 1976). These documented reactions of caribou were from aircraft that circled and repeatedly flew over caribou groups. Aircraft traffic associated with exploration is likely to pass overhead of caribou once during any flight to or from the platforms, and the disturbance reactions of caribou are expected to be brief, lasting for a few minutes to no more than 1 hour. The duration of the effect (time it takes caribou to return to undisturbed behavior) and the amount of stress on individual animals is not likely to have an appreciable effect on the health of affected caribou. Even in a severe case where some caribou calves could be separated from the cows, resulting in the possible loss of the calves, such incidents are likely to be rare or infrequent (calves generally do not become permanently separated from the cow unless aircraft harassment is deliberate and persistent). The area of displacement is expected to be local--within 1 mi of the aircraft-flight path--and represent a LOW effect.

CONCLUSION: The effects of the proposed Sale 124 low-case activities on caribou are expected to be LOW.

8. Effects on the Economy of the North Slope Borough:

a. Employment: In the low case, the gains in direct employment from Sale 124 would result from petroleum-exploration activities. These gains would be negligible relative to the NSB economy as a whole. The estimated employment for the low case would be approximately 190 jobs in the years 1992 and 1993. Most of these jobs would be offshore, and all of them would be filled by commuters who would live and work at the work sites. Most workers would commute to permanent residences in the following three regions of Alaska: Southcentral; Fairbanks; and, to a lesser extent, the North Slope. Some workers would commute to permanent residences outside of Alaska. Because of the low overall employment generated in this case, and because most of this employment would go to commuters from outside the region who would be living and working either offshore or at the Prudhoe Bay enclave, the effect on employment in the NSB would be insignificant.

b. NSB Revenues and Expenditures: The low-case projections are expected to have an insignificant effect on NSB property taxes and expenditures. There are not expected to be any significant

increases in onshore facilities related to oil exploration. The NSB only has the ability to tax onshore facilities.

**CONCLUSION:** For the low case, the effects on the economy of the NSB are expected to be VERY LOW.

9. **Effects on Sociocultural Systems:** In the low case, only exploration in the proposed Sale 124 lease-sale area would occur, and it is not known where exploration might occur within the sale area. Effects could occur in any of the communities near the proposed sale area: Wainwright, Barrow, Nuiqsut, Kaktovik, or Atkasuk. The primary aspects of the sociocultural system covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.2. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level--predominantly by industrial activities, increased population, and increased employment or effects on subsistence-harvest patterns associated with the sale. Potential effects are evaluated relative to the primary tendency of introduced social forces to support or disrupt existing systems of organization and relative to the duration of such behavior. (For a detailed discussion of the parameters for the sociocultural systems analysis, see Sec. IV.C.9[1].)

a. **Industrial Activities:** In the low case, any of the communities--Barrow, Wainwright, Nuiqsut, and Kaktovik--could be used for some air support. It is likely that Prudhoe Bay would be used for primary air support in the Beaufort Sea, but Kaktovik has been used for transportation of some freight and personnel to exploration platforms. Personnel and air freight could be flown by fixed-wing aircraft to any of the airports and transferred to helicopters. One helicopter trip per day per platform is assumed for the low case (see Table II-A-1). The existing facilities at these airports are adequate to handle the projected needs. Industrial activities for the low case are not expected to be significant enough to have more than VERY LOW effects on sociocultural systems.

b. **Population and Employment:** Sale 124 is projected to affect the population of the NSB through more petroleum-industry-related jobs as a consequence of Sale 124 exploration. Employment projections as a consequence of Sale 124 are provided in Section IV.B.8.b. Exploration should not create much additional employment in the NSB. In the low case, employment would peak in 1992 with 189 jobs. All or most of these jobs most likely would be filled by commuters who would be present at the work sites approximately half of the days in any year. Most workers are expected to permanently reside outside of the North Slope. Sale 124 is projected to increase resident employment by 1.06 percent or more above the declining existing-condition projections between 1994 and 2010. In 2010, resident employment would be 0.33 percent above existing-condition projections. Resident employment as a result of the low case would peak in 1993 with 12 jobs (0.72% increase in employment). Increased employment as a result of exploration in the proposed lease-sale area is expected to be low enough that it should have a minimal effect on the population of the NSB. Sale 124 in the low case is projected to increase the NSB population by less than 1 percent above the existing-condition level from 1992 to 2010.

The increases in population and employment as a result of the low case are expected to be minimal. None of the communities are expected to experience much of an increase in sale-related or sale-induced employment. These changes in employment are not expected to be significant and would not cause more than VERY LOW effects on the sociocultural systems of these communities.

c. **Effects on Subsistence-Harvest Patterns:** Subsistence is important to the Inupiat sociocultural system (see Sec. III.C.3 for a detailed description). Overall, LOW effects are expected on subsistence-harvest patterns in the low case (see Sec. IV.B.10) Sale 124 area as a result of effects on Wainwright's bowhead whale harvest. Other effects on subsistence harvests in Wainwright and all other communities are not expected to be more than LOW in the low case. Although subsistence-harvest patterns would experience LOW disruptions, these are expected to be short term and would not have a tendency to displace sociocultural systems--a LOW effect.

**CONCLUSION:** In the low case, the effects of the proposed sale are expected to be LOW for the sociocultural systems.

10. **Effects on Subsistence-Harvest Patterns:** The low case assumes only exploration would occur in the proposed Sale 124 lease-sale area. Effects on subsistence-harvest patterns would be expected to occur only as a result of noise and disturbance. Noise and disturbance during exploration would be associated with the (1) surveys that are part of the preliminary activities of the lease-sale phase; (2) well

drilling during the exploration phase; and (3) aircraft and marine support of the preceding activities.

Animals may avoid areas of high noise and disturbance (see Sec. IV.B.6.b) and, thus, become unavailable to a particular community or become more difficult to harvest. Short-term effects, such as flight behavior or increased wariness, also may make animals difficult to harvest.

Industrial activity is not expected to result in distributional changes in the bowhead population. However, support vessels and drilling units in the vicinity of the subsistence-harvest area could disturb the harvest without disturbing the general bowhead population. Exploration-drilling units and their associated support activities are not likely to affect bowhead whaling in the Sale 124 area because bowhead whaling occurs in the spring, when narrow leads are formed and little open water exists. Exploration-drilling units are not likely to be moved into operation until after the whaling season, when open water has formed. However, once in place, bottom-founded drilling units could be in place year-round and could be located in the vicinity of the bowhead whale-harvest area. The spring whaling camps may be as far as 16 to 24 km offshore. Later in the spring, when the leads widen, the Wainwright and Barrow whalers could possibly travel another 25 km offshore to look for whales.

Noise from bottom-founded exploration-drilling units, support vessels, or icebreakers could disrupt the whaling effort. Although not extremely likely, if a vessel or rig were in the pathway of a whale chase, it could cause that particular harvest to be unsuccessful. Icebreakers moving through the whale-harvest area also could cause an unsuccessful harvest. Icebreakers could be sent to the Sale 124 area prior to the open-water season during the bowhead whale migration (beginning mid-April [see Sec. III.C.3]) and the whale hunting season. Spring whaling usually occurs in the open-water area between the pack ice and the fast ice or the shore at a time when the length and width of the open-water area is restricted. If disturbed, bowheads might move into the pack ice and thus might become unavailable to whalers. During fall whaling in Nuiqsut and Kaktovik, the situation is somewhat different because whaling is done in open water and not in narrow ice leads. Even so, there could be disturbance to the bowhead harvest.

Recent evidence indicates that a whale may react to vessel-engine noise as far as 12 km away from the source, although disruption is likely to be short term and temporary (see Sec. IV.B.6.a for a complete discussion). Such disturbance would most likely be short and temporary enough that, during a normal whaling season (2 months), there would be plenty of opportunities to harvest other whales. However, during a year when the weather and ice conditions are poor and the whalers' ability to harvest any whales is limited, the noise disruption could occur during the only brief period when harvesting a whale is possible.

The probability of a drilling rig being located in an area critical to whaling during the whaling season cannot be determined; however, if this condition did occur, potential conflict could be mitigated by the cessation of drilling operations during the whale migration. Since fall ice conditions are not predictable events, the second effect--user conflicts between vessels and whalers due to bad ice conditions--might be more difficult to mitigate.

With the exception of Barrow, not many bowheads are harvested because of the limitations of the International Whaling Commission (IWC) quota. Some years, no more than one or two whales in a village may be harvested. If there were disruptions to the bowhead whale hunt due to noise and disturbance associated with exploration drilling and it occurred in a year when the weather restricted the whaling season to a few weeks, it is likely that the harvest could be decreased, although it would most likely still be available. If the bowhead whale harvest became unavailable for one season, this would be a MODERATE effect on the bowhead harvest in Wainwright; however, it is more likely that some of the harvest would still be attained--a LOW effect. Nuiqsut and Kaktovik also could experience a conflict, resulting in MODERATE effects if drilling occurred in the whale-harvest area. With only four exploration wells assumed in the entire sale area, the probability of such an event occurring is less likely. Thus, only LOW effects are expected.

Belukha whales also may avoid industrial activities in the Arctic, but this is expected to be short term and temporary. Belukha whales can react to active icebreaker noise 35 to 50 km away from the source (Sec. IV.B.5). Because the peak season for harvesting belukha whales occurs during the summer (open-water) months in all of the communities near the Sale 124 area, a drilling unit, vessel, or icebreaker located near an open-water area used for belukha whaling could disturb a community's whaling. However, disruptions are most likely to be short term and are not expected to affect harvest levels. In the early summer, belukhas are harvested in the pack-ice leads. Vessels--other than icebreakers--probably would not be in the leads at that time because it is too dangerous; however, icebreakers or platforms in the area could cause some

disturbance. Because the belukha-hunting season for Barrow, Wainwright, and Atqasuk (with Barrow) takes place under two different conditions (in ice leads and in open water) and hunting is possible at different times over a 6-month period, noise and disturbance would be expected to cause some effects but would not cause the harvest to be unavailable (a LOW effect) during the belukha-hunting season.

Noise and disturbance are expected to have insignificant effects on subsistence-fish stocks. Disturbance from seismic activity associated with Sale 124 would occur more than 5 km (3 mi) from subsistence-fishing areas, and boat noise would have only transitory effects on fishes. Effects on subsistence fishing from noise and disturbance activities associated with Sale 124 are expected to be VERY LOW.

Seals are somewhat susceptible to noise and disturbance from aircraft and vessel traffic. Industrial activity associated with Sale 124 is not expected to result in distributional changes in seal populations. Disturbance from aircraft or vessels could cause short-term, localized effects on seals and some short-term disruption to the seal harvest; however, this would not affect annual harvest levels, and seals would not become unavailable during the year. LOW effects on seal harvests due to noise and disturbance are expected in Barrow's (Atqasuk's), Wainwright's, Nuiqsut's, and Kaktovik's subsistence-harvest areas.

Noise and disturbance generally do not affect walrus-distribution patterns; however, noise and disturbance from aircraft can have localized, short-term effects that would cause some disruption to the harvest but would not cause walrus to become unavailable. LOW effects on the walrus harvests due to noise and disturbance are expected in the Barrow (Atqasuk), Wainwright, and Nuiqsut subsistence-harvest areas; Kaktovik does not generally harvest walrus.

Noise and disturbance from activities associated with exploration drilling may disturb waterfowl-feeding and -nesting activities. Such low-level biological effects would be too brief to have significant effects on bird harvesting by the communities in the Sale 124 area. Effects on bird harvests in the Sale 124 area from noise and traffic disturbance are expected to be VERY LOW. Polar bears could experience short-term, localized aircraft-noise-disturbance effects that would cause some disruption in the polar bear harvest but would not affect annual harvest levels. LOW effects due to noise and traffic disturbance can be expected on the polar bear harvests of Barrow (Atqasuk), Wainwright, Nuiqsut, and Kaktovik.

**SUMMARY:** Although noise from exploration-drilling units, support vessels, or icebreakers could disrupt the bowhead whaling harvest, it is not likely that the bowhead whale harvest would be reduced in the low case. Exploration is not expected to have more than LOW effects on the harvests of bowhead and beluga whales, seals, walrus, and polar bears. VERY LOW effects are expected on the harvests of fishes and birds.

**CONCLUSION:** Effects from the proposed lease sale in the low case are expected to be LOW in Barrow (Atqasuk), Nuiqsut, Kaktovik, and Wainwright. Regional effect on subsistence-harvest patterns are expected to be LOW.

**11. Effects on Archaeological Resources:** Effects of the low case on archaeological resources could result from lease exploration, employees (directly and indirectly employed) in sale-related activities who visit archaeological-resource sites, and other exploration-related activities. Section II.B.1 describes the Sale 124 scenario for the low case for Alternative I.

Onshore archaeological resources might be exposed to recreational visits by petroleum-industry workers. Because the population of these workers hired as a result of Sale 124 is expected to be small (see Sec. III.C.1); the effects of such recreational visits on the onshore archaeological resources are expected to be minimal.

The probability of offshore prehistoric resources surviving ice-gouging and other environmental changes is given briefly in Section III and in detail in the MMS reports (Appendix I). These analyses indicate that there is very little probability, but some possibility, that prehistoric sites in the proposed Sale 124 area would survive the extensive ice gouging experienced in this part of the OCS. However, offshore shipwrecks (shipwrecks in waters deeper than 25 m) have a moderate probability of surviving. Finding such wrecks while doing pre-exploratory sample-type surveys, which are done with sonic equipment and video cameras, is unlikely because of the limited coverage in these surveys. If greater areas were covered and finer line spacing were used in the surveys, the chance of discovering wrecks would increase. The same argument can apply to the probability of effect on a shipwreck--that is, exploration would occur in only a modest portion of

a lease block; and the resultant moderate percentage of disturbed bottom would contribute to producing a mid-level effect.

Ice gouging in waters less than 25 m deep is extensive. Therefore, the probability of survival of shipwrecks in waters less than 25 m deep would be small except very near shore and on the shore, as evidenced by the existence of wrecks of 100 years ago. These shipwrecks could be slightly disturbed by accidental contact with exploration-related populations living in onshore facilities or visiting the shore area for nonwork reasons (activities other than oil exploration).

It is expected, therefore, that the effects of exploration on prehistoric archaeological resources would be LOW, and that effects on shipwrecks would be LOW.

CONCLUSION: The effects of the low case on archaeological resources are expected to be LOW.

## 12. Effects on Air Quality:

a. Effects on Air Quality Relative to Standards: Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-A-4). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and total-suspended particulates (TSP) to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Specific limited incremental concentrations are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas; Class I allows the least degradation and also restricts degradation of visibility. The entire northern coast of Alaska is an attainment area designated as a Class II PSD area (State of Alaska, DEC, 1982). Baseline PSD-pollutant concentrations and the portion of the PSD increments already consumed are established for each location by EPA and the State of Alaska prior to issuance of air-quality permits. Air-quality standards do not directly address all other potential effects such as acidification of precipitation and bodies of freshwater or effects on nonagronomic plant species.

Because air-quality regulations are focused on protection of human health and welfare, they are applied over land areas. Consequently, MMS uses a three-step analytical procedure to evaluate potential air-pollutant emissions from offshore activities and to determine whether air-quality standards are expected to be met at the shoreline during offshore oil and gas activities. The procedure is described in detail in the Code of Federal Regulations (30 CFR Part 250) and is summarized as follows:

- The first step is to determine if the amount of pollutants emitted per year during peak activities would exceed exemption levels determined in part by a distance multiplier (Table IV-C-12-1) to account for the location of activities relative to the shoreline. The exemption levels are conservative; that is, they tend to overestimate the amount of emissions that would reach the shore. If the exemption levels are not exceeded, air-quality standards would be met easily and further analysis is unnecessary.
- Second, if an exemption level is exceeded, it is necessary to determine if USDOJ significance concentrations (expressed as incremental-pollutant concentrations attributable to the offshore source) would be exceeded at the shoreline. Except in the case of volatile organic compounds (VOC), the determination is made by application of the Offshore and Coastal Dispersion (OCD) Model (Hanna et al., 1984). The VOC emissions are deemed significant if the exemption level is exceeded. The OCD Model, which is approved by EPA, is especially adapted for atmospheric behavior across shorelines.
- Third, if a significance level would be exceeded, the lessee would be required to reduce emissions through application of Best Available Control Technology (BACT) to the emission sources. A specific analysis would be required of the lessee prior to operations to account for the actual location and equipment being used. In any event, USDOJ regulations would not allow emissions that would violate onshore air-quality standards, including the incremental limits prescribed by the PSD limitations (Table III-A-3). The expected effects of the low case on air quality according to the above analytical procedure are described in the following paragraphs.

For the low case, the relatively pristine air quality (see Sec. III.A.6) would be affected by a maximum of two

exploration wells that would be drilled in a year. The wells would be drilled farther from land than the 20-m isobath (approximately 19 km, or 12 mi). Estimated annual emissions for exploration and support activities are given in Table IV-C-12-1. None of the pollutant-exemption levels would be exceeded, less than 5 percent of the available national standards or PSD concentration increments for any regulated pollutant would be used, and the existing air quality would be maintained by a large margin.

b. Effects of Air Quality Not Addressed by Standards: Effects of air pollution from OCS activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation and acidification of coastal tundra, as discussed in Sections III.D.7 and IV.G.7 of the Diapir Field Lease Offering (Sale 87) FEIS (USDOI, MMS, 1984) and in Olson (1982). This information is incorporated by reference, and a summary pertinent to this proposed Sale 124 follows. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (on the scale of half or more of the North Slope of Alaska), or local (near the shore only). The analysis for Sale 87 was conducted on the basis of emissions occurring 5 km (3 mi) from shore. For the low case of Sale 124, the distances would be greater than approximately 19 km (12 mi), allowing for much more dispersion of pollutants. Consequently, the likelihood of either regional or local effects is reduced.

The amount of air pollutants reaching the shore is expected to be negligible spatially and temporally because of the small amount of emissions from exploration activities and their distance from shore. Concentrations are expected to be less than 5 percent of available national standards or PSD increments. In addition, the probability of a blowout is 1 to 2 percent; and there is no development or production under the low-case scenario to serve as a source of evaporation or smoke from oil spills.

CONCLUSION: Effects on air quality are expected to be VERY LOW.

13. Effects on Land Use Plans and Coastal Management Programs: Most activities that would result from Sale 124 would require some local or State determinations with respect to the NSB Land Management Regulations (LMR's) or the Alaska Coastal Management Program (ACMP) as amended by the North Slope Borough Coastal Management Program (NSB CMP). Potential conflicts with the policies of these programs are assessed on the basis of the effects determined in the previous sections (Secs. IV.B.1 through 12).

a. NSB Comprehensive Plan and Land Management Regulations: These regulations apply only to activities that occur within the NSB. In the low case, no development is assumed in order to support the offshore exploration activities. As a result, no conflict with the land use plan for the NSB is anticipated. Some LMR's will apply by virtue of corresponding with NSB CMP policies that may be applicable. However, the avenue for implementation would be through the review of the Exploration Plan to which only coastal policies apply.

b. Alaska Coastal Management Program: Section 307 (c)(3)(B) requires lessees to certify that each activity which is described in detail in their exploration and development and production plans that affects any land use or water use in the coastal zone complies with the state's coastal program and will be implemented consistent with it. The State has the responsibility to concur with the certification or object to the lessees' determinations. This analysis of potential conflicts between the activities assumed to occur and the ACMP is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that all the events that are hypothesized will occur as assumed in this EIS. Changes made by lessees as they explore and develop and produce petroleum products from leases offered in this sale could affect the accuracy of this assessment.

Noise and disturbance were identified in Sections IV.B.1 through 12 as the primary source of conflict. Birds, marine mammals, and caribou probably would exhibit avoidance or startle responses to the disturbance. If this were to occur, the NSB CMP policy 2.4.4(a) requires that "vehicles, vessels, and aircraft. . .likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated." Although significant disturbance is not anticipated, horizontal and vertical buffers may be required. Conflict with this policy is not inherent.

The other conflict that may become apparent as a result of noise and disturbance is disruption of the bowhead whale harvest. If the harvest for any of the communities were disrupted in a year when the whaling season was short due to weather, the possibility exists that the harvest would be unavailable for that season.

The Statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources (6 AAC 80.120). Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. The NSB CMP policy 2.4.3(b) states that "offshore drilling and other development within the area of bowhead whale migration during the migration seasons shall not significantly interfere with subsistence activities nor jeopardize the continued availability of whales for subsistence purposes." Conflict with this policy is possible.

CONCLUSION: For the low case, the effects of potential conflicts with land use plans and coastal management programs are expected to be LOW.

at toxic levels (see Sec. IV.A.2.f). The highest concentration observed following the Argo Merchant spill was 0.25 ppm, despite the presence of 20 percent by volume of more-soluble cutting stock (Howarth, 1985; NRC, 1985). Volatile liquid hydrocarbons in the Ixtoc spill decreased from 0.4 ppm near the blowout to 0.06 ppm at a 10-km distance and to 0.004 ppm at a 19-km distance from the blowout (NRC, 1985). Similarly, relative and rapid decreases also were found for specific toxic compounds such as benzene and toluene. Concentrations of volatile-liquid hydrocarbons-- present mostly as oil-in-water emulsion--within 19 km of the Ekofisk Bravo blowout in the North Sea ranged up to 0.35 ppm (Grahl-Nielsen, 1978). Lesser amounts of oil [probably less than 0.02 ppm] were detectable in some samples at a 56-km distance but not at an 89-km distance.

In more restricted waters during flat calm, a test spill during the Baffin Island Oil Spill Project resulted in maximum hydrocarbon concentrations in the water column of 1 to 3 ppm (Green, Humphrey, and Fowler, 1982). These concentrations were reached within 2 hours of the spill and persisted through 24 hours. No oil was detected deeper than 3 m, and the most oil and highest concentrations were in the top meter.

These concentrations of oil in the water column are relatively low because even if a slick were completely mixed into the same watermass through use of chemical dispersants, vertical--and especially horizontal--dispersion and consequent dilution would rapidly decrease hydrocarbon concentrations for all but the largest spills in several hours to a few days after spillage ceases (see Mackay and Wells, 1983). The volume of water contaminated would increase in direct proportion to the decrease in concentration, however, because the oil is diluted, not decomposed.

Because of unavoidable chronic and accidental discharges of oil, measurable degradation of existing pristine water quality is likely to occur in the sale area. Plumes of dissolved hydrocarbons from a 100,000-bbl spill could be above ambient standards and detectable over the low background levels for perhaps 100 km or possibly 500 km, if under ice (Cline, 1981). However, a major spill of such size is not anticipated. Other smaller but more likely spills could cause transient increases in dissolved-hydrocarbon concentrations underneath the (discontinuous) slick--over a 60- to 1,000-km<sup>2</sup> area for a 22,000-bbl spill (see Appendix M), and over a smaller area for a smaller spill.

Only a small portion of the oil from a spill would be deposited in the sediments in the immediate vicinity of the spill or along the pathway of the slick. The observed range in deposition of oil in bottom sediments following offshore spills is 0.1 to 8 percent of slick mass (Jarvela, Thorsteinson, and Pelto, 1984). Generally, the higher percentages of deposition occur in spills near shore, where surf, tidal cycles, and other inshore processes can mix oil into the bottom. Farther offshore, suspended sediment loads are low, and only about 0.1 percent of a crude would be incorporated into sediments within the first 10 days of a spill under such conditions (see Manen and Pelto, 1984).

If the spilled oil were of a composition similar to that of Prudhoe Bay crude, about 40 percent of the spilled oil could persist on the water surface, dispersed into individual tarballs, after the slick disappeared. Slow photo-oxidation and biological degradation would continue to slowly decrease the residual amount of oil. Through 1,000 days, about 15 percent of the tarballs would sink, with an additional 20 percent of slick mass persisting in the remaining tarballs (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980). Because of drift of the oil over distances of hundreds or thousands of kilometers during the slow process of sinking, individual, sunken tarballs would be extremely widely dispersed in the sediments. The "average" levels of local or regional contamination in sediments would be insignificant. Only if oil were mixed into the shoreline and then dispersed offshore could elevated concentrations of hydrocarbons locally occur. Suspended loads of sediment in nearshore waters--150 ppm dry weight or less--are not high enough to significantly enhance oil removal from the slick or water column. Oil either would be locally present in the sediment as a tarball or, more likely, absent. For a spill of 22,000 bbl, the 15 percent of the oil that sinks within 1,000 days would be equivalent to seven small (10-g) tarballs per hectare within the proposed sale area.

Under ice, the volatile compounds from a spill would be more likely to freeze into the ice within hours to days rather than dissolve or disperse into the water underneath the ice. After onset of melt, oil spilled under ice generally tends to reach the ice surface in an unweathered state--that is, with its volatile fraction intact. However, once formed, a hydrocarbon plume in the water column underneath the ice would persist above ambient standards and background over about a fivefold greater distance than under open water (see Cline, 1981).

Decomposition and weathering processes for oil are much slower in Alaskan OCS waters than in temperate OCS areas. Prudhoe Bay crude remained toxic to zooplankton in freshwater tundra ponds for 7 years after an experimental spill, demonstrating persistence of toxic-oil fractions or their weathering and decomposition products (Barsdate et al., 1980). In marine waters, advection and dispersion would reduce the effect of any similar release of toxic-oil fractions or their toxic-degradation products--including those from photo-oxidation--except possibly to isolated waters of embayments or shallow waters under thick ice, or from a fresh spill in a rapidly freezing lead.

In the Sale 124 area, no isolated embayments exist--the lead system off of Barrow would be the most susceptible exception because Barrow Canyon could funnel pollutants downslope (Payne, 1984). A spill in the lead system during a period of rapid ice growth could leach water-soluble aromatics into the sinking brine waters. Mixing of brine waters would be restricted by both topography and the high density of the brine. The brine and any dissolved oil could flow down the bottom of the Barrow Canyon farther offshore and form a thin, intermediate-density layer at about a 100-m-water depth. Stability of the stratified watermass would limit dispersion of the dissolved hydrocarbons, and high concentrations (a few ppm) could be hypothesized to persist for several years. However, oil released under such conditions (rapid ice formation) would freeze into the ice in at most 5 to 10 days, stopping dissolution and limiting the effect of this freezeup scenario (Thomas, 1981).

It is likely that accidental oil spills will occur: one or more spills of at least 1,000 bbl are likely, and one has been assumed to occur as a result of proposed Sale 124; and, in addition to this large spill, more chronic spillage of smaller volumes is also expected (see Sec. IV.A.1). During drilling of 14 exploration and delineation wells over 5 years, on the order of two such chronic spills could occur, but the total oil spilled would amount to only about 18 bbl. For production, an additional 211 small spills of less than 1,000 bbl each, totaling 3,000 bbl, are projected over the life of the field. Small spills of this magnitude are relatively common in western and northern Alaska.

Regional, long-term degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is very unlikely. A spill of 22,000 bbl or more could temporarily contaminate water over a few hundred square kilometers above the chronic criterion of 0.015 ppm, but concentrations above the 1.5-ppm-acute criterion are not anticipated. The large number of very small spills anticipated over the production life of the field could result in local, chronic hydrocarbon contamination of water within the margins of the oil field. Thus, effects on LOCAL water quality from oil spills are expected to be LOW. The effects on REGIONAL water quality from oil spills are expected to be VERY LOW.

b. Causeways: Causeways of 800 m or less length may be necessary to bring oil pipelines ashore at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson, doubling the current number of causeways along the sale-area coast. Causeways currently exist at both sides of Prudhoe Bay, at Oliktok Point, and the Endicott Development; and one has been proposed for the Niakuk Field.

Causeways can locally affect turbidity through enhanced sedimentation of suspended loads, through redirection of the flow of watermasses carrying the suspended loads, and by lengthening the period of ice cover within about a 5-km distance (Hale and Hameedi, 1989; Sec. III.A.3). Turbidity levels are more likely to be decreased rather than increased by these changes.

The redirection of flow also changes local temperature and salinity regimes, and these changes can exceed those allowed by State and Federal chronic standards and criteria. Relevant State standards (to protect marine wildlife and human consumption of raw seafood; State of Alaska, DEC, 1979) for marine water temperatures are a no more than 1 °C increase in the weekly average water temperature, with maximum rate of change not to exceed 0.5 °C per hour. Normal daily temperature cycles are not to be altered in amplitude or frequency. The parallel State standards (for dissolved inorganic substances (salinity) are (1) no man-induced alteration that would cause a change of more than ±10 percent of the natural variation and (2) a maximum allowable variation above natural salinity of 1 to 4 parts per thousand (‰), depending on natural salinity.

Federal marine criteria for water temperature are similar to the State standards, with the additional caveat that summer thermal maxima should not be artificially exceeded (EPA, 1986). There is no Federal marine criterion for salinity. The rationale for State salinity standards are derived from the analysis of the National Technical Advisory Committee to the Secretary of the Interior (1968).

The above standards and criteria for temperature and salinity are designed to protect against chronic or secondary effects rather than against direct toxicity. Much greater temperature or salinity increases than permitted in these standards and criteria would be required to cause direct mortality.

The causeways projected for the sale would not extend into Federal waters, and their effect on the water quality of the Beaufort Sea would be limited to under 50 km<sup>2</sup> per causeway or 200 km<sup>2</sup> overall for the base case. The intensity of the effect on water temperature and salinity would be magnified by a significant asymmetric supply of coastal, brackish water around the Oliktok Point and Point Thomson causeways. The effect on LOCAL water quality would be long term but MODERATE. The effect on REGIONAL water quality would be VERY LOW.

c. Dredging: Dredging would be used primarily for trenching and burial of subsea pipelines. Dredging also might be used to prepare foundations for the two projected production platforms, but this latter use would be comparatively small. Pipeline installation would involve greater volumes of dredged materials and greater areal disturbance. The greatest effect on water quality from dredging would be related to turbidity.

Suspended sediments have very low direct toxicity for sensitive species, with expected toxicity somewhere between that of a clay such as bentonite (LC<sub>50</sub> [= concentration at which half the test organisms die within 3 days] greater than 7,500 ppm for the eastern oyster) and that of calcium carbonate (LC<sub>50</sub> greater than 100,000 ppm for the sailfin molly) (see NRC, 1983). These are very low toxicities, falling into the ranges generally described as slightly toxic to nontoxic. Direct toxicity from suspended sediments, therefore, has not been considered a regulatory issue, and toxic or acute marine standards have not been formulated by either the State of Alaska or EPA.

For the purpose of analysis, this EIS will use 7,500 ppm suspended solids as an unofficial, acute (toxic) criterion for water quality. This value is the lowest (most toxic) LC<sub>50</sub> for a clay or calcium carbonate reported in the NRC (1983) assessment of drilling fluids in the marine environment.

The State of Alaska standards and Federal criterion for marine waters that do exist are considered chronic standards and a chronic criterion in this analysis. Both State standards and the Federal criterion are directed toward protecting biota from chronic stresses rather than from acute toxicity, but the limits are very different in formulation. One State standard is 25 nephelometric-turbidity units, and the Federal criterion and other State standard are a 10-percent decrease in the seasonally averaged compensation depth for photosynthetic activity.

If oil is found, 440 km (275 mi) of offshore pipeline could be emplaced over a 3-year period in the planning area and inshore waters (Sec. II.B.2.a). Only 120 km (75 mi) of this pipeline would be placed in a dredged trench at a rate of about 1.3 km per day during summer. Trenching and dumping of dredged spoils would disturb 1,200 ha (4.6 mi<sup>2</sup>) in the Beaufort Sea Planning Area and inshore waters, or somewhat less if the spoils were used to backfill the trench (see Appendix H, Table H-4).

Experiences with actual dredging or dumping operations in other areas show a decrease in the concentration of suspended sediments with time (2-3 hours) and distance downcurrent (1-3 km) from the discharge. Similarly, in the dredging operations associated with artificial-island construction and harbor improvement in mostly sandy sediments of the Canadian Beaufort Sea, the turbidity plumes also tended to disappear shortly after operations ceased; they generally extended a few hundred meters to a few kilometers (Pessah, 1982).

The size, duration, and amount of turbidity depend on the grain-size composition of the discharge, the rate and duration of the discharge, the turbulence in the water column, and the current regime. However, turbidity would not be expected to extend farther than 3 km from the trenching and dumping operations.

Because dredging occurs at a rate of 1.3 km per day, the extent of the turbidity plumes would be about 3.9 km<sup>2</sup> (300 ha) at any one time (a 1.3- by 3-km plume). Over the three summers of pipeline dredging, perhaps an equal area would be separately affected by turbidity from dumping on a daily basis. Dumping of dredged spoils is not expected to introduce or mobilize any chemical contaminants. Beaufort Sea Planning Area sediments do contain elevated levels of hydrocarbons, but these do not appear to be labile (Sec. III.A.5).

Based on the analysis in this EIS, the increased turbidity from dredging (and dumping) would be local and short term, causing a more than 10-percent, temporary change in photocompensation depth over a distance

of 3 km or less, a LOW LOCAL effect on water quality. A VERY LOW REGIONAL effect on water quality from dredging would be expected.

d. Deliberate Discharges During Exploration: Exploratory vessels would discharge drilling fluids in bulk quantities (Table II-A-1) along with sanitary wastes from wastewater-discharge sources. Discharges of drilling muds and drill cuttings from exploration are projected from the development scenario in Section II.B.2.a; they would occur over a 5-year period. Discharges during exploration would peak in 1993 and 1994 at 2,330 metric tons (2,520 English short tons) of drilling muds per year and 2,980 metric tons (3,280 English short tons) of drill cuttings per year.

Drilling muds used offshore of Alaska are of relatively low toxicity and are limited to this low level of toxicity in permits for their discharge granted by the EPA. During exploration, only barium concentrations in discharged muds are expected to be always more than a hundredfold greater than concentrations in nearby sediments (Table IV-B-1-1). Concentrations of cadmium, lead, mercury, and zinc in discharged muds, however, may be more than a hundredfold greater than concentrations in nearby sediments.

Based on the above and additional information presented in Appendix L, EPA has determined that exploratory discharges are not likely to exceed applicable water-quality criteria outside of a 100-m radius, or 0.03 km<sup>2</sup> around each discharge site. The maximum number of exploratory platforms that may be present during a single year is estimated to be three, and water quality within an area of 0.03 km<sup>2</sup> around each platform, for a total of 0.09 km<sup>2</sup>, could be temporarily degraded at any one time and 0.42 km<sup>2</sup> for all of exploration during active discharge of drilling muds and cuttings. Therefore, the effect of exploration discharges on water quality would persist for a few hours within the 100-m-radius mixing zone around each platform, a VERY LOW effect on both LOCAL and REGIONAL water quality.

e. Deliberate Discharges During Production: The description of deliberate discharges from oil and gas platforms in Jones and Stokes Associates, Inc. (1983), is incorporated by reference; a summary of this description, as augmented by additional material, as cited, follows. Platforms on the OCS would discharge drilling fluids in bulk quantities along with low levels of petroleum hydrocarbons and sanitary wastes from wastewater-discharge sources. However, the quantities of deliberate discharges other than drilling muds, cuttings, and formation waters are too small to have an appreciable effect on water quality.

Discharges of drilling muds and drill cuttings (Table II-A-1) are projected from the development scenario in Section II.B.2.a at 128,500 metric tons (141,600 English short tons) of drill cuttings and up to 74,000 metric tons (81,600 English short tons) of drilling muds. Discharges would occur over a 4-year period but would likely peak in 1999--when 50 of 120 production wells would be drilled.

These quantities projected to be discharged are small compared with the natural sediment load of the Beaufort Sea Planning Area (Sec. III.D.6 in the Sale 87 FEIS, USDO, MMS, 1984). Inshore waters of the Chukchi Sea (Sharma, 1979) and the Beaufort Sea are naturally turbid. The Colville River alone carries 9 million metric tons of sediment into the Alaskan Beaufort Sea. High rates of erosion occur all along the coast (Sec. IV.A.2.b). Coastal erosion adds 300,000 metric tons annually to Simpson Lagoon. The seafloor itself is considered an erosional environment out to a 20-m-water depth (Sec. III.A.1.b). High turbidity from runoff following breakup on land extends to the 13-m-water-depth contour and limits primary production.

With only two drilling rigs per platform and assuming that maximum discharge rates are limited by EPA to the same extent during production as during exploration (see Appendix L), instantaneous discharges would be of the same order of magnitude in production as in exploration. The total quantity of drilling muds discharged in production is estimated to be no more than ninefold greater than during exploration (Table II-A-1). Total discharge of drill cuttings during production drilling would be twelvefold greater than the total discharged during exploration. Therefore, effects on water quality from discharges of muds and cuttings during production drilling should be about an order of magnitude greater than during exploration, but still only local and short term--on the order of square kilometers or less--and would persist over a 4-year period of drilling, an effect on both REGIONAL and LOCAL water quality that is expected to be VERY LOW.

Formation waters are produced from wells along with the oil (see Roberts, 1987). These waters contain dissolved minerals and soluble fractions of the crude oil. Process equipment installed on the production platform separates the formation water from the oil and treats it for disposal. The salinity usually ranges from 1 to 250 ‰. (Seawater has a salinity of 35 ‰.) Oil and grease concentrations in such waters are

limited by EPA to a maximum of 72 milligrams per liter (72 ppm) with a maximum monthly average of 48 milligrams per liter (48 ppm). The EPA-approved analytical procedures used to measure oil and grease exclude lower molecular-weight hydrocarbons (less than C14), which pose most of the risk to the biota (NRC, 1985). The NRC has estimated that formation waters average 20 to 50 ppm of lower molecular-weight hydrocarbons and 30 ppm of higher molecular-weight hydrocarbons. In Alaska, treatment facilities for State fields in Cook Inlet discharge 6.6 to 21 ppm total-aromatic hydrocarbons into Cook Inlet (Federal Register, 1986). (Lower molecular-weight and total-aromatic categories overlap but are not identical.)

Over the life of a field, the volume of formation water produced may be equal to 20 to 150 percent of the oil-output volume (Collins et al., 1983). As oil is pumped from a field, the ratio of water to oil being produced increases. For example, some of the older Cook Inlet/Kenai fields in Alaska are now producing up to 5.1 bbl of water for every barrel of oil produced, while the newer Endicott and Prudhoe Bay fields are producing 0.3 and 0.7 bbl of water per barrel of oil, respectively (State of Alaska, Alaska Oil and Gas Conservation Commission [AOGCC], 1990). Toward the very end of the productive life of a field, 10 bbl of water may be produced for every barrel of oil. On the basis of these considerations, the production of formation waters over the life of the field can be estimated at 180 to 1,350 MMbbl, with up to 170 MMbbl of this amount produced in the last year of field production. Over the life of the field, the mass equivalent of 14,000 to 108,000 bbl of oil would be contained in produced water.

Treated formation waters may be discharged into the open ocean, reinjected into the oil-producing formation to maintain pressure, or injected into underground areas offshore. Discharge of formation waters would require an EPA permit and would be regulated so that water-quality criteria, outside an established mixing zone, are not exceeded. To date, for exploration in the Beaufort Sea, EPA has prohibited discharge of formation waters into waters less than 10 m deep. Reinjection and injection projects to maintain field pressure have become almost standard operating procedure. Of the 10 active oil fields in Alaska as of March 1990, 8 had water-injection projects (State of Alaska, AOGCC, 1990). However, treatment facilities for State Cook Inlet fields still discharge formation waters into Cook Inlet (Federal Register, 1986). On the other hand, formation water from the Endicott Reservoir, the first offshore-producing field in the Beaufort Sea, is reinjected into the oil formation as part of a waterflood project.

The major constraint to underground injection is finding a formation at shallow depth that (1) has a high enough permeability to allow large volumes of water to be injected at low pressure and (2) can contain the water (Roberts, 1987). Also, injection should not be into a formation that might otherwise be a future potable-water supply.

If formation waters were reinjected or injected into a different formation, no discharge of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local but would last over the life of the field, an expected MODERATE LOCAL effect and VERY LOW REGIONAL effect.

**SUMMARY:** An oil spill of 1,000 bbl or greater would temporarily and locally increase water-column hydrocarbon concentrations. The large number of very small spills anticipated over the production life of the field could result in local, chronic contamination within the margins of the oil field. Oil spills are expected to have a LOW LOCAL effect and a VERY LOW REGIONAL effect on water quality. Other effects could result from (1) sale causeways, which could have long-term effects on salinity, temperature, ice cover, and turbidity over up to 200 km<sup>2</sup> for a MODERATE LOCAL effect and VERY LOW REGIONAL effect on water quality; (2) construction activities, which would at most increase turbidity over a few square kilometers in the immediate vicinity of the construction and only while the activity persisted--this would produce an expected LOW effect on LOCAL water quality and VERY LOW effect on REGIONAL water quality; and (3) discharges of formation waters. Deliberate discharges of muds and cuttings are regulated by EPA such that any effects on water quality must be extremely local; water-quality criteria must be met at the edge of the mixing zone established by the EPA-issued discharge permit. Over the life of the field, discharge of formation waters (with whatever the formation waters contain)--rather than their reinjection into the seafloor--would result in local pollution, an expected MODERATE effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality.

**CONCLUSION:** For the base case, MODERATE effects on LOCAL water quality and VERY LOW effects on REGIONAL water quality are expected.

## 2. Effects on Lower-Trophic-Level Organisms

This discussion summarizes and incorporates by reference the discussion of effects on lower-trophic-level organisms contained in the FEIS's for Sales 87 (USDOJ, MMS, 1984) 100 (USDOJ, MMS, 1985a), and 97 (USDOJ, MMS, 1987a). Exploration and development of oil resources in the Sale 124 area could have several potential effects on lower-trophic-level organisms. These effects include responses to petroleum hydrocarbons released into the environment, seismic surveys, the discharge of drilling fluids, dredging or related construction activities, and the presence of platforms and pipelines. A discussion of each of these potential effects follows.

Marine plants and invertebrates of greatest concern, due to their abundance or trophic relationships, are: (1) planktonic and epontic communities--with special emphasis on primary production and trophic linkages; (2) the abundant epibenthic invertebrates in nearshore waters that are fed on extensively by anadromous and some marine fishes; and (3) the Stefansson Sound Boulder Patch, an apparently unique, kelp-dominated community.

Aside from the Boulder Patch community, which is vulnerable because of its extremely restricted distribution, marine plants and invertebrates assume importance as primary producers (transforming energy from the sun into organic carbon) and as sources of food for other organisms. In the Beaufort Sea, the length of the food chains in the food web is short (Fig. III-B-1); and a number of marine mammals (including the endangered bowhead whale), as well as birds and fishes, depend on invertebrates as their primary food sources. These invertebrates are, in turn, dependent on primary producers. Since both marine plants and invertebrates can occur in different habitats, consideration is given to effects on pelagic, benthic, and epontic communities.

a. Effects of Oil Spills: Oil has been observed to cause both lethal and sublethal effects to marine plants and invertebrates. Although lethal effects may be initially more obvious or compelling, sublethal effects of oil also may be important and generally develop at much lower concentrations than lethal effects (Steele, 1977; Rossi and Anderson, 1978). These effects include reduction in growth and/or fecundity, increased physiological stress, and behavioral changes. These sublethal effects may increase the probability of death, or they may lead to reductions in future population size.

Concentrations of oil used in lab experiments are usually higher than those observed following natural and experimental spills (see Sec. IV.C.1); however, concentrations less than 1 ppm have produced a variety of negative effects in marine organisms ranging from phytoplankton to fish (see Table B-18, NRC, 1985).

Effects of oil on marine plants and invertebrates are briefly summarized here:

(1) Effects of Oil on Marine Plants: In the Sale 124 area, the marine plants of greatest concern are (1) the phytoplankton and epontic algae, and the relation between these primary producers and consumers; and (2) the brown kelp Laminaria solidungula, which predominates in the Boulder Patch community.

Because effects on phytoplankton and zooplankton are interrelated, the likely effects of oil on the plankton are discussed later in this section in Effects of Oil on Pelagic Communities. The effect of an oil spill on phytoplankton is most likely to be LOW.

Effects of oil on the kelp Laminaria solidungula have not been examined directly. Tests with the kelp Laminaria saccharina, from Liverpool Bay and the Eskimo Lakes in the Canadian Beaufort Sea, indicated that primary production was significantly inhibited by all types and concentrations of oil tested. Exposures to whole crude-oil concentrations as low as 43 ppm caused about 25-percent inhibition of photosynthesis, while concentrations of 4,000 ppm caused a 45- to 60-percent decline in photosynthesis (Hsiao, Kittle, and Foy, 1978). Shiels, Goering, and Hood (1973) found that 7 ppm of Prudhoe Bay crude oil inhibited the photosynthesis of L. saccharina, as well as two green algae, Cladophora stimpsonii and Ulva fenestrata.

An oil spill contacting areas of the Beaufort Sea containing macroscopic algae would be expected to have a short-term effect on kelp and other macroscopic algae, particularly since these plants are all subtidal and thus are not likely to be coated by oil. Photosynthesis might be reduced; and this effect could be translated, if it persisted long enough, into reduced growth and/or reproduction. Because Laminaria solidungula shows maximum growth in late winter or early spring, a reduction in photosynthetic rate during the open-water season might later become manifested in reduced growth or reproduction the next year. Thus, the most

likely effect of an oil spill on kelp and other macroscopic algae in the Beaufort Sea is expected to be LOW. The probability of at least one spill of 1,000 bbl or greater occurring during the open-water season and contacting Land Segment 36 (the closest to the Boulder Patch) within 30 days is less than 0.5 percent, so effects from spills are unlikely.

Under the base case, the effects of spilled oil on phytoplankton and macroscopic algae are expected to be LOW.

(2) Effects of Oil on Invertebrates: Oil spills have often resulted in extensive mortality of marine invertebrates, which has been particularly observable in the intertidal area (Teal and Howarth, 1984). Sublethal effects, as observed in both the laboratory and in the field, include effects on physiology, growth, development, and behavior (see Johnson, F.G., 1977; Cowles and Remillard, 1983; Cowles, 1983; NRC, 1985). Effects may be linked, e.g., reduced feeding may lead to reduced reproductive effort, etc., and alterations in behavior may increase the probability of death. Of great concern is the potential for disruption of chemically mediated behaviors, which are common among invertebrates and which appear to be disturbed by very low concentrations of hydrocarbons (as low as 1 ppb) (Johnson, F.G., 1977; Takahashi and Kittredge, 1973; Jacobson and Boylan, 1973). If such disruption occurred, feeding, mating, and habitat-selection activities could all be affected. Both reproduction and recruitment of benthic invertebrates and zooplankton may be affected by exposure to sublethal concentrations of petroleum hydrocarbons (Cowles and Remillard, 1983; Berdugo, Harris, and O'Hara, 1977; Johnson, F.G., 1977; Teal and Howarth, 1984). Invertebrate larval forms are generally more sensitive to toxic agents than are adults (Johnson, F.G., 1977; Lewbel, 1983), with eggs often somewhat less sensitive than larvae (Lewbel, 1983).

In the Sale 124 area, invertebrates of greatest concern include (1) zooplankton, especially as a trophic link between phytoplankton and higher order consumers; and (2) nearshore epibenthic invertebrates, which are an important food of seasonally abundant anadromous fishes. Because effects on phytoplankton and zooplankton are interrelated, the likely effects of an oil spill on the plankton are discussed later in this section, in Effects of Oil on Pelagic Communities.

Among the important invertebrates are crustacean members of the plankton (especially copepods and euphausiids--primary prey of bowhead whales) or the epibenthos (prey of fishes and other animals; see Fig. III-B-2). Crustaceans and other invertebrates that are benthic as adults but that occur in the plankton while they are larvae are susceptible to the surface slicks of spilled oil, dissolved fractions of oil that move through the water column, and oil that becomes entrained in sediments. Lab studies have indicated that oil concentrations ranging from 1 to 4 ppm can cause significant mortality to both adult and larval crab and shrimp after 96 hours of exposure (Starr, Kuwanda, and Trasky, 1981).

Within the plankton, copepods and euphausiids are important because of their abundance and as primary prey of the endangered bowhead whale. Copepods are the predominant zooplankton group, both in numbers and biomass (see Sec. III.B.1.a[2]). A number of studies have examined the effects of oil on copepods (see Wells and Percy, 1985; NRC, 1985; and Gilfillan, Vandermeulen, and Hanson, 1986). Petroleum hydrocarbons can be acutely toxic to copepods, and a variety of sublethal effects have been identified (e.g., narcosis, decreased feeding and defecation rates, disrupted phototaxis, and altered feeding activity). The WSF of various oils can quickly paralyze copepods at concentrations of 0.2 to 0.5 ppm. Often, recovery from sublethal effects can occur if exposures are of short duration (Wells and Percy, 1985).

Laboratory studies with the euphausiid *Thyssanoessa raschii* have indicated that sensitivities of this species to the WSF of Prudhoe Bay crude oil were within the range expressed by other species of Alaskan marine crustacea. However, unlike other marine crustacea tested, the larvae appear to be less sensitive than older lifestages. Also, gravid females were the most sensitive lifestage (Fishman, Caldwell, and Vogel, 1985).

Sensitivities to oil may vary among invertebrate species; Rice, Karinen, and Korn (1978) found that although subtidal species were in general more sensitive to oil than intertidal species, among the subtidal species, mysids were considered tolerant. In the Beaufort Sea where mysids are an important component of nearshore and inshore environments, such a difference in sensitivity or tolerance could affect local species composition following a spill, leading in turn to some changes in fish diets.

Amphipods are another important group in the inshore environment as well as in fish diets. Amphipods, in particular ampeliscid amphipods, seem sensitive to oil; and some species have suffered great mortality following spills (Teal and Howarth, 1984; Howarth, 1985). Both laboratory and field experiments have

investigated the effects of oil on amphipods (see reviews in Wells and Percy, 1985, and NRC, 1985; also Busdosh and Atlas, 1977; Atlas, Horowitz, and Busdosh, 1978; Busdosh et al., 1978; and Anderson, Kiesser, and Blaylock, 1979). Amphipods that come into contact with oil have high mortality rates (Busdosh and Atlas, 1977; Percy, 1974). However, amphipods did not die when exposed to the asphaltic fraction of Prudhoe Bay crude oil, which is the portion of spilled oil most likely to be left after weathering and biodegradation, and which would sink to the bottom and coat sediments. Effects are more likely in nearshore areas where water depths are shallow. Field experiments by Atlas, Horowitz, and Busdosh (1978) have shown that contamination of sediments by oil led to mortality of or emigration by indigenous invertebrates (primarily the amphipods). Although recolonization of oiled sediments began shortly after contamination, the species composition of oiled versus control (un-oiled) sediments differed at 2 months. Amphipods declined in the oiled sediments; the isopod *Saduria entomon* seemed unaffected, and the response of polychaetes seemed species-dependent. An oil spill contacting organisms or sediments in nearshore areas could cause the mortality or emigration of some invertebrates (notably, amphipods). Isopods and mysids would be expected to be less affected (see also Table 1 in Wells and Percy, 1985).

Anadromous fishes move into the warm, brackish-water zone nearshore seasonally to feed, but some studies (Craig and Halderson, 1981; Moulton, Fawcett, and Carpenter, 1985) suggest that, in general, food does not appear to be limiting to these fishes (see discussion of fish feeding in Sec. III.B.2). Thus, a local reduction in invertebrate biomass following a spill might not have large consequences for these fishes. Fish might be affected through effects on their prey if a very large spill occurred and contacted the nearshore area, especially if the oil contaminated sediments.

For the base case, the probability of one or more oil spills of 1,000 bbl or greater occurring and contacting land in the open-water season within 30 days is 5 percent (Appendix G, Table G-17). For particular land segments, the probability is less than or equal to 2 percent for open-water spills (to contact within 30 days) or less than or equal to 4 percent for winter spills (over the entire season). Thus, there is a low probability that spilled oil would reach nearshore areas. A spill of 1,000 bbl or greater (for discussion purposes a size of 22,000 bbl is chosen) after 3 days (when it is unweathered and still highly toxic) would cover an area of 1.8 km<sup>2</sup> (Appendix M, Table M-1). Given the generally broad distributions of most invertebrate species in the Beaufort Sea and the relatively small area likely to be contacted by spilled oil, the effects of oil on invertebrates are expected to be LOW.

(3) Effects of Oil on Communities: The effects of oil on pelagic, epontic, and benthic marine communities as discussed in the Sale 100 FEIS (USDOI, MMS, 1985a) are summarized and incorporated by reference. Effects on benthic and pelagic communities are also discussed in Teal and Howarth (1984), Howarth, 1985; Clark, 1982; and NRC, 1985. Examination of communities following oil spills and laboratory and mesocosm experiments have indicated that major shifts in species composition can take place. These shifts appear to take place when the predominant species are more sensitive to oil than other species in the community. Changes in species composition or predominance may qualitatively change food-web dynamics and also could lead to a decreasing efficiency of energy transfer to higher trophic levels if the number of linkages is increased. Indirect effects also can occur when the interactions between or among species are altered.

(a) Pelagic Communities: Because of the fluid, mobile environment of planktonic communities, the broad distributions of the species components, and the believed ease of recolonization, persistent effects of oil are unlikely for these communities unless chronic discharges occur. If a spill occurred nearshore, or in more open-ocean areas, then plankton abundance and dynamics within the plankton could be affected. The effects of an oil spill will depend on (1) whether species composition within either the zooplankton or phytoplankton changes due to differing relative sensitivities to oil and (2) whether zooplankton or phytoplankton are relatively more sensitive.

In the Beaufort Sea, with its relatively simple food web, effects on plankton could immediately affect important consumers such as bowhead whales and arctic cod. Regional populations of planktonic organisms are unlikely to be affected, however, given the low probability of oil spills of 1,000 bbl or greater occurring in the Sale 124 area, the likelihood that only a portion of the sale area would be affected (see Appendix M, Table M-1), and the broad distributions of most planktonic species. For the base case, the effects of oil spills on planktonic communities are expected to be localized and LOW.

(b) Epontic Communities: Epontic (under-ice) communities are transient in the nearshore areas of the Beaufort Sea, and effects of accidental oil spills are believed to be very localized. Oil spilled onto the surface

of the ice would reduce the light reaching the epontic algae, probably resulting in lowered productivity. If oil were spilled under the ice and trapped directly beneath it, those epontic organisms that were not highly mobile probably would be lost. The oil probably would become encapsulated within the ice with increasing time. The areal extent of these effects would be small. An area covering 3.5 ha would be affected assuming a 1,000-bbl-or-greater spill and homogenous spreading to a thickness of 1.0 cm on the undersurface of the ice. If oil on, in, or under the ice should be released during ice breakup, then effects could spread. Because the ice algae are thought by some to serve as an important source of food in early spring, when food is presumably in short supply in the pelagic environment, effects on the epontic community could extend to the open-water community. If the average-size spill of 22,000 bbl occurred, only a small portion of the regional community would be affected, and effects are expected to be LOW.

(c) **Benthic Communities:** Changes in species composition have been observed following a number of spills due to massive kills of species present, followed by colonization or proliferation of species that are more resistant and/or opportunistic. Shifts in composition in benthic communities may be persistent, especially if sediments (which are the major substrate in the Sale 124 area) become contaminated with oil. Most macroscopic benthic organisms are longer-lived than species in planktonic and epontic communities, and shifts in species composition may be very long-lasting if the newly predominant species inhibit recruitment or recolonization of previously predominant species. Many epibenthic invertebrate species that predominate in the nearshore Beaufort Sea are good colonists, because the zone is less than 2 m in depth, where shorefast ice occurs, and is probably repopulated on an annual basis. Thus, persistent effects in these shallow waters are not likely unless sediments become contaminated and emigration or settlement is affected. Such effects, if they occurred, would be very localized and are not expected to cover a large areal extent (see Appendix M, Table M-1).

Amphipods, especially ampeliscids, are very sensitive to oil pollution and have disappeared from areas as a result of spills and chronic pollution (Elmgren et al., 1980; Sanders et al., 1980; d'Ozouville et al., 1979; Cabioch et al., 1981; Elmgren and Frithsen, 1982). In the Sale 124 area, amphipods may be important in the diets of other invertebrates, as well as fish. However, a number of epibenthic invertebrates, as well as some fishes, serve as prey to fishes abundant in the nearshore zone. So, although the local demise of some prey due to a spill could affect some fish, resulting in increased mortality, populations of fishes are not expected to be significantly affected. Since many of the epibenthic invertebrates apparently are good colonists, affected areas might be rapidly recolonized unless sediment contamination were too great. Since anadromous fishes in the nearshore zone do not appear to be food-limited (Craig and Haldorson, 1981; Moulton, Fawcett, and Carpenter, 1985), some local effects on their prey are not expected to significantly affect fish populations.

For the base case, the effects of spilled oil on benthic communities are expected to be LOW. Greater detail is given in Section IV.C.2.a(1), Effects of Oil on Marine Plants, and Sec. IV.C.2.a(2), Effects of Oil on Invertebrates.

(d) **Trophic Interactions:** Although trophic considerations have been discussed within the framework of pelagic, epontic, and benthic communities, it is important to remember and consider that all of these communities are linked. To some extent, the linkages have been explored in the preceding sections, but some elaboration and summarizing are pertinent.

Certain aspects of the Beaufort Sea environment and communities make its constituents perhaps more vulnerable to effects deriving from oil-related activities. For one, the environment is highly seasonal. Timing and synchronization of events can be exceedingly important. Pulses of primary production, whether resulting from epontic or open-water activity, may be critical to the success of zooplankton and to the reproductive activities of these and other consumers. Activities that significantly reduce primary production or alter timing in such a way that utilization of resources is affected could have significance beyond the expected magnitude of effect. Epontic production may be more important as an early pulse of energy available to larval or overwintering forms than for the magnitude of its production. Invertebrates are dependent upon very seasonal production for garnering the energy necessary for growth, maintenance, reproduction, and perhaps overwintering. MacGinitie (1955) was struck by the preponderance of zooplankton with natural oil obviously sequestered in their bodies (probably energy-rich lipids), which presumably was used in reproduction or as a future energy reserve (for overwintering).

A broad-scale disruption of the link between primary producers and secondary producers could have dramatic effects on higher order consumers, as well as the secondary producers. Zooplankton consumers such as arctic cod and bowhead whales could be readily affected. Frost and Lowry (1984) believe that a

number of vertebrate consumers may be competing for food during years of lower primary production. Although the effects on plankton are expected to be LOW for the base case, due to the small area likely to be affected and the presumed ease of recolonization, if a large spill occurred, then zooplankton consumers or the balance among the myriad of plankton consumers (see Fig III-B-1) could be affected. This becomes more of a concern in the cumulative case (see later discussion). In general, activities or events associated with the base case are not expected to have significant, broad effects on trophic interactions due to the small areas expected to be affected.

b. Effects of Seismic Surveys: The sources of acoustical energy used in seismic surveys have included explosives of different sorts; airguns, which capitalize on compressed-air releases to generate sounds; and waterguns, which use the release of water pressure to create a seismic pulse. Since most algae do not contain critical gas chambers, effects of seismic exploration on marine plants are expected to be VERY LOW. In general, even high explosives (e.g., dynamite) have relatively little effect on marine invertebrates, presumably due to lack of air-containing chambers, such as the swim bladder of fish (Falk and Lawrence, 1973). Airguns, which are much more innocuous for fish than explosives, were shown to have no effect on caged oysters placed close to the airgun (Gaidry, unpublished, cited by Falk and Lawrence, 1973). Effects of waterguns on marine organisms have not, to our knowledge, been assessed, but their effects are expected to be as low or lower than those of airguns because a lesser amount of energy is involved. Due to the prevalent use of airguns and waterguns in Alaskan OCS waters, seismic surveys are expected to have VERY LOW effects on invertebrates as well as on marine plants.

c. Effects of Drilling Discharges: The "Fate and Effects of Exploratory Phase Oil and Gas Drilling Discharges in the Beaufort Sea Planning Area, Lease Sale 124" have been analyzed by the EPA in Appendix L. Probable effects on phytoplankton, zooplankton, and benthic communities are discussed in that appendix. During exploration, 14 wells are projected to be drilled over a 5-year period (1992-1996), including 2 from bottom-founded mobile units and 1 from a manmade (ice) island. During exploration, the discharge of drilling muds and cuttings is expected to peak in 1993 and 1994 at 2,330 metric tons (2,520 English short tons) of drilling muds per year and 2,980 metric tons (3,280 English short tons) of drill cuttings per year. During the production phases, 120 wells are expected to be drilled from four platforms, with the total release of up to 74,000 metric tons (81,600 English short tons) of drilling muds and 128,500 metric tons (141,600 English short tons) of drill cuttings. Discharges would occur over a 4-year period, but would likely peak in 1999, when 50 of the 120 production wells would be drilled. Details of extent and timing of water-quality effects are presented in Section IV.C.1, Effects on Water Quality.

Drilling muds and cuttings generally have been shown to have low toxicity to marine organisms. However, recent research by Dr. Daniel Morse and colleagues at the University of California at Santa Barbara has indicated that additives and heavy metals (cadmium, zinc, and mercury) associated with drilling fluids can interfere with the ability of larval abalone to settle and metamorphose successfully. These effects resulted from concentrations one to three orders of magnitude lower than cause mortality (Morse, 1987, personal commun.). This suggests that significant effects to marine organisms may be occurring over a broader area than previously suspected, as drilling fluids become diluted with discharge. For phytoplankton and zooplankton, the effect of discharging drilling muds and cuttings is expected to be LOW, primarily because of the generally low levels of toxicity demonstrated and the small area (0.03 km<sup>2</sup>/drilling unit during exploration) that should be affected. Benthic communities also are expected to incur a LOW effect; however, effects probably will be longer lasting (but localized) due to the deposition of drilling muds and cuttings. Further details are presented in Appendix L.

Formation waters are produced from wells along with oil (see Roberts, 1987). Toxic effects on marine plankton and benthos could be produced by the hydrocarbons, metals, or chlorides (brine content) in the formation waters. Discharges of formation waters differ from those of other drilling fluids in that almost all such discharges would occur during development and are likely to be continuous through production. Such discharges should increase in volume as the oil reservoir is depleted. The production of formation waters over the life of the field can be estimated at 180 to 1,350 MMbbl, with up to 170 MMbbl of this quantity produced during the final year of field production (see Sec. IV.C.1, Effects on Water Quality). ReInjection of formation waters back into the reservoir as an enhanced oil-recovery mechanism would lower the total amount discharged. Complete reinjection would produce no effects on marine life.

Formation-water discharge as a result of the base case will likely produce only small effects. Factors that suggest this are (1) the low toxicity of formation waters (LC<sub>50</sub> values range from 1,850 to 408,000 ppm; Menzie, 1982); (2) the rapid dilution of these discharges a short distance from the source; and (3) the

relatively small area that would be affected by these discharges (1,000-m radius).

Acute toxic effects appear to be low (Menzie, 1982). Chronic lethal and sublethal effects may present more of a problem because of the continuous nature of the discharge and the potential for accumulating hydrocarbons in the sediments. The latter could produce long-term effects on benthic organisms.

Dilutions greater than the toxicity values reported probably would be achieved within several hundred meters of a platform. Assuming a 1,000-m radius for all effects in both the water column and sediments around each of four production platforms, a total of 12 km<sup>2</sup> could be affected.

The effects of formation waters on planktonic and benthic organisms would very likely occur through the development and production phases, assuming no reinjection. These effects, as well as those from drilling-fluid discharges, are expected to be LOW.

d. Effects of Construction Activities: Construction activities, in addition to the release of drilling muds and cuttings, could alter habitats of benthic or epibenthic animals and plants. Activities relating to installation and construction of platforms, pipelines, and causeways are expected to be very localized. In the Sale 124 area, four platforms and four short causeways are expected to be installed in conjunction with the production activities of the sale. Platforms, and to some extent causeways, add a three-dimensional structure to the environment, which may provide habitat for refuging fishes or for invertebrates and plants requiring hard substrate for settlement. In general, one would expect organisms relying on soft-sediment areas altered or preempted by platforms, pipelines, and causeways to be negatively affected, whereas organisms utilizing hard substrate may be favored by the installation of platforms. Due to the small number of platforms (four) expected to be installed for the production activities of Sale 124, the small area expected to be affected, and the apparently broad distributions of most adult and larval marine organisms in the Beaufort Sea, regional populations are not expected to be affected. However, the localized effects are expected to be long term for those benthic organisms that are affected.

During development and production, oil is assumed to be transported between local facilities (offshore and onshore) via pipelines. In conjunction with Sale 124 activities, an estimated 275 mi of pipeline will be laid offshore and another 325 mi onshore. Trenching would be involved in laying 75 mi of the offshore pipeline, with an estimated 4.6 mi<sup>2</sup> of offshore benthos disturbed. Trenching can affect marine organisms by physically altering the benthic environment; increasing sediments suspended in the water column, thereby decreasing water quality; displacing sediments and, in so doing, smothering some benthic organisms; altering water currents by modifying benthic topography; and killing some organisms directly through mechanical actions (Starr, Kuwada, and Trasky, 1981; Lewbel, 1983).

Effects of pipeline installation are expected to be localized but may be long term for benthic invertebrates, because pipelines would be in place for years. Because regional populations of marine plants and invertebrates should not be affected, and only a very small portion of the benthos would be affected, effects are expected to be LOW.

In summary, effects of installation and construction activities would vary depending on the species involved. Some sessile marine organisms would be killed or displaced by these activities, but effects are expected to be extremely localized. Those species that require hard substrate for settlement and growth may increase in abundance because platforms increase the available substrate. Construction activities should benefit these species. In general, effects on marine plants and invertebrates are expected to be LOW. Regional populations of these organisms are not expected to be affected.

**SUMMARY:** Marine-plant and -invertebrate resources of greatest concern, due to their abundance or trophic relationships, are (1) planktonic and epontic communities--with special emphasis on primary production and trophic linkages; (2) the abundant epibenthic invertebrates in nearshore waters that are fed on extensively by anadromous and some marine fishes; and (3) the Stefansson Sound Boulder Patch, an apparently unique, kelp-dominated community.

Oil spills are more likely to cause widespread negative effects to marine plants and invertebrates than are other activities associated with exploration and development and production of oil resources. In general, oil spills are expected to have LOW effects on marine plants and invertebrates, because the distributions of most of these organisms are quite broad and recolonization of affected areas is quite likely unless sediments become too contaminated. Benthic and epibenthic organisms living in nearshore shallow environments where

contact with oil is more probable are at greater risk.

However, the oil-spill-risk analysis indicates that nearshore areas are very unlikely to be affected by spilled oil. If nearshore areas or sediments were contacted by oil, effects would be expected to be very localized. Even if the abundant epibenthic invertebrates in nearshore environments were affected locally, it is most likely that fish populations would not be significantly affected and that recolonization by invertebrates could be rapid. Oil-spill effects on the planktonic and eponic communities are expected to be LOW due to the limited area likely to be affected. Effects in these communities are not expected to be noticeably translated to higher-trophic levels.

Effects from other activities (seismic surveys; discharge of drilling fluids, cuttings, and formation waters; and construction activities) should be very localized. The effects of seismic surveys are expected to be VERY LOW. Effects from the other activities are expected to be LOW.

The Stefansson Sound Boulder Patch community is more vulnerable to effects from oil-related activities, because it is a very restricted community spatially. If oil contacted the community, then effects would be expected to be HIGH, because productivity and successful recruitment could be affected. However, LOW effects to this community are expected, due to the unlikelihood of contact by an oil spill.

**CONCLUSION:** For the base case, effects on lower-trophic-level organisms are expected to be LOW.

### 3. Effects on Fishes

This discussion summarizes and incorporates by reference the discussion of effects on fishes contained in the FEIS's for Sales 87 and 97 (USDOJ, MMS, 1984, and 1987a, respectively), the Sale 100 FEIS (USDOJ, MMS, 1985a), and the Sale 109 FEIS (USDOJ, MMS, 1987b), with augmentation by additional information as cited. Effects on fishes from activities associated with the exploration and development and production of oil and gas in the Beaufort Sea could come from released oil, seismic surveys, drilling discharges, and construction activities. Potential effects derived from these activities are described in the following section.

Fishes of greatest concern, due to their abundance, trophic relationships, or vulnerability, are: (1) the anadromous fishes that are abundant seasonally in the nearshore zone, especially arctic cisco, arctic char, least cisco, and broad whitefish; (2) fish species narrowly dependent on conditions in the Stefansson Sound Boulder Patch (e.g., the kelp snailfish); (3) arctic cod, an abundant and trophically-important fish; and (4) capelin, a species that is vulnerable because it comes into nearshore areas to spawn. Some of these species also are important because they figure prominently in subsistence (e.g., arctic char, ciscoes, whitefishes, arctic cod, rainbow smelt, capelin, and salmon).

a. Effects of Oil Spills: Petroleum is a complex substance composed of many constituents. These constituents vary in structural complexity, volatility, and toxicity to organisms. A more detailed discussion of these differences, plus modes of release and factors affecting concentrations of oil in the water column, is found in Sections IV.A.2 and IV.C.1.

(1) General Effects: Possible effects of hydrocarbons include short-term lethal effects, sublethal physiological effects, and effects on behavior. Evidence for these effects is discussed rather briefly, emphasizing data for arctic marine and anadromous fishes; vulnerable aspects of species' life histories, habits, and habitats are then examined.

The death of adult fish has occurred almost immediately following some oil spills (the Florida and Amoco Cadiz; Hampson and Sanders, 1969; Teal and Howarth, 1984); however, lethal effects to adults may pose less threat to fisheries than damage to eggs and larvae or changes in the ecosystem supporting the fishery (Teal and Howarth, 1984). As mobile animals, adults may be able to avoid areas containing spilled oil or dissolved hydrocarbons (although evidence for this is contradictory: see especially the results of Weber et al., 1979, 1981); and, even if fish contact oil and become contaminated (MacLeod et al., 1978; Neff and Haensly, 1981; Mackie, Hardy, and Whittle, 1978), they are often able to quickly purge the oil from their systems after a return to uncontaminated waters (Brocksen and Bailey, 1973; Neff et al., 1976b; McKeown, 1981). Contamination of fishes was observed after the Argo Merchant, Amoco Cadiz, and Bravo spills, but generally there were low levels of contamination in only a small portion of the fish examined (Teal and Howarth, 1984). The significance of "tainted" fish or fear of tainted fish to commercial or subsistence fisheries is not known. Effects of tainted fish on natural predators also are unknown.

Sublethal effects often occur at lower hydrocarbon concentrations and thus are more likely to occur, and to occur over a broader area, than are lethal effects. Some sublethal effects also ultimately would lead to the death of the individual. The major types of sublethal effects are behavioral and physiological changes. Within these two major categories are changes that affect the growth, feeding, fecundity, and survival of an animal; thus, they could possibly affect current or future population size. Some support for this contention has come from studies conducted following major oil spills.

#### (2) Aspects of Habitats and Life Histories Vulnerable to Effects of Oil

(a) Habitats: Fishes occupying different habitats may be differentially susceptible (i.e., vulnerable) to exposure to hydrocarbons. This variation in vulnerability combined with individual sensitivities determines the potential for effect. Determining effects on a particular species also can be complicated by variation in location and feeding habits of different life stages within the species (Table IV-C-3-1 and Sec. III.B.2). In comparing fishes that use different habitats, pelagic species appear more sensitive to oil than demersal fishes; however, they may be less vulnerable because they spend less time in estuarine areas where spilled oil tends to accumulate and persist (Rice et al., 1976), or in close association with shallow, soft-bottomed habitats, which are extensive in the Beaufort Sea. Those fishes that rely on epibenthic organisms in the nearshore zone also could potentially be affected if their prey were contaminated by oil or killed; see discussions of Effects of Oil on Invertebrates and Effects of Oil on Benthic Communities, Sections IV.C.2.a(2) and (3).

Table IV-C-3-1  
 Beaufort Sea Major Fish Species  
 Potential Oil-Spill-Interactions Analysis

Species	Habitats			Effect Potential	
	Adult	Eggs	Larvae/ Immature	Season	Type
<b>ANADROMOUS SPECIES</b>					
Arctic Char	Coastal	Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns.
Arctic Cisco	Coastal	Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns. Some adults vulnerable when overwintering in delta areas.
Least Cisco	Coastal	Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns. Some adults vulnerable when overwintering in delta areas.
Bering Cisco	Coastal	Presumed Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns. Some adults vulnerable when overwintering in delta areas.
Humpback Whitefish	Coastal	Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns.
Broad Whitefish	Coastal	Freshwater	Coastal	Summer	Reduction in food; interference with migration patterns.
Chum Salmon	Pelagic	Freshwater	Pelagic	Summer	Possible interference with migration patterns.
Pink Salmon	Pelagic	Some Inter-tidal Demersal	Pelagic	Summer	Possible interference with migration patterns; toxic to eggs and larvae.
Rainbow Smelt	Coastal	Freshwater	Coastal	Winter	Possible interference with migration patterns; vulnerable when overwintering in nearshore areas and river mouths.
<b>MARINE SPECIES</b>					
Arctic Cod	Demersal	Pelagic	Pelagic	Winter	Toxic to eggs and larvae; eggs float and thus are particularly vulnerable.
Capelin	Pelagic	Demersal/ attached to sand or gravel on beach or bottom	Possibly Pelagic	July/ August	Toxic to eggs and larvae, contamination of spawning substrate.
Fourhorn Sculpin	Demersal	Demersal	Pelagic?/ Demersal	Summer/ Fall	Fry vulnerable when they come into nearshore in huge numbers in late summer/fall.

Source: USDOl, MMS, Alaska OCS Region.

In the Beaufort Sea, two fish habitats can be considered more vulnerable to effects from oil-related activities: the nearshore zone and the Boulder Patch community. The nearshore areas in the Beaufort Sea appear to have a greater abundance of fishes than offshore areas (see references in Sec. III.B.2, Fishes). During the open-water season, anadromous fishes extensively use the nearshore brackish-water habitats as feeding, migrating, and rearing areas. Most of these fishes overwinter and spawn in freshwater habitats (Sec. III.B.2, Fishes). Within the nearshore-brackish zone, fish tend to be concentrated along the mainland and island shorelines rather than in lagoon centers or offshore. Details of variation in extent of coastal distributions, onshore-offshore distribution, and seasonal shifts in distribution are given in Section III.B.2, Fishes. Several marine species also are abundant in the nearshore zone, with some moving in seasonally or sporadically to feed. Some marine species continue to inhabit, feed, and reproduce in the nearshore zone during winter. Thus, the nearshore zone in the Beaufort Sea would be among the habitats considered more vulnerable to effects from oil-related activities.

Particular areas of concern are the major river deltas, which are the areas of greatest species diversity and which also harbor some overwintering fishes. Among these rivers and their associated deltas, the Colville figures prominently as an area of high species diversity and the river with the most extensive overwintering habitat for anadromous fishes in the Alaskan Beaufort Sea. Other major rivers include the Sagavanirktok, Meade, Ikpikuk, Kuparuk, and Canning.

The community associated with the Boulder Patch also is vulnerable to effects from oil-related activities, in large part due to its uniqueness and restricted extent. Three fish species have been reported in the Boulder Patch community: the kelp snailfish, the fourhorn sculpin, and the fish doctor (Dunton, Reimnitz, and Schonberg, 1982; Craig, 1984a). Of these, the kelp snailfish is probably most dependent on the environment and/or community of the Boulder Patch, since it apparently requires hard substrate on which to lay its eggs. The other two species apparently are not so environmentally limited. Thus, the kelp snailfish could be vulnerable to effects from oil-related activities.

(b) Life Histories: Several aspects of fish life histories may make fish populations vulnerable to effects from spilled oil. In particular, recruitment or reproduction could be affected because:

- Eggs and larvae of fishes are more sensitive to oil than other life-history stages, and those of some species may be more vulnerable due to ecological conditions, such as location.
- Oil may increase the already high mortality of larvae in the plankton by increasing the length of time in the plankton or by decreasing planktonic food.
- Recruitment or survival of fishes could be reduced by oil affecting the spawning of adults, movement and feeding patterns of adults or juveniles, or overwintering juveniles or adults.

(3) Species-Specific Effects: This section considers, consecutively, effects on anadromous species; marine pelagic species; demersal species; and then capelin, a marine species that spawns along the coast. Trophic effects also are considered.

Among the various activities associated with Sale 124 oil development, oil spills apparently pose the greatest threat to fishes. Adult fish are generally unlikely to suffer great mortality as a result of an oil spill; however, anadromous fishes in the nearshore, warm, brackish-water band might be affected by having their movements to feeding, overwintering, or spawning grounds impeded. Effects of an oil spill could include increased swimming activity; decreased feeding; interference with movements to feeding, overwintering, or spawning areas; impaired homing abilities; and death of some adult or juvenile fishes. Fish also may suffer increased physiological stress when making the adjustment from fresh to brackish or marine water and vice versa. Effects are more likely for fishes that make extensive migrations from natal streams (e.g., arctic cisco), for fishes with high fidelity to natal streams (e.g., arctic char), and for fishes that overwinter in nearshore environments (such as the major river deltas, e.g. rainbow smelt).

Larvae, eggs, and juvenile fishes are generally more sensitive to oil spills than are adult fishes. In particular, species with floating eggs (e.g., arctic cod) or eggs and larvae in more vulnerable positions (e.g., capelin eggs and developing larvae attached to substrates in the intertidal and/or shallow subtidal) could suffer extensive mortality (dependent on the amount and type of oil spilled, the areal extent of the spill, etc.). In the Beaufort Sea, nearshore demersal eggs or larval fishes spending time in coastal areas are the fish most

vulnerable to adverse effects of spilled oil. These vulnerable categories include capelin and larval fishes of species such as fourhorn sculpin and snailfish, which can have great bursts of abundance in nearshore areas (Sec. III.B.2, Fishes; Houghton, 1985, personal commun.; and Morrow [1980] citing Andriyashev, 1954, and Westin, 1970).

(a) Anadromous Fishes: Anadromous fishes of importance because of abundance, life history, or use in domestic and commercial fisheries are arctic cisco, least cisco, arctic char, and broad whitefish. A number of anadromous species in the region have complicated life-history patterns that are not fully understood. For the most part, anadromous fishes in the Beaufort Sea, unlike salmon, spend the major part of their lives in freshwater rivers and lakes but undertake seasonal migrations to coastal regions in the ice-free season to feed (Craig, 1989). They generally return to fresh- or brackish-water habitats in the late summer or fall to spawn or overwinter. The details of foraging migrations of the more abundant anadromous fishes appear to vary not only among species but among life-history stages of the same species. These differences in migratory habits lead to spatial and temporal differences in the relative abundance of different species and lifestages in the nearshore zone (Bond, 1987; Cannon and Hachmeister, 1987). Thus, an oil spill contacting the nearshore environment might affect various species and age classes of anadromous fishes as they move to feeding, overwintering, or spawning grounds. Because most anadromous fishes make spawning runs and outmigrations over a period of time, it is not too likely that an entire year-class would be lost as it moved toward a spawning stream or migrated out of a stream. Even if fish were held up because a delta area was contacted by oil, it is unlikely that the major river deltas would be entirely contacted, given the broad expanses of the deltas and the estimated size of a 1,000-bbl-or-greater spill (a 22,000-bbl spill after 30 days would cover 4.8 km<sup>2</sup>; Appendix M, Table M-1). The Mackenzie River Delta covers about 210 km of coastline, the Colville about 32 km, and the Sagavanirktok and Canning about 16 km each. It is most likely that not all channels of these rivers would be affected and thus only a portion of the spawning run or a portion of the variously-aged fish in a population would be affected. The probability of one or more 1,000-bbl-or-greater oil spills occurring and contacting the Colville, Kuparuk, Ikpikpuk, Sagavanirktok, Canning, and Mackenzie River Deltas in the open-water season within 30 days is less than 0.5 percent. Thus, the probability of important river deltas being contacted is very low.

Arctic cisco are vulnerable to effects from oil spills because they are believed to make extensive migrations from and to what is believed to be their natal river, the Mackenzie. Various age classes could be vulnerable to spilled oil, but the variation in timing of their movements suggests that severe effects on all age classes are not likely to occur from a single spill. During the year in which they spawn, adults may migrate eastward from as far away as the Colville to the Mackenzie, beginning their movements early in the open-water season. The departure of these spawning-year fish from coastal areas leaves the nearshore habitat occupied by juveniles and mature non-spawners throughout the summer (Bond, 1982). Most studies along the Beaufort Sea coast have found few mature arctic cisco during the summer (Bond, 1982, citing: Griffiths et al., 1975, and Griffiths, den Beste, and Craig, 1977; Galbraith and Hunter, 1975; Jones and den Beste, 1977; and Lawrence, Lacho, and Davies, 1984). Young-of-the-year arctic cisco moving westward from the Mackenzie to the Colville appear in western Canadian waters about mid-July and start reaching the Colville in late August. In 1985, catches of 0-age arctic cisco increased in number until sampling ceased September 11 (Fawcett, Moulton, and Carpenter, 1986). Thus, an oil spill contacting the nearshore zone may affect an assemblage of variously aged arctic ciscoes but is unlikely to decimate the majority of both those migrating to spawn and young-of-the-year. If either one of these groups were greatly affected, then possibly a year-class could be reduced significantly. The spatial and temporal spread in movements of a single year-class (i.e., they arrive at a location over a period of time) reduces the probability of large effects to an age class.

The U.S. Department of Defense (USDOD), U.S. Army Corps of Engineers (COE) (1984), estimated that 33 to 38 percent of the Mackenzie River arctic cisco become resident in Alaskan waters; however, it is not known how good this estimate is, nor whether fish in Alaskan waters represent the entire stocks of smaller drainages within the Mackenzie. If they do comprise the entire stocks of smaller drainages within the Mackenzie, then effects to fish in Alaskan waters could be magnified locally within the Mackenzie. It is expected that an oil spill contacting the nearshore zone in Alaska would have a MODERATE effect on an assemblage of variously aged arctic ciscoes, because some fish might die, be displaced, or suffer increased mortality later. However, if either the majority of eastward-migrating, spawning-year adults or westward-moving, young-of-the-year arctic cisco were seriously affected, then most of a year-class could be affected. This result might be felt for several generations, leading to a HIGH effect.

Arctic char, which have only recently (Everett and Wilmot, 1987) been found to show genetic dissimilarity between drainages (suggesting the presence of separate stocks), may also be vulnerable to the effects of

spilled oil. Arctic char are found in at least 16 rivers in the central Beaufort Sea region ranging from the Colville River in the west to the Mackenzie River in the east (Craig, 1984a). The stocks in the Sagavanirktok and Canning Rivers are perhaps the largest (Cannon and Hachmeister, 1987). Because each drainage may contain a separate population, an oil spill affecting the majority of a year-class, spawning run, or migration in or out of a particular river could significantly affect that population. The total population in a drainage is not expected to be decimated by an oil spill for several reasons. Young fish from 0 up to 4 years of age remain in freshwater (between ages 2-5, char start moving to sea in the summer). In some populations, male char do not migrate to saltwater even though females in the same population are anadromous (Glova and McCart, 1974; Morrow, 1980). Also, the movements of large and small char vary somewhat with time: in the Sagavanirktok River, large, mature fish move out of overwintering areas to deltas early in the summer and by mid-to-late June are dispersing to the coast and through the nearshore environments. Smaller char are slower to move to the delta regions, remain in or near the delta regions for a longer period of time, and are thus slower to disperse into nearshore environments. Large char start staging in delta regions for the return migration upstream in late July or August, and by late August most are moving upriver to spawning locations. Smaller, immature char begin returning to the delta regions in mid-August; and large numbers are found in late August and early September in the Sagavanirktok River Delta, where they stage prior to moving upriver (Cannon and Hachmeister, 1987). Perhaps the most vulnerable time for char in nearshore environments would be in mid-to-late August, when some overlap between small char and large char occurs in the delta regions. In general, the variation in timing of movements of these different age classes reduces the probability that both these groups will suffer large effects from an oil spill.

Also, at least a few adult arctic char are known to have overwintered in other than their natal streams (Everett and Wilmot, 1987). Kristofferson (1987) suggests that the evidence for interdrainage exchange is the exception rather than the rule. Thus, depending on the extent to which this occurs, effects on spawning adults from one drainage could be ameliorated.

An oil spill contacting the nearshore environment in midsummer, when arctic char are widely dispersed, is expected to have a MODERATE effect on arctic char. However, contact with char while they are in close association with the delta of their home drainage may result in a HIGH effect, because individuals are aggregated and one or more age classes could be affected, with a resultant effect that could last for more than one generation.

The other two most abundant anadromous species in nearshore environments, the least cisco and broad whitefish, appear less vulnerable to effects from spilled oil than arctic ciscoes and arctic char because they have multiple streams of origin and are not known to show high fidelity to streams of origin (broad whitefish: C. Johnson, 1987, personal commun.). Like arctic cisco and arctic char, anadromous members of these species move into nearshore coastal areas to feed in the summer.

Anadromous least cisco in the Sale 124 area originate from streams and rivers ranging from Wainwright to the Colville River. Although absent from lakes and streams of the central Beaufort Sea region, the least cisco is also found in rivers on the northern coast of the Yukon and Northwest Territories.

Broad whitefish in the Alaskan Beaufort Sea occur in close association with the freshwater discharges of the larger rivers from Point Barrow east to the Sagavanirktok River Delta, and they have also been reported from the Canning River. This species is probably present in most of the rivers draining into the Chukchi Sea (Morrow, 1980). Broad whitefish are not very tolerant of saline waters and thus are often found near or within the delta regions and discharges of rivers. Studies in the Colville River have suggested that many broad whitefish use the delta region throughout the open-water season; however, large fish also have been reported to move long distances in the nearshore coastal environment (Fawcett, Moulton, and Carpenter, 1986).

Like the anadromous species discussed above, effects on these species while they are dispersed in the nearshore zone are expected to be MODERATE, whereas if they are contacted while concentrated or aggregated in delta regions, then HIGH effects are possible. For arctic cisco, if a significant number of spawning-year fish or age-0 fish were affected, then the effects are expected to be HIGH. Because oil spills are more likely to affect anadromous species while they are dispersed in the nearshore, rather than during the shorter timeframe in which they are aggregated, a MODERATE effect is most likely for these species.

(b) Marine Pelagic Species: Fishes having basically pelagic distributions are expected to be little affected by spills; most of them are thought to have broad distributions in the proposed sale area. Even if larvae,

which are generally more sensitive, are affected, only a portion of those in the plankton would be harmed; and the effects would be difficult to determine, given the high natural mortality of fish larvae and the unpredictability of recruitment from year to year. If some adults were killed, recruitment into the population might not be affected, because for marine fish species having planktonic larvae, there is little correlation between the size of the adult population and recruitment. Effects on recruitment would be particularly difficult to assess in the Beaufort Sea because very few studies of offshore fishes have been made. Effects might be most noticeable if predators of these pelagic fishes decline in abundance or fail to reproduce, but the cause of such an effect might not be apparent. In general, effects under the base case are not expected to exceed MODERATE for pelagic fishes.

(c) Marine Demersal Species: Demersal fishes in deeper water areas are not expected to be greatly affected by oil spills, as the likelihood of oil reaching the sea bottom in any appreciable amounts or over an extensive area is very small (see Sec. IV.C.1), especially given that more than one spill of 1,000 bbl or greater is unlikely to occur in the Arctic Ocean. However, demersal or coastal fishes in shallow, soft-bottomed areas could be affected by a spill if the water column is mixed and oil comes to contaminate sediments and/or prey. Food in the nearshore environment does not appear to be limiting to most anadromous fishes feeding in the shallows, with the possible exception of arctic cisco (Moulton, Fawcett, and Carpenter, 1985; Craig and Haldorson, 1981). Since most species have broad distributions in the Sale 124 area, and effects of spills are expected to be relatively localized and are unlikely to affect the deeper benthos, effects on the regional populations of demersal fishes are expected to be MODERATE.

For arctic cod, a demersal species that is patchy in distribution and has floating eggs, it may be extremely difficult to determine the effect of an oil spill. Adult arctic cod have been reported to suffer 50-percent mortality ( $LC_{50}$ ) at concentrations of 1.569 ppm  $\pm$  0.004 oil over an 8-day period (USDOC, NOAA, NMFS, Northwest and Alaska Fisheries Center [NWAFC], 1979, as cited by Starr, Kawada, and Trasky, 1981). Although arctic cod can be extremely abundant in nearshore, lagoonal environments (comprising 8-78% of all fish caught in Simpson Lagoon during two summers; Craig et al., 1982), the importance of nearshore versus offshore environments to the lifecycle is not known (Craig et al., 1982). If larvae were concentrated in nearshore environments or occurred in patches in the open ocean, then they would certainly be more vulnerable to effects from an oil spill. Even though arctic cod are more vulnerable to effects from oil spills because they have floating eggs, the effect of the base case on this species is expected to be MODERATE, because only one spill of 1,000 bbl or greater is projected to occur in the Arctic Ocean over the production life of the Sale 124 area.

(d) Capelin: Capelin spawn in coastal sandy areas in the Beaufort Sea in July and August and thus are susceptible to negative effects from an oil spill, especially if the spill is large and affects a large portion of their spawning area. Hatching of capelin eggs has been shown to be negatively affected by concentrations of 10 to 25 micrograms per liter (100-250 ppb) of crude oil (Johannessen, 1976). Capelin are not abundant in the Beaufort Sea, and the areal extent of their spawning is not known (Craig, 1985, personal commun.). Thus, it is difficult to assess the most probable effect of an oil spill on capelin populations in the Beaufort Sea. If capelin spawn along a broad extent of coastline, then an oil spill is expected to have a MODERATE effect on the populations, because the probability of a spill of 1,000 bbl or greater occurring and contacting the coastline is extremely low (Appendix G, Tables G-16 and G-18). However, this effect is not anticipated. In other regions, it is thought that capelin spawn at about 3 years of age and that most individuals die after spawning (Jangaard, 1974). If this is the case, and if an oil spill occurred and decimated a year-class of young from one area, then the effects could be felt in successive years. In this case, effects on capelin are expected to be HIGH.

(e) Trophic Effects: Fish populations may be affected indirectly, through effects on food sources, either planktonic or benthic, but these effects are little studied and are extremely difficult to predict. Since no evidence suggests significant biomagnification of oil through trophic linkages (Varanasi and Malins, 1977; Cimato, 1980), adult fish may be little affected by tainted food. However, larval or juvenile fish may be affected by increased food-limitation, slower growth rates, and increased predation.

Trophic effects could occur indirectly through contamination of sediments in the nearshore zone or the shallow subtidal zone. In shallow depths less than 2 m (which freeze to the bottom each year), contaminated sediments might affect the seasonal immigration of epibenthic invertebrates, which constitute the major prey of fishes in the nearshore zone during the open-water season. If sediments in depths greater than 2 m were contaminated, both immigration and recruitment of epibenthic invertebrates could be affected, and their fish predators as well. Effects to the benthos would be expected to be fairly localized (see discussion in Sec.

IV.B.1.a [1]); and, because food does not appear to be limiting to fishes in the nearshore zone (Craig and Haldorson, 1981; Moulton, Fawcett, and Carpenter, 1985), effects to fishes are expected to be MODERATE.

(4) Site-Specific Effects: For the base case, the most likely number of spills of 1,000 bbl or greater occurring during the projected production life of the Sale 124 area is one. The probability that one or more spills of at least 1,000 bbl would occur and contact land in the open-water season within 30 days during the production life of the Sale 124 area is 5 percent. The probability of a spill occurring and contacting individual land segments adjoining areas of particular interest to fishes (e.g., river deltas, lagoon systems) is considerably less: for individual land segments from Point Hope to the Mackenzie River Delta, the probability of contact within 30 days is less than or equal to 2 percent for spills in the open-water season (Appendix G, Table G-18) or less than or equal to 4 percent for spills over the entire winter (Appendix G, Table G-16). The probability of a 1,000-bbl-or-greater spill occurring and contacting the Colville, Kuparuk, Ikpikpuk, Sagavanirktok, Canning, and Mackenzie River Deltas in the open-water season within 30 days is less than 0.5 percent. Thus, the probability of important river deltas being contacted is very low. This combination of factors suggests that effects to fishes in nearshore waters are expected to be MODERATE. HIGH effects are possible for some anadromous species and capelin if spawning-year individuals, aggregated multi-age assemblages, or a year-class of young were affected. However, since delta areas are unlikely to be contacted, these HIGH effects are not expected to occur. For pelagic species or those in offshore waters, effects of an oil spill are expected to be MODERATE, given the small number of spills projected, the broad distributions of these fishes, and the relatively small area (see Appendix G, Tables G-1 to G-12) that a spill would cover.

In general, then, the effect of spilled oil on fishes for the base case is expected to be MODERATE for most fish species, although HIGH effects are possible for some anadromous species (e.g., arctic cisco, arctic char, least cisco, and broad whitefish) and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. These HIGH effects are not expected to occur.

b. Effects of Seismic Surveys: This subject was introduced in Section IV.C.2.b, Effects on Lower-Trophic-Level Organisms. Within the Sale 124 area, only airguns and waterguns will be used for seismic testing. Falk and Lawrence (1973) have compiled a review of several types of seismic surveys and their effects on fish.

High explosives can be quite lethal to fish, but they will not be used in the Beaufort Sea. Experiments testing the effects of airguns on caged coho salmon smolts found no harmful effects (Weaver and Wienhold, 1972, cited by Falk and Lawrence, 1973). Kostyuchenko (1973) examined the effect of airguns (as well as electric-pulse generators and TNT charges) on fish eggs and larvae in the Black Sea. Airguns had little effect on even the most sensitive fish eggs at distances of 5 m from the discharge source. Even at a distance of 0.5 m from the source, the survival rate of eggs was 75.4 percent compared to the control's rate of 92.3 percent. Airguns were not observed to have any effect on larvae; however, only limited numbers of larvae were examined. Airguns have been found to have few harmful effects, especially as compared to high explosives. Waterguns, which use the rapid release of water to generate a seismic pulse, release less energy than airguns. Effects of waterguns on marine organisms have not, to our knowledge, been assessed, but effects are expected to be as low or lower than those of airguns. Due to the expected prevalent use of airguns and waterguns for seismic surveys in the Sale 124 area, LOW effects on fish are anticipated.

c. Effects of Drilling Discharges: The general types of effects that discharged drilling fluids and cuttings could produce are reviewed and discussed in Appendix L. This referenced material discusses lethal, as well as chronic or sublethal, effects and effects on populations and communities.

Only 12 fish species have been tested for acute lethal concentrations of drilling fluids (see Table 19, NRC, 1983). In general, fish appear less sensitive to drilling fluids than invertebrates, but this may reflect the fewer number of tests done with fish and a lesser examination of effects on different lifestages.

Pink salmon fry were found to be moderately sensitive to drilling fluids, exhibiting 96-hour  $LC_{50}$  values of 3,000 to 29,000 ppm (Dames and Moore, 1978). ( $LC_{50}$  values indicate the concentration of test substance that caused 50-percent mortality of the experimental organisms.) Toxicity increased when experimental solutions were well stirred. The increased toxicity observed might relate to gill damage (whole muds were used in the acute lethal bioassay test); gill histopathology was observed in pink salmon fry exposed to a 30,000-ppm suspension of used high-weight chromium lignosulfonate from Cook Inlet (Houghton, Beyer, and Thielk, 1980). Tests with coho salmon have resulted in 96-hour  $LC_{50}$  values of 15,000 to 190,000 ppm for

whole-mud suspensions (Monaghan, McAuliff, and Weiss, 1977).

A few studies on certain tissues suggest that fish do not accumulate trace metals in their tissues (Payne et al., 1982; Tillery and Thomas, 1980). Other tissues than those tested, however, may be more likely to accumulate trace metals.

An area of special vulnerability that should be kept free of discharged material is the Boulder Patch. Fishes that depend on or are largely restricted to this habitat may be vulnerable to effects from discharged material, as would be demersal fish eggs laid within the Boulder Patch. Fish could die or could suffer gill damage or other sublethal effects, while eggs could be smothered or otherwise be damaged. Effects to this community from drilling-fluid discharge are highly unlikely, since available lease tracts are situated far from the Boulder Patch; the EPA Beaufort Sea NPDES Permit does not allow discharges within 1,000 m of the Boulder Patch.

During exploration, 14 wells are projected to be drilled over a 5-year period (1992-1996), including two from bottom-founded mobile units and one from a manmade (ice) island. Exploration discharges of drilling muds and cuttings are expected to peak in 1993 and 1994 at 2,330 metric tons (2,520 English short tons) of drilling muds per year and 2,980 metric tons (3,280 English short tons) of drill cuttings per year. During the development and production phase for the base case, 120 wells are expected to be drilled from four platforms, with the release of up to 74,000 metric tons (81,600 English short tons) of drilling muds and 128,500 metric tons (141,600 English short tons) of drill cuttings. Effects should be very localized. Discharges would occur over a 4-year period but would likely peak in 1999, when 50 of the 120 production wells would be drilled. Details of extent and timing of water-quality effects are presented in Section IV.C.1, Effects on Water Quality.

The amounts of drilling muds and cuttings expected to be released are small relative to the natural suspended-sediment load of the Sale 124 area. (See Sec. III.D.6 in the Sale 87 FEIS, USDOJ, MMS, 1984, and Sec. IV.C.1, Effects on Water Quality, of this EIS.) Sediments are contributed by rivers, coastal erosion, runoff from breakup, and mixing of inshore waters. Most fish (except for demersal eggs and planktonic forms) should be able to avoid areas of active discharge. Demersal eggs in those areas could be buried by discharged material (see Appendix L and Jones and Stokes, 1983).

The overall effects of drilling discharges on the fish fauna of the Sale 124 area are expected to be LOW because (1) fish are mobile; (2) in general, fish do not seem to be very sensitive to discharged drilling fluids and cuttings; and (3) the area projected to be affected will be small (see Sec. IV.C.1, Effects on Water Quality).

d. Effects of Construction Activities: Construction activities, as well as the release of drilling muds and cuttings, could alter the habitats of demersal fishes. The discussion of effects of gravel construction on fishes in the Arctic Sand and Gravel Lease Sale FEIS (USDOJ, MMS, 1983a) is summarized and incorporated by reference. On-land construction of roads and bridges that could affect fish populations or habitats would be regulated by Federal agencies such as the U.S. Army COE and FWS or by the State of Alaska.

During development and production, oil is expected to be transported between local facilities (offshore and onshore) via buried pipelines. An estimated 275 mi of pipeline would be laid offshore in conjunction with the activities of Sale 124. A certain amount of trenching would be involved in laying the pipeline, and an estimated 4.6 mi<sup>2</sup> of the offshore benthos would be disturbed in the process. Trenching can affect marine organisms by physically altering the benthic environment; increasing sediments suspended in the water column, thereby decreasing water quality; displacing sediments and, in so doing, smothering some benthic organisms; altering water currents by modifying benthic topography; and killing some organisms directly through mechanical actions (Starr, Kuwanda, and Trasky, 1981; Lewbel, 1983).

Effects of pipeline installation on fishes are expected to be very localized and of temporary duration. Since the epibenthic invertebrates that serve as food for many fishes annually recolonize shallow environments that are seasonally disturbed, disruption of the bottom substrates should not significantly affect their abundance. The general effect is expected to be LOW.

Four short (possibly 1,500 to 2,500 ft) shore-approach causeways or jetties may be built in conjunction with the pipelines (Sec.II.B.2.a.[4]). According to the scenario, these landfalls and associated causeways might

occur near Point Thomson in the eastern part of the Beaufort Sea, Oliktok Point in the central part, Pitt Point in the western Beaufort, and Point Belcher in the Chukchi Sea. Solid-fill, variously breached gravel causeways already have been constructed in association with oil and gas activities in the Beaufort Sea. The effects of such causeways have been a topic of much controversy and are considered in some detail in the Cumulative Effects on Fishes (Sec. IV.I.3.d). Of primary concern are the potential impedence of movements and migrations of anadromous fishes and the alteration of nearshore habitat (e.g., temperature, salinity). Causeways have been observed to cause measurable changes in both broad-scale and local oceanographic parameters (Sec. III.A.3 and Segar, 1989), as well as affecting breakup and freezeup patterns near causeways (Hale and Hameedi, 1989).

The actual siting of a proposed causeway or jetty and its design would greatly affect its potential for having effects on fishes. Unless or until more particulars are known, it is not possible to predict the effects that a particular causeway/jetty would have on watermass characteristics. Site-specific modelling could enable better prediction of potential effects on watermass characteristics. Of the four projected landfall sites, causeways at Oliktok Point and Point Thomson might be expected to have greater potential for affecting watermass characteristics and/or movements of anadromous fishes than would structures at Pitt Point and Point Belcher. The nearshore zone at Point Belcher becomes deep (steeper bathymetry) much closer to shore than the sites in the Beaufort Sea, so a shorter causeway or alternative design would be likely to be used there. Pitt Point is located on the coast between Smith Bay on the west and Cape Halkett on the east. Less is known about watermass characteristics and fish movements here than in the Prudhoe Bay region, but neither barrier islands nor large rivers are located nearby. Oliktok Point occurs just east of the Colville River Delta and at the western edge of Simpson Lagoon (near the Jones Islands). The West Dock causeway occurs on the eastern edge of Simpson Lagoon. A causeway situated here could easily affect the movements of nearshore waters, depending of course on its length and the particulars of its siting. Of particular concern might be the juxtaposition of causeways on either end of Simpson Lagoon. Of particular concern at Oliktok Point would be the potential for disruption of flow of more brackish waters into and out of the lagoonal system and possible delays of movements of fishes into and out of overwintering habitat in the Colville River. These effects could be particularly important for least and arctic ciscoes. Point Thomson occurs on the mainland approximately across from the Mary Sachs Entrance between the Maguire Islands and Flaxman Island, with the Canning River to the east. Again, depending on the length and design of the causeway/jetty, watermass characteristics between the barrier islands and the mainland could be affected, with possible ramifications for fishes. Of greatest concern in the Point Thomson area would be the potential deflection of brackish nearshore water offshore under east winds. This would be particularly critical if nearshore water were deflected out past the barrier islands, because migrations of young-of-the-year arctic cisco from the Mackenzie River in Canada to Alaskan rivers could be adversely affected.

Existing long causeways have been shown to alter hydrographic conditions, but the linkage between observed oceanographic changes and effects on fishes is not understood (Segar, 1989). Potential effects of short causeways or jetties that might be proposed as part of the Sale 124 activities could be better addressed in a development and production EIS, which would allow for very site-specific analysis. Without such site-specific information and appropriate modelling, projecting the possible effects on fishes of such construction activities is quite difficult.

The projected short length of the causeways in the Sale 124 scenario means that the magnitude of hydrographic changes should be less than for long causeways sited at the same location. However, effects on fish movements and migrations still might occur. Most effects on movements are likely to be both localized and short term and would result in a LOW effect on fishes. However, if causeway length were to exceed the 1,000-2,500-ft length estimated in the scenario, then effects to fishes could be substantially greater. Of particular concern would be the siting of a long causeway at Oliktok Point, where significant effects on movements and populations could occur. A long, solid-filled causeway at Oliktok Point could potentially have a VERY HIGH effect on fishes.

In summary, the effect of construction activities on fishes in the Sale 124 area is likely to be LOW.

**SUMMARY:** Oil spills are more likely than other events or activities to cause higher order effects on fishes as a result of Sale 124. Adult fish are not likely to suffer great mortality due to an oil spill; but larvae, eggs, and juveniles are more vulnerable because they are more sensitive and less mobile. In particular, species with floating eggs (e.g., arctic cod) or eggs in more vulnerable positions (e.g., capelin eggs and developing larvae attached to substrates in the intertidal and/or shallow subtidal) could suffer extensive mortality (dependent on the extent and amount of spilled oil, etc.). Capelin spawn in coastal sandy areas and thus are

susceptible to negative effects from an oil spill. The effect of an oil spill on capelin is expected to be MODERATE. However, a HIGH effect--one felt for multiple generations--is less likely but possible if spawning-year individuals, aggregated multiaged assemblages, or a year-class of young were affected. Because most individuals may die after spawning (as occurs in other regions; Jangaard, 1974), effects for spawning capelin or their offspring may be felt for a longer period of time than for fishes that spawn multiple times.

An oil spill that occurred nearshore also could affect the movement patterns of anadromous fishes. If an oil spill occurred in the open-water season and affected a segment of the nearshore region, then it could adversely affect the ability of fish to reach feeding or overwintering areas or to reach spawning streams. Effects are more likely for fishes that make extensive migrations from natal streams (e.g., arctic cisco), for fishes with high fidelity to natal streams (e.g., arctic char), and for fishes that overwinter in nearshore environments (such as the major river deltas, e.g., rainbow smelt). Anadromous fishes in nearshore areas, especially juvenile fishes, may be susceptible to spilled oil. The effects of an oil spill on fishes in the Beaufort Sea region are expected to be MODERATE, since some individuals in a localized area and/or a short time period would probably be affected. However, HIGH effects are possible for some anadromous species (e.g., arctic cisco, arctic char, least cisco, broad whitefish) if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. These HIGH effects are less likely to occur.

In conclusion, the effect of an oil spill on fishes in the Beaufort Sea is expected to be MODERATE, although for some species (capelin and some anadromous species), HIGH effects are possible.

Construction activities, in particular, the projected construction of four short causeways or jetties associated with activities from Sale 124 are likely to have a LOW effect on fishes, due primarily to localized effects on movements and migrations of anadromous species.

Effects from other activities (seismic exploration and discharge of drilling fluids) should be very localized. The effects of these activities on fishes are expected to be LOW.

**CONCLUSION:** Activities for the base case are expected to have a MODERATE effect on fishes.

#### 4. Effects on Marine and Coastal Birds

Several million migratory birds of about 150 species occur on marine habitats within and/or on coastal and tundra habitats adjacent to the proposed Sale 124 area. Oldsquaw, red phalarope, glaucous gull, and common eider are among the most abundant species present. Important coastal habitats are shown in Graphic 1. The primary adverse effects on marine and coastal birds from base-case OCS exploration and development activities in the proposed sale area could come from oil pollution of the marine environment, noise and disturbance of bird populations, and alteration of habitats.

To aid in the interpretation of the following effects discussion, an explanation of the term "population in the region," found in the definitions (Table S-2), follows. A population of marine and coastal birds is the number of a particular species of seabird, waterfowl, or shorebird that breeds within or number that occurs seasonally within the Beaufort Sea Planning Area or within the North Slope region. A portion of a population in the region would be, for example, the number of common eiders that nest on the barrier islands or the number of Pacific brant that nest on the Colville River Delta.

##### a. Effects of Oil Spills

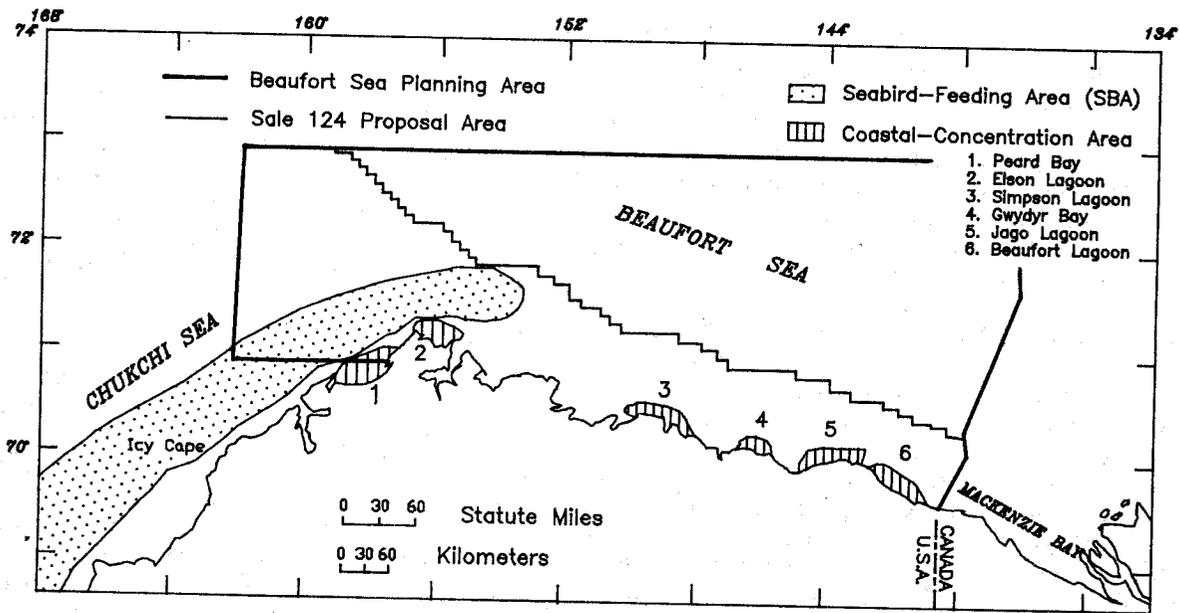
(1) General Effects: The effects of oil spills on birds are well documented. (For a detailed discussion of the nature of these effects, see Alaska OCS Region Technical Paper No. 3, Hansen, 1981, which is summarized here and incorporated by reference.) Direct oil contact alone usually is fatal and often results in substantial mortality of many birds. Oiling of birds causes death from hypothermia, shock, or drowning. Oil ingestion through preening of oiled feathers significantly reduces reproduction in some birds and causes various pathological conditions such as endocrine dysfunction, liver function impairment, and significant weight loss and reduced growth in young birds (Holmes, 1985; Harvey, Phillips, and Sharp, 1982; Peakall et al., 1980; and Koth and Vank-Hentzelt, 1988). Oil contamination of eggs by oil-fouled feathers of parent birds also significantly reduces egg hatching through toxic effects on the chick embryo or by abandonment of the eggs, chicks, and nest by parent birds (Stickel and Dieter, 1979; and Butler et al., 1988).

Indirect effects of oil pollution include reduction, contamination, and displacement of food sources, as well as contamination of shoreline habitats. A sudden oil-spill-related, local adverse effect on major food sources that occurred during a migration stopover period, or during the nesting period, could lower reproduction and survival of the bird populations that depend on the affected food source. Long-term, low-level contamination of food sources and habitats also can lead to chronic toxicity in birds through the accumulation of hydrocarbon residues that may adversely affect their physiology, growth, reproduction, and behavior.

The effects on birds of an oil spill in the Sale 124 area would vary with the season; volume, nature, and duration of the spill; species and numbers of birds occurring in the areas affected; and many other variables. Spills that occurred during the winter would have no immediate effects on birds because of their absence from the sale area during this season. If any oil remained in the ice after winter-cleanup efforts, however, it could directly affect birds during the following spring-breakup period or indirectly affect them through changes or reductions in food-source availability.

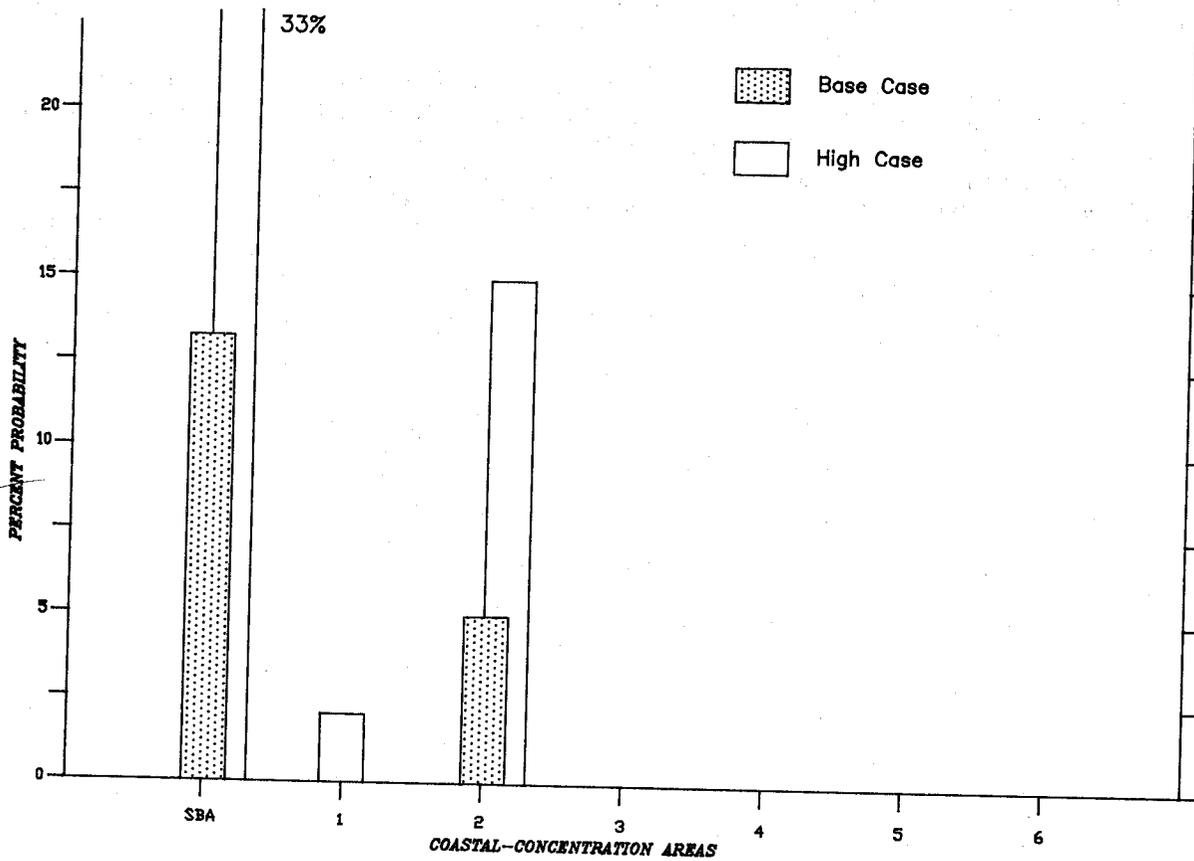
(2) Site-Specific Effects: Unless otherwise specified, oil-spill contact and probabilities referred to in this section assume the occurrence of exploration and development to the extent estimated herein (Table IV-A-1-1) and associated spill rates (Sec. IV.A.1). Most attention is devoted to spills greater than or equal to 1,000 bbl, which have a trajectory period of up to 30 days during the open-water period. It is assumed that one oil spill of 22,000 bbl (68% chance of one spill occurring) would occur under the base case.

For this analysis, the combined probabilities of oil spills occurring throughout the year and contacting specific bird-habitat areas during the open-water season are compared in Figure IV-C-4-1. For the base case, these marine- and coastal-bird habitats have a range of less than a 1-percent up to a 13-percent chance of being contacted during the open-water period, including contact from overwintering spills. The important offshore seasonal feeding area near Point Barrow referred to as the Seabird-Feeding Area (Bering Sea Intrusion Area, see Sec. III.B.3) has the highest risk of oil-spill contact (Fig. IV-C-4-1). The Elson Lagoon coastal-concentration area is at greater risk than other lagoon habitats. Spill-contact risks to all coastal habitats are less than 15 percent for the base case and spill-contact risks to any wetlands area are less than 5 percent under the base case (Fig. IV-C-4-1 and Appendix G, Table G-18, Land Segments 19-23).



COMBINED-PROBABILITY SCALE

SBA AND COASTAL-CONCENTRATION AREAS



IV-C-4-1. Combined Probabilities of Oil-Spill Occurrence and Contact of Seabird-Feeding and Coastal-Concentration Areas--Base and High Cases

(Combined probabilities of one or more oil spills occurring and contacting SBA and Coastal-Concentration Areas during the open-water season within 30 days over the production life of the lease area.) Taken from OSRA , Appendix G, Table G-17.

Over the life of the proposed field, there is a 68-percent chance of one or more oil spills of 1,000 bbl or greater. For this analysis, at least one such spill is assumed to occur during the winter and melt out during the open-water season or occur during the summer and contact one of the bird-habitat areas compared above (Fig. IV-C-4-1). If the spill occurred during the winter season, at least part of the spill would not be effectively cleaned up prior to ice breakup and could contact one or more of the above habitat areas (Fig. IV-C-4-1) after ice breakup. An oil spill contacting nearshore (less than 20-m water depth) or coastal habitats during the open-water period could expose the following average number of birds per square kilometer (birds/km<sup>2</sup>) to contamination: Elson Lagoon-Plover Islands, 100; Pitt Point-Cape Halkett, 145; Harrison Bay, 30; Simpson Lagoon, 70; Gwyder Bay-Flaxman Island, 80; Camden Bay, Jago Lagoon-Hulahula River, and Beaufort Lagoon, approximately 25 (densities taken from Divoky, 1983).

Depending on spill size and spreading, several hundred or more birds are likely to be affected by a spill in nearshore waters west of Cape Halkett, while probably fewer birds would be contaminated by a nearshore spill east of Flaxman Island. If a spill contaminated lagoon waters where large aggregations of several thousand oldsquaw or other bird species were rafting, several thousand birds might be killed. If an oil spill contaminated the seabird-feeding area offshore of Point Barrow during the open-water season, an average of 38 birds/km<sup>2</sup> (of the common species) could be affected. The contamination or loss of a small portion of the seasonally abundant crustaceans in the Point Barrow feeding area (the Bering Sea intrusion) due to an oil spill could temporarily (30 days) reduce available food sources of some of migratory shorebirds very near the spill. Bird mortality during fall migration for a portion of the North Slope shorebird populations could increase for that year as could mortality for some Ross' gulls. This could represent a MODERATE effect on some species' populations.

The direct loss of birds due to one or more oil spills might range from a few to several thousand. Local reduction or contamination of available food sources due to an oil spill also could temporarily reduce survival and reproductive rates of a few to several thousand additional migratory birds for that season. Most migratory species use various Beaufort Sea coastal habitats, depending on food availability. The contamination of some local habitat areas is not likely to affect a large portion of a species' regional population frequenting the Beaufort Sea coast. An oil spill contacting the Point Barrow seabird-feeding area is likely to affect only a portion of this habitat and bird food source because much of the spill would disperse and evaporate rapidly in open water. The death of several thousand oldsquaw, other sea ducks, or other abundant species would not have a long-term (more than one generation) effect on the regional population of those species, because natural recruitment within abundant species' populations such as oldsquaw would probably replace such losses within less than one generation. Species (such as murrelets or auklets) with low reproductive rates or species with low population levels are not likely to suffer high mortality as a result of an oil spill occurring in the Beaufort Sea, since murrelets and auklets are not abundant in the sale area and loon populations are not concentrated. Therefore, the effects of oil spills on marine and coastal birds in the Sale 124 area are expected to be MODERATE.

#### b. Effects of Disturbance

(1) General Effects: Human activities associated with OCS exploration and development, especially air traffic near nesting waterfowl and seabirds, could reduce the productivity of some species and may cause abandonment of important nesting, feeding, and staging areas. Effects studies in the arctic indicate that arctic tern, black brant, and common eider all show lower nesting success in disturbed areas (Gollup, Goldsberry, and Davis, 1972). Spindler (1984) reported that snow geese were particularly sensitive to aircraft disturbance during premigratory staging. The estimated threshold for response-disturbance of Pacific brant to aircraft (especially helicopters) noise appears to be considerably lower than for other waterfowl (Ward et al., 1988; Murphy et al, 1989). Flocks of molting Pacific brant in the Teshekpuk Lake area were disturbed by helicopter takeoffs and landings at distances up to 2.8 km away, and these molting brant appeared to remain disturbed for a longer period of time--6 minutes versus 1 to 2 minutes--than brant staging at Izembek Lagoon (located on the north side of the Alaskan Peninsula) that were exposed to aircraft overflights (Derksen et al., 1988).

The responses of birds to human disturbances are highly variable. These responses depend on the species; the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and many other factors. Adjacent to the proposed sale area, potential disturbance of eiders nesting on barrier islands is a primary concern.

Existing aircraft traffic in the Prudhoe Bay area already may have affected common eider nesting success on some of the barrier islands. Waterfowl (such as Pacific brant) nesting on the Colville River Delta also may be disturbed by aircraft and boat traffic, and some disturbance of molting and staging oldsquaw and/or other waterfowl and shorebirds on Jago, Elson, and Simpson Lagoons is likely to occur. However, effects studies by Ward and Sharp (1973) and Gollup, Goldsberry, and Davis (1972) indicate that long-term displacement or abandonment of important molting and feeding areas by oldsquaw due to occasional aircraft disturbance is unlikely. Disturbance of nesting birds in the sale area is expected to occur locally but probably would not involve disturbance of very large groups or very large colonies of nesting birds, such as could be the case in other lease-sale areas. The nesting activities of most species of marine and coastal birds are widely dispersed over the coastal tundra, and disturbance of local nesting birds probably would have little effect on North Slope bird populations as a whole.

Birds nesting on the barrier islands, river deltas, and coastal marshlands also may be indirectly affected by increases in predation pressure from gulls and arctic foxes, whose populations have increased in association with human development and availability of garbage. Arctic fox as predators on eggs and young of Pacific brant can limit the abundance and distribution of nesting brant and slow or prevent the recovery of this species' population (Raveling, 1989).

Frequent boat-traffic disturbance of nesting ducks has resulted in a 200- to 300-percent increase in the gull predation rate on duck eggs and young ducklings in nesting areas that occur within 200 m of gull colonies versus predation rates at undisturbed duck nesting areas (Ahlund and Gotmark, 1989).

(2) Site-Specific Noise and Disturbance Effects: Primary sources of noise and disturbance of marine and coastal birds would come from the air and marine traffic and offshore platform construction (on gravel islands) or installation that are assumed to occur with exploration and development. Air support is assumed to be centered out of Deadhorse at Prudhoe Bay, Camp Lonely, Barrow, or Barter Island with two helicopter round trips per day per exploration-drilling platform and a total of 180-360 helicopter trips per year (out to the four platforms and back to Deadhorse or other onshore base) and 34 boat trips per year for exploration. In the summer, drillships could be used during exploration. If there are drilling operations during the open-water season, MMS requires the operator to maintain an emergency standby vessel within the immediate vicinity of the drilling unit. Depending on ice conditions, two or more icebreaking vessels may be required to perform ice-management tasks for the floating units.

The greatest disturbance is likely to come from aircraft traffic flying near barrier-island bird colonies and to a lesser degree from aircraft and boats passing near lagoon concentrations of feeding and molting waterfowl and shorebirds. Aircraft flying between the exploration platforms and support facilities at Deadhorse, Camp Lonely, Barrow, or Barter Island that take a route along the coast of the sale area during the nesting season are more likely to temporarily disturb thousands of birds than aircraft that fly directly from the Deadhorse, Camp Lonely, Barrow, or Barter Island airport to the offshore platforms. Occasionally, these direct offshore flights may briefly disturb foraging flocks of seabirds with little or no lasting effects; however, aircraft disturbance of local feeding or molting concentrations of waterfowl and shorebirds in the lagoon areas during the fall may reduce the ability of migratory birds to acquire the energy (fat-lipid reserves) necessary for successful migration. The buildup of lipid reserves in migratory birds is critical because these birds greatly increase their utilization of fats-lipids during long periods of fasting that occur during migration (Cherel, Robin, and Le Maho, 1988). If such disturbance occurred frequently, migration mortality might increase and winter survival of other affected birds might be reduced, but the amount of air traffic (one or two flights/day per platform during drilling of the exploration wells) is not likely to disturb more than a few local feeding and molting flocks of birds near a portion of the coast or near the drill platforms on occasion. The noise and disturbance effects on birds from aircraft traffic are not likely to be more than LOW.

The noise associated with drilling operations and the movement of barges and supply vessels could disturb foraging seabirds near drilling sites. However, the low-frequency sounds emitted from drilling operations have not been shown to continually displace foraging seabirds from active oil-development areas along the California coast or in Cook Inlet. Expected Sale 124 vessel traffic of about 34 boat trips per year to and from Prudhoe Bay during exploration and development could temporarily disturb local assemblages of marine and coastal birds. As the vessels pass near the birds, short-term diving or flight responses may result. Unless industry uses small boats or hovercraft capable of moving through very shallow water and boat operators deliberately pass through the coastal lagoons and river deltas, local disturbance of birds by vessel traffic is likely to be very brief and probably have a VERY LOW effect. It is very unlikely that industry operations under the proposed marine-support and transportation scenarios would have any reason for

moving boats through the shallow lagoons adjacent to the sale area. However, if industry boat traffic were to pass through the lagoons, disturbance effects on birds would be similar to those of low-flying aircraft. The overall effect of noise and disturbance from aircraft, boat traffic, and drilling activities on marine and coastal birds is likely to be LOW.

(3) Noise and Disturbance Effects from Exploration Construction Activities: For Sale 124 exploratory drilling, one to two drilling units are expected to be used each year during the exploration phase. Construction activities associated with platform installation could temporarily displace (one season) several birds near the platform-installation sites. Some brief displacement of birds could occur because of noise and aircraft and boat traffic movement. This local disturbance of birds within about 1 mile of construction activities would be short term (one season or less), representing a LOW effect.

c. Effects of Habitat Alteration--Pipeline Development: For the proposed action, the base-case development would include onshore pipelines (325 mi) and offshore pipelines with landfalls occurring at four locations: Point Belcher on the Chukchi Sea coast and Pitt Point, Oliktok Point, and Point Thomson along the Beaufort Sea coast. The trenching and/or burial of 275 mi of offshore pipelines with 4.6 mi<sup>2</sup> of benthic habitat altered would have temporary effects on the availability of food sources of some birds very near or within a mile or two of the pipelaying operation due to turbidity and removal of prey organisms along the pipelines, representing a VERY LOW effect. The construction of onshore elevated pipelines and adjacent access roads could have more persistent effects on the local distribution of nesting birds and waterfowl brooding activities because the onshore pipelines are assumed to be accompanied by roads and associated vehicle traffic and adjacent habitat changes (creation of water impoundments and dust shadow along the roads). The onshore pipeline and access road from Pitt Point to the Trans-Alaska Pipeline (TAP) would include the crossing and local alteration within 100 to 200 yd of the pipeline of many miles of wet tundra, lake and pond habitats. Pipelines from Pitt Point, Oliktok Point, and Point Thomson to TAP would tie into existing onshore pipeline systems such as the Kuparuk and Endicott pipelines. The onshore pipeline from Point Belcher (400 mi) is assumed to be connected to an onshore-pipeline system associated with OCS Sales 97 and 109 development that would include a 400 mi pipeline crossing the National Petroleum Reserve-Alaska (NPR-A) south of the "lake district," avoiding coastal wetlands and connecting to TAP at Pump Station No. 2.

The formation of water impoundments along the pipeline roads would benefit some waterfowl species but adversely affect (displace) the nesting of shorebirds in localized areas near the pipeline-road complex (a LOW effect). The creation of a dust shadow due to the traffic along the pipeline roads also would benefit some waterfowl-feeding activities during the spring due to early snow melt and early plant growth within the dust shadow but would adversely affect the availability of shorebird-prey-food items very near the road. Although such habitat effects would be persistent over the life of the base case, the effect would be very local (within 1 mi, generally within 100 m of the road-pipeline corridor) and would represent a LOW effect on marine and coastal birds. During road and pipeline construction (about 2 years for main pipeline routes), high levels of motor vehicle traffic (>100 vehicles/day) and humans on foot would be disturbance sources for nesting and feeding waterfowl and shorebirds along the pipeline-road corridors. Some waterfowl and shorebirds would be displaced along the pipeline corridors during construction that occurred in the summer months. Waterfowl and shorebird populations are expected to recover from this habitat loss and displacement within one generation (a MODERATE effect).

SUMMARY: For the base case, adverse effects on marine and coastal birds primarily would come from (1) one or more oil spills, (2) exploration activities (such as 180 helicopter round trips/year), (3) development and production activities (such as 360 helicopter round trips/year), and (4) alteration of marine (a few square km) and terrestrial habitats (about 50 km<sup>2</sup>) associated with exploration and development and production. Over the life of the base case, one oil spill (22,000 bbl) is assumed to occur and could contaminate one or more coastal-habitat areas or an important pelagic habitat, resulting in perhaps the death of several hundred to several thousand birds, particularly abundant oldsquaw and other sea ducks. If a summer-concentration area is widely contaminated, several thousand birds may be directly killed in a severe event. Some local habitats are likely to be contaminated, which could temporarily reduce available food sources of some part of various regional species populations; however, an oil spill is not likely to affect food availability on a regional basis. High bird mortality (loss of several thousand birds) in the Sale 124 area due to an oil spill would not likely result in a long-term population decline, because natural recruitment probably would replace losses of abundant species within 1 to 3 years (one to two generations). Bird species with low regional populations or species with low reproductive rates (such as alcid species) are not likely to suffer high mortality due to an oil spill in the Beaufort Sea. Effects of oil spills on marine and coastal birds such as eiders and Pacific brant are

expected to be MODERATE if population recovery occurs within one generation.

Noise and disturbance of marine and coastal birds would come from low-flying aircraft, boats, and human presence. Sensitivity of birds to these disturbance sources is highly variable. Industrial activities associated with exploration and development (180-360 helicopter round trips/year and some supply boat trips) are likely to disturb some local assemblages of nesting, feeding, and molting birds on barrier islands, lagoons, and tundra habitats. However, nesting activities of most species of marine and coastal birds are widely dispersed over the coastal tundra; and disturbance of local nesting birds probably would have little effect on North Slope bird populations as a whole. Effects of disturbance are expected to be LOW.

Construction activities associated with the base case that could affect birds include installation of four production platforms, onshore-gravel mining for road construction for 325 mi of onshore pipeline, and road development. Onshore-construction activities would destroy or alter tundra-nesting and -feeding habitat of marine and coastal birds within about 100 to 200 yd along the onshore pipelines and associated roads. The permanent loss of about 100 to 200 yd of local onshore habitats along the pipeline-road corridors and also gravel mining during the development phase would represent a small portion of the available tundra habitat. Displacement of waterfowl and shorebirds by onshore construction activities, especially motor-vehicle traffic and humans on foot, is expected to have a MODERATE effect on the distribution of nesting and feeding waterfowl and shorebirds along the pipeline-access roads during construction. Offshore construction that includes platform installation and pipeline-trenching and -laying activities, with 4.6 mi<sup>2</sup> of benthic habitat altered, represents a LOW effect and temporarily would displace some birds within about 1 mi of the activity sites. Thus, effects on birds from onshore construction activities are expected to be LOW.

**CONCLUSION:** The combined effects of potential oil spills, noise and disturbance, and habitat alteration on marine and coastal birds (waterfowl, seabirds, and shorebirds) are expected to be MODERATE.

## 5. Effects on Pinnipeds, Polar Bears, and Belukha Whales

Six species of nonendangered marine mammals--numbering over 100,000 ringed, spotted, and bearded seals; 3,000 to 5,000 polar bears; 250,000 walruses; and about 12,000 belukha whales--commonly occur year-round or seasonally in a portion of or throughout the Beaufort Sea Planning Area and are very likely to be exposed to OCS exploration and development and production activities under the base case. Oil pollution, noise and disturbance, and alteration of habitats could adversely affect marine-mammal populations found in the proposed Sale 124 area. To aid in the interpretation of the following effects discussion, an explanation of the term "population of the region" (see Table S-2) follows: A population of nonendangered marine mammals in the region is the number of ringed, bearded, or spotted seals, or number of polar bears, walruses, or belukha whales that occur seasonally within the Beaufort Sea Planning Area. A portion of a population in the region would be, for example, the number of polar bears that den on the Arctic National Wildlife Refuge (ANWR) coast during the winter.

### a. Effects of Oil Spills

(1) General Effects of Oil Pollution: This section briefly discusses the nature of effects of oil on marine mammals that commonly occur in the sale area; see OCS Report, MMS 85-0031 (Hansen, 1985) for a detailed discussion of the various possible direct and indirect effects of oil and other chemical pollutants on marine mammals. A summary of this report, which is incorporated by reference in this EIS, is as follows:

(2) Direct Effects of Oil: Direct contact with spilled oil may kill some marine mammals and have no apparent effect on others depending on factors such as the species involved and the animals' age and physiological status. Some polar bears and newly born seal pups occurring in the sale area are likely to suffer direct mortality from oiling through loss of thermoinsulation, which could result in hypothermia. Adult ringed, spotted, and bearded seals and walruses are likely to suffer some temporary adverse effects such as eye and skin irritation with possible infection. Such effects may increase physiological stress and perhaps contribute to the death of some individuals (Geraci and Smith, 1976; Geraci and St. Aubin, 1980). Deaths attributable to oil contamination are more likely to occur during periods of natural stress such as during molting or times of food scarcity and disease infestations. In case histories, the few recorded mammal deaths attributed to oil spills occurred during winter months (Duval, Martin, and Fink, 1981), a season of increased natural stress.

Although species-specific effects of oil contact on belukha whales have not been conducted, studies of hydrocarbon effects on dolphins and porpoises as representative odontocetes by Geraci and St. Aubin (1982) provide sufficient insight on potential effects of oil-spill contact on belukhas.

The findings of these experiments suggest that smooth-skinned cetaceans such as belukha whales, dolphins, porpoises, and killer whales could suffer some minor skin damage if they were confined to a small surface area contaminated with oil (such as an ice lead). However, such effects on the skin are likely to be short term or transient (oil is unlikely to adhere to the skin), with recovery occurring within a few days (Hansen, 1985).

Oil ingestion by marine mammals through consumption of contaminated prey and by grooming or nursing could have pathological effects, depending on the amount ingested, species involved, and the animal's physiological state. Death would be likely to occur if a large amount of oil were ingested or if oil were aspirated into the lungs. Ingestion of sublethal amounts of oil can have various physiological effects on a marine mammal depending on whether the animal is able to excrete and/or detoxify the hydrocarbons. Geraci and Smith (1976) demonstrated that seals are able to excrete as well as absorb oil. Both seals and cetaceans potentially can metabolize oil through the function of an oxygenase enzyme complement (Engelhardt, 1983) demonstrated as cytochrome p-450 in the liver of cetaceans (Geraci and St. Aubin, 1982) and as aryl hydroxylase in the liver and kidney tissues of seals (Engelhardt, 1982).

(3) Oil-Spill Avoidance: Seals, walruses, polar bears, and belukha whales are not likely to avoid oil spills intentionally, although they may limit or avoid further contact with oil if they experience discomfort or apprehension as a result of contact with an oil slick (Hansen, 1985). Under some circumstances, they may be attracted to the spill site if concentrations of food organisms are nearby, or they may have little choice but to move through the spill site during migration.

(4) Indirect Effects of Oil: Indirect effects of oil pollution on seals, walruses, polar bears, and belukha whales would be those associated with changes in availability or suitability of various food sources. The arctic-marine ecosystem consists of a relatively simple food web with top-level consumers such as ringed seals, belukha and bowhead whales, and marine birds feeding primarily on a few species of abundant invertebrates and arctic cod. During heavy ice years, primary productivity is comparatively low, and food could be a limiting factor for large areas of the Beaufort Sea (Frost and Lowry, 1981).

If a major spill occurred during such a heavy ice year, the short-term loss of plankton and benthic invertebrates could locally reduce marine-mammal-food sources during a critical period and result in local decreased productivity of breeding ringed seals. The local reduction in ringed seal numbers as a result of direct or indirect effects of oil could in turn affect polar bear distribution.

However, ringed, spotted, and bearded seals; walruses; and belukha whales opportunistically prey on a variety of available food organisms and are quite capable of moving from an area of local prey depletion to other locations of prey abundance. Breeding ringed seals that remain in local areas during the pupping season may be an exception, but the reduction of food organisms would persist for no more than one season due to the rapid recruitment of the food organisms and would represent a LOW effect.

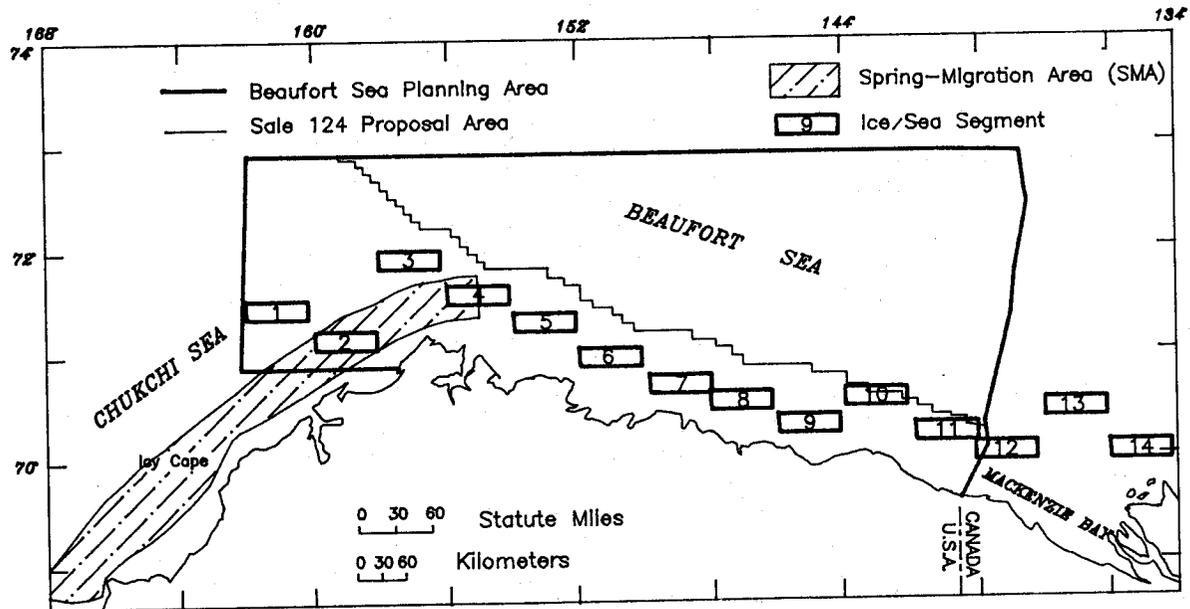
(5) Site-Specific Effects of Oil Spills: Unless otherwise specified, oil-spill contact and probabilities referred to in this section assume the occurrence of base-case development to the extent estimated in Section II.B.2.a and the associated spill rates (Sec.IV.A.1). Most attention is devoted to spills equal to or greater than 1,000 bbl that have a trajectory period of up to 30 days during the open-water period. There is a 68-percent chance of one (22,000-bbl average) or more spills of 1,000 bbl or greater occurring under the base case.

For this analysis, the combined probabilities of oil spills that occur at any time of the year contacting marine-mammal-habitat areas (segments of the ice-flaw zone and the whale-migration corridor) within 30 days during the open-water season are compared with combined probabilities of spills that occur during winter contacting the same habitat areas (Fig. IV-C-5-1). Spill risk to these habitat areas is described as follows: The portion of the whale-migration corridor off Point Barrow (Spring-Migration Area [SMA] A) has an 11-percent chance of spill contact during the spring (April 15-June 15) period due to the net westward movement of oil-spill trajectories during the winter and spring. The ice-flaw zone represented by the sea segments numbered 1 through 14 in Figure IV-C-5-1 is an important habitat area for marine mammals. This zone is extensively used during the winter by subadult and nonbreeding ringed seals, bearded seals, and polar bears. Winter spills contribute most of the risk under the base case to sections of the flaw zone located north and northeast of Point Barrow (Fig. IV-C-5-1).

Other than the SMA, the highest risk of spill contact to seals and polar bears within the flaw-zone habitat is the area north of Point Barrow (Fig. IV-C-5-1, Ice/Sea Segment 3). This higher risk reflects the assumed location of oil resources and the westward movement of spill trajectories from the east. Marine mammals using the flaw zone and pack-ice edge offshore of Smith Bay west to the Point Barrow area are at significantly greater risk of potential oil-spill contamination from the proposed action than marine mammals distributed in other offshore habitats of the Beaufort Sea (Fig. IV-C-5, Ice/Sea Segments Nos. 3, 4 and 5).

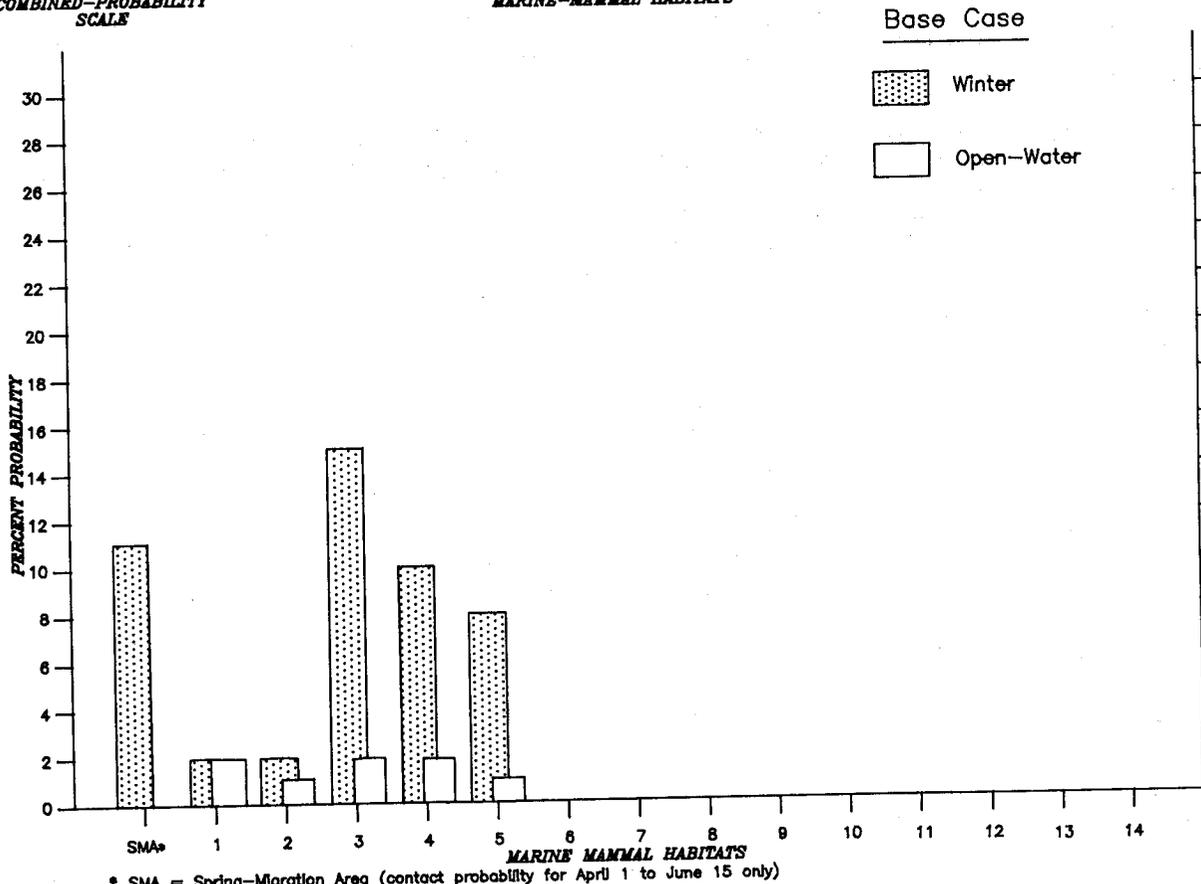
Winter spills that occur within the 20-m-isobath fast-ice zone are likely to affect some pupping and breeding ringed seals. Spills that occur in October are not likely to be cleaned up effectively under freezeup conditions and may contaminate fast-ice habitats of ringed seals. However, once freezeup occurs in the fast-ice zone, little spill movement or oil spreading would occur under fast ice. The number of ringed seal pups and adult seals contaminated is likely to be small (2-3 seals/mi<sup>2</sup> in fast ice). Oil spills occurring in the open-water period or occurring during winter in the offshore flaw zone may contaminate larger numbers of seals. Aggregations of hundreds of seals do occur in open water.

The net westward movement of spills and the chance of spill contact for the SMA during the spring (Fig. IV-C-5-1, SMA and Ice/Sea Segment No. 3) indicate that extensive walrus-feeding habitat northwest and west of Point Barrow could be at risk (11-15%) of oil-spill contact. Herds of several thousand walruses seasonally occupy marine habitats from Icy Cape to Point Barrow and along the pack-ice edge northwest of Point Barrow during the open-water season. Oil contamination of walruses probably would not result in direct mortality of healthy individuals. However, contamination could seriously stress diseased or injured animals and perhaps young calves, causing some deaths. Perhaps several hundred calves and some adults could die from oil contamination, but such a loss is likely to be replaced within one generation by natural recruitment



COMBINED-PROBABILITY SCALE

MARINE-MAMMAL HABITATS



\* SMA = Spring-Migration Area (contact probability for April 1 to June 15 only)

Figure IV-C-5-1. Comparison of Combined Probabilities of Oil-spill Occurrence and Contact of Marine-Mammal Habitats with Open-Water-Season Probabilities of Contact--Base Case

(Combined probabilities of one or more oil spills of 1,000 bbl or greater occurring and contacting marine-mammal habitats (SMA and Ice/Sea Segments) during the entire winter season compared with the open-water-season probabilities of contact within 30 mdays of summer spills or melt-out of overwintering spills during the expected production life of lease area--base case.) Taken from OSRA, Appendix G Tables G-15 and G-17.

in the population (a MODERATE effect). Little or no significant contamination of benthic food organisms and bottom-feeding habitats of walrus and bearded seals is expected, because very little oil is likely to sink to the bottom except for scattered tarballs. Presently, the walrus population is believed to be near the carrying capacity of its habitat. Therefore, the seasonal temporary loss or contamination of benthic-food sources could have noticeable effects on walrus productivity and survivorship for the following winter and spring seasons. However, the amount of benthic prey killed or contaminated by scattered tarballs from the spill is likely to be a very small or insignificant proportion of the prey and benthic habitat available in the eastern Chukchi Sea. This event probably would represent a VERY LOW effect on the availability of food to walrus and bearded seals.

Polar bears would be most vulnerable to oil-spill contamination along the ice-flaw zone north of Point Barrow (Fig. IV-C-5-1). However, the number of bears likely to be contaminated or indirectly affected by local reduction in seals as a result of an oil spill probably would be small considering the approximate density of one bear per 78 to 130 km<sup>2</sup> (Amstrup, 1983a). In a severe situation, where a concentration of perhaps 20 or 30 bears were contaminated by an oil spill and all the bears died, this one-time loss is likely to represent a LOW effect on the regional population of polar bears, with annual recruitment probably replacing lost bears within less than one generation.

Belukha whales would be most vulnerable to oil contact during spring migration off Point Barrow (Fig. IV-C-5-1, SMA and Ice/Sea Segment No. 3). Oil-slick contamination of the ice-lead system during spring migration (April to June) could directly expose several thousand whales or a large portion of the western Beaufort Sea stock to some oil-spill contact. However, oil-spill-effects studies conducted with similar smooth-skinned cetaceans suggest that such brief or intermittent contact with oil spills (as is likely to occur during migration) probably would not result in any deaths of healthy whales or have long-lasting sublethal effects after short exposure (see discussion above under General Effects of Oil Pollution). An oil spill may contact the lead system (SMA, Fig. IV-C-5-1) during the April 15 to June 15 migration period. However, the likely physical reaction between oil, ice, water temperature, and wind off Point Barrow would appreciably reduce the chance of an oil slick persisting in the lead system (Sackinger, Weller, and Zimmerman, 1983). Therefore, belukhas of the western Beaufort population may have some contact with an oil spill (hydrocarbons in the water column or on the surface) that would temporarily contaminate the lead system off Point Barrow; however, few, if any, belukha whales are likely to be seriously affected, even in a severe situation, with no significant effect on their distribution or abundance (a VERY LOW effect).

b. Effects of Noise and Disturbance: Airborne or underwater noise associated with OCS activities is the main source of disturbance of seals, walrus, polar bears, and belukha whales.

(1) Airborne Noise: Major sources of mobile airborne-noise disturbance are low-flying aircraft and high-speed motorboats as well as other high-frequency, high-pitched sounds. Low-flying aircraft are known to panic hauled-out seals and walrus (Johnson, B.W., 1977; Salter, 1979). If walrus nursery herds in the far western portion of the sale area are hauled out on the ice, disturbance may result in the death or injury of walrus calves from trampling by disturbed adults. If disturbance of hauled-out seals occurs frequently during molting, the successful regrowth of skin and hair cells may be retarded, thus increasing physiological stress on seals during a normally stressful period. Increases in physiological stress may possibly decrease fertility and longevity of affected seals. Aircraft-noise disturbance of belukha whales from flyovers generally is very transient, with events not lasting more than a few seconds (Stewart, Aubrey, and Evans, 1983). Such brief disturbances are not likely to have any serious consequences to belukha whales.

Major stationary sources of airborne noise include construction of artificial islands and dredging and drilling operations. These activities may disturb hauled-out seals, walrus, and polar bears occurring within a few kilometers of the noise sources. However, underwater noises borne from these sources could influence marine mammals over a greater area. Land-based industrial activities and human presence near polar bear dens pose potentially serious disturbances, although female polar bears apparently den more frequently on sea ice within the sale area than on the coast (Amstrup, 1985). Experience with captive female polar bears suggests that these bears can be especially sensitive to noise and human presence during maternity denning. Onshore seismic activities within 1.8 km of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds, Reynolds, and Follman, 1986). Human scent and other noises near maternity dens also may disturb the bears. The latter investigators suggest that seismic-testing activities within 200 m of the den may cause abandonment of the den. Human scent and other noises near maternity dens also may disturb the bears. Information presented on litter production rates and sexual maternity rates in polar bears and grizzly bears by Taylor et al. (1987) suggests that the loss of a litter by a female polar bear

that had abandoned the den because of disturbance would be potentially more significant to the polar bear population than a similar loss of grizzly bear cubs due to the generally higher reproductive rate in the latter species.

(2) Underwater Noise: Sound is more efficiently transmitted and travels at a greater velocity in water than in air. Underwater-sound-propagation loss is higher in shallow water than in deep water (Greene, 1981). Bottom material, structure, and the undersurface of ice cover strongly influence sound transmission; and propagation of most sound frequencies is greater in summer than in winter in the Beaufort Sea (Greene, 1981). Mobile sources of industrial-underwater noise primarily include support vessels, icebreakers, seismic boats, and aircraft; stationary sources include active dredges, drill rigs, drillships, and offshore-production and -processing facilities.

Underwater noise may alarm belukha whales and pinnipeds, causing them to flee the sound source. For example, Fraker, Sergeant, and Hoek (1978) reported the startled response and flight of belukha whales from barges and boats traveling through a whale-concentration area. In two documented cases, Finley and Davis (1984) reported strong fleeing reactions by belukha whales when icebreaker ships approached at distances of 35 to 50 km. The whales were displaced or moved over 80 km along the ice edge, or they stopped moving within 20 km when they reached coastal waters (Finley and Davis, 1984). Stewart, Aubrey, and Evans (1983) reported that belukha whales responded to outboard-motor noises by immediately moving downriver away from the source, but whale exposure to playback recordings of drilling sound had little effect on the movement and general activity of the whales. Reactions of belukha whales or pinnipeds to noise sources--particularly mobile sources, such as marine vessels--are likely to be highly variable depending on the animals' prior exposure to the disturbance source and their need to be in a particular habitat area where they are exposed to the noise and visual presence of the disturbance sources; for example, belukha whales foraging within the busy fishing grounds of Bristol Bay may be more tolerant of boat traffic, with shorter recovery times and shorter displacement distances from passing fishing vessels, than migrating belukhas that reacted to icebreaker traffic in Lancaster Sound (located between Baffin and Devon Islands in the Canadian arctic islands) as reported by Finley and Davis (1984). The latter whales may be "naive" with respect to vessel noise (Finley and Davis, 1984).

Because vocalizations are an important source of communication between mother and pups in pinnipeds, underwater noise may interfere with or mask reception of marine-mammal communication (Perry and Renouf, 1987), or it may interfere with reception of other environmental sounds used by marine mammals for navigation (Terhune, 1981). Noise produced by outboard motors operating at high speeds may have the greatest potential for interfering with belukha whale communication and some echolocation signals (Stewart, Aubrey, and Evans, 1983), but exposure to this interference source is likely to be very transient. Low-frequency noises from drilling platforms would not mask the high-frequency echolocation signals of belukha or other toothed whales (Gales, 1982). Theoretically, very noisy drilling platforms may slightly mask low-frequency whale sounds out to a range of 35 mi (56 km), but the possible masking range would more likely be limited to about 3 mi (4.8 km) (Gales, 1982). If the distance between communicating whales does not exceed their distance from the platforms, no appreciable interference is likely to occur (Gales, 1982). Experiments exposing captive belukha whales to recorded drilling sounds suggest that whales can acclimate quickly to typical oil-drilling sound levels (Aubrey et al., 1984). Informal observations of belukha whales near drilling platforms in Cook Inlet support this suggestion (McCarty, 1981).

Intense noise could damage the hearing of marine mammals or cause other physical or physiological harm (Geraci and St. Aubin, 1980; Hill, 1978). Probably the most intense noise that was associated with offshore industrial activity was the use of explosives in seismic-survey work (generally no longer used in seismic exploration). The sound pressure from these sources is very high and might physically injure or kill marine mammals near the explosion site. However, if spherical spreading of sound pressure is assumed, the pressure would fall below a harmful level at 2,752 m (3,000 yd) from the source, and nonauditory effects would be unlikely (Gales, 1982). Loss of hearing or auditory discomfort still may occur at greater distances from this potential noise source. Noise levels measured from various existing drilling platforms are generally well below a level of high marine-mammal sensitivity for toothed cetaceans such as belukha whales (Greene, 1986) and pinnipeds such as harbor seals at a distance of 15 m from the platform (Gales, 1982). This information suggests that drilling operations are not likely to cause any annoyance to nonendangered cetaceans and pinnipeds except perhaps to individuals passing very close to the platforms. The playback of recorded industrial noises in the presence of breeding ringed seals indicated no effect or no reduction in ringed seal vocalizations or other sounds made by the seals (Cummings, Holliday, and Lee, 1984). The noise associated with construction of a gravel island in shallow water could not be detected at 2 mi (3.2 km) from

the island (Greene and Johnson, 1983); and ringed seal distribution was slightly altered in the immediate vicinity of the island (Green and Johnson, 1983).

Frequent and/or intense noise that causes a flight or avoidance response in marine mammals could permanently displace animals from important habitat areas. However, the monitoring of belukha behavior and distribution for the past 10 years in the Mackenzie River Delta estuary (in association with marine traffic supporting Canadian oil and gas activities) has not shown any long-term or permanent displacement from the estuary, even with present comparatively high levels of industrial activity (Fraker, 1983). The presence of several thousand belukha whales, seals, and walruses in Bristol Bay during intensive commercial-fishing activity and their exposure to noise from numerous fishing boats suggests that these species and perhaps other marine mammals can habituate to fairly high levels of human activity.

Noise could cause disruption of reproductive activities such as displacement of ringed seals from important denning and pupping habitats. A comparison of ringed-seal densities between areas of seismic exploration and areas where no on-ice seismic activities occurred (using aerial data collected in June 1975 to 1977 to investigate variation in ringed seal distribution) showed a lower density of seals in areas where there had been seismic-exploratory activity (Burns, Shapiro, and Fay, 1980). However, such survey data are only an indication of overall survival through the long winter-spring period and provide no insight into the nature, extent, or causes of changes recorded (Burns and Kelly, 1982). Results of surveys conducted in 1981 were ambiguous as far as determining whether seismic exploration results in displacement of ringed seals (Burns, Kelly, and Frost, 1981). Burns and Kelly (1982) conducted ground examination of ringed seal-den structures to determine the fate of such structures along seismic lines and along control lines. The latter investigators reported no significant overall difference in the fates of den structures between seismic and control lines; however, they reported significant differences in the fates of den structures in relation to distance from seismic lines (within 150 m of the shot line in comparison to beyond this distance). The investigators concluded that displacement of seals in close proximity (within 150 m) to seismic lines does occur. However, based on data from aerial surveys in 1982, there is no large-scale displacement of seals away from on-ice seismic operations as currently conducted in the Beaufort Sea. Aerial surveys conducted in 1985 and 1986 along the Beaufort Sea coast also indicated no large-scale displacement of ringed seals from industrialized areas (Frost et al., 1988).

(3) Site-Specific Noise and Disturbance Effects: The primary sources of noise and disturbance of ringed, bearded, and spotted seals; walruses; polar bears; and belukha whales would come from the air and marine traffic associated with the base case and more specifically from the supply boats, icebreakers, and helicopters associated with the assumed one to three exploration-drilling units and four production platforms. Geophysical on-ice equipment, geophysical seismic boats, the onshore pipeline, and additional support facilities assumed or the base case also would be primary noise sources (see Sec. II.B.2.a). Secondary disturbance sources would be low-frequency noises from drilling operations on the exploration-drilling units and production platforms. Aircraft traffic (180 to 360 trips/year during exploration and development) centered out of Deadhorse, Barter Island, Barrow, or Camp Lonely, traveling to and from the four production platforms, could be a primary disturbance source to spotted seals hauled out on the beaches along the Colville River Delta and other haulout areas and to walruses and bearded and ringed seals hauled out on the ice. Exploration drilling would take place from bottom-founded mobile and floating drilling units; depending on ice conditions, the floating units would be supported by one or more vessels with icebreaking capabilities.

Exploratory drilling during the winter season--when natural leads are often frozen over--would result in the formation of leads and cracks in the ice on the leeward sides of the drill rigs, and such local changes in the ice habitat would attract seals and in turn attract polar bears (Stirling, 1988). Some polar bears could be unavoidably killed to protect oil workers when the bears were attracted to the rigs due to food odors and curiosity. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means in most cases to protect the rig workers from polar bear encounters. The number of bears lost as a result of such encounters is expected to be very low.

Exploration drilling from drillships in the deeper water tracts may coincide with the belukha whale fall migration through the offshore areas along the pack-ice front. Icebreaker traffic has been demonstrated to disturb belukha whales within 35 to 50 km of the vessel (Finley and Davis, 1984). Other than flight responses, the meaning or importance of behavioral changes correlated with the sound and presence of boats is uncertain. Boat traffic could briefly (a few days) interfere with migration when the vessels are near

marine-mammal concentrations within a lead system; and it may temporarily interrupt the movements of belukha whales, seals, and walruses or temporarily displace some populations when the vessels pass through the area. However, there is no evidence to indicate that vessel traffic would block or significantly delay marine-mammal migrations. In fact, severe ice conditions are likely to have a far greater influence on spring and fall migrations than vessel traffic associated with the leasing proposal. Such traffic is not likely to have more than a LOW effect on marine-mammal migrations or distributions, but the displacement of pinnipeds, polar bears, and belukha whales could affect the availability of these animals to subsistence hunters for that season. Icebreaker activity also may physically alter some ice habitats and destroy some ringed seal lairs in pack-ice areas, perhaps crushing or displacing some ringed seal pups and perhaps displacing some denning polar bears.

Some of the air traffic to and from exploration-drilling units (180 helicopter trips/year) and to and from the four production platforms (up to 360 helicopter trips/year) could disturb hauled-out seals and walruses, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing walruses and seals hauled out on the ice. During the summer through fall period (July through September), if walrus nursery herds that were hauled out on the ice in the far western part of the sale area (see Graphic 2) were greatly disturbed by low-flying aircraft, injury or death to young calves could result from the stampede of cows into the water. Disturbance of walrus nursery herds also might cause abandonment of calves by walrus cows. Although air-traffic disturbance would be very brief, the effect on individual walruses, particularly calves, could be severe. The number of walruses and seals affected would depend on the number of disturbance incidents (one or two aircraft flights/day to four platforms). Because the walrus nursery herds are widely distributed along the ice front and along lead systems during spring migration, aircraft traffic to and from the drill platforms is not likely to disturb a major portion of the calving population. However, LOW effects on portions of the walrus calf population are expected. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast or disturbance of bearded seals hauled out offshore near the two drill platforms is not likely to result in the death or injury of large numbers of seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals if disturbances were frequent.

c. Effects of Geophysical Seismic Activities: It is assumed that approximately 560 seismic-line mi of geophysical surveys over a total of about a 125 mi<sup>2</sup> would be shot over a 28-day period during exploration primarily during the open-water season using about two vessels. About 760 line mi of geophysical surveys totaling 142 mi<sup>2</sup> would occur during development in association with platform installation (see Sec. II.B.2.a).

Ringed seals pupping in shorefast-ice habitats within about 150 m of the on-ice shot lines are likely to be disturbed by on-ice seismic exploration (Burns and Kelly, 1982). However, the number of ringed seal pups that could possibly be lost as a result of this level of disturbance is likely to be less than a few hundred, considering the low density of breeding seals in the Beaufort Sea, and would represent no more than a LOW effect on the population. During development, an estimated 142 mi<sup>2</sup> of open-water shallow-hazards survey lines at four survey sites (based on past seismic activity), using perhaps two seismic boats for 28 days, could disturb pinnipeds, polar bears, and belukhas during the 4 weeks of survey activity. Similar to other boat traffic, open-water, active seismic activities are likely to result in startle responses by ringed, bearded, and spotted seals; walruses; polar bears; and belukha whales near the sound source. As with other vessel traffic, this disturbance response is likely to be brief; and the affected animals are likely to return to normal behavior patterns within a short period of time after a seismic vessel has left the area. Noise and disturbance from seismic boats and other vessels could be a problem if boat traffic moved near marine-mammal-haulout areas or interfered with spotted seal and walrus movements. However, this effect is unlikely, given the expected amount of vessel traffic associated with the base case. If the presence of noise from industrial activity occurred very near coastal subsistence areas and reduced or delayed the use of these habitats by marine mammals, the availability of these subsistence resources to villagers could be adversely affected (see Sec. IV.C.3, Effects on Subsistence). Overall, noise and disturbance from air and marine traffic associated with the base case is expected to have a LOW or short-term, local effect on marine-mammal populations.

d. Effects of Offshore Construction: Under the assumed development scenario, one to three exploration-drilling units per year (1992-1996) and four oil-production platforms are assumed to be used in the sale area. Platform-site preparation and pipeline trenching could affect marine mammals through noise and disturbances, through habitat alterations (4.6 mi<sup>2</sup>) of benthic habitat representing less than 1% of the benthic habitat in the sale area affected by pipeline trenching), and through temporary changes in availability of food sources within this area. Some pinnipeds, polar bears, and belukha whales could be

temporarily displaced by noise and disturbance from platform-installation and pipelaying activities and also from other support activities. Temporary displacement could occur within 2 to 3 km of the following platform locations: northwest of Barter Island, Harrison Bay, west of Harrison Bay, and offshore of Peard Bay in the Chukchi Sea. Prey species could be temporarily disrupted or buried near the pipeline-trenching and platform-preparation sites (see Sec. IV.C.2). During construction, some marine mammals near platform-installation sites and along the total of 275 mi of offshore pipelines could be temporarily displaced for approximately one season. In theory, marine mammals could continue to be disturbed and habitat use could continue to be diverted a few kilometers away from the platforms over the life of the field, possibly representing a VERY HIGH effect. However, the amount of displacement and change in habitat use is likely to be very small in comparison with the natural variability in seasonal habitat use and natural variations in marine-mammal distributions. Noise-disturbance and adverse-habitat effects associated with platform and offshore-pipeline installation are expected to be LOW.

e. Effects of Onshore Construction: Onshore landfall development for pipelines to TAP is assumed to take place at Point Thomson, Oliktok Point, Pitt Point, and Point Belcher with the construction of 325 mi of elevated onshore pipelines to TAP. During construction, this development could disturb and perhaps displace a small number of seals and polar bears within a few kilometers of these four landfall sites.

Ringed seals that seasonally inhabit shorefast ice along the coast and a few polar bears could be displaced near the site. However, the number of animals disturbed and/or displaced would be few, and the amount of coastal habitat altered would be localized near the pipeline-landfall sites. Under the base case, onshore-development effects on regional marine-mammal populations are likely to be LOW, with any disturbance of seals and polar bears declining after construction activities are complete.

SUMMARY: For the base case, oil spills; noise and disturbance; and habitat alterations from drill-platform installation, pipeline laying, and other construction could have some adverse effects on pinnipeds, polar bears, and belukha whales found in the lease-sale area. There is a 68-percent chance of one (22,000-bbl average) or more oil spills of 1,000 bbl or greater occurring during base-case exploration and development. Potential oil spills pose the greatest risk of contact to all marine mammals in the Point Barrow offshore area (SMA) and in ice-flaw-zone habitats located from Smith Bay west to Point Barrow (Fig. IV-C-5-1).

Some aggregations of about 10 to perhaps a few hundred ringed, spotted, and bearded seals and walrus occurring in these habitats could be contaminated and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups are likely to be contaminated by a winter oil spill resulting perhaps in the death of some pups--probably no more than 100 (due to the sparse distribution of pupping lairs). Polar bears also would be most vulnerable to oil spills in the ice-flaw zone; however, a small number of bears (probably fewer than 50-100) are likely to be affected due to their sparse distribution (a LOW effect).

Walrus herds of several thousand and their seasonal feeding habitat west and north of Point Barrow could be at some risk of oil-spill contact. Direct effects of oil are likely to be MODERATE. Healthy adult walrus are not likely to die from oil-spill contact, but several hundred or more young calves could be killed if oiling occurred. The oil contamination of part of the walrus herd could result in the loss of several hundred calves and some adult walrus, but such a loss is likely to be replaced by natural recruitment within one generation. Little or no significant contamination of benthic-food sources of walrus and bearded seals is expected, because very little oil is likely to sink to the bottom except for scattered tarballs. This contamination is not expected to reduce the availability of benthic organisms. This is likely to be a VERY LOW effect on the walrus and bearded seal populations.

Belukha whales are most vulnerable to oil-spill contact during spring migration off Point Barrow. The western Beaufort Sea population of belukhas is likely to have some contact with hydrocarbons in the water column or on the surface if an oil spill contaminated the lead system off Point Barrow during spring migration. However, few belukha whales are likely to be seriously affected by probable brief exposure to the spill (a LOW effect).

Ringed seal pups and polar bears are the species most likely to suffer direct mortality from oil spills in the lease area. A small number of ringed seals--perhaps 75 to 100 pups and highly stressed adults--and a small number of polar bears (no more than perhaps 20-30 in a severe case) could die if a spill occurred. This would represent no more than a MODERATE effect on the Beaufort Sea populations, with losses within the populations replaced within one generation.

Present knowledge of the behavior of nonendangered marine mammals and the nature of noise associated with offshore oil and gas activities suggests that intense noise causes brief startle, annoyance, and/or flight responses of pinnipeds, polar bears, and belukha whales. Helicopter trips and boat traffic to and from base-case exploration-drilling units and production platforms could disturb some hauled out ringed, bearded, and spotted seals and walruses, causing them to panic and charge into the water and resulting perhaps in the injury or death of some seal pups and walrus calves. Because the walrus nursery herds and nursing seals and pups are widely distributed along the ice front, aircraft moving to and from drill platforms are likely to temporarily disturb only a small portion of the walrus and seal populations. Thus, aircraft-disturbance effects are likely to be LOW. Vessel traffic associated with the drilling units, production platforms, and seismic vessels operating during the open-water season temporarily could displace or interfere with marine-mammal migration and change local distribution for a few hours to a few days. Such short-duration and local displacement is expected to have a LOW effect on pinnipeds, polar bears, and belukha whales.

The installation of two production platforms and the laying of 275 mi of offshore pipelines with 4.6 mi<sup>2</sup> of benthic habitat altered are likely to have a short-term and local or LOW effect on these marine mammals. The combined effect of oil spills, noise and disturbance, and habitat alterations is likely to be MODERATE.

**CONCLUSION:** The effects from activities associated with the base case are expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales.

## 6. Effects on Endangered and Threatened Species

The effects of the Sale 124 base case on endangered and threatened species are discussed by examining potential effects of exploration and development on the bowhead and gray whales and the arctic peregrine falcon, listed species likely to be present in or near the sale area. Information contained in this section is summarized from the Beaufort Sea Sale 97 FEIS (USDOI, MMS, Alaska OCS Region, 1987a), which is incorporated by reference. Also, a full discussion of the effects from noise-disturbance activities and the ESA Section 7 consultation process is found in the low-case effects analysis (see Sec. IV.B.6.).

a. Effects on Bowhead Whales: The OSRA is used in this analysis to assess the vulnerability of bowhead whale habitat to contact by oil spills. Appendix G, Tables G-15 to G-18, show the combined probabilities of oil-spill risk to given environmental resource areas (the probability of one or more spills occurring and contacting identified resource areas). Combined probabilities assume exploration and development and production over the expected life of the lease-sale area. Unless otherwise noted, combined probabilities during the open-water season referenced in this discussion refer to occurrence and contact by one or more spills of 1,000 bbl or more during a simulated 30-day period following a spill or after meltout of a winter spill. Combined probabilities referenced for winter trajectories refer to occurrence and contact by one or more spills of 1,000 bbl or more during the entire winter. (Refer to Fig. IV-C-6-1 for locations of spill-sites and endangered whale-habitat areas.)

Areas of bowhead whale habitat most vulnerable to occurrence and contact by one or more oil spills when bowheads are present would include Bowhead Spring-Migration Corridors A and B (April through mid-June), an 11- and 6-percent probability of occurrence and contact, respectively (Table G-15); and Bowhead Fall-Feeding-Area A (mid-June through September), a 7-percent probability of occurrence and contact (Table G-17). All other bowhead-habitat areas would have less than a 0.5-percent probability of oil-spill occurrence and contact.

Assuming bowhead whale habitat is contaminated with spilled oil while bowheads are present, some whales could experience one or more of the following: skin contact, baleen fouling, inhalation of hydrocarbon vapors (from a fresh spill, not an old or melted-out spill), a localized reduction in food resources, the consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size and duration of the spill, the density of the whale population in the area of the spill, and the whales' ability or inclination to avoid contact with oil. Unless whales stopped to feed in the area of a spill or were trapped in a lead into which oil was spilled, contact with oil would be brief. Even a large spill of 22,000 bbl under open-water conditions could produce a slick that, after 30 days, would cover about 3 to 5 square km<sup>2</sup> (Appendix M, Table M-1). Bowheads migrating at an average speed (about 1.9 mi/hr [3 km/hr]) would be expected to pass through the discontinuous oiled area in less than 8 hours. Of this time, less than 10 to 15 minutes would be spent passing through or under actual oil slicks. No more than several hundred bowheads would be exposed to lightly weathered oil from a spill of short duration, because the migration continues for approximately 2 months through any one area; after several days, the spill should have moved out of the whale-migration corridor, and weathering should render the oil relatively harmless to the whales. If a prolonged spill (such as an uncontrolled blowout) were to occur at the start of the bowhead migration, most of the whale population could be exposed to lightly weathered crude oil. This event would be extremely unlikely. During the period 1971 through 1983 (the period for which statistics are available), over 13,000 OCS wells were drilled; only a fraction of these wells were drilled in the arctic region. No oil was spilled as a result of drilling blowouts, and less than 1,000 bbl were spilled as a result of nondrilling blowouts.

Should oil be released in Alaskan waters when bowhead whales are present, the whales would be most likely to contact oil as they surface to breathe. Bowhead whales have not been observed in the presence of an oil spill, so it is uncertain if they would avoid surfacing in the oil. Other baleen whales, including the closely related right whale, were seen surfacing and even feeding in or near an oil slick off Cape Cod, Massachusetts. Oil is unlikely to adhere to smooth areas of bowhead skin, and any effects are likely to be transient. Oil might adhere to rough areas on the skin surface. If bowheads vacated oiled areas, it is probable that most of the oil would wash off the skin and body surface within a short period of time. However, if bowheads remained in oiled areas, oil might adhere to the skin and other surface features (such as tactile hairs) for longer periods of time, possibly resulting in skin ulceration or compromising the function of the tactile hairs.

If feeding bowheads contacted spilled oil, the baleen fringe filaments could be fouled, resulting in a reduced filtration efficiency. Bowheads most likely would occupy oiled waters for only a short period of time, and

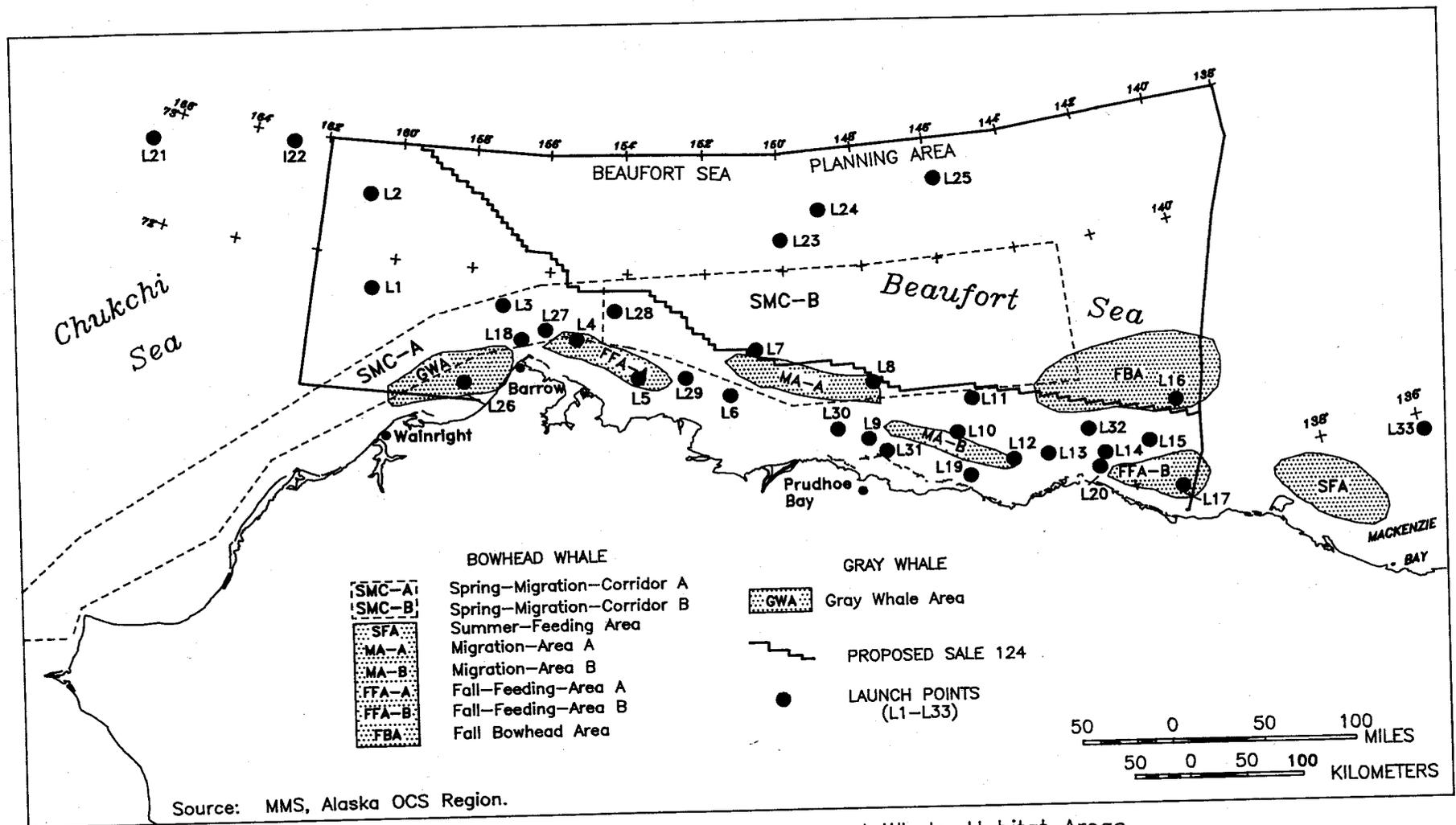


Figure IV-C-6-1. Study Area, Spill-Launch Points, and Endangered Whale-Habitat Areas

zooplankton-filtration efficiency would return to normal in a matter of hours as oil is flushed from the baleen; however, repeated baleen fouling over an extended period of time might result in reduced food intake and blubber deposition that might, in turn, adversely affect the health and survival of bowheads.

If bowheads contacted an oil slick, it is unlikely that they would inhale oil into the blowhole while breathing; however, bowheads surfacing in a spill of lightly weathered oil could inhale some petroleum vapors, which might result in pulmonary distress. Perhaps the most serious situation that could occur is if oil were spilled into an ice lead that bowheads could not escape. In this case, whales could die or suffer pulmonary distress from the inhalation of toxic vapors. The probability of such an occurrence is extremely low, and generally only a few whales would likely occupy the affected lead at any given time and thus be subject to possible mortality. Vapor concentrations that could be harmful to whales would be expected to dissipate within several hours after termination of a spill.

While feeding, bowheads sometimes skim the water surface, filtering large volumes of water for extended periods; consequently, they might ingest some spilled oil if any were present. It has been suggested that baleen filaments and ingested oil may clump together to form a gastrointestinal obstruction, although this has never been observed in nature. Based on extrapolation of studies involving oil ingestion by rats, it appears unlikely that a cetacean would accidentally ingest a sufficient quantity of oil to be at risk.

Pelagic zooplankton, the major food source of bowhead whales, is generally considered to be largely unaffected by oil spills. If a substantial quantity of oil were to reach the seafloor, the bowhead's secondary food source could be reduced through the death of benthic invertebrates or through sublethal effects such as reduced fecundity and larval settlement or a change in species composition. Bowheads might ingest some oil-contaminated prey items, but it is likely that these organisms would comprise only a small portion of the bowhead's food intake, and there is evidence to indicate that bowheads may be capable of metabolizing and excreting low levels of petroleum hydrocarbons.

Many individuals are concerned about the effects of oil spilled into the spring-lead system during the bowhead whale migration. A discussion of such effects is contained on pages IV-B-78 through IV-B-82 of the Chukchi Sea Oil and Gas Lease Sale 109 FEIS (USDOJ, MMS, Alaska OCS Region, 1987b), and is summarized and incorporated by reference.

The presence of ice could restrict the spread of the oil. Agitation of ice particles in combination with oil could initially increase oil dispersion into the water column; however, it also would result in a more rapid formation of a water-in-oil emulsification. Grease ice (newly formed ice) and spilled oil would be blown downwind and would accumulate in a band along the downwind edge of open leads or ice floes. When the lead closes or ice floes are blown together, the accumulated grease ice and oil would be pushed onto the adjacent ice. It is unlikely that oil would completely cover the surface of the water except in cracks and small pools sheltered from the wind. Toxic vapors would be carried away from any leads by the wind, and volatile compounds would be lost within 24 to 48 hours of weathering at the surface. Harmful concentrations of toxic vapors from spilled oil should not persist for more than a few hours after the oil has weathered at the surface. Oil spilled under winter ice would pool and freeze to the underside of the ice. Multiyear sea ice--the most prevalent type in the area--can trap 1.8 MMbbl/km<sup>2</sup> in under-ice relief. Consequently, oil spilled in heavy ice cover would be unlikely to spread appreciably under the ice before being frozen into the ice. The spilled oil would then move as part of the pack ice. The oil would either melt out at the southern ice edge as the pack retreated or migrate through brine channels and pool on top of the ice as melting conditions began to occur.

Spilled oil might contact migrating whales as they surface to breathe. Contact would likely be brief unless the whales stopped to feed in the area. Effects of oil contacting bowheads under winter or broken-ice conditions would generally be similar to those previously described, including baleen fouling, inhalation of toxic vapors (from a fresh spill, not an old or melted-out spill), ingestion of oil or oil-contaminated prey, and irritation of skin or sensitive tissues. Bowheads may migrate through an oil-spill area without actually contacting oil because, as mentioned earlier, the oil would accumulate along the downwind edge of any open-water areas. On occasion, bowheads have been observed continually returning to the same small area of open water, presumably because there was no other readily available open water where they could surface. If a substantial quantity of fresh crude oil or an aromatic refined-petroleum product were spilled into such an area of open water, it is possible that the animals trapped there could die or suffer pulmonary distress from the inhalation of toxic vapors. However, this is expected to be a very rare case that would affect only a low number of whales.

Should a large oil spill occur and cover a substantial stretch of a major spring lead used by migrating bowheads, a number of bowheads may contact oil and/or a portion of the bowhead spring migration might be delayed or temporarily blocked. Bowheads probably would not migrate through the pack-ice zone to avoid an oil spill blocking a lead unless the pack-ice zone had an adequate number of cracks or small ponds for bowhead respiration. Bowheads may migrate under the ice and avoid the oil contamination. Such a spill could affect a substantial portion of the bowhead population; but unless the spill were prolonged, its effects would likely be short lived. Within several hours to several days after cessation of the spill, the oil should have accumulated along the downwind or downcurrent edge of the lead and should no longer pose an impediment to the migration. Such a short-term delay in the migration should not result in significant effects on the population, because there is considerable natural variability in the timing of the migration due to ice conditions. A substantial number of bowheads could contact oil if individuals, driven by the migratory urge, attempted to swim through the oil-covered lead. Some of these individuals might succumb to toxic vapors if the spill were very fresh. It has been shown, however, that bowheads are quite adept at migrating beneath at least thin ice (George et al., 1989); and bowheads may migrate under the ice around the area of oil contamination.

There could be a number of minor alterations in bowhead habitat as a result of Sale 124. Bottom-founded drilling units and production platforms may cover small areas of benthic habitat, and muds and cuttings from drilling may bury portions of the seafloor that support benthic invertebrates used for food by bowhead whales; however, the effects are expected to be minimal--bowheads feed primarily on pelagic zooplankton, and the areas of sea bottom that are affected would be very small in relation to the available habitat.

Base-case noise-producing activities most likely to affect bowhead whales would include aircraft traffic, icebreaking or other vessel traffic, geophysical-seismic surveys, drilling, pipeline laying, and production operations. Helicopter trips during exploration-well drilling are estimated to average one trip per day per site, and two trips per week per platform are expected during production. Generally, vessel traffic would be limited to routes between the exploratory-drilling units or production platforms and the shore base. Each drilling unit probably would have one vessel remaining nearby for emergency use, and one supply vessel per week. Depending on ice conditions, floating drilling units may have two or more icebreaking vessels standing by to perform ice-management tasks. Units drilling production and service wells would be resupplied by barge during the open-water period. Two to three support vessels would be associated with pipeline installation.

Shallow-hazards seismic surveys for exploration-delineation-well sites would be conducted during the ice-free season. The total seismic activity associated with the Sale 124 exploration phase is estimated to take 28 days and to cover 125 mi<sup>2</sup> (324 km<sup>2</sup>). Approximately 142 mi<sup>2</sup> (184 km<sup>2</sup>) of shallow-hazards surveys taking 28 days would be conducted prior to installation of the production platforms.

Another source of noise would be from drilling units, production platforms, and dredging and trenching that may occur in construction of the gathering pipeline projected for the production phase. An estimated 14 exploration and delineation wells would be drilled within the Sale 124 area during the first 6 years following the sale. Two to four exploration or delineation wells would be drilled per year with a maximum of three drilling units operating contemporaneously. Four production platforms are projected to be installed following exploration. An estimated 75 mi of trenching would be required for the offshore pipelines.

The above-described noise-producing activities associated with the base case could produce a variety of effects to the bowhead whale. Effects from these activities could include short-term startle responses and avoidance of stationary noise sources, such as drilling or dredging. A full discussion of noise and disturbance effects can be found in Sec. IV.B.6.b.

**SUMMARY:** There is a low probability of one or more oil spills of 1,000 bbl or more occurring and contacting bowhead whale habitat when bowheads are expected to be present. The bowhead Spring-Migration Corridors A and B have the greatest probability of occurrence and contact (11 and 6%, respectively); other areas have less than a 7-percent probability of occurrence and contact. The probability of oil actually contacting whales would be considerably less than the probability of contact with bowhead habitat. If an uncontrolled, uncontained spill were to occur, bowheads could experience one or more of the following: skin contact with oil, baleen fouling, inhalation of hydrocarbon vapors, a localized reduction in food resources, the consumption of oil-contaminated prey items, and perhaps temporary displacement from some feeding areas. Some individuals may be killed or injured as a result of prolonged exposure to freshly spilled

oil; however, the number of individuals so affected is expected to be small. Should a large oil spill occur and cover a substantial stretch of a major spring lead used by migrating bowheads, a portion of the spring bowhead migration might be delayed or temporarily blocked; or it may result in a substantial number of bowheads contacting oil. The effect of these factors on the bowhead whale population is expected to be MODERATE.

Bowhead behavior can be affected markedly but temporarily by the close approach of vessels and less consistently by aircraft. Bowheads do not seem to travel more than a few miles in response to a single disturbance incident, and their activities do not seem to be interrupted for long. Occasional brief interruption of feeding by a passing boat or aircraft is probably not of major significance. Similarly, the energetic cost to bowheads of travelling a few extra miles to avoid a closely approaching noise source is very small in comparison with the energetic cost of migration between the central Bering and eastern Beaufort Seas. However, these factors might become significant if industrial activity were sufficiently intense to cause repeated displacement of specific individuals (which we do not believe to be the case at the level of development projected under the base case). Reactions are less obvious in the case of industrial activities that continue for hours or days, such as distant seismic exploration, drilling, and dredging. Behavioral studies have suggested that bowheads habituate to noise from distant ongoing drilling, dredging, or seismic operations (Richardson, Wells, and Wursig, 1985; Richardson et al., 1985), but there is still some apparent localized avoidance (Davis, 1987). There is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely affect bowhead use of that area (Richardson et al., 1985b), but there has been no documented evidence that noise from OCS operations would serve as a barrier to migration. As a result, the effect of acoustic disturbance from operations associated with Sale 124 is expected to be LOW.

**CONCLUSION (Effects on Bowhead Whales):** The combined potential effects on bowhead whales of activities associated with the base case are expected to be MODERATE.

b. **Effects on Gray Whales:** Nonacoustic effects on gray whales include effects of oil spills and habitat alteration. Direct effects of oil spills on endangered gray whales can be divided into two parts: (1) the vulnerability of the whales to oil-spill contact and (2) assuming contact is made, the potential sensitivity of individuals to spilled oil.

The OSRA was used in this analysis to assess the vulnerability of gray whale habitat to contact with oil. Appendix G, Tables G-15 to G-18, show the combined probabilities of oil-spill risk to given target areas (the probability of spills occurring and contacting identified resource areas). Combined probabilities assume exploration and development and production over the expected life of the lease-sale area. Unless otherwise noted, combined probabilities referenced in this discussion refer to contact by spills of 1,000 bbl or more during a simulated 30-day period following a spill or after meltout of a winter spill.

The Gray Whale Area (Fig. IV-C-6-1) has a low probability (7%) (Table G-17) of occurrence and contact by spilled oil during the summer gray whale-feeding period. Assuming gray whale habitat is contaminated with spilled oil when whales are present, some gray whales could experience one or more of the following: skin contact with oil, baleen fouling, inhalation of sublethal concentrations of hydrocarbon vapors, a localized reduction in food resources, the consumption of some contaminated prey items, and local displacement from some feeding areas. The effect of oil contact on gray whales would be similar to that previously described for bowhead whales. The number of whales contacted would depend on the size of the spill, the number of whales in the area of the spill, and the whales' ability or inclination to avoid contact with oil.

Should oil be released in waters occupied by gray whales, whales would probably contact oil as they surface to breathe and may react similarly to gray whales observed off the California coast. Some whales changed their swimming direction and thus avoided surface oil, while others maintained their swimming direction but took fewer breaths, remained submerged for longer periods, and swam faster while in oiled waters. Prolonged contact with skin or eyes may result in irritation or ulceration; however, brief contact should not result in serious long-term harm to the whales.

Gray whales that feed or pass through oiled areas with their mouths open may be susceptible to short-term fouling of their baleen. However, spilled crude oils should not significantly obstruct waterflow through the baleen, and filtering efficiencies should return within minutes after discontinuing feeding in oil.

Should an oil spill occur in an area where gray whales are present, it is possible that the whales could inhale

toxic hydrocarbon vapors. Inhaled petroleum vapor may result in respiratory distress. Animals already stressed by liver and lung parasites and adrenal disorders might be particularly vulnerable to the effects of even low levels of hydrocarbon vapors. Within 24 hours of the spilled oil being exposed to the air, most of the toxic vapors would have dissipated. It is unlikely that more than a few gray whales would be exposed to toxic hydrocarbon vapors, and no mortalities are expected.

Some feeding areas may be precluded from use or made less desirable by the presence of oil; however, only a small portion of gray whale-feeding habitat is within the sale area, and the vast majority of this habitat would remain unaffected by an oil spill. Gray whale-food sources may undergo a localized reduction as a result of an oil spill. Gray whales also may consume some contaminated prey items or benthic substrate; however, given the large area over which whales feed, ingestion of contaminated prey is not likely to pose a serious health threat.

It is assumed that two or three drilling units per year will be used for exploration. If located in a gray whale-feeding area, these units could temporarily occupy several acres of habitat and could possibly displace a few whales from several hundred yards to a few miles from the drilling unit for one season. One or both of the two expected oil-production platforms may be located within gray whale-feeding areas. Effects of production platforms on gray whales would be similar to the effects of the drilling units but would last for a greater length of time. A few whales may be excluded from feeding within a few hundred yards of the production platforms. Discharges of fluids from drilling units and production platforms are not expected to significantly reduce gray whale-food resources. Pipeline installation should have little effect on gray whales, because few gray whales venture east of Point Barrow.

Noise-producing activities that occur primarily in the Chukchi Sea portion of the sale area and are most likely to affect gray whales would include aircraft and vessel traffic, geophysical-seismic surveys, and drilling operations and production platforms. The potential noise-producing activities associated with the base case would be as described previously for the bowhead whale (Sec. IV.C.6.a). Stationary sound sources would have very minor effects on gray whales due to the fact that in any one year only two to three exploration-drilling units and a total of four production platforms are expected in the base case. Reactions generally would be short-term and temporary in nature, consisting of localized movements away from the sound source. Whales may avoid feeding within several hundred yards of drilling units and production platforms. A full discussion of noise and disturbance effects can be found in Sec. IV.B.6.c.

**SUMMARY:** As a result of an oil spill, a low number of gray whales may experience one or more of the following: skin contact with oil, baleen fouling, respiratory distress caused by inhaling sublethal concentrations of hydrocarbon vapors, a localized reduction in food resources, the consumption of some contaminated prey items, the possible abandonment of a localized portion of their summer-feeding range, and/or avoidance of an oil-contaminated area. Gray whales would be affected by noise-generating activities such as seismic surveys, aircraft and vessel traffic, drilling units, and production platforms. Reactions generally would be short-term and temporary in nature, consisting of localized movements away from the sound source. Some gray whales may avoid feeding within several hundred yards of drilling units and production platforms. It is not anticipated that summer-feeding activities would be precluded or seriously impaired by noise activities in the Sale 124 area during oil and gas exploration, and effects are expected to be LOW.

**CONCLUSION (Effects on Gray Whales):** The effects on gray whales of activities associated with the base case are expected to be LOW.

c. **Effects on the Arctic Peregrine Falcon:** If oil were released and contacted coastal areas near peregrine-nest sites or feeding areas, peregrine falcons may be affected through direct contact by adults (when hunting or via prey caught in the vicinity of the spills) or indirectly through disruption or a reduction in prey organisms (seabirds and shorebirds). The probability of such an event would be related to the probability of spilled oil being present in the vicinity of peregrine-nesting and/or -feeding areas. There is a very low probability that arctic peregrine falcons would contact spilled oil. Peregrines may occur in coastal areas such as the Colville or Canning River Deltas in the fall or near coastal nest sites south of Barrow. Appendix G, Table G-18, shows less than a 0.5-percent probability that one or more spills of 1,000 bbl or greater would contact the Colville River Delta (Land Segments 31 and 32) or the Canning River Delta (Land Segment 38) within a 30-day period following a spill. Probabilities of spilled oil contacting the coast south of Barrow (Land Segments 1-19) during the nesting season are less than 0.5 percent. Because these probabilities are greater than the risks to which peregrines actually would be exposed--due to their transient

occurrence in the area (and since they do not typically occur in the water)--it can be concluded that it is very unlikely that oil spills would come in contact with areas inhabited by peregrine falcons and, thus, very unlikely that the peregrines would be significantly affected by oil spills. If oil spills affected peregrine-prey populations, short-term, localized reductions in food availability could occur.

Nesting peregrines could, on rare occasions, be disturbed by aircraft overflights related to the proposed sale that may occur inland from the coast. Nesting sites such as those near Ocean Point on the Colville River, about 25 mi inland, and along the coast south of Barrow may be vulnerable to such occasional disturbance. The extent of such disturbance would depend on future locations of support facilities. Aircraft based in Deadhorse or Barrow would not typically fly over this area. Thus, significant disturbance of peregrine falcons associated with the exploration phase is unlikely. Significant population-level-disturbance effects associated with the development and production phase would be unlikely as well. It appears that the onshore-gathering pipelines projected for the production phase will be routed coastward of all peregrine falcon-nesting sites, and it should not adversely affect the species. Consultation with FWS will likely be reinitiated at the time of actual pipeline-corridor planning to ensure that pipeline construction and operation can occur without adverse effects to the species. Gravel mining for any artificial islands associated with Sale 124 is also unlikely to affect the peregrine, because extraction is expected to occur near the Beaufort Sea coast where peregrines are not known to nest.

CONCLUSION (Effects on Arctic Peregrine Falcons): The degree of potential effects on peregrine falcons from oil spills and disturbance is expected to be VERY LOW.

## 7. Effects on Caribou

Among the terrestrial-mammal populations that could be affected by Sale 124 are the more than 448,000 caribou of the Western Arctic, Central Arctic, Teshekpuk, and Porcupine caribou herds (referenced in this discussion as the WAH, CAH, TLH, and PCH, respectively) occurring along the coast adjacent to the Beaufort Sea Planning Area. Under the base case, the primary potential effects of OCS exploration and development activities on caribou would come from motor-vehicle traffic (disturbance) along pipeline-road corridors and near other onshore-support facilities (aircraft traffic is likely to have less of an effect, see Sec. IV.B-7). Secondary effects could come from potential oil spills contacting coastal areas used by caribou for insect relief and small areas of habitat alteration associated with onshore pipeline-road construction including gravel mining for roads, for onshore facilities, and for possible artificial-island construction.

### a. Effects of Disturbance

(1) General Effects: Caribou can be briefly disturbed by low-flying aircraft, fast-moving ground vehicles associated with an onshore pipeline, and the construction of other facilities (Calef, DeBock, and Lortie, 1976; Horejsi, 1981). The response of caribou to potential disturbance is highly variable--from no reaction to violent escape reactions--depending on their distance from human activity; speed of approaching disturbance source; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Cow and calf groups appear to be the most sensitive to vehicle traffic, especially during the summer months, while bulls appear to be least sensitive during that season.

Tolerance to aircraft, ground-vehicle traffic, and other human activities has been reported in several studies of hoofed-mammal populations in North America including caribou (Davis, Valkenburg, and Reynolds, 1980; Valkenburg and Davis, 1985; and Johnson and Todd, 1977). The variability and unpredictability of the arctic environment (snow conditions, late spring, or early winter, etc.) dictate that caribou have the ability to adapt behaviorally (such as change the time and route of migration) to some environmental changes. Consequently, repeated exposure to human activities such as oil exploration and development over several hundred square kilometers of summer range has led to some degree of tolerance by most caribou of the CAH. Some groups of caribou that overwinter in the vicinity of Prudhoe Bay and near Camp Lonely on the NPR-A, and that have been continually exposed to disturbance stimuli, apparently have become accustomed to human activities; however, the majority of the North Slope caribou herds that overwinter south of the Brooks Range are less tolerant to human activities, to which they are seasonally or intermittently exposed, than some caribou that overwinter on the arctic coast.

Some displacement of the CAH from a small portion of the calving range near Prudhoe Bay facilities has occurred (Cameron, Whitten, and Smith, 1981, 1983). This displacement of some caribou cows and calves has occurred within about 4 km (2.5 mi) of some oil facilities (Dau and Cameron, 1986). However, the use of specific calving sites within the broad calving area varies from year to year; and the amount of displacement is probably of secondary importance due to the low density of caribou on the calving range and the abundance of the CAH's calving habitat.

(2) Sale-Specific Disturbance Effects Associated With Oil and Gas Exploration: Disturbance of caribou associated with exploration activities would come primarily from helicopter traffic (250 flights/year) to and from Deadhorse, Camp Lonely, or Barter Island or other onshore facilities and offshore-exploration platforms. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of 60 m or less and exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 500 to 1,000 ft (Calef, DeBock, and Lortie, 1976). These documented reactions of caribou were from aircraft that circled and repeatedly flew over caribou groups. Aircraft traffic associated with exploration is likely to pass overhead of caribou once during any flight to or from the platforms; and the disturbance reactions of caribou are expected to be brief, lasting for a few minutes to no more than 1 hour (a LOW effect).

(3) Effects of Exploration Habitat Alteration: No significant habitat alteration is expected to occur during exploration because it is assumed that existing onshore support facilities at Prudhoe Bay, Camp Lonely, Barter Island, or other facilities will be used. The only habitat alteration that might occur would be gravel extraction from onshore mining sites used in construction of an artificial gravel-island drilling platform. Such gravel is likely to come from existing quarries and would represent a very small (a few acres or hectares) or VERY LOW loss of tundra habitat.

## b. Effects of Oil Spills

(1) General Effects: Caribou sometimes frequent barrier islands and shallow coastal waters during periods of heavy insect harassment and may possibly become oiled or ingest contaminated vegetation. Caribou that become oiled are not likely to suffer the loss of thermoinsulation through fur contamination, although toxic hydrocarbons could be absorbed through the skin and also could be inhaled. Oiled caribou hair would be shed during the fall before the caribou grow their winter fur. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects of oil ingestion in caribou. However, caribou frequent coastal areas to avoid insects and thus are not likely to be grazing on coastal or tidal plants that may become contaminated. In the event of an onshore oil spill that contaminated tundra habitat, caribou probably would not ingest oiled vegetation because they are selective grazers that are particular about the plants they consume. However, caribou that become oiled by contact with a spill in coastal waters could die from toxic-hydrocarbon inhalation and absorption through the skin.

(2) Site-Specific Effects of Oil Spills: Unless otherwise specified, oil-spill-contact probabilities referred to in this section assume the occurrence of exploration and development activities to the extent estimated for the base case in Section II.B.2.a and associated spill rates (Sec. IV-A-1). Attention is devoted to one spill of about 22,000 bbl and to spill contacts that occur within 30 days of meltout or summer spillage. Coastlines that may be frequented by caribou in the ANWR, Prudhoe Bay, and Cape Halkett areas have a less than 0.5-percent chance of oil-spill contact (Appendix G, Table G-18, Land Segments 27 through 44), while barrier islands that may be used by caribou in the Cape Simpson west to the Plover Islands area have a 1- to 2-percent chance of spill contact (Appendix G, Table G-18, Land Segments 20-23). The chance of a spill contacting any coastlines within 30 days is 5 percent for the base case (Appendix G, Table G-17). Thus, some caribou may come in contact with contaminated coastlines and oiled vegetation if a spill occurred. However, probably only a very narrow band of coastline would be oiled (see Sec. IV.A.2.b). The number of caribou affected (perhaps a few hundred) is likely to be small in comparison to the number of caribou (probably several thousand) that die from natural causes on the arctic slope.

If the spill occurred during the open-water season, caribou that frequent coastal habitats such as in the Cape Halkett or Prudhoe Bay areas possibly could be directly exposed to and contaminated by the spill along the beaches and in shallow waters during periods of insect-pest-escape activities. However, even in a severe situation, a comparatively small number of animals (a few hundred to perhaps a thousand) is likely to be directly exposed to the oil spill and die as a result of toxic hydrocarbon inhalation and absorption. This effect probably would be LOW to any of the caribou herds, with losses replaced within less than one generation.

## c. Effects of Development

(1) General Disturbance Effects Associated With Pipelines: Recent studies (Roby, 1978; Cameron, Whitten, and Smith, 1981, 1983) indicate significant seasonal avoidance of habitat near (within 4 km) some existing Prudhoe Bay area facilities by cows and calves during calving and postcalving periods (May through August). Therefore, disturbance from vehicle traffic and human presence associated with present levels of oil development in the Prudhoe Bay area apparently has affected caribou local distribution on a small percentage (an estimated 5%) of their summer range. However, caribou abundance and overall distribution have not been affected--the CAH has greatly increased since oil development began, although this increase in caribou numbers is not to be inferred as caused by oil development.

Cameron, Whitten, and Smith (1983) also reported that caribou cow/calf groups avoid the 200-km-long northern portion of the TAP Dalton Highway (Haul Road) corridor, particularly during the postcalving period. However, caribou cow/calf groups may be avoiding the TAP corridor because it runs primarily along the riparian habitat of the Sagavanirktok River valley, a habitat type that cows and calves normally avoid using during the postcalving season due to the possible presence of hidden predators such as wolves (Carruthers, Jakimchuk, and Ferguson, 1984). Carruthers, Jakimchuk, and Ferguson (1984) reported no significant differences in cow/calf distribution between the TAP corridor and other riparian habitats on the summer range of the CAH. Also, caribou cow/calf groups did not avoid a portion of the TAP corridor on the North Slope, which is separate (4 km away) from riparian habitat and the Dalton Highway (Carruthers, Jakimchuk, and Ferguson, 1984). The latter investigators concluded that the differences in the distribution of caribou cows with calves along the TAP corridor reported by Cameron, Whitten, and Smith (1983) reflect the seasonal-habitat preference of caribou cows with calves in avoiding riparian habitats, on which most of the

corridor is located. However, Carruthers, Jakimchuk, and Ferguson (1984) did not investigate the question of whether caribou cows with calves avoid the Dalton Highway pipeline during periods of high levels of truck traffic. The mere physical presence of the pipeline and associated facilities probably has no apparent effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall may prevent some animals from crossing under or over the pipeline in local areas. On the other hand, human activities associated with transportation routes--particularly road traffic--can have short-term effects on the behavior and distribution of caribou.

Vehicle traffic (particularly high traffic levels such as 40-60 vehicles/hour) on a road adjacent to a pipeline has the greatest manmade influence on caribou behavior and movement while they are crossing the Prudhoe Bay and Kuparuk oil fields and pipeline corridors (Murphy and Curatolo, 1984). A decline in the frequency at which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road and the frequency of severe disturbance reactions exhibited by caribou during crossing (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline (there is no problem with buried pipelines) and may be delayed in crossing a pipeline and road for several minutes or hours during periods of heavy road traffic, but successful crossings do occur. Caribou have returned to areas of previous disturbance after construction was complete in other development areas (Hill, 1984; Northcott, 1984). Since the pipeline road crossing NPR-A is not expected to be open to the public (except for a limited number of public tours that are restricted to certain areas and times-dates) during the life of the oil fields and road traffic on the oil fields would be restricted to oil-support traffic, the frequency of vehicle-traffic disturbance of caribou by nonindustrial activities would be limited because such traffic is allowed only by oil-company permit. Access on the Dalton Highway north of the Brooks Range is restricted to oil-industry-support traffic only of less than 10 vehicles per hour (Louis Berger and Associates, 1984).

(2) General Effects of Habitat Alteration: The construction of pipelines and other onshore facilities on the North Slope necessitates the use of very large quantities (several million tons) of gravel. With the construction of roads and gravel pads for facility-building sites, small areas of tundra vegetation are excavated at the gravel-quarry sites and several square kilometers of caribou tundra-grazing habitat destroyed by onshore development represents a very small percentage of the range habitat available to the caribou herd. The construction of roads and gravel pads provides the caribou with additional insect-relief habitat on the roads and gravel pads, particularly when there is little or no road traffic present.

(3) Effects of Site-Specific Onshore Development: This analysis assumes that transportation activities associated with exploration would be centered out of the Prudhoe Bay area and that no permanent roads would accompany exploration (see Sec. II.B.2.a). Other exploration-support activities might be located at Camp Lonely, Barter Island, and Barrow. Exploration alone in the proposed sale area would not substantially increase industrial development on the North Slope; neither would it greatly increase disturbance of caribou-calving activities (see Section IV.B.7, low-case analysis).

If oil development takes place in the Beaufort Sea, the following potential oil-transportation (pipeline) projects and facility-construction projects could take place and affect the caribou herds. The following assumptions are made under the base case: (1) gas will be uneconomical to develop and produce for the foreseeable future, (2) the TAP will have the capacity to handle production from the lease sale; and (3) three main pipeline routes will be required to connect TAP with the acreage offered (see Sec. II.B.2.a)--these routes would originate one east and one west of Prudhoe Bay and one west of Point Barrow.

(a) Oil Transportation East of Prudhoe Bay: Oil transportation from an assumed platform located northeast of Barter Island and connecting with the leases from Sales 87 and 97 in this area is assumed to be by offshore pipeline connecting to an onshore pipeline with a landfall at Point Thomson. An onshore pipeline would connect to TAP through the Endicott pipeline. Effects of oil development on the PCH probably could be avoided if no extensive onshore system of roads, pipelines, pump stations, and other facilities would cross the calving or summer range of this herd. However, decisions on whether there would be onshore or offshore pipelines east of the Canning River Delta would be influenced by the decision of the U.S. Congress on possible exploration and development in the ANWR. The onshore pipeline and road from Point Thomson to TAP would increase vehicle traffic by perhaps several hundred vehicles per day during construction, which could temporarily disturb some of the 18,000 caribou of the CAH within about 2 mi of Point Thomson and along the pipeline and road corridors to TAP, particularly during construction activities. Disturbance and habitat effects on the CAH are expected to be LOW because interference with caribou movements would be temporary (probably a few minutes to less than a few days); caribou would eventually cross the pipeline-road complex. Additionally, disturbance reactions would diminish after construction is

complete, and vehicle-traffic levels are likely to decrease to less than 100 per day at the most. The abundance and overall distribution of the CAH and PCH are not likely to be affected by the construction and operation of oil-transportation facilities east of Prudhoe Bay that are assumed to be associated with the base case. Local distribution within 2 to 3 mi of the pipeline-road could be affected during construction of the pipeline and road, but such an effect is not expected to persist beyond the construction period (2 years) and would represent a MODERATE effect.

(b) Oil Transportation West of Prudhoe Bay to Barrow: It is assumed that oil would be transported from two offshore platforms located west of Prudhoe Bay; one of these assumed platforms is north of Oliktok Point and the other west of Harrison Bay and northeast of Pitt Point (or north of Smith Bay). The pipeline for the former platform is assumed to have a landfall located at Oliktok Point. From there, it would be connected to TAP by offshore pipeline. The pipeline landfall for the latter platform is assumed to be at Pitt Point, where it would be connected to a main onshore pipeline. Construction and support activities associated with this onshore pipeline from Pitt Point to TAP--with accompanying road-vehicle traffic (zero to several hundred vehicles/day)--would temporarily disturb some caribou of the CAH, WAH, and TLH, particularly when high levels (several hundred vehicles/day) of vehicle traffic are present during construction-gravel hauling. After construction is complete, disturbance levels would subside within 2 years or one generation (because of the great reduction in vehicle traffic to less than 100 vehicles/day, at most or 4-5/hour); and disturbance is expected to have a MODERATE effect on caribou. This level of effect is expected because the animals would eventually cross the pipeline and road, and their numbers and regional distribution are not expected to be affected.

(c) Oil Transportation West of Point Barrow: It is assumed that oil transportation from an offshore platform located northwest of Peard Bay in the Chukchi Sea would be connected to a pipeline system associated with OCS Sales 97 and 109 leases. The offshore pipeline would come onshore at Point Belcher on the Chukchi Sea coast. From there, it would cross NPR-A south of the lake district (but probably north of the Colville River), connect with potential NPR-A leases, cross the Colville near Umiat, and connect with TAP at Pump Station No. 2. This pipeline (altering about 4,000 ha of habitat) would transect all movements of the WAH to the Beaufort Sea coast and would transect the southward spring movement of several thousand caribou that overwinter north of the calving range (an estimated 30,000 caribou of the WAH overwinter on the North Slope (USDOI, NPR-A, 1978). However, caribou that winter on the North Slope apparently do not use well-defined migration routes to the calving range (they do not have to cross the mountain range to get to the calving area). The pipeline would not transect the calving range or migration routes through the mountain passes used by the majority of WAH that overwinter south of the Brooks Range (Fig. III.B.3).

Development of the pipeline could temporarily interfere with some caribou-migration movements, particularly of cows and calves during construction activities and during periods of heavy vehicle traffic (several hundred vehicles/day). Approximately 10 to 20 percent of the WAH (that portion of the herd that winters on the North Slope) would encounter the pipeline. High levels of motor-vehicle traffic (>100 vehicles/day) associated with the pipeline and access road could affect the local distribution and movement of the WAH within about 2 to 3 mi of the pipeline road during the construction period (a MODERATE effect), but such an effect is not expected to persist for more than one generation. The WAH caribou movements would not be blocked. Some caribou would have temporary difficulty crossing the pipeline road during periods of heavy traffic, but successful crossing still would occur during these periods. The temporary disturbance of some caribou groups of the WAH and the short-term interference with movements during construction is expected to be a MODERATE effect.

(4) Onshore Oil-Spill Effects: In the event of an onshore-pipeline spill, some tundra vegetation in the pipeline corridor would become contaminated. An estimated 188 small oil spills averaging from 6 to 1,500 bbl (USDOI, MMS, 1987b) could be associated with the base case. However, caribou probably would not ingest oiled vegetation because they are selective grazers and are particular about the plants they consume (Kuropat and Bryant, 1980). When a pipeline spill occurs, it is likely that control and cleanup operations (ground vehicles, air traffic, and personnel) at the spill site would frighten caribou away from the spill and prevent the possibility of caribou grazing on the oiled vegetation. Thus, onshore oil spills associated with the Proposal are not likely to directly affect caribou through ingestion of oiled vegetation (a VERY LOW effect).

Onshore oil spills on wet tundra kill the moss layers and above-ground parts of vascular plants, or they kill all macroflora at the spill sites (McKendrick and Mitchell, 1978). Thus, pipeline oil spills can destroy or alter

the local grazing habitat along the pipeline corridor. Damage to oil-sensitive mosses may persist for several years if the spill sites are not rehabilitated (e.g., by applying phosphorus fertilizers to spill sites) (McKendrick and Mitchell, 1978). For the most part, onshore oil spills would be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter caribou range within the pipeline corridor. The effect of onshore oil spills on caribou is therefore expected to be VERY LOW.

**SUMMARY:** The primary source of disturbance to caribou is vehicle traffic (perhaps as much as several hundred vehicles/day) that could be associated with onshore transportation of oil from offshore leases. Possible oil spills, offshore construction, and marine transportation probably would have a LOW effect on caribou. The construction and presence of onshore pipelines and roads and the development of other facilities and associated motor-vehicle traffic are disturbance factors to caribou, particularly cow/calf groups of the CAH, TLH, and WAH on their summer range. The CAH-caribou surveys have shown some displacement of cow/calf groups from coastal habitats (an estimated 5% of their summer range) within 4 km of some but not all Prudhoe Bay area industrial facilities on the calving range of the CAH.

Disturbance of caribou along the pipelines and road from Pitt Point to TAP would be most intense during the construction period (perhaps 6 months), when motor-vehicle traffic is highest, but would subside after construction is complete. Caribou are likely to successfully cross the pipeline corridor within a short period of time (a few minutes to a few days) during breaks in the traffic flow, even during high traffic periods, with little or no restriction in movements because caribou successfully cross other roads and TAP during spring and fall migrations (Cameron, Whitten, and Smith, 1986; Eide, Miller, and Chihuly, 1986); and a local reduction in cow-calf distribution within about 2 to 3 mi along the pipeline-road corridor is not expected to persist for more than one generation (a MODERATE effect).

The onshore pipeline associated with OCS Sales 97 and 109 as well as the proposal from Point Belcher to TAP could interfere with some WAH caribou cow-calf movements during construction of the pipeline and during other periods of heavy motor-vehicle traffic (>100 vehicles/day). Perhaps 10 to 20 percent of the WAH that winters on the North Slope would encounter the pipeline-road corridor. During periods of heavy traffic, the local distribution and movements of some caribou groups are expected to be affected within 2 to 3 mi of the corridor, but caribou-migration movements would not be blocked. The temporary disturbance of some caribou groups of the WAH and the short-term interference with some caribou movements during construction of the pipeline and during heavy traffic periods are expected to have a MODERATE effect.

Because oil transportation for development of Federal offshore leases east of the Canning River is expected to be located offshore of ANWR, caribou of the PCH that calve on the ANWR are not likely to be affected. However, a pipeline from offshore blocks east of Flaxman Island running onshore along the coast of Camden Bay could be a possibility if the U.S. Congress allows oil exploration and development to occur on the ANWR. The local distribution of some PCH caribou cows and calves would be affected during the high-traffic construction season, but this effect is not expected to persist for more than one generation (a MODERATE effect). Overall movements and distribution of PCH caribou and abundance of PCH caribou are not likely to be significantly affected by the base case. Brief interruptions in caribou movements during high traffic levels along pipelines and roads are expected to occur (a LOW effect).

**CONCLUSION:** The effects of the base case on caribou are expected to be MODERATE.

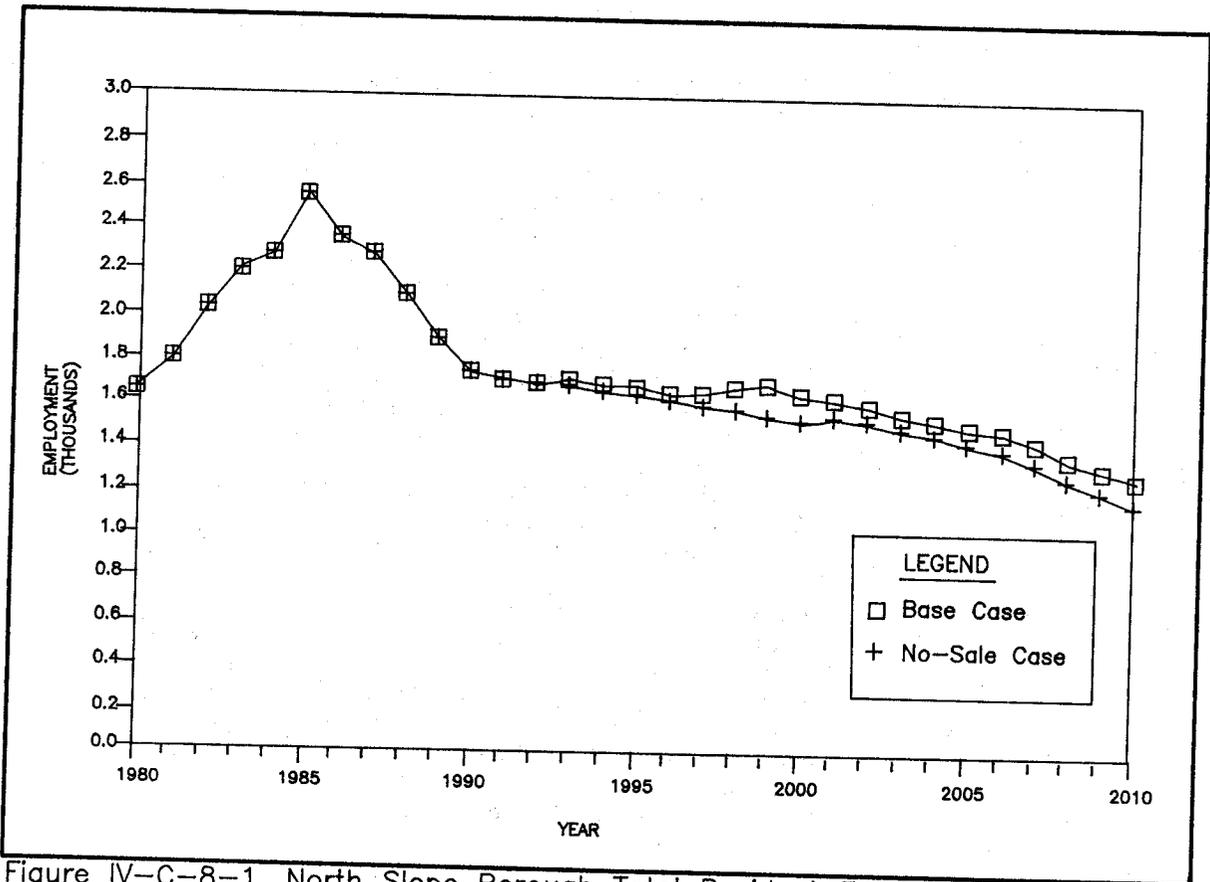


Figure IV-C-8-1. North Slope Borough Total Resident Employment, Comparison of Base and No-Sale Cases.

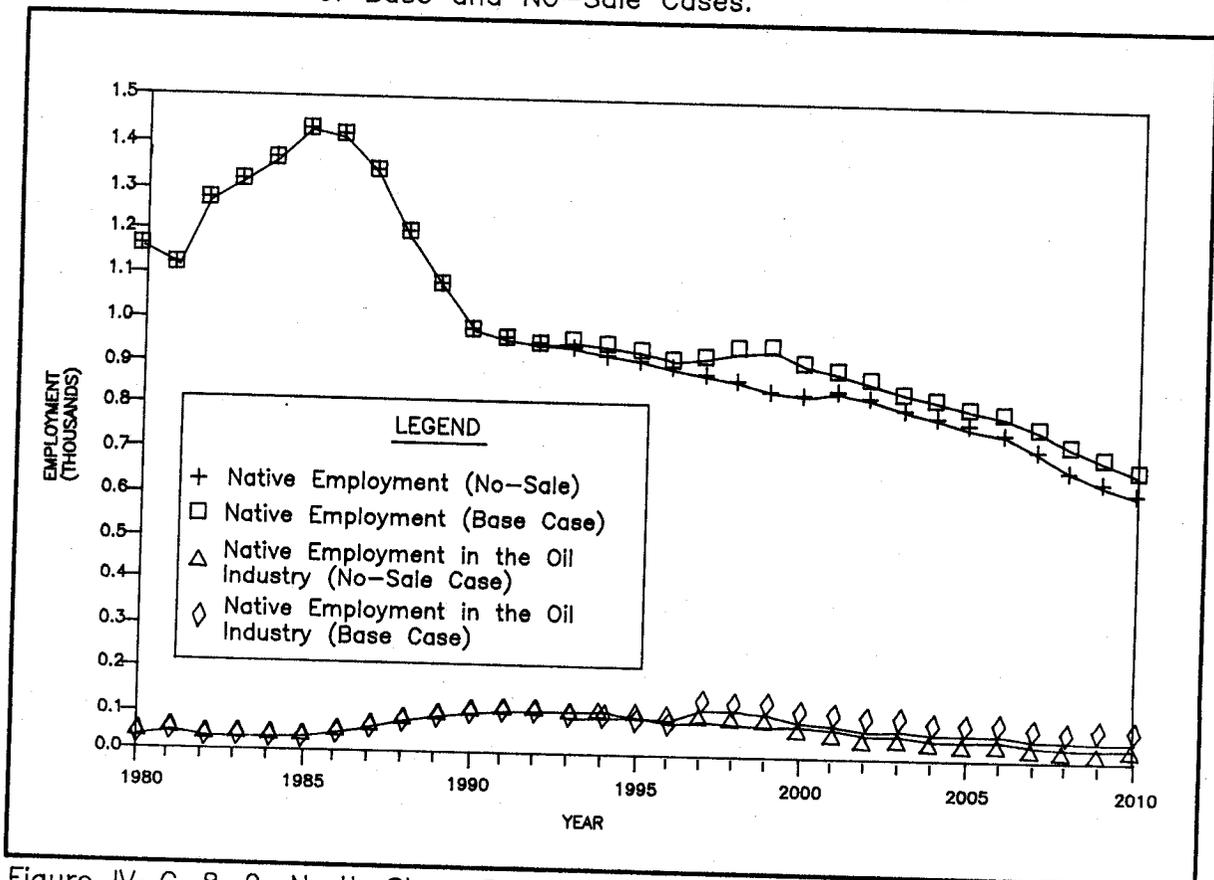


Figure IV-C-8-2. North Slope Borough Total Native Employment, Comparison of Base and No-Sale Cases.

## 8. Effects on the Economy of the North Slope Borough

Analysis of economic effects resulting from proposed Sale 124 is limited to effects on the NSB. The information that follows is from the Rural Alaska Model, prepared for MMS by the Institute for Social and Economic Research, and from the NSB Census (Draft Report, May 26, 1989).

a. NSB Revenues and Expenditures: Under existing conditions, total property taxes in the NSB and NSB revenues are in general projected to steadily decline, as discussed in Section III.C.1. As also discussed in this section, these revenues will be determined by several different factors; and, therefore, the revenue projections should be used with the understanding that many uncertainties exist about these factors. The proposed sale is projected to increase property taxes starting in the year 1993. This value is expected to reach a maximum of 12 percent above the declining existing-condition levels in the year 1999 and again in the year 2010. The average percentage change is expected to be approximately 5 percent. Also, under existing conditions, the two expenditure categories that affect employment--operations and the CIP--are projected to steadily decline. Of these two categories, only expenditures on operations would be affected by the proposed sale's effects on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be affected.

Sale 124 is projected to increase operating revenues, anywhere from 1 percent in 1993 to a high of 9 percent in 1994, above the declining existing-condition level. The percentage change in operating revenues is expected to average 4 percent. Revenues are expected to be 9 and 7 percent above the existing-condition levels in the years 1999 and 2000, respectively, as a result of the construction activity concentrated in this 2-year period that would affect both employment and population. The population effect of sale-induced employment would affect NSB revenues by allowing collection of additional intergovernmental and property-tax operating revenues that are proportional to the NSB population. The percentage effect on operating revenues would begin to rise again after 2005 because of the expected declining existing-condition levels and the induced-population effect on revenues.

b. Employment: The gains from Sale 124 in direct employment would include jobs in petroleum exploration and development and production and jobs in related activities. The estimated peak employment would be 1,869 jobs in the year 1998 (see Appendix J, Table J-2), of which 1,383 would be offshore and 599 would be onshore. Additionally, throughout the production phase, total employment would average about 690 jobs, of which approximately 120 would be onshore. All of these jobs would be filled by commuters who would be present at the work sites approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska--Southcentral; Fairbanks; and, to a much smaller extent, the North Slope. Some workers would commute to permanent residences outside of Alaska, especially during the exploration phase. Because economic effects in other parts of Alaska would be insignificant, only employment increases in the North Slope region are discussed.

The proposed sale is projected to affect employment of the region's permanent residents in two ways: (1) more residents would obtain petroleum-industry-related jobs as a consequence of Sale 124 exploration and development and production activities, and (2) more residents would obtain NSB-funded jobs as a result of higher NSB expenditures, as discussed above.

While the proposed sale is projected to generate a large number of industry jobs in the region, the number of jobs filled by permanent residents of the region is not projected to be large. The predominant factor in the decline of employment in both cases is declining NSB expenditures. Total base-case resident employment is expected to be less than 10 percent greater than existing-condition employment. In the years 1999 and 2000, the sale is projected to increase employment by 9 and 7 percent, respectively, because of concentrated sale-related construction in those years. Total base-case employment should decline at a slightly slower rate and, therefore, employment should not decline as far by the end of the projection period as it would under existing conditions. The average percent change in resident employment resulting from the proposed sale is expected to be 4 percent. Even so, the increase in employment opportunities may partially offset declines in other job opportunities and, therefore, delay expected outmigration.

Figure IV-C-8-1 presents a comparison of total resident employment for the no-sale case and for the base case. Figure IV-C-8-2 presents total resident Native employment for both the no-sale and base cases. It is assumed that all of the direct industry employment of residents is filled by Natives. As can be observed, most of the sale-induced employment is not with the petroleum industry, and the number of sale-induced petroleum-industry jobs would drop as a percentage of sale-induced employment. In addition to the

constraints on industry employment of Native residents discussed in Section III.C.1, the projected small, sale-induced effect can be attributed to a combination of an already historically high level of industry employment assumed under existing conditions and declining petroleum-related employment in the region (see Fig. IV-C-8-2). As industry employment declines in the region, there probably would be less effort made to recruit and retain Native workers.

As for the case under existing conditions, the unemployment rate for Natives is projected to rise from 0 percent in the year 1985 to 50 percent by the year 2002 and to remain at that level until the end of the projection period in the year 2010. While the unemployment rates are about the same for both cases, the sale case is projected to have a larger number of unemployed and a larger labor force, which results in similar rates. As under existing conditions, non-Native residents who lose their jobs are assumed to leave the region.

c. Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents in a number of ways. Adverse effects would be felt primarily through the direct loss of subsistence resources. In addition, loss of subsistence resources would increase demand for store-brought goods and result in an inflation of prices. In the case of an oil spill, a strain in infrastructure resulting from the influx of spill workers could occur.

Subsistence activities are an integral component of the NSB economy as well as the culture. If one or more subsistence resources become unavailable for harvest, the economic well-being of NSB residents would be harmed. There are two components to the economic well-being associated with subsistence resources--the value of subsistence resources as a source of food and the cultural value of the resources. Both of these values can be represented as a direct source of economic well-being for NSB residents. Subsistence resources, very simply, enter into household income as a food source that does not have to be purchased in the marketplace. This food source is a substitute for income earned in the marketplace that would have to be used to purchase food. Subsistence activities and the value derived from these pursuits, however, go beyond a substitute for food bought in the market. As a way of life, there is a real, measurable economic value gained from NSB residents having access to such activities. Although there have been no studies to measure this value for NSB residents, studies that measured the recreational hunting values and existence values of natural resources in other parts of the U.S. give a rough indication of the magnitude of such values (see, e.g., Brookshire, Eubanks, and Randall, 1983). A disruption of a subsistence harvest would result in a real loss of economic well-being to residents.

The interaction between the "Western" market-oriented economy and subsistence activities is a complex relationship that does not fit neatly into standard economic theory. Much of the reason for this is because the unit of analysis in standard economic theory is the household, whereas the extended-kinship network is important for economic decision making in the Inupiat culture of the NSB. The kinship-sharing network that is characteristic of Inupiat culture distorts the standard economic outlook on an economy. For example, jobs in the market economy are often held in order to support subsistence activities. Earnings from these jobs frequently are not earned by the principal harvester of subsistence resources but rather are contributed to the harvester's subsistence effort by the market-wage earner. Likewise, subsistence resources are contributed to those engaged in market-oriented activities. This, however, is only one possible combination of the relationship between the market economy and subsistence activities. Market-wage earners also may directly engage in subsistence activities. Furthermore, the sharing of resources among the kinship network is not a simple trade of equally valuable goods. Rather, it is based on tradition and status among the individuals within the network.

Because of this extensive subsistence user/kinship network, a disruption to a subsistence resource caused by, for example, an oil spill could have ramifications that extend beyond the immediate family of the subsistence harvester to households that, by all appearances, principally engage only in market-economy activities. For example, an MMS survey research project on the North Slope found that for six North Slope communities (Barrow, Wainwright, Nuiqsut, Point Hope, Anaktuvuk Pass, and Kaktovik), about 70 percent of all households (regardless of ethnicity) obtained the majority of meat and fish in their diet from subsistence activities. A loss of a subsistence resource would be a loss of income to the entire community. This loss of income would result from the loss of the value of the food, plus the loss of the cultural value, and most likely could not be compensated for by the market economy through purchases of Western foods. There is considerable evidence that Western foods are not considered equivalent to Native foods (Kruse et al., 1983). Even if an equal portion of Western foods were substituted for the lost subsistence foods, there still would be a loss in well-being and, in turn, a loss in income because the substitute foods would be an inferior product.

This aspect of the loss does not begin to address the lost value associated with having to forego participating in subsistence activities and, in general, the lost value associated with not being able to participate in the Native culture. This is not to deny the possibility of additional income to local residents earned through cleanup jobs; however, cleanup opportunities are not expected to fully compensate for the lost value resulting from being denied use of subsistence resources.

In addition to the loss of value and, in turn, income associated with a loss of subsistence resources as the result of an oil spill, there also would be an effect on the NSB resulting from an influx of oil-spill-cleanup workers. This could manifest itself through inflationary pressures as the influx of workers compete with local residents for goods and services and cause prices to rise. It also is expected that a strain would be placed on local infrastructure that would force local governments to expend additional, unbudgeted resources. All of these factors could have a negative effect on the local economy.

CONCLUSION: The economic effects of the base case on the NSB region are expected to be MODERATE.

## 9. Effects on Sociocultural Systems

This discussion is concerned with those communities that could be affected by Beaufort Sea Sale 124. Under the base-case scenario for this sale (see Sec. II.B.2.a), the Sale 124 communities that potentially could host some petroleum-industry offshore-support facilities, particularly during exploration (for the base case) include Barrow and possibly Nuiqsut and Kaktovik, to a limited extent, as air-support bases. Offshore pipeline landfalls and possible shore-base facilities could be located at Point Belcher, closest to Wainwright; Pitt Point, closest to Barrow and Nuiqsut; Oliktok Point, closest to Nuiqsut; and Point Thomson, closest to Nuiqsut and Kaktovik. The sociocultural systems of Atkasuk also are analyzed primarily because of the MODERATE effects on the subsistence harvests of Barrow (Atkasuk harvests sea mammals with Barrow residents) THAT are expected as a result of Sale 124. This analysis does not include the "other communities" described in Section IV.C.10.c.(5), because there will be no additional industrial activities (see Sec. IV.A.1), population growth or employment (see Sec. IV.C.8), or effects on subsistence-harvest patterns (see Sec. IV.C.10) in these communities.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.2. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, and increased employment or effects on subsistence-harvest patterns associated with the sale. Potential effects are evaluated relative to the primary tendency of introduced social forces to support or disrupt existing systems of organization and relative to the duration of such behavior.

### a. Introduction

(1) Parameters of This Analysis: An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Social groups are generally based on kinship and marriage systems, as well as nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, and community. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society. Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of the subsistence cycle also could change the way these groups are organized. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being (see Sec. III.C.2). In rural Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations. The individuals one cooperates with help define kin ties; the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, etc. (see Sec. III.C.2). Disruption of the subsistence cycle also could undercut the system of traditional leadership and threaten the community's stability. It also might create a disruption of family ties, kinship networks, and the community's sense of well-being, which would damage the social bonds that hold the community together. Any serious disruption of sharing networks could appear in a community as a threat to the way of life itself and could set off an array of emotions--fear, anger, frustration, and a sense of loss and helplessness. Perceived threats to subsistence activity and its psychological importance in these sharing networks is an important source of the anxieties about oil development.

An analysis of cultural values looks at values shared by most members of a social group. These values are shared conceptions of what is desirable. They are ideals that the members of some social group accept, explicitly or implicitly. Forces powerful enough to change the basic values of an entire society include a seriously disturbing change in the physical conditions of life--a fundamental cultural change imposed or induced by external forces, e.g., when an incoming group induces acculturation of the residing group, or when a series of fundamental technological inventions change the physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). Cultural values on the North Slope include strong ties to Native foods, the environment and its wildlife, the family, the virtues of sharing the proceeds of the hunt, and independence from the outside (see Sec. III.C.2). A serious disruption of subsistence-harvest patterns could alter these cultural values. For the system of sharing to operate properly, some households must be able to produce--rather consistently--a surplus of subsistence goods. It is more difficult for a household to produce a surplus than to adequately satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, may be more sensitive to harvest disruptions than the consumption of these foods by active producers.

(2) Effect Agents: This section discusses the agents associated with Sale 124 that could affect the sociocultural systems in communities in the sale area (described in Sec. III.C.2): industrial activities, changes in population and employment, and effects on subsistence-harvest patterns.

(a) Industrial Activities: During the exploration phase (in the base case), any of the communities--Barrow, Wainwright, Nuiqsut, and Kaktovik--could be used as air-support bases at which personnel and air freight would be transferred to helicopters. One helicopter trip per day per platform is assumed for exploration (see Table II-1). The existing facilities at these airports are adequate to handle the projected needs during exploration. During the development and production phase, air support would gradually shift to the shore-base facility at Prudhoe Bay. It is also possible that shore-base facilities would be constructed at or near Pitt Point, Oliktok Point, Point Thomson, and Point Belcher. Three production platforms are assumed in the Beaufort Sea and one in the Chukchi Sea. Atqasuk is too far from the proposed industrial activities for their sociocultural systems to be directly affected by activities associated with development and production; however, a pipeline from the landfall at Point Belcher to TAP Pump Station No. 2 would go through Atqasuk's subsistence-harvest area. Other industrial activities associated with oil and gas development that could have an effect on sociocultural systems would be as a result of cleanup if an oil spill should occur.

(b) Population and Employment: Sale 124 is projected to affect the population of the North Slope Borough through two types of effects on employment in the region: (1) more petroleum industry-related jobs as a consequence of Sale 124 exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.C.8.a). Employment projections as a consequence of Sale 124 are provided in Section IV.C.8.b. Throughout the development and production phase, total employment would peak in 1998 at 1,869. Resident employment as a result of Sale 124 would peak at 139 in the year 2000. Most workers are expected to permanently reside outside of the North Slope. Sale 124 is projected to increase resident employment by an average of 4 percent or more above the declining existing-condition projections between 1993 and 2010. In 1999 and 2010, respectively, employment would be 9 and 8 percent above existing-condition projections. The average percent change in resident employment resulting from the proposed sale is expected to be 4 percent.

The effect on the population in the North Slope from increased employment opportunities would partially offset expected declines in other job opportunities and, therefore, delay expected outmigration. Sale 124 is projected to increase the NSB population at an average of 7 percent per year, peaking at 16 percent above the existing-condition level in 1998. By 2010, the effect would be over 12 percent greater than existing conditions. The population of the NSB is not expected to decline because of the increased employment opportunities as a consequence of the sale. The Native proportion of the population is not expected to change much from 81 percent Native in 1992 to 85 percent Native in 2010, and Native employment is expected to improve as a consequence of Sale 124 (see Fig. IV-C-8-2). It is expected that Nuiqsut's and Kaktovik's proximity to the shore bases at Point Thomson, Nuiqsut's proximity to Oliktok Point, Nuiqsut and Barrow's proximity to Pitt Point, and Wainwright's proximity to Point Belcher would encourage more residents from these communities to apply for sale-related jobs (see Sec. IV.C.8).

Atqasuk is not expected to experience much of an increase in sale-related employment, although there may be some degree of sale-induced employment. These changes in employment are not expected to be significant and would not cause effects on the sociocultural systems in addition to those already experienced under the NSB CIP.

(c) Effects on Subsistence-Harvest Patterns: Subsistence is important to the Inupiat sociocultural system (see Sec. III.C.3 for a detailed description). Regional, HIGH effects are expected on subsistence-harvest patterns in the Sale 124 area as a result of effects on Nuiqsut's bowhead whale harvest due to construction activities at Point Thomson. MODERATE effects are expected in Barrow, Atqasuk, Wainwright, and Kaktovik subsistence-harvest patterns as a result of noise and disturbance effects on bowhead whale harvests (see Sec. IV.C.10 for these analyses).

b. Effects on Barrow, Atqasuk, Wainwright, Kaktovik, and Nuiqsut: This section discusses the effects of the base case on the communities whose sociocultural systems may be affected by Sale 124. The relatively homogenous nature of these communities--they are all predominantly Inupiat--indicates that changes in the communities would be similar. The exception to this may be Barrow, which is larger, has a larger percentage of non-Natives, and has already experienced more change than the other, smaller North Slope communities (see Sec. III.C.2). This section analyzes effects of industrial activities, population and employment, and subsistence-harvest patterns on North Slope social organization,

cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Social Organization: The social organization of communities that might be affected by Sale 124 includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-production and -consumption levels, informally derived systems of respect and authority, strong extended families--although not always living in the same household--and stratification between families focused on success at subsistence endeavors, and access to subsistence technology (see Sec. III.C.2). These non-Western elements of social organization could be altered to become less oriented toward the family and exhibited in a breakdown of kinship networks as a result of OCS-induced social conditions. Increased air traffic during exploration is unlikely to have a large effect on any of the communities where exploration activities are taking place, and it is not known where that will be at this time. Air-traffic delays potentially could strand workers in the villages for many hours or days; however, this increase in non-Natives in the community would not be more than the increased number of non-Native workers present in North Slope communities during the peak of the CIP construction years in the 1980's. Other OCS industrial activities (Pitt Point, Oliktok Point, Point Thomson, and Point Belcher shore-base facilities and pipeline landfalls) would occur close to Barrow, Nuiqsut, Kaktovik, and Wainwright, respectively, but not within the communities; and the changes in population and employment would not be more excessive than those the communities already have experienced.

In Barrow, there has been a decrease in the Inupiat population from 91 percent to 61 percent from 1970 to 1985 and an increase in the non-Native, non-Caucasian population as well as the Caucasian population (see Sec. III.C.2), as well as an increase in high-paying jobs during the peak of CIP-project construction (see Sec. IV.C.9). Beginning in the early 1980's, there has been an increased number of "strangers" present in Wainwright--usually construction workers working on new buildings for the community. The difference between Barrow and Wainwright is that Barrow's non-Native population is permanent (see Sec. III.C.2). With Sale 124, this trend would continue in both communities. However, while disruptions would occur to Barrow's, Nuiqsut's, and Kaktovik's social organization as a result of increases in temporary or permanent population growth and increases in population, these disruptions would not be significantly higher than those already occurring as a result of NSB CIP development; and it is not likely that Barrow's, Nuiqsut's, Kaktovik's, or Wainwright's social organization would be displaced.

The construction of a winter ice-road between Pitt Point or Oliktok Point and Nuiqsut, Point Thomson and Kaktovik, or Wainwright and Point Belcher could cause disruptions to Nuiqsut's, Kaktovik's, or Wainwright's social organizations due to an increase of social interaction between residents and oil-industry workers. Other instances of increased interaction would occur if local residents were employed in oil-industry jobs. While some oil-industry workers could exhibit a respect and understanding of Inupiat culture, others could come equipped with prejudices too ingrained to be modified by experience. Some of the interactions of oil workers with the local Inupiat population are likely to be unpleasant and could lead to a growth in racial tension. In addition, the presence of the oil workers could be stressful in communities as small as Nuiqsut and Kaktovik (population 314 and 227, respectively, in 1989); while in Barrow, the higher population (3,223 in 1989) and larger proportion of non-Natives (39%) are more likely to absorb any additional interaction with non-Natives if Barrow also were used for air support. Nuiqsut and Kaktovik already have been exposed to oil workers due to their proximity to Prudhoe Bay. It is not likely that the number of oil workers associating with local residents would increase much above the number that is already occurring. Atqasuk is not expected to experience any of these effects because it is not located close to sale-related industrial activities and thus would experience insignificant, indirect population and employment growth. Social interaction of oil-industry workers with Barrow, Nuiqsut, Kaktovik, or Wainwright residents would be long term; but while there may be a disruption of their social organization, there would not be a tendency toward displacement of their social organization.

Subsistence is important to Inupiat social organization through sharing subsistence foods, task groups, crew structure, and strengthening social bonds. Effects on Nuiqsut's subsistence-harvest patterns are expected to be HIGH; effects on Barrow's, Atqasuk's, Wainwright's, and Kaktovik's subsistence-harvest patterns are expected to be MODERATE (see Sec. IV.C.10 for this analysis). These effects are expected on bowhead whale harvests as a result of oil spills, noise and traffic disturbance, and construction activities. Subsistence is a naturally cyclical activity. It is expected that harvests would vary from year to year, sometimes substantially. It is precisely for this reason that numerous species are hunted in order to compensate for a reduced harvest of any resource in any one year. However, multiyear disruptions to even one resource--particularly one as important as the bowhead whale--could disrupt sharing networks and subsistence task groups. Crew

structures, particularly bowhead whale-hunting crews, could be disrupted, resulting in ramifications in the social organization through loss of status and kinship ties. Effects on sharing networks and subsistence task groups could cause a breakdown in family ties and the community's sense of well-being as well as damage linkages between communities. Tensions and anxieties caused by the disruptions could occur at high levels.

Other tensions could be caused by OCS activities perceived as a threat to subsistence resources, especially if oil-industry activities are visibly evident and North Slope residents in the Sale 124 area do not perceive OCS development as a benefit to the Inupiat people. Nuiqsut is the only community where a HIGH effect is expected on a subsistence resource, and that effect is expected only on the bowhead whale harvest. Construction activities at Point Thomson could interfere with Nuiqsut's bowhead whale harvest. Although Nuiqsut is a community that has not always gotten a bowhead whale and thus might be able to cope with a zero harvest, Nuiqsut residents might view a zero harvest differently if harvest interference resulted from oil-industry activities versus what the Inupiat considered "an act of God." A zero harvest that is perceived to be the fault of the oil industry is more likely to generate additional stress on the sociocultural system--with possible tendencies toward disruption of the sharing networks and task groups--which also would disrupt the social organization (as well as disrupt cultural values [see discussion below]). This disruption is not likely to last more than 1 to 2 years and would not lead to a displacement of existing institutions, resulting in a MODERATE effect on sociocultural systems. MODERATE effects on social organization are expected in Nuiqsut, as well as Barrow, Kaktovik, and Wainwright. Disruptions in Atqasuk would be short term and would not have a tendency toward displacement of existing sociocultural institutions--a LOW effect on social organization as a result of lease-sale activities.

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations to the subsistence cycle. Of these, the only changes expected in Nuiqsut, primarily, and somewhat in Barrow, Kaktovik, and Wainwright are in the social organization (see discussion above) and the subsistence cycle (see Sec. IV.C.10 and discussion above). Only the subsistence-harvest patterns of Atqasuk are expected to be affected by the proposed sale.

A trend toward displacement of the social organization could lead to a decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood, with an increased emphasis on individualism, wage-labor, and entrepreneurialism. Interaction with oil-industry workers could result in introduction of new values and ideas, as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions could be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining traditional Inupiat institutions for maintaining social stability and cultural continuity (see Sec. IV.11.b.[3]). Cultural values and orientations can change slowly or suddenly (Lantis, 1959). Long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruption effects, which could be expected to occur under the scenario for the proposed lease sale in the base case. These changes already are occurring to some degree on the North Slope as a result of onshore oil and gas development, increased employment, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the introduction of television.

Although the degrees of intensity of these changes are not yet documented nor are they easily quantifiable, it appears that these changes are trends that could increase rapidly with more intensive development as a result of this lease sale. However, in Barrow, many of these changes already have occurred to a much greater extent than in the remainder of the smaller North Slope communities. Additional effects as a result of the base case would not be felt in Barrow to the same extent that they would in the smaller communities. Subsistence is considered the core value and a central feature of Inupiat cultural values (see Sec. III.C.2). While a year-long disruption to only one subsistence resource would not be likely to cause long-term, chronic disruption of the sociocultural system with a displacement of existing systems, multiyear disruptions throughout the 30-year life of the project as well as LOW disruptions of more than one resource would be more likely to begin affecting cultural values, with the potential for long-term sociocultural change and a tendency toward the displacement of existing institutions. When a group's identity is formed around being able to hunt--particularly to hunt the bowhead whale--and this hunt is not possible or not successful due to oil-industry activity, a considerable amount of social stress, tension, and anxiety are likely to occur. It would also be expected that the inability to hunt would cause a disintegration of subsistence-task groups as well as a tendency to replace sharing networks and, consequently, a decrease in the importance of subsistence as a cultural value. Nuiqsut is the most likely community to experience such effects, since HIGH effects are

expected on bowhead whale harvests. It is likely that multiyear disruptions of the bowhead whale harvest would occur as a result of Sale 124 activities because of the location of the proposed landfall and the anticipated noise and disturbance in the Nuiqsut bowhead harvest area during exploration and development and production. These disruptions could be long term but more likely would only last 1 to 2 years and probably would not cause displacement of Nuiqsut or Kaktovik cultural values--a MODERATE effect.

MODERATE effects on subsistence-harvest patterns in Wainwright, Barrow, Atqasuk, and Kaktovik (summarized above, see also Sec. IV.C.10) are expected as a result of proposed lease-sale activities. These effects on subsistence-harvest patterns would be short term and would not have more than LOW effects on cultural values in Barrow, Atqasuk, Wainwright, and Kaktovik.

(3) Other Issues: Increases in social problems--rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide (as described in Sec. III.C.2.d) also are issues of concern to this analysis of sociocultural systems. Participating in the oil-spill cleanup--as local residents did in the Prince William Sound oil spill in 1989--could cause residents to: (1) not participate in subsistence activities, (2) have a surplus of cash to spend on material goods as well as drugs and alcohol, and (3) not seek or continue employment in other jobs in the community (since oil-spill-cleanup wages are higher than average). While no studies have been completed as of the publication of this EIS, early indications are that the sudden dramatic increase in income as a result of working on oil-spill cleanup as well as being unable--or unwilling--to pursue subsistence harvests due to the Prince William Sound oil spill caused a tremendous amount of social upheaval--particularly seen in increases in depression, violence, and substance abuse (Anchorage Daily News, September, 26, 1989; New York Times, September 18, 1989).

Additional problems could arise if roads were constructed between Nuiqsut and the shore base at Pitt Point (even if only an ice road) or Oliktok Point, between Kaktovik at Point Thomson, or between Wainwright and Point Belcher, from the increased presence of oil workers in the community, and from Nuiqsut, Kaktovik, or Wainwright residents working in the oil industry. This situation has the potential for creating new access to alcohol and drugs. Although the oil industry generally strictly forbids consumption of alcohol and drugs when workers are in camp, many such events frequently occur in Prudhoe Bay and Kuparuk (Armstrong, 1985, oral commun.). In Prudhoe Bay, it is often the service industries that have not complied in enforcing the ban on alcohol. The increased availability of drugs and alcohol in Nuiqsut and Kaktovik as a result of the increased traffic through the airport, visitors in town, and shore-base workers associating with local residents could be disruptive to the social well-being in the community. A similar situation has occurred in Nuiqsut, which is within 56 km of Kuparuk and 105 km of Prudhoe Bay. Although not accessible by road year-round, Nuiqsut is connected to the Prudhoe Bay/Kuparuk industrial complex by a winter road and by air. There is some indication of an increase in social problems (consumption of alcohol and drugs, sexual abuse, domestic violence) in Nuiqsut at a rate higher than in other North Slope communities (Armstrong, 1985, oral commun.).

Although there may be additional reasons for differences in social problems in Nuiqsut, it is clear that the proximity to industrial enclaves is enabling the residents easier access to drugs and alcohol, thereby affecting the social health of the community--an effect that could also occur in Kaktovik and intensify in Nuiqsut as a result of this lease sale. Any effects on social health would have ramifications in the social organization and possibly result in a breakdown in cultural values due to dissension in the family unit, weakening in kinship networks, and disintegration of the Inupiat value system.

c. The Effects of Stress on Sociocultural Systems: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also, Kiev, 1964; Murphy, 1965; Inkeles, 1973). As a community grows, the rates of all types of mental illness appear to increase because rates of mental illness are higher "... in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). Native communities help buffer the individual by providing a sense of continuity and control.

People live with recognized role expectations, values, beliefs, and lifestyles. Bethel is an Alaskan example of a village that experienced these acculturative pressures rather early, as seen in its violent-death-rate increase

in the 1930's (Anderson and Eells, 1935). Similarly, others found that a notable increase in mortality due to these causes in non-Native Fairbanks parallels the pipeline work (Klausner and Foulks, 1982). Increased social mobility may isolate individuals from kinsmen and supportive social situations (Stillner and Stillner, 1974). The growth of smaller communities into larger ones may have a similar effect.

Psychic stress leads to social pathologies; such problems may result from people being socialized for a lifestyle that no longer exists (Brower, 1980; see also Kiev, 1964, 1972; Chance, 1966; Milan, 1964; Murphy, 1965). New routes to success, created by development, may contradict the more traditional patterns of reciprocity and egalitarianism and lead to social conflict and feelings of guilt (Hippler, 1969). Conversely, people may identify with new goals that are inaccessible or for which they lack skills. This leads to lowered self-esteem and increased anger and frustration (Chance, 1965, 1966; Chance, Rin, and Chu, 1966; Kiev, 1964; Murphy, 1965). Problems of self-image are critical to the development or nondevelopment of social pathologies (Chance, 1966). The substitution of one set of nominative behaviors for another may disrupt the standard set of expectations, predictions, and responses used to understand social settings. This, too, leads to lowered self-esteem and increased frustration (Erasmus, 1961; Kiev, 1964).

The nature and direction of change may not be clear or understood, or change may accelerate and "overload" the existing sociocultural system (Murphy, 1965). Such a situation decreases the sense of control and increases perceptions of an external threat as well as psychic stress. A sense of control is particularly important for adjustment (Chance, 1966), just as a sense of an uncontrolled, external threat is particularly detrimental (Kiev, 1964; Murphy, 1965).

Several salient points in the evaluation of possible sociocultural effects of oil-related developments due to this lease sale should be made.

1. Change itself--even though induced primarily by forces outside the communities--does not necessarily cause the levels of psychic stress that lead to pathology (for a general discussion, see Inkeles, 1973).
2. And related to the first point, not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Employment of the underemployed resident Inupiat in oil-industry operations could assist in filling the economic vacuum created by decreasing North Slope revenues. Additionally, income from oil-industry employment could improve living conditions, although major dependence on a nonrenewable-resource-based economy could cause long-term social costs at the time of resource depletion.
3. Rapid and wide-ranging sociocultural effects are significant, not only because a way of life is altered but also because these alterations can come with high social costs. These costs include growing alienation; increasing rates of mental illness, suicide, homicide, and accidental death; growing disruption of family and social life; and substance abuse.
4. What makes sociological change disruptive "... is the manner in which changes occur" (Murphy, 1965).
5. The conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Nuiqsut, Kaktovik, and Wainwright are the most likely communities in the North Slope region that are expected to experience additional sale-related effects in social health and well-being above those effects already being experienced as a result of the NSB CIP and indirect effects from current oil development. These effects on social health could be long term but would only last 1 to 2 years and would have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with current development. MODERATE effects as a result of effects on "other issues" are expected in Nuiqsut, Kaktovik, and Wainwright; no more than LOW effects are expected in Barrow and Atkasuk.

**SUMMARY:** Effects on the sociocultural systems of communities in the Sale 124 area would occur as a result of industrial activities, changes in population and employment, and effects on subsistence-harvest patterns. These effect agents would affect the social organization, cultural values, and social health of the communities in the Sale 124 area. Nuiqsut, Kaktovik, and Wainwright are the communities that are most

likely to be affected by Sale 124 due to their proximity to the (possible) shore bases at Pitt Point, Oliktok Point, Point Thomson, and Point Belcher, respectively, and the resultant effects on their bowhead whale harvest. In addition, Nuiqsut, Kaktovik, and Wainwright are small, relatively homogenous communities that would not absorb the presence of non-Natives as well as a community like Barrow. Increased non-Native population, as well as Natives interacting with non-Natives or leaving the community to work in the industrial enclave, could lead to a breakdown of kinship networks as well as an increase of social stress in the community. A disruption of the social organization could lead to a decreased emphasis on the importance of the family, cooperation, and sharing.

Multiyear disruptions of Nuiqsut's subsistence-harvest patterns--especially that of the bowhead whale, which is an important species to the Inupiat culture--could disrupt sharing networks, subsistence-task groups, and crew structures and could cause disruptions of the central Inupiat cultural value: subsistence as a way of life. These disruptions also could cause a breakdown in sharing patterns, family ties, and the community's sense of well-being and could damage sharing linkages with other communities. Other effects might be a decreasing emphasis on subsistence as a livelihood, with an increased emphasis on wage employment, individualism, and entrepreneurialism.

Kaktovik, Nuiqsut, and Wainwright also may experience an increase in social problems due to the increased presence of oil workers in the community and the possible construction of a road connecting Nuiqsut to Pitt Point or Oliktok Point, Kaktovik to Point Thomson, or Wainwright to Point Belcher--both of these factors would enable easier access to drugs and alcohol and would affect the social health of the community. Effects on the sociocultural system, such as increased drug and alcohol abuse, breakdown in family ties, and weakening of social well-being, would lead to additional stresses on the health and social services available to Nuiqsut. These effects most likely would not be long term. There could be a tendency for additional stress on the sociocultural system but without tendencies toward displacement, resulting in MODERATE effects on Nuiqsut's, Kaktovik's, and Wainwright's sociocultural systems.

Sale-related increases in population and employment predicted for the Sale 124 area are expected to occur primarily in Barrow. Although Barrow would be in proximity to industrial activities, would have increases in population and employment, and would sustain MODERATE effects on one subsistence-harvest resource--the bowhead whale harvest--these changes should not be more significant than those changes that have already been felt in Barrow, particularly from 1975 to 1985. Barrow is a much larger community that is more heterogenous than others on the North Slope, and it could withstand some degree of increased population and employment opportunities. These disruptions could be long term; however, they most likely would not lead to a displacement of existing institutions, resulting in a MODERATE effect on sociocultural systems. Atqasuk is too distant from onshore industrial activities to be directly affected by Sale 124 and is not expected to experience direct, sale-related population and employment increases. Atqasuk may experience some indirect rises in population and increases in employment, but they are not expected to be significant. Disruptions in Atqasuk would be short term and would not have a tendency toward displacement of existing sociocultural institutions--a LOW effect on social organization as a result of lease-sale activities.

**CONCLUSION:** The effects of proposed Sale 124 on sociocultural systems are expected to be MODERATE for the base case.

## 10. Effects on Subsistence-Harvest Patterns

Section III.C.3(1) describes the subsistence-harvest patterns characteristic of Inupiat communities adjacent to the Sale 124 area, (2) outlines the important seasonal subsistence-harvest patterns by community and by resource, (3) provides figures depicting the areal extent of each community's general subsistence-harvest area and the timing of harvests, and (4) presents estimated quantities of subsistence resources harvested. Section IV.C.10.a below summarizes the subsistence-harvest patterns. Sections III.C.2 and 3 demonstrate that significant aspects of each community's economy, culture, social organization, normative behavior, and beliefs interact with--and depend on--patterns of subsistence harvest. The sociocultural aspects of subsistence are addressed in Section IV.C.9.

a. Introduction: This section analyzes the effects of the proposed action for the base case on subsistence-harvest patterns of communities close to the proposed Sale 124 area. Included in this analysis of potential effects from the base case is some discussion of the low case because of similarities in the types of activities that occur during the exploration phase and the effects on subsistence-harvest patterns. This analysis is organized by subsistence resource and discusses effects on subsistence-harvest patterns as a result of oil spills, noise and disturbance, and construction activities. The discussion of effects on subsistence-harvest patterns that follows this analysis is organized by community.

Effects on communities outside of the lease-sale area are not discussed in this analysis because: (1) effects of noise and disturbance on subsistence are very localized and would not affect the subsistence harvests of Alaskan (or Canadian) communities other than Wainwright, Barrow (Atqasuk), Nuiqsut, or Kaktovik; (2) it is extremely unlikely that an oil spill that might occur would contact subsistence-harvest areas of Alaskan (or Canadian) communities other than Barrow (Atqasuk), Kaktovik, Nuiqsut, or Wainwright; and (3) onshore-support facilities and pipelines would be constructed only in the lease-sale area and effects from construction would be localized.

The Sale 124 area includes the entire marine-subsistence-resource areas of Barrow (also used by Atqasuk residents [see Sec. III.C.3]), Nuiqsut, and Kaktovik as well as a substantial portion of Wainwright's marine-subsistence-resource area. Moreover, if economically recoverable amounts of oil were discovered, onshore pipelines and other facilities associated with its development could affect the terrestrial subsistence resources that are harvested by these four coastal communities as well as the inland community of Atqasuk.

As noted in Sections III.C.2 and 3, onshore-oil developments at Prudhoe Bay already have affected the subsistence-harvest system. Many of these effects are the indirect result of increased wage employment made available through projects and services funded by the NSB. Wage employment has led to an upgrading of hunting technology but, alternatively, has constricted the total time available for hunting. However, over the 30-year life of the project, household incomes and available jobs are expected to decrease (see Secs. III.C.1 and IV.C.8). If this decrease occurs, hunting technology will remain constant while the time available for hunting will increase. Currently, constricting household incomes are encouraging increased harvest levels for many subsistence resources, and this trend is expected to continue.

Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of oil spills, noise disturbance, and construction activities. The following analysis examines the effects of each of these causal agents on the subsistence resources harvested by the Inupiat living near the Sale 124 area, with specific information by community, where applicable. This analysis includes the marine and terrestrial resources harvested by the residents of Wainwright, Barrow, Nuiqsut, and Kaktovik and the terrestrial resources, fishes, and marine and coastal birds harvested by the residents of Atqasuk. Because Atqasuk residents also harvest marine mammals--but only in conjunction with Barrow harvests and in the same areas--Atqasuk is included in the discussion of Barrow. All effects on marine mammals in Barrow also would occur in Atqasuk.

The factors affecting the subsistence-harvest patterns of Wainwright, Barrow, Nuiqsut, Kaktovik, and Atqasuk are summarized as follows (the information on harvests is taken from records of annual subsistence-resource harvests averaged over 20 years [Stoker, 1983, as cited by ACI/Braund, 1984]):

- Heavy reliance on caribou (16-58% of the annual average harvest for Barrow, Wainwright, and Kaktovik [see Table III-C-10]).

- Reliance on bowhead whales (8-27% for Barrow, Wainwright, and Kaktovik [see Table III-C-10]) and 8.6% for Nuiqsut (Table III-C-9). (This percentage of bowheads of all harvests has gone up since these figures were calculated in 1982 because of the increase--double--in the IWC quota.)
- Reliance on fish (1-22% for Barrow, Wainwright, and Kaktovik [see Table III-C-10]).
- Hunting ranges overlap for all species harvested by Wainwright, Barrow, Nuiqsut, Kaktovik, and Atqasuk.
- Hunting and fishing are cultural values that are central to the Inupiat way of life and culture.
- In 1989, the population of Wainwright was 502; Barrow, was 3,223; Nuiqsut 314; Kaktovik, 227; and Atqasuk, 219.

#### Causal Agents Affecting Subsistence-Harvest Patterns

**Oil Spills:** Subsistence-resource areas for Wainwright, Barrow, Nuiqsut, Kaktovik, and Atqasuk are shown in Figure IV-C-10-1 to indicate important marine-mammal-harvest areas used by communities that would be vulnerable if an oil spill occurred and contacted these areas. There is a 49-percent chance of one or more oil spills of 1,000 bbl or greater occurring in the Arctic Ocean during the life of the project. The average size of such a spill is 22,000 bbl.

Resource Areas A, B, and C (see Fig. IV-C-10-1 and Tables G-15 and G-17) are used to indicate important marine-mammal subsistence-harvest areas. There is a 3-percent chance in winter and a 1-percent chance during April to June or in the open-water season of one or more oil spills of 1,000 bbl or greater occurring and contacting Resource Area A within 10 or 30 days. Since Resource Area A includes most of the ocean area used by Wainwright's hunters, these figures indicate little likelihood that this community's harvests would be contacted--or affected--by an oil spill.

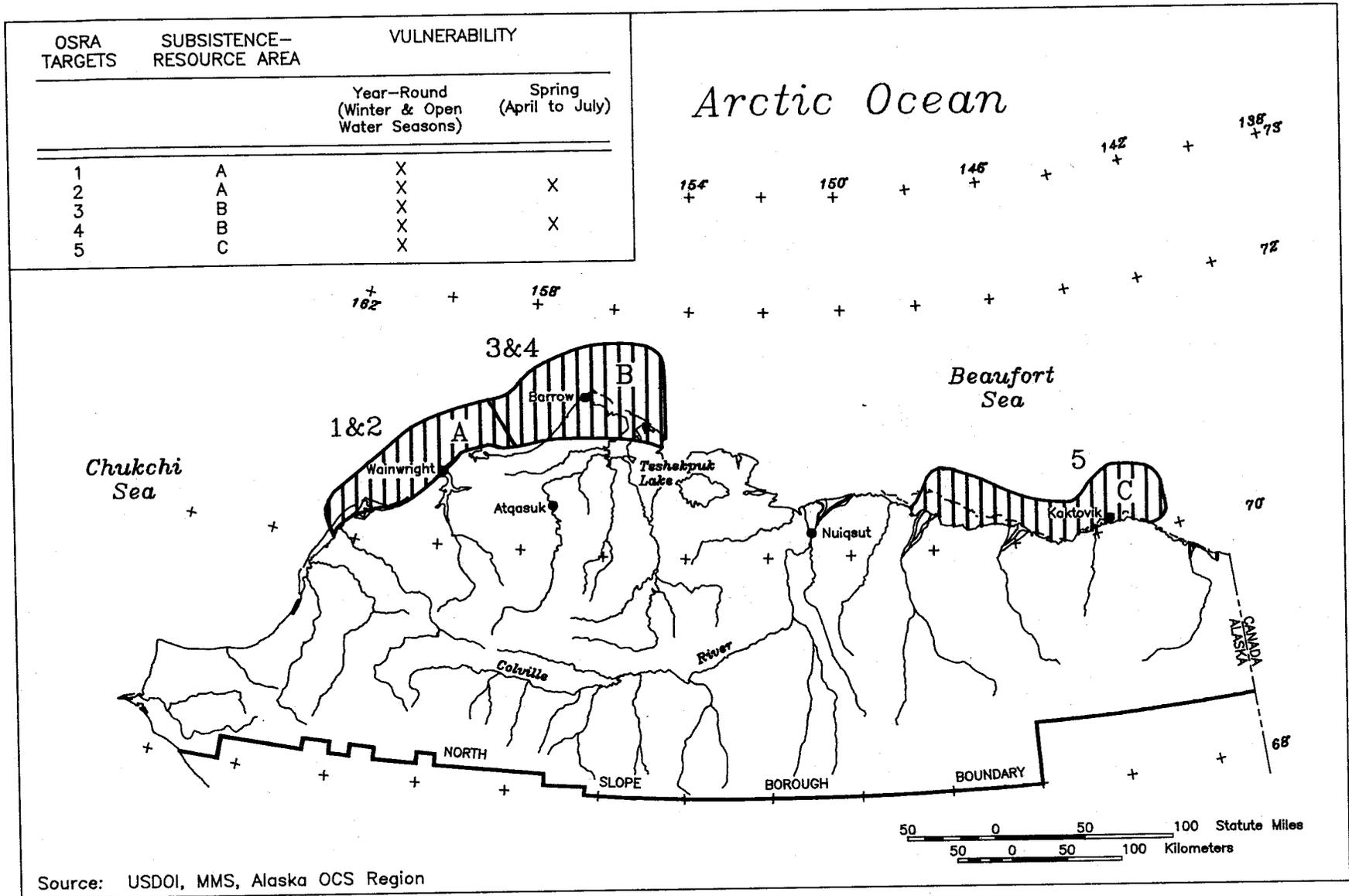
Resource Area B includes much of the area used by Barrow hunters to harvest marine mammals. There is a 20-percent chance of one or more oil spills of 1,000 bbl or greater occurring and contacting this area within 10 or 30 days during the winter (November to July) and a 1-percent chance of contact from such a spill during the open-water season. There is a 7-percent chance that one or more oil spills of 1,000 bbl or greater could occur and contact Resource Area B during Barrow's spring whaling season (April to June). During the winter, such contact could affect sealing and polar bear hunting; during the spring season, it could affect sealing, whaling, and bird hunting; during the fall, it could affect whaling and ocean-fish netting. A spill during the open-water season is not likely to occur. If one did occur, it could affect sealing, whaling (belukha), walrus hunting, and bird hunting.

Resource Area C is used to indicate Kaktovik's and a portion of Nuiqsut's marine-mammal-harvest areas. There is a less than 0.5-percent chance of one or more oil spills of 1,000 bbl or greater contacting this area during the winter or during the open-water season. These figures indicate little likelihood that these communities' harvests would be contacted--or affected--by an oil spill.

Subsistence harvests by Barrow and Nuiqsut residents also occur between Resource Areas B and C. The probability of one or more oil spills greater than 1,000 bbl occurring and contacting the area between Resource Areas B and C (Land/Sea Segments 23 through 35) is less than 0.5 to 1 percent in winter and in the open-water season (Appendix G, Tables G-16 and G-18). The low probability of an oil spill occurring and contacting this area indicates little likelihood of an oil spill contacting or affecting that portion of Nuiqsut and Barrow's subsistence-harvest area.

Analyses of the effects of oil spills on each subsistence resource are provided in Section IV.C.10.b. Cleanup activities associated with an oil spill would have only short-term, localized effects on biological resources and subsistence-harvest patterns.

**Noise and Disturbance:** Animals may avoid areas of high noise and disturbance and, thus, become unavailable to a particular community or become more difficult to harvest. Short-term effects, such as flight behavior or increased wariness, also may make animals difficult to harvest. This is a particular concern in the case of bowhead whaling because these whales may flee into the broken-ice zone. Noise and disturbance



Source: USDOI, MMS, Alaska OCS Region

Figure-IV-C-10-1. Subsistence-Resource Areas Used in the Oil-Spill-Risk-Analysis

may lower fertility rates of waterfowl by causing them to leave their nests, which could adversely affect the availability of some species. Finally, fishes and fish eggs may be killed by seismic activities; and this, too, might affect the availability of harvestable resources.

Noise and disturbance would be associated with the (1) surveys that are part of the preliminary activities of the lease-sale phase; (2) movement, installation, and operation of drilling units and production platforms; (3) well drilling during the exploration and development and production phases; (4) offshore-pipeline-trenching and -laying operations; (5) onshore-pipeline and road construction; (6) aircraft and marine support of the preceding activities (see following analysis); and (7) cleanup activities in the event of an oil spill. Noise and traffic would be a factor throughout the life of the proposed action during exploration and development and production (see Sec. II.B.2.a). (An analysis of the effects of noise and disturbance on each subsistence resource is provided below.) The following activities are predicted for the base case: 14 exploration and delineation wells would be drilled; one vessel would support each platform during the open-water season; there would be at least one supply-boat trip a week, possibly one workboat trip a day, and at least one round-trip helicopter flight per day per platform for each day of drilling. Four production platforms and offshore trunk pipelines would be installed, and there will be two helicopter flights per week per platform during production. The pipelines from the platforms in: (1) the western Beaufort would have a landfall at Pitt Point, (2) the central Beaufort would have a platform at Oliktok Point, (3) the eastern Beaufort would have a landfall at Point Thomson, and (4) the Chukchi Sea would have a platform at Point Belcher. The onshore segments of the pipelines total about 325 mi and connect with TAP Pump Station No. 1. Pitt Point is not central to any major subsistence-harvest areas, and noise and traffic disturbance or construction activities associated with the platform, the pipeline to Pitt Point, or landfall should not have more than LOW effects on subsistence-harvest patterns.

**Construction Activities:** Construction activities that may adversely affect subsistence include the installation of mobile bottom-founded drilling units such as the Concrete Island Drilling System or Single Steel Drilling Caisson, bottom-founded concrete production platforms, the excavation of glory holes if floating units are used in exploration, offshore-pipeline-trenching and -laying operations (see Sec. II.B.2.a), and onshore construction of pipelines or roads. A shore base might be constructed in the vicinity of a pipeline landfall to support offshore-development drilling and pipeline trenching. The support base would occupy 60 to 75 acres (25-30 ha) and include a 1.2-mi airstrip, living accommodations, storage facilities for drilling and pipelaying, and maintenance facilities. During construction, disturbance from such activities may cause some animals to avoid areas in which they are normally harvested or to become more wary and difficult to harvest. The latter is a particular concern in the case of bowhead whaling because bowheads may flee into the broken-ice zone. In some instances, as in the case of nesting birds, construction activities may decrease the biological productivity of an area. Restrictions may be placed on the use of firearms in areas surrounding new oil-related installations (such as roads, pipelines, and drilling platforms) in order to protect oil workers and valuable equipment from harm. Finally, structures such as onshore pipelines may limit hunter access to certain active hunting sites.

Trenches for the offshore pipeline would be cut and the pipe would be laid during the open-water season, although these pipelaying activities may require ice-management operations. Construction of the onshore segments of the pipeline and support road from the landfalls to TAP Pump Station No. 1 would take about 2 years. These onshore-construction activities could take place at anytime of the year. Construction activities associated with the onshore pipeline and support road and shore base in the base case could affect Wainwright's, Barrow's, Nuiqsut's, and Kaktovik's subsistence-harvest patterns. (An analysis of the effects of construction activities on each subsistence resource is provided below in Sec. IV.C.10.b.)

b. **Effects on Subsistence Resources by Resource:** The following discussion analyzes the potential effects of oil spills, noise and disturbance, and construction activities on specific subsistence resources within the Sale 124 area. Section IV.C.10.c follows this resource-specific discussion and summarizes and assesses the effects on each community that might be directly affected by Sale 124.

(1) **Bowhead Whales:** The bowhead whale is the Inupiat's most culturally important subsistence resource (see Sec. III.C.2). It also is the resource that provides the second- to fourth-most meat to Barrow, Wainwright, and Kaktovik residents (see Sec. III.C.2 [Table III-C-10; see Fig. III-C-7 for harvest areas]). Section IV.C.6.a concludes that MODERATE biological effects from oil spills are anticipated on bowhead whales. MODERATE biological effects could force the IWC to reconsider and possibly lower the current bowhead whale quotas. Only one to four whales are harvested annually by each whaling community (with the exception of Barrow, which recently has had a higher quota of 5-10 whales). Whaling begins in late

March to early April and ends in late May to early June in Wainwright and Barrow. Barrow also conducts fall whaling in late August-early October, but spring whaling is their major whaling time. Nuiqsut and Kaktovik harvest the bowhead whale from mid- to late August through the beginning of October. Although the whaling season is approximately 1 1/2 to 2 months long, poor whaling conditions can reduce the whale hunting to as little as a few weeks.

Whaling activities are localized and occur within a short time period; consequently, an untimely oil spill could disrupt a community's subsistence effort for an entire season. There are so few bowhead whales harvested that a decrease in the harvest could mean a reduction from one to zero whales--an elimination of the harvest. Even if oil did not affect the entire population of bowhead whales and only a number of individuals in a localized area were oiled, or even if oil were in the area but did not affect the whales, the bowheads still would be rendered inedible or perceived as such and consequently would not be harvested. This perception could extend beyond the Sale 124 whaling communities and include the whaling communities of Point Hope, Wales, Savoonga, and Gambell. In the proposed lease-sale area, no more than one spill greater than 1,000 bbl (the spill is assumed to be 22,000 bbl) is expected during the life of the project. Although it is possible that an oil spill might eliminate the whale harvest, it is more likely that a spill would force hunters to move to a new location. The forced move would shorten the whaling season and might decrease the number of whales harvested--an effect that is most likely to occur in the Barrow subsistence-harvest area (7% chance of an oil spill occurring and contacting Resource Area B from April to June). An oil spill in the winter (20% chance) could still be a problem during the spring as the ice melts, and the oil could be present in the lead system. Oil-spill cleanup also could cause noise and disturbance that would alter the migratory path of bowheads and make them unavailable to Barrow whalers. An oil spill during Barrow's spring harvest or before the harvest during the winter could cause the whale harvest to be discontinued--a MODERATE effect. Wainwright's bowhead-harvest area (Resource Area A) has a 3-percent chance of an oil spill occurring and contacting this area and Nuiqsut and Kaktovik have a less than 1-percent chance of an oil spill contacting their whale-harvest areas; thus, it is not expected that Wainwright's, Nuiqsut's, or Kaktovik's bowhead harvests will be affected--a VERY LOW effect.

In the event of an oil spill that occurred and contacted the bowhead whale migration, it is possible that the Native bowhead whale hunt could be suspended by the IWC; the NOAA; or, less likely, the Alaska Eskimo Whaling Commission (AEWC). The NOAA has a Cooperative Agreement with the AEWC and is responsible for ensuring that the bowhead hunt occurs within the guidelines and restrictions set forth in the Cooperative Agreement. It is possible that, in response to public pressure of perceived effects on the bowhead from an oil spill, the NOAA or the IWC might suspend bowhead whaling without waiting for scientific evidence of effects on the regional population (Braund, 1987, oral commun.; Brownell, 1987, oral commun.; Crichton, 1987, oral commun.; Lefevre, 1987, oral commun.). Such an event occurred in 1969 after the Santa Barbara oil spill off the coast of California. A limited scientific catch of gray whales had been permitted. During the oil spill, a few dead whales were found on the beach. Without waiting for scientific evidence to prove that the whales were dead as a result of the oil spill, the Bureau of Commercial Fisheries (which had jurisdiction over endangered whales at the time but was later absorbed into NOAA) ceased permitting a scientific catch of gray whales strictly because of public pressure and perceived fears regarding what the oil spill could do to the gray whale (Brownell, 1971). Despite these concerns, however, there were no efforts to suspend or terminate the subsistence harvest of gray whales in Alaska. No scientific evidence was ever documented to demonstrate that these whales died because of the oil spill; in fact, it was later revealed that there were no more whales found dead on the beach in 1969 than in the previous 20 years (Brownell, 1971).

Although a precedent has been set for curtailing a scientific catch of gray whales without evidence of oil-spill effects, this does not mean that in 8 years or more when development in the Beaufort Sea might occur (29 years after the Santa Barbara spill), NOAA would suspend the Native catch of bowheads in the event of an oil spill. There is currently much more information known about the effects of oil spills on whales (see Sec. IV.C.6). In addition, the bowhead whale population has increased considerably each year; and NOAA has learned to look for scientific evidence of effects before responding to public perceptions and fears. If evidence were produced to indicate that the bowhead whale population was affected by an oil spill, it is probable that either the AEWC, NOAA, or the IWC could consider the possibility of suspending the bowhead hunt or decreasing the quota (Montanio, 1987, oral commun.; Roots, 1987, oral commun.). A suspension is not likely since the whale-population count has been increasing (and should continue to increase during the 30-year life of the Sale 124 field), and no more than LOW effects on the bowhead are expected in the Sale 124 area (see Sec. IV.C.6). Thus, suspension of the bowhead whale hunt certainly might be considered by the AEWC, NOAA, or the IWC in the event of an oil spill that occurred during the whale

migration; however, it is expected that no agency would react out of perceived fears but rather would wait until scientific evidence indicated a level of effects that would warrant a suspension.

Industrial activity is not expected to result in distributional changes in the bowhead population (Sec. IV.C.6). However, support vessels and platforms in the vicinity of the subsistence-harvest area could disturb the harvest without disturbing the general bowhead population. Exploration drillships and their associated support activities are not likely to affect Wainwright's or Barrow's (spring) bowhead whaling in the Sale 124 area because bowhead whaling occurs in the spring, when narrow leads are formed and little open water exists. Exploration drillships are not likely to be moved into operation until open water has formed after the whaling season. However, bottom-founded exploration-drilling units and production platforms would be in place year-round and could be located in the vicinity of the bowhead whale-harvest area. The whaling camps may be as far as 16 to 24 km offshore. Later in the spring, when the leads widen, the Wainwright and Barrow whalers could possibly travel an additional 25 km offshore to look for whales.

In the Nuiqsut and Kaktovik subsistence areas, exploration drillships would be operating during the bowhead whale-hunting season. Noise from exploration drillships, bottom-founded exploration-drilling units, production platforms, support vessels, or icebreakers associated with the platforms could disrupt the whaling effort. If a vessel or rig were in the path of a whale chase, it could cause that particular harvest to be unsuccessful. Icebreakers moving through the whale-harvest area also could cause an unsuccessful harvest. Icebreakers could be sent to the Sale 124 area prior to the open-water season during the spring bowhead whale migration (beginning mid-April [see Sec. III.C.3]) and the whale-hunting season. Wainwright and Barrow whaling usually occur in the open-water area between the pack ice and the fast ice or the shore at a time when the length and width of the open-water area is restricted. If disturbed, bowheads might move into the pack ice and thus might become unavailable to whalers. Recent evidence indicates that a whale may react to vessel-engine noise as far as 12 km away from the source (Sec. IV.C.6), although disruption is likely to be short term and temporary. Such disturbance would most likely be short and temporary enough that, during a normal whaling season of a couple of months' duration, there would be plenty of opportunities to harvest other whales. However, during a year when the weather and ice conditions are poor and the whalers' ability to harvest any whales is limited, the noise disruption could occur during the only brief period when harvesting a whale is possible.

The probability of a drilling rig being located in an area critical to whaling during the whaling season cannot be determined; however, if this condition did occur, potential conflict could be mitigated by the cessation of drilling operations during the whale migration. Since fall ice conditions are not predictable events, the second effect--user conflicts between vessels and whalers due to bad ice conditions--might be more difficult to mitigate. This problem has been reported once for the Alaskan arctic: in the fall of 1985, extreme ice conditions curtailed the length of Kaktovik's whaling season and, at the same time, caused vessels traveling to their overwintering sites to operate near whaling locations (Smythe, 1987, oral commun.). As a result of this conflict, a cooperative program was formed in 1986 between the NSB, the AEWC, the Nuiqsut and Kaktovik whaling captains, and those petroleum companies interested in conducting geophysical studies and exploration-drilling activities in the Beaufort Sea. This program was approved through a Memorandum of Understanding between NOAA and the AEWC pursuant to the 1983 Cooperative Agreement, as amended. The 1986 Oil/Whalers Working Group established a communication system and guidelines to assure that industry vessels avoided interfering with or restricting the bowhead whale hunt and to establish criteria whereby the oil industry would provide certain kinds of assistance to the whalers. The program was successful for 2 years; however, it has been discontinued due to some difficulties with the communication systems and equipment. Presently, individual companies are coordinating with the whalers; this coordination was a requirement under leases for Sales 97 and 109. The company must submit a plan of cooperation as a part of their exploration plan. Other on-lease activities such as seismic surveys require submission of a letter stating that cooperation will occur. The Oil/Whalers Working Group cooperative program was a good example of how interference with a subsistence harvest can be effectively mitigated. In the absence of such mitigation, such a curtailment of the whaling season for the year due to noise and traffic disturbance associated with Sale 124 would cause the bowhead to become locally unavailable for no more than 1 year, representing MODERATE effects on the bowhead whale harvests of Wainwright, Nuiqsut, and Kaktovik. Barrow harvests enough bowheads that while the harvest may be affected or decreased, the harvest would still occur--a LOW effect.

During the development and construction phase, construction of an offshore pipeline landfall and shore base at Point Thomson might disturb Nuiqsut's bowhead whale harvest, and an offshore pipeline landfall and shore base at Point Belcher might disturb Wainwright's bowhead whale harvest. Point Thomson is only 25

mi from Kaktovik, but it is outside of the Kaktovik whale-harvest area (see Fig. III-C-7). Flaxman Island--the area most commonly used by Nuiqsut hunters for their base camp for hunting bowhead whales--is just off the coast of Point Thomson. A landfall and shore base at Point Thomson would concentrate noise and traffic disturbance in this harvest area. The ice conditions in the Beaufort Sea are more predictable than in the Chukchi Sea. It is likely that construction activities would begin after the onset of the open-water season and would end during or after the fall whale migration. This analysis assumes that such activities would occur during the whaling season. Since bowhead whales may be particularly sensitive to noise and traffic disturbance associated with construction activities (which would occur over a period of possibly 3 years), Nuiqsut's bowhead whale harvest could become locally unavailable 1 year or more--a HIGH effect on the harvest of bowhead whales. It may be possible for Nuiqsut hunters to move to a different location, but Flaxman Island is considered the best location for hunting bowheads. Moving to another location could further limit their ability to harvest the bowhead whale. A landfall and shore base at Point Belcher could have similar effects on Wainwright's bowhead whale harvest. A bottom-founded production platform would be in place year-round and could be located in the vicinity of the bowhead whale-harvest area. The whaling camps may be as far as 16 to 24 km offshore. Later in the spring, when the leads widen, the Wainwright whalers could possibly travel an additional 25 km offshore to look for whales. Noise from bottom-founded production platforms, construction of the platform, support vessels, or icebreakers associated with the platforms could disrupt the whaling effort. If a vessel or rig were in the way of a whale chase, it could cause that particular harvest to be unsuccessful. Whaling usually occurs in the open-water area between the pack ice and the fast ice or the shore at a time when the length and width of the open-water area is restricted. If disturbed, bowheads might move into the pack ice and thus might become unavailable to whalers. During a normal whaling season of a couple of months' duration, there would be ample opportunities to harvest other whales. However, during a year when the weather and ice conditions were poor and, thus, the whalers' ability to harvest any whales would be limited, the noise disruption could occur during the only brief period when harvesting a whale would be possible. This conflict could be mitigated by the cessation of drilling operations during the whale migration. Without mitigation, industrial activity could result in the reduction of the bowhead whale harvest in Wainwright. It also is possible that if the weather were bad and the whaling season were short, no whales would be harvested that year--a MODERATE effect on the harvest of bowhead whales. For Wainwright--whose whaling location is better than Nuiqsut's--it is not anticipated that this could occur for more than one whaling season.

Due to the absence of construction activities in the Barrow or Kaktovik bowhead whale subsistence-harvest areas in the base case, effects on the bowhead harvest in Barrow or Kaktovik from construction activities would be VERY LOW.

(2) Belukha Whales: Coastal communities in the Sale 124 area depend on belukhas much less than other marine resources--primarily because these communities are able to harvest the bowhead whale, which is a preferred food (see Sec. III.C.3; see Fig. III-C-8 for harvest areas). In a subsistence study in Barrow from 1987 to 1989, no belukha whale harvests were recorded (Stephen R. Braund and Associates, 1989a). However, during years when a bowhead is not harvested or the harvest is decreased, other marine resources--including belukhas--become more crucial to compensate for the lost bowhead harvest. Belukha whales are sometimes harvested in Barrow and Wainwright in conjunction with bowhead whales in the ice leads, although they are more likely to be hunted after the bowhead hunt is over--during the open-water months throughout the summer from June to August.

Biological effects on belukha whales (Sec. IV.C.5) from oil spills associated with Sale 124 are expected to be LOW. Although oil spills are not likely to affect belukha whales, even if they were oiled or ingested oil, the belukhas would likely be rendered inedible or be perceived as such and consequently would be unharvestable. The harvest also could be hindered by oil-spill-cleanup efforts if cleanup were conducted during the harvest. The belukha hunting season in Barrow lasts from the beginning of the bowhead whaling season (late March) until August; consequently, an oil spill most likely would not eliminate the entire belukha hunting season. Although belukha whales would not become unavailable, the belukha harvest would be affected for a period of less than 1 year, which would result in LOW effects on Barrow's belukha harvest. During the past 20 years, Barrow has annually harvested only an estimated five belukhas (estimated 0.5% of their total annual subsistence harvest [Table III-C-9]). However, if the whalers could not harvest a bowhead, they would most likely actively hunt belukhas. The Barrow belukha harvest has a 7-percent probability of being affected by an oil spill in spring and a 1-percent probability of being affected by an oil spill during the summer. The low probabilities of an oil spill occurring and contacting Wainwright's, Nuiqsut's, and Kaktovik's subsistence-resource areas indicates that effects on their belukha harvests would be VERY LOW.

Belukha whales are not as likely as bowhead whales to avoid industrial activities in the Arctic. Although belukha whales can react to active icebreaker noise 35 to 50 km away from the source (Sec. IV.C.5), it is not anticipated that this reaction to noise would cause interference to the belukha whale harvests. Disruptions are most likely to be short term and are not expected to affect harvest levels. In the early summer, belukhas are harvested in the pack-ice leads. Vessels--other than icebreakers--probably would not be in the leads at that time because it is too dangerous; however, icebreakers or platforms in the area could cause disturbance (Sec. IV.C.5). Because the belukha hunting season for Barrow, Wainwright, Nuiqsut, and Kaktovik takes place under two different conditions (in ice leads and in open water) and hunting is possible at different times over a 6-month period, noise and traffic disturbance would be expected to cause some effects but would not cause the harvest to be unavailable (LOW effects) during the belukha hunting season.

During construction of the shore bases at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson and an offshore pipeline from drilling platforms to these shore bases, the belukha whale hunt might be disturbed. However, these areas are not areas of intensive belukha whale hunting. No more than LOW effects on the belukha whale harvests of Wainwright, Barrow, Nuiqsut, and Kaktovik are expected due to continuing activities.

(3) Caribou: Caribou, the largest source of meat for the communities adjacent to the Sale 124 area, contributes to an estimated 50 to 70 percent of the subsistence diets of Barrow, Wainwright, Nuiqsut, and Kaktovik. Annual harvest levels (averaged from 1962-1982) were 3,500 in Barrow, 1,200 in Wainwright; 400 in Nuiqsut; and 5,250 in Kaktovik; others are not reported (see Sec. III.C.2 [Table III-C-9]; see Fig. III-C-9 for harvest areas). The base case is expected to have LOW biological effects on caribou, with local disturbance of caribou near the shore base and pipeline corridor subsiding after construction is completed. Caribou movements, distribution, or abundance are not likely to be significantly affected by the base case (see Sec. IV.C.7). Wainwright, Atqasuk, and Barrow harvest caribou from the Western Arctic herd; and Nuiqsut, Kaktovik, and Barrow harvest caribou from the Central Arctic herd. Caribou that move to barrier islands and shallow coastal waters in summer could become oiled or could ingest contaminated vegetation. Because only a small number of animals are likely to be involved, biological effects on the population would be insignificant (Sec. IV.C.7). Effects on the subsistence harvest of caribou in the communities near the Sale 124 area as a result of oil spills are expected to be VERY LOW. An onshore-pipeline oil spill from the pipelines near Point Belcher, Pitt Point, Oliktok Point, and Point Thomson to the TAP would contaminate tundra vegetation. However, onshore oil spills are expected to have VERY LOW biological effects on caribou (see Sec. IV.C.7 for the analysis). Effects would be localized and are not expected to significantly contaminate or alter the caribou range within the pipeline corridor. Since the caribou would not be affected by an onshore oil spill, VERY LOW effects would be expected on the subsistence harvest of caribou.

Noise- and vehicle-traffic-disturbance effects on caribou are more likely to occur as a result of construction of the onshore pipeline projected to carry oil from Point Belcher, Pitt Point, Oliktok Point, and Point Thomson to TAP Pump Station No. 1 and the associated support road. Effects also would occur throughout the life of the project as a result of traffic along the pipeline corridor. This pipeline would not cross major calving areas of the Western or Central Arctic herds. Section IV.C.7 concludes that the biological effects on caribou would be LOW, with temporary disturbance of caribou and short-term delays in caribou movements across the pipeline corridor.

An onshore pipeline could create a physical barrier to subsistence access that could make Barrow, Wainwright, Atqasuk, Nuiqsut, and Kaktovik hunters' pursuit of caribou more difficult (Kruse, Baring-Gould, and Schneider, 1983). But because arctic pipelines are constructed to allow for the passage of caribou, the pipeline corridor would not be a major problem. The mere physical presence of the pipeline, support road, and associated facilities probably would have no effect on the behavior, movement, or distribution of caribou, except perhaps if heavy snowfall prevented some animals from crossing under or over the pipeline in local areas (see Sec. IV.C.7). During construction, caribou movement could be temporarily blocked and crossings might be slower; but successful crossing still would occur (see Sec. IV.C.7). Although traffic associated with a support road might serve as a temporary barrier to cow/calf movements, it would not block migration movements. Development of the pipeline corridor would increase hunter access to the Western and Central Arctic caribou herds and thus increase pressure on the population, but current regulation of the harvest should prevent overhunting. There also may be some disturbance from aircraft surveillance of the pipeline, but this would cause only brief flight reactions of some caribou and is not likely to delay movement for more than a few hours to a few days (see Sec. IV.C.7). Such a delay in movement could temporarily disrupt the caribou harvest, with possible short-term reductions of the season's harvest; but caribou would not become

locally unavailable, resulting in LOW effects on the Wainwright, Barrow, Atqasuk, Nuiqsut, or Kaktovik caribou harvests.

(4) Fishes: While fish do not serve as Inupiat cultural symbols--as do bowhead whales and caribou--their reliability and year-round availability make them an important subsistence staple. In the communities adjacent to the Sale 124 area, fish provide an estimated 1 to 22 percent of the total annual subsistence harvest (Table III-C-9; see Fig. III-C-12 for harvest areas). However, there currently are no data on proportions of specific fish species harvested. A rough estimate of total kilograms of fishes harvested annually is 27,955 kg (6.6% of total harvest) in Barrow; 1,273 kg (0.8% of total harvest) in Wainwright; and 7,045 kg (21.7% of total harvest) in Kaktovik (Table III-C-4). No data are available for other communities. The nearshore areas of the Beaufort--particularly the fish-overwintering areas in and near the major river estuaries in Barrow and Kaktovik subsistence-use areas--would be the most sensitive to the effects of the base case, with MODERATE biological effects expected on chum and pink salmon smolts, arctic cod, and capelins if a spill occurred during the open-water (summer) season and on rainbow smelt if a spill occurred during the winter (Sec. IV.C.3).

In the subsistence-use areas of Wainwright, Nuiqsut, and Kaktovik, LOW biological effects are expected on fishes (see Sec. IV.C.3). The low combined probability of an oil spill occurring in Wainwright, Nuiqsut, and Kaktovik subsistence-harvest areas (see Sec. IV.C.3) indicates that it is unlikely that an oil spill would affect the subsistence harvest of fishes in these areas. For this reason--and because of the diversity of fishes harvested (capelin, char, cod, grayling, salmon, sculpin, trout, ling cod, rainbow smelt, Bering and least ciscoes, flounder, saffron cod, Pacific herring, and tomcod) and the large harvest areas (fish are harvested along most of the Beaufort and Chukchi Sea coasts near the communities and along all major rivers [see Sec. III.C.3 and Fig. III-C-12])--VERY LOW effects on subsistence harvests are expected in Wainwright, Nuiqsut, and Kaktovik.

If a large oil spill occurred and contacted the Barrow subsistence-harvest area, effects on fish-subsistence harvests could be LOW--not only because of the biological consequences (see Sec. IV.C.3) but also because of a fear of tainting (Ellanna, 1980; Luton, 1985). As with other subsistence resources, fishes that were oiled likely would be rendered inedible or perceived as such and consequently would be unharvestable. However, even if fishes in the Barrow or Kaktovik area were oiled, fishing is conducted in a wide area (see Fig. III-C-12), and the overall harvest levels would not be affected. Barrow residents harvest marine fishes from Peard Bay to Pitt Point. Peak harvest periods occur from September through October, although fishing occurs all summer and fall. Although the most important fish harvest occurs from September through November, fishes also are harvested during the summer months. The variety of fishes harvested, the number of different areas for harvesting fishes, and the longer season for harvesting fish would enable Barrow residents to harvest other subsistence fishes--or the same fishes in other areas--if an oil spill contacted the Barrow subsistence-harvest area. Effects from oil spills associated with Sale 124 on the Barrow fish-subsistence harvest are expected to be LOW.

Noise and disturbance are expected to have insignificant effects on subsistence-fish stocks (see Sec. IV.C.3). Disturbance from seismic activity associated with Sale 124 would occur more than 5 km (3 mi) from subsistence-fishing areas, and boat noise would have only transitory effects on fishes. While some access problems may arise due to the placement of onshore facilities at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson, harvest pressures are not expected to increase significantly. Effects on subsistence fishing from noise and disturbance and construction activities associated with Sale 124 are expected to be VERY LOW.

(5) Seals: Bearded and hair seals comprise between 11.5 and 16.7 percent, respectively, of the total subsistence-resource harvests for the communities in the Sale 124 area (Sec. III.C.3 [Table III-C-2-7]; see Fig. III-C-10 for harvest areas). Bearded seals comprised (over a 20-year average) 2.9 percent (150 seals) of Barrow's total harvest, 12.3 percent (250 seals) of Wainwright's, and 7.4 percent (30 seals) of Kaktovik's; no information on seals is available for the other communities. Hair seals comprise 4.3 percent (955 seals) of Barrow's total harvest, 4.4 percent (375 seals) of Wainwright's, and 4.7 percent (70 seals) of Kaktovik's total harvest (see Table III-C-2-9).

Section IV.C.5 concludes that LOW biological effects are anticipated as a result of Sale 124 and that an oil spill could cause some contamination of seals, loss of the subsistence and economic value of contaminated seal hides, and loss of some of one season's young pups in affected areas. Even if only a small number of seals were heavily affected by an oil spill in the area, seals that were oiled would likely be rendered inedible

or perceived as such and consequently would be unharvestable. Oil-spill effects are most likely to occur in the Barrow seal-harvesting areas. Wainwright, Nuiqsut, and Kaktovik should not be affected because of the low probabilities of an oil spill occurring and contacting these subsistence-harvest areas. The seal harvest occurs over a longer period of time (harvests are possible during the entire year [see Sec. III.C.3]) than harvests of other subsistence resources. However, although the potential effects on seals from an oil spill associated with Sale 124 might cause harvesters to hunt longer or take extra trips, these effects should not cause more than LOW effects on seal harvests, with a possible reduction in harvests during a portion of the seal-hunting season; but seals would not become unavailable during the year.

Seals are somewhat susceptible to noise and disturbance from aircraft and vessel traffic. Industrial activity associated with Sale 124 is not expected to result in distributional changes in seal populations (Sec. IV.C.5). Disturbance from aircraft or vessels used in exploration and development and production could cause short-term, localized effects on seals and some short-term disruption to the seal harvest; however, this would not affect annual harvest levels, and seals would not become unavailable during the year. LOW effects on seal harvests due to noise and traffic disturbance are expected in Barrow's, Wainwright's, Nuiqsut's, and Kaktovik's subsistence-harvest areas.

Construction of a shore base at, and an offshore pipeline to, Point Belcher, Pitt Point, Oliktok Point, and Point Thomson might disturb the hunting of ringed, spotted, and bearded seals by Wainwright, Barrow, Nuiqsut, and Kaktovik residents. Flaxman Island, immediately offshore Point Thomson, is an important area for Nuiqsut and Kaktovik spotted, ringed, and bearded seal harvests. The area in the vicinity of Oliktok Point is an important area for Nuiqsut seal harvests, and Point Belcher is in the vicinity of important sealing areas for Wainwright and Barrow. Landfalls at Point Belcher, Oliktok Point, and Point Thomson would concentrate noise and disturbance in these harvest areas. If construction occurred during peak harvest periods (June and July), the harvests of bearded and ringed seals could be affected in the Wainwright, Barrow, Nuiqsut, and Kaktovik subsistence areas. However, the long seal-harvest period would enable residents to harvest seals during other times of the year. LOW effects on Wainwright, Barrow, Nuiqsut and Kaktovik seal harvests can be expected as a result of Sale 124-related construction activities at Point Belcher, Oliktok Point, and Point Thomson.

(6) **Walrus:** Walrus are most important in Wainwright, where this resource comprises an estimated 18.5 percent (86 walrus) of the total annual subsistence harvest (estimated 20-year average) (Table III-C.2-7; see Fig. III-C-11 for harvest areas). In Barrow, walrus are less important (4.6% [55 walrus] of the total annual subsistence harvest [see Table III-C-9]); no data are available for Nuiqsut. Walrus are rarely seen as far east as Kaktovik. Section IV.C.5 concludes that LOW biological effects on walrus are expected as a result of oil spills associated with Sale 124. Although oil spills could cause some contamination of walrus and the loss of some of one season's young in affected areas, walrus are not expected to be affected by oil spills to any great extent. However, walrus that were oiled likely would be rendered inedible or perceived as such and consequently would be unharvestable. Barrow and Wainwright walrus harvests occur west of Point Barrow. The Barrow subsistence-harvest area is the most sensitive to oil spills due to the higher probability (20% in Resource Area B) of oil spills contacting the area during the winter (7% probability from April-June). Walrus hunting is concentrated in each community's subsistence-resource area during the open-water months, primarily from late May and early June through the end of August. An oil spill that contaminated the annual walrus harvest of Barrow would cause walrus to become locally unavailable for no more than 1 year, resulting in MODERATE effects. Similar effects on the walrus harvest also would occur in Wainwright, Nuiqsut, or Kaktovik. While it is likely that if an oil spill occurred its effects would be MODERATE, the low probability of an oil spill occurring in these areas indicates that VERY LOW effects can be expected in this subsistence-harvest area.

Noise and disturbance generally do not affect walrus-distribution patterns (Sec. IV.C.5); however, noise and disturbance from aircraft can have localized, short-term effects that would cause some disruption to the harvest but would not cause walrus to become unavailable. LOW effects on the walrus harvests due to noise and disturbance are expected in the Barrow (Atqasuk), Wainwright, Nuiqsut, and Kaktovik subsistence-harvest areas.

Construction of offshore pipelines to, and a landfall at, Point Thomson or Pitt Point would concentrate noise and traffic disturbance in these areas; however, neither of these areas generally are locations of walrus harvests. The construction of an offshore pipeline to, and a landfall at, Point Belcher would concentrate noise and traffic disturbance in this subsistence-harvest area and might temporarily disturb Wainwright walrus hunting for one season. Noise and disturbance of this level in this subsistence-harvest-concentration

area during the Barrow, Atqasuk, and Wainwright walrus hunts could cause walrus to become unavailable for no more than 1 year, resulting in MODERATE effects from construction activities associated with Sale 124 on walrus hunting in the Barrow, Atqasuk, and Wainwright, subsistence-harvest areas. Thus, MODERATE effects on walrus hunting are expected from construction activities associated with Sale 124.

(7) Birds: Waterfowl are considered an important subsistence resource, not because of the quantity of meat harvested (Table III-C-9), or the time spent hunting them (see Sec. III.C.3), but because of their dietary importance during spring and summer and because they are a preferred food. Waterfowl comprise less than 3 percent of the total annual subsistence harvest over 20 years (0.9% or 3,636 kg of meat in Barrow; 0.3% or 545 kg of meat in Wainwright; 0.4% or 136 kg of meat in Kaktovik; no data are available for other villages [Table III-C-9]).

According to Section IV.C.4, if an oil spill occurred during breakup or the open-water period--the seasons when bird hunting takes place--it would likely have immediate effects on birds. Eiders and oldsquaw (both subsistence species) would be most likely to suffer direct mortality; brant and other waterfowl could be harmed indirectly through contamination of saltmarshes.

The probability of one or more spills occurring and contacting any subsistence-harvest area within 30 days in summer is low. Since most eider hunting occurs on the oceans and along the coasts during two spring months, and most brant hunting occurs along the coasts during two fall months, the probability that an oil spill would affect all subsistence-bird hunting--even if oil contacted these bird-habitat areas--is lower than the probability of contact for that resource area. On the other hand, because of the short hunting season, oil contact could reduce the harvest levels of birds for an entire season. If an oil spill occurred and contacted the Barrow, Nuiqsut, or Kaktovik bird-hunting areas, birds would become unavailable. However, it is not likely that the entire subsistence-bird harvest would be affected. This harvest occurs over two spring months and two fall months, indicating that the effects on Barrow, Nuiqsut, and Kaktovik subsistence-bird harvests would be LOW.

The noise caused by construction of both offshore and onshore oil facilities may disturb waterfowl-feeding and -nesting activities. Construction of offshore pipelines also may disrupt waterfowl-food sources but is likely to result in only local and temporary effects. Such low-level biological effects would be too brief to have significant effects on bird harvesting by the communities in the Sale 124 area. Effects on all bird harvests in the Sale 124 area from noise and traffic disturbance and from construction activities are expected to be VERY LOW.

(8) Polar Bears: Polar bears contribute less than 1 percent to the total annual subsistence harvest for community residents near the Sale 124 area (0.4% or 7 bears in Barrow; 1.0% or 7 bears in Wainwright; 2.8% or 4 bears in Kaktovik; 0.1% or 1 bear in Nuiqsut; no data are available for Atqasuk [see Table III-C-9 and Sec. III.C.3]). Section IV.C.5 concludes that oil spills could cause some contamination of seals (polar bear prey), loss of the subsistence and economic values of polar bear hides, and loss of some of one season's young in affected areas. Prey contamination also could cause some mortality in the polar bear population. Thirty to forty bears could be directly killed by an oil spill (see Sec. IV.C.5). Such effects are most likely to occur in Barrow's, Wainwright's, Nuiqsut's, and Kaktovik's polar bear-harvest areas but could affect bears available to any coastal communities. The polar bear harvest occurs year-round; and while the effects that may occur on polar bears from an oil spill associated with Sale 124 might cause residents to hunt longer or take extra trips, these effects would not reduce harvests for an entire year. Effects of oil spills related to Sale 124 on Barrow's, Wainwright's, Nuiqsut's, and Kaktovik's polar bear harvest are most likely to be LOW. However, it is possible--although considered unlikely--that 20 to 30 polar bears could be killed by an oil spill (see Sec. IV.C.5.a.[5]). This is considered a severe case and not considered particularly likely. If such a large number of polar bears were killed, it is possible that the FWS would find it necessary to curtail all or a substantial portion of the Alaskan Native polar bear subsistence harvests in the area (currently up to 35 animals per year in the Alaskan Beaufort Region) for a year or more. While it might appear that the cessation of the polar bear harvest for a year or possibly more might cause hardship to the community, very few polar bears are actually harvested in each community (1 to 7). The meat is not a preferred meat. Although HIGH effects are possible, it is expected that this would not occur--LOW effects from oil spills are expected on the subsistence harvest of polar bears.

Polar bears could experience short-term, localized aircraft-noise disturbance effects that would cause some disruption in the polar bear harvest but would not affect annual harvest levels. LOW effects due to noise and traffic disturbance can be expected on polar bear harvests in Barrow, Wainwright, Nuiqsut, and Kaktovik.

Wainwright, Barrow, Nuiqsut, and Kaktovik polar bear harvests may be temporarily disturbed by construction activities at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson.

c. Effects on Subsistence Resources by Community: The following discussion summarizes the preceding section by community; see Sections IV.C.10.b.(1) through (8) for the complete analysis.

(1) Wainwright: Oil spills are not expected to have large biological effects on bowhead whales, nonendangered marine mammals, caribou, or fishes. The low probability of an oil spill occurring and contacting the Wainwright subsistence-harvest area indicates little likelihood that the community's subsistence harvests would be affected.

Construction of a pipeline to and landfall at Point Belcher would concentrate noise and disturbance and construction activities in Peard Bay and would disturb subsistence harvests. During the development and construction phase, an offshore pipeline to Point Belcher might disturb Wainwright's bowhead whale hunt. Wainwright's bowhead whale harvest could become locally unavailable for up to 1 year--representing MODERATE effects on the harvest of bowhead whales. Ringed and bearded seals and walrus also are harvested at Point Belcher and in Peard Bay. Development and construction activities could disturb seal and walrus harvests. Seals are harvested over most of the year, thus it is likely that while the harvest may be affected, it would not become locally unavailable--a LOW effect. Walrus harvests, however, occur in a short time period and would be more likely to be substantially reduced--a MODERATE effect.

CONCLUSION (Effects on Wainwright): In the base case, effects from the proposed lease sale on subsistence harvests are expected to be MODERATE.

(2) Barrow (Atqasuk): Barrow's entire marine subsistence-harvest area lies within the Sale 124 area (with the exception of a 3-mi-wide band within State waters). An oil spill could affect Barrow's spring or fall whaling for 1 year. This would affect the availability of bowheads for no more than 1 year--a MODERATE effect. Oil spills are unlikely to have long-term biological effects on bowhead whales, belukha whales, seals, walrus, polar bears, caribou, or fishes and would have no more than LOW effects on subsistence harvests. While an oil spill also could make some waterfowl locally unavailable for 1 year, the large numbers of waterfowl harvested in a large area--in addition to harvests occurring in the spring and the fall--might decrease waterfowl harvests; however, some harvests still should occur.

Localized, short-term effects from noise and disturbance are not expected to have long-term biological consequences on bowhead whales. However, since whaling occurs in narrow leads and whales can easily escape into the pack ice, this activity may be particularly sensitive to noise disturbance. During exploration and development, noise from support vessels may disrupt whaling at Barrow during one season, particularly if ice conditions were severe. Disturbance of such activities is not likely to occur to the extent that no whales are harvested for more than one season in Barrow because there are more bowheads harvested in Barrow than in any other community (7 in 1988 and 11 in 1989)--a LOW effect. Belukha whales also may be sensitive to noise and traffic disturbance. However, like the harvests of seals and polar bears, the harvests of belukhas occur over a longer time period and in a larger geographical range. For these reasons, belukha whales, seals, walrus, and polar bears are not likely to be made unavailable--a LOW effect.

Construction activities are not likely to greatly affect Barrow's subsistence harvests. The construction of a pipeline from the TAP to Pitt Point may locally reduce the availability of caribou for less than 1 year for some areas harvested by Barrow-Atqasuk (a LOW effect), but this would not cause the harvest to be unavailable. Construction activities should not affect other harvests in Barrow's subsistence-harvest area.

CONCLUSION (Effects on Barrow ([Atqasuk]): In the base case, effects from the proposed lease sale on subsistence-harvest patterns are expected to be MODERATE.

(3) Nuiqsut: Nuiqsut's entire marine-subsistence harvests occur within the proposed Sale 124 area (with the exception of a 3-mi-wide band within State waters). In the immediate vicinity of Nuiqsut, there is a low probability of an oil spill occurring and contacting the Nuiqsut subsistence-harvest area (1% or less). However, Nuiqsut residents often travel long distances to harvest marine mammals. Harvests of bowheads occur closer to Kaktovik. The probability of an oil spill occurring and contacting this harvest area is low. Oil spills are unlikely to have more than LOW effects on harvests of bowhead and belukha whales, seals, walrus, polar bears, caribou, or fishes.

Localized, short-term effects from noise and disturbance are not expected to have long-term biological consequences on bowhead whales. During exploration and development, however (as in the case of Barrow), noise from support vessels may disrupt whaling during one season--a MODERATE effect. The availability of belukha whales, seals, walrus, caribou, fishes, polar bears, and birds may be affected for less than one season--a LOW effect.

The landfall at Point Thomson is directly off of Flaxman Island, the primary location for Nuiqsut bowhead whale harvests. Construction activities could cause bowhead whales to avoid the area and force Nuiqsut whalers to travel farther to hunt bowheads. Nuiqsut's bowhead whale harvest is usually only one, but sometimes two, bowheads. Disruption from construction activities could cause the bowhead whale to become unavailable to Nuiqsut whalers for 1 to 2 years--a HIGH effect. Under the base-case scenario, landfalls are suggested at Pitt Point, Oliktok Point, and Point Thomson. A landfall at Pitt Point is likely to have only LOW effects on the caribou harvests of Nuiqsut. Construction activities and development at Oliktok Point are likely to have no more than LOW effects on Nuiqsut harvests.

CONCLUSION (Effects on Nuiqsut): In the base case, effects from the proposed lease sale on subsistence-harvest patterns are expected to be HIGH.

(4) Kaktovik: Kaktovik's entire marine-subsistence-harvest area lies within the proposed Sale 124 area (with the exception of a 3-mi-wide band within State waters). Oil spills are unlikely to have more than LOW effects on the harvests of bowhead and belukha whales, seals, walrus, polar bears, caribou, or fishes.

During exploration and development, noise from support vessels may disrupt whaling at Kaktovik during one season, particularly if ice conditions were severe. Such a disruption would not make bowheads locally unavailable for more than 1 year--a MODERATE effect. Belukha whales may be sensitive to noise and traffic disturbance. However, like the harvests of seals and polar bears, the harvests of belukhas occur over a longer time period and in a larger geographical range. For this reason, belukha whales, seals, walrus, and polar bears are not likely to be made unavailable.

Noise and traffic along the onshore pipeline corridor may disturb caribou and cause temporary disruption to caribou harvests, they will not make caribou unavailable. Effects on caribou harvests are most likely to occur from the placement of onshore-support facilities and pipelines. Construction of a landfall and facilities at Point Thomson and of a pipeline from Point Thomson to TAP may locally reduce the availability of caribou for less than 1 year for some areas harvested by Kaktovik, but this would not cause the harvest to be unavailable. Construction activities should not affect other harvests in Kaktovik's subsistence-harvest area.

CONCLUSION (Effects on Kaktovik): In the base case, effects from the proposed lease sale on subsistence-harvest patterns are expected to be MODERATE.

CONCLUSION: The effects of the base case for Sale 124 on subsistence-harvest patterns are expected to be HIGH in Nuiqsut and MODERATE in Wainwright, Barrow (Atqasuk), and Kaktovik. Regional effects from the proposed lease sale in the base case are expected to be HIGH.

## 11. Effects on Archaeological Resources

Effects of the base case on archaeological resources could result from lease exploration, onshore-facility construction, construction of pipelines to shore from the production platforms, employees (directly and indirectly employed) in sale-related activities who visit archaeological-resource sites, and other oil-related activities. Section II describes the Sale 124 scenarios. For the base case, 10 exploratory and 4 delineation wells are expected to be drilled; and 120 production and service wells are expected to be drilled from two installed production platforms. Approximately 275 mi of offshore pipelines and 325 mi of onshore elevated pipelines are expected to be installed. The burial of offshore pipelines in excavated trenches could affect shipwrecks offshore within water depths of 40 m or less. Excavations for pipeline burial also would affect cultural resources, if they exist in the area.

The survival of offshore prehistoric resources has been estimated by MMS for Sale 124 (MMS Regional Archaeological Analysis, Appendix I). An analysis of various data sources, including fathograms, subbottom seismic profiles, and sidescan-sonar records, indicates that there is very little probability but a small possibility that prehistoric sites in the proposed sale area could have survived the extensive ice gouging experienced in this part of the OCS. However, offshore shipwrecks may have escaped destruction if the wrecks took place beyond ice-gouging depths or were recent enough that by chance, gouging has not occurred in the wreck area. Finding such wrecks while doing surveys for exploratory drilling is unlikely, but it is more likely while conducting activities associated with other petroleum activities such as surveying for pipeline trenches, trench making, and pipeline maintenance in the Sale 124 area. A discussion of shipwreck survival in such areas is found in the Shipwreck Update Analysis (Appendix I), and a discussion of the likelihood of prehistoric archaeological resources is found in the Prehistoric Resource Analysis, Proposed Sale 124, Beaufort Sea (Appendix I, this EIS). Such a cause of disturbance raises the anticipated effect above VERY LOW; therefore, the effects of oil exploration along with the disturbance are expected to be LOW. Selection of pipeline landfalls at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson (see Fig. IV-A-1-1) would affect onshore archaeological resources on Land Segments 14 to 16, 25 to 27, 32 to 34, and 40 to 42, respectively, by adding to the activity at those segments. However, this activity of trenching for pipelines and maintaining the pipelines at the landfall sites would be expected to be modest.

The offshore pipeline could place at risk land segments near other feasible landfalls along the shores of the Beaufort and the Chukchi Seas: There are three land segments (Appendix G, Table G-11, this EIS) on the Chukchi Sea coast that are the most sensitive of the 45 Beaufort Sea Planning Area segments of the OSRA. The three segments (13, 15, and 19) (Fig. IV-A-1-1) have the highest number of known shipwrecks, some discovered remnants of wrecks, and known archaeological sites. However, oil-spill-contact probability for these segments for the base case is quite low, all less than 0.5 percent (Appendix G). The OCS off Point Belcher (Seg. 15) is an historic whaling area with remnants of 38 ships nearshore (Tornfelt, In Prep.). There are six known prehistoric and historic sites onshore. Some personnel from the petroleum-industry facilities or their relatives might recreate on and/or tour the land segments. It is possible that some archaeological material could be adversely affected by such visits, although this is unlikely because industry guidelines and regulations prohibit their personnel from disturbing archaeological sites. It is not certain how many people will be aware of these regulations and some adverse contacts, however small, could occur. Therefore, the effect of this combined OCS activity is expected to be LOW for Segments 13, 15, and 19.

There are about 16 segments along the coast near the Sale 124 area (Appendix G, Table G-11, this EIS) that have above the mean number of archaeological sites (four) but no known shipwrecks offshore or on beaches. Although the remains of the archaeological sites might not be contacted directly by oil-industry personnel in normal activities, cleanup efforts that might be required in the vicinity of known archaeological sites could bring in cleanup equipment and workers that might affect the sites or remains. Of these, Nuiqsut (Seg. 32) and Kaktovik (Seg. 41) probably would incur the most effect because they would receive industry and oil-related managers as visitors and possibly be visited by petroleum-industry personnel and/or their relatives. Segments 12, 22, 33, and 36 (Fig. IV-A-1-1) have the most known archaeological sites; and Segment 20, east of Barrow, has approximately 24 undiscovered shipwrecks in the waters offshore. All segments mentioned have many onshore archaeological sites, but the disturbance is likely to be small. It is expected that tourist and OCS-population visits related to oil-exploration activity could have an effect on any cultural remains on the beaches of Segment 20; and, if there is cleanup of oil spills, cultural sites are generally expected to be adversely disturbed only to a small degree.

**CONCLUSION:** The overall effects on archaeological resources of the base case for Alternative I are expected to be LOW.

## 12. Effects on Air Quality:

a. Effects on Air Quality Relative to Standards: Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (see Table III-A-4). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based on an annual averaging period. The standards also include PSD provisions for NO<sub>2</sub>, SO<sub>2</sub>, and TSP to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Specific limited incremental concentrations are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas; Class I allows the least degradation and also restricts degradation of visibility. The entire northern coast of Alaska is an attainment area designated as a Class II PSD area (State of Alaska, DEC, 1982). Baseline PSD-pollutant concentrations and the portion of the PSD increments already consumed are established for each location by EPA and the State of Alaska prior to issuance of air-quality permits. Air-quality standards do not directly address all other potential effects such as acidification of precipitation and bodies of freshwater or effects on nonagronomic plant species.

Because air-quality regulations are focused on protection of human health and welfare, they are applied over land areas. Consequently, the MMS uses a three-step analytical procedure to evaluate potential air-pollutant emissions from offshore activities and to determine whether air-quality standards are expected to be met at the shoreline during offshore oil and gas activities. The procedure is described in detail in the Code of Federal Regulations (30 CFR Part 250) and is summarized as follows:

- The first step is to determine if the amount of pollutants emitted per year during peak activities would exceed exemption levels determined in part by a distance multiplier (Table IV-C-12-1) to account for the location of activities relative to the shoreline. The exemption levels are conservative; that is, they tend to overestimate the amount of emissions that would reach the shore. If the exemption levels are not exceeded, air-quality standards would easily be met and further analysis is unnecessary.
- Second, if an exemption level is exceeded, it is necessary to determine if USDOJ significance concentrations (expressed as incremental-pollutant concentrations attributable to the offshore source) would be exceeded at the shoreline. Except in the case of VOC, the determination is made by application of the OCD Model (Hanna et al., 1984). The VOC emissions are deemed significant if the exemption level is exceeded. The OCD Model, which is approved by EPA, is especially adapted for atmospheric behavior across shorelines.
- Third, if a significance level would be exceeded, the lessee would be required to reduce emissions through application of BACT to the emission sources. A specific analysis would be required of the lessee prior to operations to account for the actual location and equipment being used. In any event, USDOJ regulations would not allow emissions that would violate onshore air-quality standards, including the incremental limits prescribed by the PSD limitations (Table III-A-3). The expected effects of the base case on the relatively pristine air quality (see Sec. III.A.6) according to the above analytical procedure are described in the following paragraphs.

Under the base case, the peak exploration year would include 2 exploration and 2 delineation wells drilled from three rigs; and the peak development year would include installation of 2 production platforms, 30 production wells, approximately 167 km (104 mi) of offshore pipeline, and 155 km (96 mi) of onshore pipeline. The peak production year would include 76 MMbbl of oil produced from four platforms and transported by pipeline. Under the base-case scenario, exploration activities would be scattered beyond the 20-m isobath (approximately 19 km or 12 mi offshore), and development and production activities would be centered approximately 56 km (35 mi) northeast of Barter Island, 64 km (40 mi) north of Oliktok Point, 81 km (50 mi) north of Pitt Point, and 113 km (70 mi) northwest of Point Belcher. The projected emissions would not exceed the exemption levels during the peak years of any of the potential operations near these locations at the shoreline (Table IV-C-12-1). Concentrations at the shoreline are expected to be less than 5 percent of available national standards or PSD increments. Air-quality standards at the shore would be maintained by a wide margin, and the application of the OCD Model for further evaluation is unnecessary at this time.

b. Effects of Air Quality Not Addressed by Standards: Effects of air pollution from OCS activities and other sources on the environment not specifically addressed by air-quality standards include the

Table IV-C-12-1  
 Estimated Uncontrolled Emissions and USDOJ Exemption Levels For  
 Proposed Beaufort Sea Lease Sale 124  
 (metric tons per year)

	Pollutant <sup>1/</sup>				
	CO	NO <sub>x</sub>	TSP	SO <sub>2</sub>	VOC
<b>Low Case</b>					
Peak Year (Exploratory Drilling Only) <sup>2/</sup>	63.4	192.8	5.6	16.7	9.7
<b>Base Case<sup>3/</sup></b>					
Peak Exploration Year	63.4	192.8	5.6	16.7	9.7
Peak Development Year	123.0	383.7	22.5	34.1	21.6
Peak Production Year	311.5	418.9	24.1	3.5	79.9
<b>High Case<sup>4/</sup></b>					
Peak Exploration Year	63.4	192.8	5.6	16.7	9.7
Peak Development Year	138.3	457.1	23.1	34.6	22.5
Peak Production Year	169.7	372.1	21.3	3.2	70.5
<b>Exemption Levels--</b>					
Low Case at 19 km <sup>5/</sup>	16,161.0	362.4	362.4	362.4	362.4
<b>Exemption Levels--</b>					
Base Case at 42 km <sup>5/</sup>	27,059.0	785.0	785.0	785.0	785.0
Exemption Levels at 48 km <sup>5/</sup>	29,767.0	906.0	906.0	906.0	906.0
Exemption Levels at 71 km <sup>5/</sup>	42,365.0	1,329.0	1,329.0	1,329.0	1,329.0
Exemption Levels at 81 km <sup>5/</sup>	41,843.0	1,510.0	1,510.0	1,510.0	1,510.0
Exemption Levels at 108 km <sup>5/</sup>	50,857.0	2,024.0	2,024.0	2,024.0	2,024.0
Exemption Levels at 112 km <sup>5/</sup>	52,363.0	2,115.0	2,115.0	2,115.0	2,115.0
Exemption Levels at 132 km <sup>5/</sup>	58,188.0	2,477.0	2,477.0	2,477.0	2,477.0
Exemption Levels at 132 km <sup>5/</sup>		132 km <sup>5/</sup>			

Source: USDOJ, MMS, Alaska OCS Region. Computed from factors in Form and Substance (1983).

- <sup>1/</sup> CO = Carbon Monoxide
- NO<sub>x</sub> = Nitrogen Oxides (assumed predominately NO<sub>2</sub>)
- TSP = Total Suspended Particulates (includes most particulate matter less than 10 micrometers in aerodynamic diameter)
- SO<sub>2</sub> = Sulfur Dioxide
- VOC = Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)
- <sup>2/</sup> Assumes 2 wells drilled in peak year in widely-spaced locations. Consequently, it is necessary to compare emissions for 1 well with exemption levels.
- <sup>3/</sup> Assumes 4 exploration wells drilled in peak exploration year (3 simultaneously), 2 production platforms and 200 miles of pipeline installed and 30 production wells drilled in peak development year, and 76 MMbbl of oil produced from four platforms in peak production year. Because exploration drilling and production platforms would be widely scattered under the scenario, it is necessary to compare emissions for each exploration well and production platform against the exemption levels. Therefore, peak exploration and production emissions are given for 1 exploration well and 1 production platform.
- <sup>4/</sup> Assumes 9 exploration wells drilled in peak exploration year; 3 platforms installed, 200 mi of

pipeline laid, and 40 production wells drilled in the peak development year; and 218 MMbbl of oil produced from 7 platforms and 85 production wells drilled in the peak production year. Because exploration and development and production would be widely scattered under the scenario, it is necessary to compare emissions from each exploration well, platform installation, and production platform with the exemption levels. Therefore, emissions are given for one exploration well, one platform installation, and one production platform, including their support activities.

\*/

Exemption levels based on USDOJ exemption criteria accounting for distance from shore (30 CFR 250.45).

possibility of damage to vegetation and acidification of coastal tundra, as discussed in Sections III.D.7 and IV.G.7 of the Diapir Field Lease Offering (Sale 87) FEIS (USDOJ, MMS, 1984) and in Olson (1982). This information is incorporated by reference, and a summary pertinent to this proposed Sale 124 follows. Effects may be short term (hours, day, or weeks), long term (seasons or years), regional (on the scale of half or more of the North Slope of Alaska), or local (near the shore only). The analysis for Sale 87 was conducted on the basis of emissions occurring 5 km (3 mi) from shore. For Sale 124, exploration activities would be scattered beyond 19 km (12 mi) from shore, and the nearest development and production would be approximately 42 km (26 mi) from shore, allowing for much more dispersion of pollutants. Consequently, the likelihood of either regional or local effects is reduced.

A significant increase in ozone concentrations onshore is not likely to result from development and production under the base case. Photochemical pollutants such as ozone are not emitted directly, but rather form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present 24 hours each day during the summer in the sale area, temperatures remain relatively low (Brower et al., 1988). Also, the activities under the base case are well offshore and separated from each other, diminishing combined effects from sale-related activities and greatly increasing atmospheric dispersion of pollutants before they reach shore.

Olson (1982) reviewed the body of knowledge that demonstrates the known high susceptibility of fruticose lichen, an important component of the coastal-tundra ecosystem, to sulfurous pollutants. There is evidence that SO<sub>2</sub> concentrations as low as 12.0 micrograms per cubic meter for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 micrograms per cubic meter. Also, the sensitivity of lichen to sulfate is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO<sub>2</sub> emissions on the North Slope of Alaska other than near Prudhoe Bay, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. The most recent ambient-measured SO<sub>2</sub> concentrations for the Prudhoe Bay area are considerably less than allowed by standards (including PSD limitations) (see Table III-A-3). Because of the remoteness of the proposed activities from the shore, attendant increased atmospheric dispersion, and low existing levels of onshore-pollutant concentrations, the effect of the base case on vegetation is not expected to be noticeable, even locally and short term.

Effects of Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. The number of OCS blowouts--almost entirely gas and/or water--has averaged 3.3 per 1,000 wells drilled since 1956 (Fleury, 1983). The data show no statistical trend of a decreasing rate of occurrence. The blowout rate has actually averaged somewhat higher since 1974, at 4.3 per 1,000 wells drilled, but the difference between the post-1974 period and the longer 1956 to 1982 record is statistically insignificant.

A gas blowout could release 20 metric tons per day of gaseous hydrocarbons, of which about 2 metric tons per day would be nonmethane hydrocarbons classified as VOC. Based on the assumption of the Poisson distribution, the probability of experiencing one or more blowouts in drilling the 83 wells projected for the base case would be 24 to 30 percent. If a gas blowout occurred, it would be unlikely to persist more than 1 day, and it would very likely release less than 2 metric tons of VOC. Since 1974, 60 percent of the blowouts have lasted 1 day or less; and only 10 percent have lasted more than 7 days.

A gas blowout may release up to 0.03 metric tons of hydrogen-sulfide gas per day (Stephens, Braxton, and Stephens, 1977). Hydrogen sulfide and other gases from blowouts could be extremely harmful to workers on or near the drilling rig. At farther distances or onshore, no significant effects would result because of rapid dispersion and oxidation of hydrogen sulfide to sulfur dioxide (forming up to 9.09 metric tons of sulfur dioxide per day). Because most blowouts last 1 day or less and the total amount of sulfur dioxide for blowouts would be much lower than normal, sulfur-dioxide emissions over the life of the field are not expected to be noticeable onshore, even locally or on a short-term basis.

Oil spills are a second accidental source of gaseous emissions. The average size of a 1,000-bbl-or-greater OCS spill is 22,000 bbl for spills from platforms, pipelines, and tankers. Modeling predictions of hydrocarbon evaporation (Payne and Kirstein, 1983, 1987) from a 22,000-bbl slick over 30-day periods near Prudhoe Bay estimate that between 4,049 and 4,189 bbl or 565 to 585 metric tons of hydrocarbon would evaporate. Because approximately 10 percent of gaseous hydrocarbons are nonmethane VOC, between 56.5 and 58.5 metric tons of VOC would be lost to the atmosphere. This does not exceed the USDOJ exemption criteria for VOC emitted at a distance of 5 km (3 mi) from shore. The movement of the oil slick during this time

would result in lower concentrations and dispersal of emissions over an area several orders of magnitude larger than the slick itself. Under the base case, the most likely number for one spill of 1,000 bbl or greater is one. More than one such spill in any single year under the base case is not anticipated. Smaller spills of less than 1,000 bbl occur more frequently than larger spills. The number of small spills projected for the base case is 213 totaling 3,000 bbl over the life of the field. Evaporations from these spills could release an additional 8.7 metric tons or 62.6 bbl of VOC over the projected 27 years of exploration and production for the proposed sale.

Gas or oil blowouts may catch fire. In addition, in situ burning is a preferred technique for cleanup and disposal of spilled oil in oil-spill-contingency plans. For catastrophic oil blowouts, in situ burning may be the only effective technique for spill control.

Burning affects air quality in two important ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and very slightly increase emissions--relative to quantities in other oil and gas industrial operations--of other pollutants (Table IV-C-12-2). If an oil spill is ignited immediately after spillage, the burn can combust 33 to 67 percent of the crude oil or higher amounts of fuel oil than otherwise would evaporate. On the other hand, incomplete combustion of oil injects about 10 percent of the burned crude oil as oily soot plus minor quantities of other pollutants into the air (Table IV-C-12-3). For a major oil blowout, setting fire to the wellhead could burn 85 percent of the oil with 5 percent remaining as residue or droplets in the smoke plume--in addition to the 10-percent-soot injection (see Evans et al., 1987). Clouds of black smoke from a 360,000-bbl-oil-spill tanker fire 75 km off the coast of Africa locally deposited oily residue as rain 50 to 80 km inland. Later the same day, clean rain washed away most of the residue and allayed fears of permanent damage.

Based on qualitative information, burns that are two or three orders of magnitude smaller do not appear to cause noticeable fallout problems. Along the Trans-Alaska Pipeline, 500 bbl of a spill were burned over a 2-hour period "apparently without long-lasting effects" (Schulze et al., 1982). The smaller volume Tier II burns at Prudhoe Bay had no visible fallout downwind of the burn pit (Industry Task Group, 1983).

Coating portions of the ecosystem with oily residue is the major but not the only potential air-quality risk. Recent examination of polycyclic-aromatic hydrocarbons (PAH) in crude oil and smoke from burning crude oil indicates that the overall amounts of PAH change little during combustion, but the kinds of PAH compounds present do change. Benzo(a)pyrene, which is often used as an indicator of the presence of carcinogenic varieties of PAH, is present in crude-oil smoke in quantities approximately three times larger than in the unburned oil. However, the amount of PAH is very small (Evans, 1988). Investigators have found that, overall, the oily residue in smoke plumes from crude oil is mutagenic but not highly so (Sheppard and Georgiou, 1981; Evans et al., 1987). The Expert Committee of the World Health Organization considers daily average smoke concentrations of more than 250 micrograms per cubic meter to be a health hazard for bronchitis.

Over the life of oil exploration and production in the sale area, oil spills of 1,000 bbl or greater could be accidentally or deliberately set on fire. Predominant winds in the sale area would transport smoke plumes to the west-southwest, toward or parallel to the coast if a spill occurred east of Barrow. Predominant winds would transport smoke away from land west of Barrow. Potential contamination of the shore would be limited because development and production activities under the base case would be at least 48 km (30 mi) offshore, with the exception of the oil-transport pipelines. Also, large fires create their own local circulating winds--toward the fire at ground level--that affect plume motion. In any event, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains, limiting any health effects to the very short term.

**SUMMARY:** Exemption levels for emissions of regulated air pollutants would not be exceeded under the base case, pollutant concentrations at the shoreline are expected to be less than 5 percent of available national standards or PSD concentration increments, and air-quality standards would be maintained by a large margin. Principally because of the substantial distance of emissions from land, the other effects of air-pollutant concentrations at the shore due to exploration and production or accidental emissions would not be sufficient to harm tundra vegetation on more than a short-term basis even locally. However, a light, short-term coating of soot over a localized area could result from oil fires set to clean a spill. Overall, the effects on air pollution under the base case are expected to be LOW.

**CONCLUSION:** Effects on air quality are expected to be LOW.

Table IV-C-12-2  
Emissions from Burning 20 Metric Tons of Natural Gas per Day  
During a Blowout  
(metric tons)

	Duration of Blowout		
	1 Day	4 Days	7 Days
Total Suspended Particulates	0.009	0.04	0.06
Sulfur Dioxide	0.0003	0.001	0.002
Volatile Organic Compounds	0.004	0.02	0.03
Carbon Monoxide	0.009	0.04	0.07
Nitrogen Oxides	0.04	0.15	0.26

Source: Calculated from emission factors in Frazier, Maase, and Clark, 1977.

Table IV-C-12-3  
Emissions from Burning Crude Oil  
(metric tons)

	Size of Burn	
	10,000 barrels	100,000 barrels
Total Suspended Particulates <sup>1/</sup>	130.0	1,300.0
Sulfur Dioxide <sup>2/3/</sup>	86.0	860.0
Volatile Organic Compounds <sup>2/</sup>	0.5	5.0
Carbon Monoxide <sup>4/</sup>	89.0	890.0
Nitrogen Oxides <sup>4/</sup>	3.8	38.0

Source: USDOl, MMS, Alaska OCS Region.

<sup>1/</sup> Estimated as 10 percent of the total burn less residue (Evans et al., 1987).

<sup>2/</sup> Burning assumed to be the same as residual oil firing in industrial burners. Emissions calculated from factors in Frazier et al. (1977).

<sup>3/</sup> Assumes a sulfur content of 2.9 percent.

<sup>4/</sup> Emissions calculated from factors in Evans et al. (1986, 1987).

### 13. Effects on Land Use Plans and Coastal Management Programs

Onshore activities and some offshore activities resulting from Sale 124 would be subject to the NSB Comprehensive Plan and Land Management Regulations (LMR's) and the Alaska Coastal Management Program (ACMP) as amended by the NSB CMP. The NSB LMR's are applied to all developments occurring on private and State lands. In the Sale 124 scenario, these developments would include the shore bases and portions of the road/pipeline corridor--including the offshore portion within the NSB boundary. All development that occurred within the coastal management boundaries identified in the approved NSB CMP or affected uses of the coastal zone, including activities described in Exploration Plans and Development and Production Plans, would be subject to the Statewide standards and NSB district policies of the ACMP. The policies of the LMR's and the ACMP are examined for potential conflicts with the potential effects identified in Sections IV.C.1 through IV.C.12.

Development on the coastal plain of ANWR still has not been authorized by Congress. None of the pipeline route is assumed to traverse the refuge; no conflict with ANWR policy is inherent in the scenario.

a. NSB Comprehensive Plan and Land Management Regulations: During exploration, most onshore support would be based in existing facilities at Deadhorse. Any permits that are requested probably would be conditional-use permits for specific temporary activities; these are permissible in the Conservation District. The extensive and more permanent development associated with production would require that a master plan be prepared describing anticipated activities and non-Federal land be rezoned from the Conservation District to the Resource Development District or Transportation Corridor.

Areawide policies in the revised LMR's are the same as those for the NSB CMP policies. The primary difference would be the process used for implementation and the geographic areas covered. The LMR's have been applied to all lands within the NSB that are not in Federal ownership. Policies in the ACMP cover only activities within the coastal zone but can be applied to Federal lands in many instances (see Sec. IV.C.14[b]). Therefore, development assumed to occur following this lease sale usually would be subject both to the LMR's areawide policies and the ACMP policies. To avoid a redundant analysis, potential conflicts with the LMR's areawide policies are included with the NSB CMP policies in the analysis of the ACMP rather than here.

Policies considered in this section are those in the other LMR policy categories--Villages, Economic Development, Offshore Development, and Transportation Corridors. Potential conflict with these policies is limited to some extent by the locations assumed for the development that accompanies this lease sale.

No development is anticipated to occur within Village boundaries; therefore, the four policies directly related to developing within NSB communities would not be applicable.

Economic Development policies afford special consideration for projects during land use reviews that have features the NSB considers beneficial impacts (NSBMC [NSB Municipal Code] 19.70.030[A] through [G]). Economic Development policies foster hiring practices favorable to NSB businesses and residents--including special work schedules for those who pursue subsistence activities--and generate excess tax revenues over demand for expenditures. Two features assumed in the Sale 124 scenario would be viewed favorably. First, the proximity of the development from the western portion of the lease sale to the community of Wainwright may facilitate local employment in sale-related jobs (Sec. IV.C.10). Second, the project would provide an excess of tax revenues over demand for expenditures (Sec. IV.C.10).

Offshore Development policies are intended to guide the approval of development and uses in the portion of the Beaufort Sea within the NSB. Policy 19.70.040.E is the only one of these that applies to activities other than drilling. This policy requires that "(a)ll nonessential boat, barge and air traffic associated with drilling activity. . .occur prior to or after the period of whale migration through the area." Moreover, essential traffic is required to avoid disrupting the migration and subsistence activities and be coordinated with the AEWC. This policy will be especially applicable during development. Of particular concern would be during those periods when the landfall at Point Thompson is under construction because this area is a primary location for bowhead whale harvests for whalers from Nuiqsut.

The last category of policies covers the Transportation Corridor. To date, the only area included in this district is the Dalton Highway. It is assumed that if a pipeline corridor were built from Pitt Point, Oliktok Point, and Point Belcher to TAP or from Point Thomson to existing gathering lines east of TAP, (1) the

areas would become zoned as Transportation Corridors and (2) these policies would apply as the pipeline crossed land subject to NSB LMR's. Conflict with policies for transportation corridors is not inherent in the scenario, but developers would be held responsible for minimizing airport use, ensuring proper sand and gravel extraction and reclamation, buffering stream banks, locating away from active floodplains, avoiding sensitive habitats, and identifying and documenting archaeological sites prior to construction (NSBMC 19.70.060.C, D, E, F, G, H, I, and J, respectively).

In conducting reviews for other development projects in the NSB that have some features comparable to those anticipated for the pipeline corridor, the NSB has established special conditions to assure conformance with several land use policies. Policy areas of concern in the past related to deposition of toxic materials and untreated solid wastes, emissions, subsistence resources, sensitive areas, pollution, habitat changes and disturbance, and permafrost.

b. Alaska Coastal Management Program: Section 307 (c)(3)(B) requires lessees to certify that each activity which is described in detail in their exploration and development and production plans that affects any land use or water use in the coastal zone complies with the state's coastal program and will be implemented consistent with it. The State has the responsibility to concur with or object to the lessees' certification. Activities within the coastal zone include the pipeline landfalls, the offshore pipeline within 3 geographical (nautical) statute miles of the coast, and transportation facilities. In addition, the State reviews all exploration and development and production plans to certify that activities that could affect the use of the coastal zone are consistent with the ACMP.

Standards of the ACMP are related to the scenario and to potential effects identified in other sections of this EIS. Policies of the NSB CMP are assessed in conjunction with the most closely associated Statewide standard. As noted in Section IV.C.13.a, the NSB CMP policies have been incorporated into the LMR's. Therefore, the corresponding LMR policy number is listed following that of the NSB CMP policy.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that all the events that are hypothesized will occur as assumed in this EIS. Changes made by lessees as they explore, develop, and produce petroleum products from leases offered in this sale could affect the accuracy of this assessment.

(1) Coastal Development (6 AAC 80.040): Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments that can be placed inland do not displace activities dependent on locations along limited shoreline areas. The only OCS developments hypothesized in the scenario that require a shoreline location are the landfall sites for the pipelines. Most other developments could be located either inland or offshore. It is unlikely that the hypothetical development would conflict with this policy.

State standards also require that the placement structures and discharge of dredged material into coastal waters comply with the regulations of the U.S. Army COE (6 AAC 80.040 [b]). All offshore and much of the onshore development hypothesized in the scenario would be subject to the COE regulations. Hypothetical developments along the Beaufort Sea coast that would require COE permits include constructing a berm for the shoreline approaches for the pipelines, dredging and possibly burying offshore pipelines, and placing pipelines and associated roads onshore. None of these projects necessarily is allowed or disallowed under the provisions of the COE regulations. Site-specific environmental changes pursuant to such development would be assessed, as they were for the Endicott and Lisburne projects, and permitted depending on the attendant effects.

(2) Geophysical Hazard Areas (6 AAC 80.050): State policies require coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

Several hazards are evident in the lease area. Sea ice is the principal physical hazard in the development of the oil and gas resources in the lease-sale area of the Beaufort Sea. However, drilling and completing wells in the Arctic is possible with existing technology (Sec. IV.A.3). In the EIS, permafrost, storm surges, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the seafloor sediments were related specifically to offshore activities. The conclusion reached in Section IV.A.3

identifies three measures to lessen the effects of these hazards. These include scheduling activities appropriately, conducting surveys for best locations, and designing facilities to withstand a range of environmental forces. Through these strategies and conformance with the regulations of 30 CFR 250, Oil and Gas and Sulphur Operations in the OCS, hazards can be addressed.

Conformance with 30 CFR 250 regulations also should alleviate conflict that could occur with respect to two NSB CMP policies. Policy 2.4.4(b) (NSBMC 19.70.050.I.2) requires that "offshore structures must be able to withstand geophysical hazards and forces which may occur while at the drill site." These structures also "must have monitoring programs and safety systems capable of securing wells in case unexpected geophysical hazards or forces are encountered." Policy 2.4.4(h) (NSBMC 19.70.050.I.8) requires that "Offshore oil transport systems (e.g., pipelines) must be specially designed to withstand geophysical hazards, specifically sea ice."

Onshore development and some offshore development will be sited in areas of permafrost. Development in these areas must "maintain the natural permafrost insulation quality of existing soils and vegetation" (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). More than likely, some of the onshore development (e.g., pipelines) will be located in wetlands, in floodplains subject to a 50-year recurrence level, and in geologic-hazard areas identified on Map 22 of the NSB CMP Resource Atlas. These last two areas are specifically identified in the NSB CMP policies (NSB CMP 2.4.5.1[k] and NSBMC 19.70.050.J.11). For developments to proceed in these areas, there would have to be a significant public need, no feasible and prudent alternatives, and all feasible and prudent steps taken to avoid the adverse effects the policy is intended to prevent. A final requirement is that development in floodplains, shoreline areas, and offshore areas be "sited, designed, and constructed to minimize loss of life or property" due to geologic forces (NSB CMP 2.4.6[f] and NSBMC 19.70.050.L.6). Safeguards offered by these policies are enforced at the time an activity or project is proposed; there is no inherent conflict with these policies prior to that time.

(3) Energy Facilities (6 AAC 80.070): The State CMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 standards.

The ACMP standards require that facilities be sited to (1) minimize adverse environmental and social effects while satisfying industrial requirements and (2) be compatible with existing and subsequent uses (6 AAC 80.070 [1] and [2]). The projected facilities along the Beaufort Sea coast are expected to tie into existing production lines. However, Flaxman Island, located immediately offshore Point Thomson, is an important area for subsistence harvests of marine mammals. A landfall at Point Thomson would concentrate noise and disturbance in this area, especially during the years of construction, and affect the bowhead whale harvest for 1 to 2 years (a HIGH effect). User conflicts also might arise between vessels and whalers during years with bad ice conditions if industry vessels use the open-water area where whalers are hunting. If previous development has not occurred and these conflicts have not been resolved, they likely will create conflict with this element of the Statewide energy-facility standard. Adverse environmental and social effects also could be possible if pipelines along the Beaufort Sea coast are not placed offshore in the area of landfast ice as hypothesized.

Other ACMP standards require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). The NSB CMP also requires that "transportation facilities and utilities must be consolidated to the maximum extent possible" (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050.K.6). New onshore activities hypothesized for this lease sale are consolidated at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson where the pipelines come onshore. Existing facilities can accommodate the remaining support services, thereby conforming with another standard (6 AAC 80.070 [7]). These locational decisions conform to NSB CMP policy 2.4.5.2(c) (NSBMC 19.70.050.K.3) that requires facilities not absolutely required in the field be located in designated compact service bases that are shared to the maximum extent possible.

Facilities must be designed to permit free passage and movement of fish and wildlife with due consideration for historic migratory patterns (6 AAC 80.070 [12], NSB CMP 2.4.4 [i], and NSBMC 19.70.050.I.9). As is evidenced by the Endicott development, this standard does not preclude causeways or berms, but it does require careful consideration of the effects on circulation and fish populations before approval can be obtained. No causeway is hypothesized for this development; however, berms may be used to bring pipelines ashore. However, these berms--when added to the existing causeways--can lead to HIGH levels of effects on fish. Offshore pipelines should pose no barriers to migrating fish and wildlife.

Finally, the Statewide standard requires that facilities be sited "so as to minimize the probability, along shipping routes, of spills or other forms of contamination which affect fishing grounds, spawning grounds, and other biologically productive or vulnerable habitats. . ." (6 AAC 80.070 [b][11]). The sites selected as landfall sites appear to conform with this requirement. For example, oil spills pose the greatest threat to fishes of all possible effect agents; however, the analysis in Section IV.C.3 does not indicate that these sites accentuate the potential for adverse effects from an oil spill. The same conclusion also holds true for birds, pinnipeds, marine mammals, polar bears, and caribou (Secs. IV.C.4, 5, 6, and 7).

The NSB CMP has two additional requirements associated with this standard (State of Alaska, 1985). Policy 2.4.4(f) (NSBMC 19.70.050.I.6) requires that plans for offshore drilling include "a relief well drilling plan and an emergency countermeasure plan" and describes the content of such plans. Policy 2.4.4(g) (NSBMC 19.70.050.I.7) requires "offshore drilling operations and offshore petroleum storage and transportation facilities. . .to have an oilspill control and clean-up plan" and describes what the plan should contain. Because these policies are not intended to establish new regulations for offshore facilities, conformance is assured through the implementation of MMS regulations.

Construction associated with energy-related facilities resulting from Sale 124 also must comply with siting standards that apply to all types of development. These more general standards are discussed under (g) Habitats and (h) Air, Land, and Water Quality.

(4) Transportation and Utilities (6 AAC 80.080): The State standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. Assuming that after an offshore pipeline crossed the beach it would continue inland of the beaches, conformance with this policy is possible.

The NSB CMP contains several additional policies related to transportation that are relevant to this analysis. All but one of the policies are "best-effort policies" and subject to some flexibility if (1) there is a significant public need for the proposed use and activity, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. "Transportation development, including pipelines, which significantly obstructs wildlife migration" is subject to the three criteria (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Conflict with this policy is not anticipated. Section IV.C.7 indicates that interference with caribou movements would be temporary, and regional distribution and numbers are not expected to be affected.

No duplicative transportation corridors are anticipated from Sale 124. As noted in the previous standard for energy facilities, transportation facilities are expected to be consolidated to the maximum extent possible. Therefore there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent possible. Although the NSB CMP limits support facilities for tankering oil to market, the scenario indicates that pipelines will be used; therefore, the policy is not relevant.

The final policy falls under the category of "Minimization of Negative Impacts." NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2) requires that alterations to shorelines, water courses, wetlands, and tidal marshes and significant disturbance to important habitat be minimized. In the discussion of habitats, it is recognized that alterations to wetland habitat and ponds and lakes will occur and birds could be disturbed during construction. Such changes and disturbances could have MODERATE effects on birds. This policy also requires that periods critical for fish migration be avoided. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities; conflict with these is not inherent in the assumed activities.

(5) Mining and Mineral Processing (6 AAC 80.110): Extraction of sand and gravel is a major concern on the North Slope, and gravel requirements associated with development from blocks leased in Sale 124 could be extensive. Gravel resources are needed for construction pads for all onshore development to protect the tundra and also for roadbeds, berms or causeways, and docks. The ACMP Statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses and activities, State and national needs, and district programs (6 AAC 80.110 [a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and

prudent noncoastal alternative is available to meet the public need (6 AAC 80.110 [b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Although industry's preferences for gravel sources and removal procedures and the Statewide standards and NSB CMP policies may diverge on occasion from those that are deemed consistent, conflict is not inherent in the scenario.

(6) Subsistence (6 AAC 80.120): The Statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Potential conflicts with this Statewide standard and the supporting district policies are based on the analysis of effects of activities assumed for the base case on subsistence in the NSB (Sec. IV.C.10).

Effects of development along the Chukchi Sea coast would be greatest where activities off the coast of Wainwright coincide with spring whaling during conditions of poor weather that might limit visibility. During exploration, this event is highly unlikely because drillships--the most likely method for drilling in much of the Chukchi Sea--would not be operating this early in the season. During development (and exploration in the event that bottom-founded structures could be used), drilling activities might deflect or disturb the whales, which then might escape into the ice pack and not be available for that year.

Effects on subsistence are greatest for Nuiqsut residents. Point Thomson, one of the sites identified as a potential landfall for an offshore pipeline, is located in the lee of Flaxman Island--the primary location for Nuiqsut bowhead whale harvests. As noted in the analysis for the facility-siting standard, conflict could be severe during the years of construction. Several NSB CMP policies address this possibility. NSB CMP policy 2.4.3(b) (NSBMC 19.70.050.B) states that "offshore drilling and other development within the area of bowhead whale migration during the migration seasons shall not significantly interfere with subsistence activities nor jeopardize the continued availability of whales for subsistence purposes." Conflict is most likely with respect to development in proximity to Flaxman Island.

Access as well as interference may be an issue. Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable subsistence-user access to a subsistence resource. In addition to the potential for deflection of whales from the subsistence area, subsistence activities in the vicinity of pipelaying activities may be considered unsafe and not allowed. Given the limited number of years involved, conflict is more likely to occur with the best-effort policy addressing reduced or restricted access (NSB CMP 2.4.5.1[b] and NSBMC 19.70.050.J.2). Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of best-effort policies. None of the landfall sites along the Beaufort Sea is located on a cultural site identified in the NSB CMP. However, as noted above, Point Thomson is located immediately onshore of Flaxman Island, which is of significance. On the Chukchi Sea coast, Point Belcher has been identified as both a cultural and an archaeological site. Conflict is possible at these sites unless the development is "located, designed, and maintained in a manner that does not interfere with the use of the site that is important for significant cultural uses or essential for transportation to subsistence use areas" (NSB CMP 2.4.5.2[h] and NSBMC 19.70.050.K.8).

Several important NSB CMP policies relate to adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Neither policy is inherently subject to conflict as a result of activities assumed in this EIS. Subsistence use of the resources, rather than reduction in stocks, is the primary concern related to development activities.

(7) Habitats (6 AAC 80.130): The Statewide standard for habitats contains an overall policy plus specific policies for offshore areas; estuaries; wetlands and tidflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams and lakes; and important upland habitat. The NSB CMP contains a district policy that reiterates the applicability of the Statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat.

The ACMP Statewide standard for all habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 [b]). This overall policy is supported by an NSB CMP district policy requiring development "to be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes" (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.L.1). The analyses in Sections IV.C.2 through 7 do not indicate that resources should be subject to significant disturbance. If they are, however, the policy requires that, consistent with human safety, horizontal and vertical buffers will be required where appropriate. Although there are no inherent conflicts with the assumed activities at this point, some may appear as specific proposals are brought forward at the time of development.

Activities affect several of the habitats identified in the Statewide standard, including offshore; barrier islands and lagoons; wetlands; and rivers, lakes, and streams. Effects in each habitat are related to the applicable policies in the following paragraphs.

The offshore habitat is designated a fisheries conservation zone (6 AAC 80.130. [c][1]). In the Arctic, marine mammals are an important offshore resource and are included in the analysis of the offshore habitat. Some effects in the offshore habitat could be MODERATE in the unlikely event that an oil spill occurred in a sensitive area, such as Stefansson Sound; the lead system off Barrow when resources are present; or in specific coastal areas during critical periods for several fishes. Effects identified in Sections IV.2 through IV.6 would not preclude offshore development, assuming the developer has undertaken all feasible and prudent steps to maximize conformance. Offshore seismic exploration is subject to specific constraints; NSB CMP 2.4.6 (g) (NSBMC 19.70.050.L.7) requires that seismic exploration be conducted in a manner that minimizes its impact on fish and wildlife. Again, analysis of effects on the natural resources does not indicate greater than a LOW effect as a result of seismic activity. Conflict with this district policy is not anticipated.

Barrier islands and lagoons characterize the Beaufort Sea coast where some of the development associated with this lease sale is assumed to occur (NSB CMP Map 16). These habitats are managed to assure sediment and water conditions are maintained so neither infilling of lagoons nor erosion of barrier islands occurs. Activities that might decrease the use of the barrier islands by coastal species, including polar bears and nesting birds, are discouraged (6 AAC 80.130 [c][5]). No causeways are proposed; however, the berms--when added to the existing causeways--could exacerbate negative effects on fish. Although disruptive activities could occur in this habitat during the laying of the pipeline and construction of the landfall site, effects of offshore construction on birds and marine mammals are assessed as LOW. Oil spills are assumed to occur as a result of this lease sale. Elson Lagoon, the only lagoon area at risk from an oil spill, has only a 5-percent risk of being oiled as a result of Sale 124. Consequently, no substantial conflict with this habitat policy is anticipated.

Much of the uplands in the NSB are considered wetlands. Therefore, onshore development would need to be designed and constructed to avoid (1) adverse effects to the natural drainage patterns, (2) destruction of important habitat, and (3) the discharge of toxic substances (6 AAC 80.130 [c][3]). Pipelines and roadways would transect this habitat both to the east and to the west of TAP. Natural drainage would be affected severely as a result of a road/pipeline corridor between Pitt Point and TAP. Miles of wet-tundra habitat and lakes and ponds would be crossed before the new pipeline could tie into the existing onshore-pipeline system. Water impoundments created by the pipeline/road corridor would carry both positive and negative effects. They would benefit waterfowl but displace some nesting shorebirds (Sec. IV.C.4). Caribou could be disturbed temporarily during construction but are expected to habituate to the traffic following construction (Sec. IV.C.7). This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes this practice and provides a set of guidelines and an intent statement specifically to implement the policy. There is no inherent conflict between the crossing requirements and the assumed activities. Restrictions on storing toxic substances are covered more completely by policies related to the following topic--air, land, and water quality.

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow (6 AAC 80.130 [c][7]). The probability of river deltas being contacted by oil is very low. However, pipeline/road construction, including gravel extraction, also could affect these

waterways and would need to be conducted in a manner that ensures the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining.

(8) Air, Land, and Water Quality (6 AAC 80.140): The air-, land, and water-quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the Alaska Department of Environmental Conservation. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water- and air-quality regulations in several additional policies.

Water quality can be affected by oil spills, deliberate discharges and emissions, dredging and gravel operations, and causeways. An accidental oil spill is very likely to occur. One spill of at least 1,000 bbl has been assumed as a result of this lease sale. More chronic, smaller spills also are assumed. Although decomposition and weathering processes for oil are much slower in the arctic OCS than in temperate OCS waters, hydrocarbon contamination is very unlikely to cause regional long-term degradation of water quality above State and Federal standards (Sec. IV.C.1). As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel storage units with a capacity greater than 660 gal (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 ft of the shoreline of the coast, lake, or river "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous materials storage areas, dumps, etc.)" must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: (1) there must be a significant public need, (2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. There is no inherent conflict between this policy and the assumptions used for the proposed action.

Sale-related causeways could create variations in salinity, temperature, ice cover, and turbidity over 200 km<sup>2</sup>. Around the Oliktok Point and Point Thomson causeways, the intensity of the effect on water temperature and salinity would be magnified by a significant asymmetric supply of coastal, brackish water. These would be long-term effects due to the permanence of the causeways.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that "development resulting in water or airborne emissions. . .comply with all state and federal regulations." This is consistent with the Statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Given the rate of discharge, VERY LOW effects are anticipated as a result of exploratory drilling. During development, effects from muds and cuttings would remain VERY LOW. Formation waters produced from the wells along with the oil are regulated through an EPA permit and, depending on the conditions of the permit, may be disposed of above or below ground. If formation waters were discharged into the water, MODERATE LOCAL effects could occur.

Solid wastes disposed of offshore also are regulated through Federal permits and restrained further by Annex V of the MARPOL Convention approved in 1988 by the United States Congress. Because these discharges are so carefully regulated, no conflict is anticipated with the Statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that "industrial and commercial development. . .be served by solid waste disposal facilities which meet state and federal regulations." Onshore development associated with this sale also must meet the Statewide standard and the district policy related to solid-waste disposal. Assuming the regulations are implemented properly, there is no inherent conflict between the proposed activities and the ACMP water-quality provisions.

The district CMP also contains a policy that requires development without a central sewage system to impound and process effluent to meet State and Federal standards (NSB CMP 2.4.4[e] and NSBMC 19.70.050.I.5). This is the current practice aboard drilling vessels and production platforms; there is no inherent conflict with this district policy. This also has been the practice of the major developments on the North Slope.

Effects of dredging are expected to be short term and local. No conflict with either the Statewide standard or the district policies is anticipated.

Air quality also must conform with Federal and State standards (6 AAC 80.140, NSB CMP 2.4.3[i] and

2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis in Section IV.C.12 indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

(9) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150):

The ACMP Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of national, State, or local history or prehistory. Many areas along the coast have been identified as archaeologically important sites (Wickersham and Flavin, 1982).

The NSB developed additional policies to ensure protection of its heritage. NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is "likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall (1) be required to avoid the sites; or (2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance." NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." These NSB CMP policies establish clearly what is required. In the event such a site is encountered, such as at Point Belcher or Point Thomson, there is no inherent reason to assume conflict with these policies.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence-use areas as well as cultural-use sites. It was noted in the analysis of subsistence policies that Point Belcher has been classified as a cultural-use site and Point Thomson--although not an identified site--is immediately offshore Flaxman Island, which is an important area for Nuiqsut whalers. As a result, conflict is possible with the cultural portion of this policy as well as the subsistence portion.

**SUMMARY:** Potential conflict between activities assumed for this lease sale and the NSB LMR's and the Statewide standards and the NSB district policies of the ACMP is evident in three main areas:

- The first area relates to the siting of shore bases in proximity to Point Belcher and Point Thomson--primary locations for bowhead whale harvests. Conflict is possible with the Statewide standard for energy-facility siting that requires facilities to be compatible with existing and subsequent uses (6 AAC 80.070 [2]) and with two policies of the NSB. The first NSB policy relates to subsistence. NSB CMP 2.4.5.1[b] (NSBMC 19.70.050.J.2) requires development that restricts subsistence-user access to a subsistence resource meet three criteria: (1) there is a significant public need, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. The second NSB CMP policy relates to both subsistence and cultural resource areas. NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) requires development to be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas--again, subject to the three criteria identified above.
- The second area where conflict with ACMP Statewide standards and district policies may arise is the potential for user conflicts between offshore activities and the subsistence bowhead whale hunt. This again may have a potential conflict with the energy-facility-siting policy identified above and with a NSB CMP policy that requires that offshore drilling and other development within the area of the bowhead whale migration do not significantly interfere with subsistence activities (2.4.3[b] and NSBMC 19.70.050.B). Potential interference with the bowhead whale hunt was the prime reason that effect levels for subsistence both in the Chukchi Sea and the Beaufort Sea reached the levels they did.
- The last area of potential conflict involves the potential effects arising from the construction of four additional shore approaches for the pipelines. Potential conflicts could arise with respect to the energy-facility-siting policy related to free passage of fish (6 AAC 80.070 [12], NSB CMP 2.4.4 [i], and NSBMC 19.70.050.I.9) and the water quality criteria (6 AAC 80.140).

**CONCLUSION:** For the base case for Alternative I, the effects of potential conflicts with land use plans and coastal management programs are expected to be HIGH.

#### IV.D. Alternative I--High Case

Alternative I would offer for leasing about 4,095 blocks of the Beaufort Sea Planning Area, and the high case represents an amount of unleased oil resources (assuming hydrocarbons are present) estimated to be leased, discovered, and developed and produced as a result of Sale 124 that represents the maximum amount of resources if hydrocarbons are present (Appendices A and B). The MMS estimates the oil resources to be about 2,600 MMbbl for the high case. The types and levels of activities associated with the high case include (1) drilling 36 exploration and delineation wells (1992-1998), (2) installing 7 production platforms (1998-2000) and drilling 346 production and service wells (1999-2003), (3) installing 325 mi of offshore pipeline and 325 mi of onshore pipeline (1997-2000), and (4) producing 2,600 MMbbl of oil (2001-2019). A more detailed discussion of the types and levels of activities associated with the base case is presented in Section II.B.3.a.

This section presents the analyses of the potential effects that the high case for Alternative I might have on the physical and biological resources, sociocultural systems, and programs in and adjacent to the planning area.

1. Effects on Water Quality: Agents that are most likely to affect water quality in the Beaufort Sea sale area are oil spills, causeways, dredging, and deliberate discharges from platforms.

a. Oil Spills: Generic effects of oil spills on water quality are described in Section IV.C.1 of this EIS. In the context of this analysis, REGIONAL effects refer to effects encompassing at least 1,000 km<sup>2</sup>; LOCAL effects encompass smaller areas, most frequently a few or less square kilometers.

Because of unavoidable chronic and accidental discharges of oil, measurable degradation of existing pristine water quality is likely to occur in the sale area. Plumes of dissolved hydrocarbons from a 100,000-bbl spill could be above ambient standards and detectable over the low background levels for perhaps 100 km or possibly 500 km, if under ice (Cline, 1981). However, a major spill of such size is not anticipated. Other smaller but more likely spills could cause transient increases in dissolved-hydrocarbon concentrations underneath the (discontinuous) slick--over a 60- to-1,000-km<sup>2</sup> area for a 22,000-bbl spill (see Appendix M) and over a smaller area for a smaller spill.

Only a small portion of the oil from a spill would be deposited in the sediments in the immediate vicinity of the spill or along the pathway of the slick. The observed range in deposition of oil in bottom sediments following offshore spills is 0.1 to 8 percent of slick mass (Jarvela, Thorsteinson, and Pelto, 1984). Generally, the higher percentages of deposition occur in spills near shore, where surf, tidal cycles, and other inshore processes can mix oil into the bottom. Farther offshore, suspended-sediment loads are low, and only about 0.1 percent of a crude would be incorporated into sediments within the first 10 days of a spill under such conditions (see Manen and Pelto, 1984).

If the spilled oil were of a composition similar to that of Prudhoe Bay crude, about 40 percent of the spilled oil could persist on the water surface, dispersed into individual tarballs after the slick disappeared. Slow photo-oxidation and biological degradation would continue to slowly decrease the residual amount of oil. Through 1,000 days, about 15 percent of the tarballs would sink, with an additional 20 percent of slick mass persisting in the remaining tarballs (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980). Because the oil would drift over distances of hundreds or thousands of kilometers during the slow process of sinking, individual sunken tarballs would be extremely widely dispersed in the sediments. The "average" levels of local or regional contamination in sediments would be significant. Elevated concentrations of hydrocarbons could locally occur only if oil were mixed into the shoreline and then dispersed offshore. Suspended loads of sediment in nearshore waters--150 milligrams per liter or less--are not high enough to significantly enhance oil removal from the slick or water column. Oil either would be locally present in the sediment as a tarball or, more likely, absent. For a spill of 10,000 bbl, the 15 percent of the oil that sinks within 1,000 days would be equivalent to three small (10-g) tarballs per hectare within the proposed sale area.

A spill in the lead system off Barrow during a period of rapid ice growth could leach water-soluble aromatics into the sinking brine waters. Mixing of brine waters would be restricted by both topography and the high density of the brine. The brine and any dissolved oil could flow down the bottom of Barrow Canyon farther offshore and form a thin, intermediate-density layer at about a 100-m water depth. Stability of the stratified watermass would limit dispersion of the dissolved hydrocarbons, and high concentrations (a few ppm) could

be hypothesized to persist for several years. However, oil released under such conditions (rapid ice formation) would freeze into the ice in at most 5 to 10 days, stopping dissolution and limiting the effect of this freezeup scenario (Thomas, 1981).

It is likely that accidental oil spills will occur: three spills of at least 1,000 bbl have been assumed to occur as a result of the high case; and, in addition to these large spills, more chronic spillage of smaller volumes also is expected (see Sec. IV.A.1.). During drilling of 36 exploration and delineation wells over 7 years, on the order of four such chronic spills could occur, but the total spilled would amount to only about 36 bbl. For production, an additional 612 small spills of less than 1,000 bbl each, totaling 8,500 bbl, are projected over the life of the field. Small spills of this magnitude are relatively common in western and northern Alaska.

Regional, long-term degradation of water quality to levels above State and Federal criteria because of hydrocarbon contamination is very unlikely. Spills of 22,000 bbl could temporarily (for less than 30 days) contaminate water over a few hundred square kilometers with hydrocarbon concentrations above the chronic criterion of 0.015 ppm but less than the acute criterion of 1.5 ppm. The large number of very small spills anticipated over the production life of the field could result in local, chronic hydrocarbon contamination of water within the margins of the oil fields. Thus, oil-spill effects on LOCAL water quality are expected to be LOW, and oil-spill effects on REGIONAL water quality are expected to be VERY LOW.

b. Causeways: Causeways of 800 m (2,500 ft) or less length may be necessary to bring oil pipelines ashore at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson, the same locations as in the base case. Generic effects of causeways on water quality are described in Section IV.C.1 of this EIS. In the context of this analysis, REGIONAL effects refer to effects encompassing at least 1,000 km<sup>2</sup>; LOCAL effects encompass smaller areas, most frequently a few or less square kilometers.

The redirection of coastal flow by causeways is expected to change local temperature and salinity regimes more than is allowed by State and Federal standards and criteria. The causeways projected for the sale would not extend into Federal waters, and their effect on the water quality of the Beaufort Sea would be limited to under 50 km<sup>2</sup> per causeway or 200 km<sup>2</sup> overall for the high case. The intensity of the effect on water temperature and salinity would be magnified by a significant asymmetric supply of coastal brackish water around the Oliktok Point and Point Thomson causeways. The effect of causeways on LOCAL water quality would be long term but MODERATE. The effect of causeways on REGIONAL water quality would be VERY LOW.

c. Dredging: Dredging would be used primarily for trenching and burying subsea pipelines. Dredging also might be used to prepare foundations for the seven projected production platforms, but this latter use would be comparatively slight. Pipeline installation would involve greater volumes of dredged materials and greater areal disturbance. The greatest effect on water quality from dredging would be related to turbidity.

If oil is found, 520 km (325 mi) of offshore pipeline could be emplaced over a 3-year period in the planning area and inshore waters (Sec. II.A). About 120 km (75 mi) of the pipeline would be placed in a dredged trench at a rate of 1.3 km per day during summer. Trenching and dumping of dredged spoils would disturb 1,200 ha (4.6 mi<sup>2</sup>, see Table H-12).

Experiences with actual dredging or dumping operations in other areas show a decrease in the concentration of suspended sediments with time (2-3 hours) and distance downcurrent (1-3 km) from the discharge. Similarly, in the dredging operations associated with artificial-island construction and harbor improvement in mostly sandy sediments of the Canadian Beaufort Sea, the turbidity plumes also tended to disappear shortly after operations ceased; they generally extended a few hundred meters to a few kilometers (Pessah, 1982).

The size, duration, and amount of turbidity depends on the grain-size composition of the discharge, the rate and duration of the discharge, the turbulence in the water column, and the current regime. However, turbidity would not be expected to extend farther than 3 km from the trenching and dumping operations.

Because dredging occurs at a rate of 1.3 km per day, the extent of the turbidity plumes would be about 3.9 km<sup>2</sup> (390 ha) at any one time (a 1.3-km by 3-km plume). Over the three summers of pipeline dredging, perhaps an equal area would be separately affected by turbidity from dumping on a daily basis.

Dumping of dredged spoils is not expected to introduce or mobilize any chemical contaminants. Beaufort

Sea Planning Area sediments do contain elevated levels of hydrocarbons, but these hydrocarbons do not appear to be labile (Sec. III.A.5).

Based on the analysis in this EIS, the increased turbidity from dredging (and dumping) would be LOCAL and short term, causing a greater than 10-percent, temporary change in photocompensation depth within 3 km or less of construction activities--a LOW effect on LOCAL water quality. A VERY LOW REGIONAL effect on water quality from dredging would be expected.

d. Deliberate Discharges During Exploration: Exploratory vessels would discharge drilling fluids in bulk quantities (Table IV-B-1-1) along with sanitary wastes from wastewater-discharge sources. Discharge of drilling muds and drill cuttings from exploration are projected from the development scenario in Section II.A; they would occur over a 7-year period.

Discharges during exploration would peak in 1993 at 5,100 metric tons (5,700 English short tons) of drilling mud and 6,700 metric tons (7,400 English short tons) of drill cuttings.

Drilling muds used offshore of Alaska are of relatively low toxicity and are limited to this low level of toxicity in permits for their discharge granted by the EPA. During exploration, only barium concentrations in discharged muds are expected to be always more than a hundredfold greater than concentrations in nearby sediments (Table IV-B-1-1). Concentrations of cadmium, lead, mercury, and zinc in discharged muds, however, may be more than a hundredfold greater than concentrations in nearby sediments.

Based on the above and additional information presented in Appendix L, the EPA has determined that exploratory discharges are not likely to exceed applicable water-quality criteria outside of a 100-m radius, or 0.03 km<sup>2</sup> around each discharge site. In the year of maximum exploratory drilling, nine exploratory platforms would be present; and water quality of no more than 0.03 km<sup>2</sup> around each platform, a maximum of 0.27 km<sup>2</sup> at any one time or a total of 1.1 km<sup>2</sup>, could be temporarily degraded during active exploration discharge of drilling muds and cuttings. The effect of exploration discharges on water quality would persist for a few hours within the 100-m-radius mixing zone around each platform, a VERY LOW effect on both LOCAL and REGIONAL water quality.

e. Deliberate Discharges During Production: The description of deliberate discharges from oil and gas platforms in Jones and Stokes Associates, Inc. (1983), is incorporated by reference; a summary of this description, as augmented by additional material, as cited, follows.

Platforms on the OCS would discharge drilling fluids in bulk quantities along with low levels of petroleum hydrocarbons and sanitary wastes from wastewater-discharge sources. However, the quantities of deliberate discharges other than drilling muds, cuttings, and formation waters are too small to have an appreciable effect on water quality.

Discharges of drilling muds and drill cuttings (Table IV-B-1-1) are projected from the development scenario in Section II.A and would occur over a 5-year period. Peak discharges from the seven production platforms would occur in 2001 and 2002--when 85 wells would be drilled each year. Discharges from all 346 production wells would total 47,00 to 214,000 metric tons (51,900-235,280 English short tons) of drilling muds and 370,000 metric tons (408,280 English short tons) of drill cuttings.

These quantities projected to be discharged are small compared to the natural sediment load of the Beaufort Sea Planning Area (Sec. III.D.6 in the Sale 87 FEIS, USDOJ, MMS, 1984). Inshore waters of the Chukchi Sea (Sharma, 1979) and the Beaufort Sea are naturally turbid. The Colville River alone carries 9 million metric tons of sediment annually into the Alaskan Beaufort Sea. High rates of erosion occur all along the coast (Sec. IV.A.2.b). Coastal erosion adds 300,000 metric tons annually to Simpson Lagoon. The seafloor itself is considered an erosional environment out to a 20-m-water depth (Sec. III.A.1.b). High turbidity from runoff following breakup on land extends to the 13-m water-depth contour and limits primary production.

With only two drilling rigs per platform and assuming that maximum discharge rates are limited by EPA to the same extent during production as during exploration (see Appendix L), instantaneous discharges would be of the same order of magnitude in production as in exploration. The total quantity of drilling muds discharged in production is estimated to be tenfold greater than during exploration (Table IV-B-1-1). Total discharge of drill cuttings during production drilling would be fourteenfold greater than the total discharged during exploration. Effects on water quality from discharges of muds and cuttings during production drilling

also should be only local and short term--on the order of square kilometers or less--and would persist over a 5-year period of drilling, an effect on both REGIONAL and LOCAL water quality that is expected to be VERY LOW.

Formation waters are produced from wells along with the oil (see Roberts, 1987). These waters contain dissolved minerals and soluble fractions of the crude oil. Process equipment installed on the production platform separates the formation water from the oil and treats it for disposal. The salinity usually ranges from 1 to 250 ‰. (Seawater has a salinity of 35 ‰.) Oil and grease concentrations in such waters are limited by EPA to a maximum of 72 mg per liter (72 ppm), with a maximum monthly average of 48 mg per liter (48 ppm). The EPA-approved analytical procedures used to measure oil and grease exclude lower-molecular-weight hydrocarbons (less than C14), which pose most of the risk to the biota (NRC, 1985). The NRC has estimated that formation waters average 20 to 50 ppm of lower molecular-weight hydrocarbons and 30 ppm higher molecular-weight hydrocarbons. In Alaska, treatment facilities for State fields in Cook Inlet discharge 6.6 to 21 ppm total-aromatic hydrocarbons into Cook Inlet (Federal Register, 1986). (Lower molecular-weight and total-aromatic categories overlap but are not identical.)

Over the life of a field, the volume of formation water produced is equal to 20 to 150 percent of the oil-output volume (Collins et al., 1983). As oil is pumped from a field, the ratio of water to oil being produced increases. For example, some of the older Cook Inlet/Kenai fields in Alaska are now producing up to 5.1 bbl of water for every barrel of oil produced, while the newer Endicott and Prudhoe Bay fields are producing 0.3 and 0.7 bbl of water per bbl of oil, respectively (State of Alaska, AOGCC, 1990). Toward the very end of the productive life of a field, 10 bbl of water may be produced for every barrel of oil. On the basis of these considerations, the production of formation waters over the life of the field can be estimated at 520 to 3,900 MMbbl, with up to 490 MMbbl of this amount produced in the last year of field production. Over the life of the field, the mass equivalent of 42,000 to 310,000 bbl of oil would be contained in produced waters.

Treated formation waters may be discharged into the open ocean, reinjected into the oil-producing formation to maintain pressure, or injected into underground areas offshore. Discharge of formation waters would require an EPA permit and would be regulated so that water-quality criteria, outside an established mixing zone, are not exceeded. To date, for exploration in the Beaufort Sea, EPA has prohibited discharge of formation waters into waters less than 10 m deep. Reinjection and injection projects to maintain field pressure have become almost standard operating procedure. Of the 10 active oil fields in Alaska as of March 1990, 8 had water-injection projects (State of Alaska, AOGCC, 1990). However, treatment facilities for State Cook Inlet fields still discharge formation waters into Cook Inlet (Federal Register, 1986). On the other hand, formation water from the Endicott Reservoir, the first offshore producing field in the Beaufort Sea, is reinjected into the oil formation as part of a waterflood project.

The major constraint to underground injection is finding a formation at shallow depth that (1) has a high enough permeability to allow large volumes of water to be injected at low pressure and (2) can contain the water (Roberts, 1987). Also, injection should not be into a formation that might otherwise be a future potable-water supply.

If formation waters were reinjected or injected into a different formation, no discharge of formation waters would occur and no effect would occur. If formation waters were discharged, the effect on water quality would be local but would last over the life of each field, an expected MODERATE LOCAL effect and VERY LOW REGIONAL effect.

**SUMMARY:** An oil spill of 1,000 bbl or greater would temporarily and locally increase water-column hydrocarbon concentrations. The large number of very small spills anticipated over the production life of the field could result in local, chronic contamination within the margins of the oil field. Oil spills are expected to have LOW LOCAL effects and VERY LOW REGIONAL effects on water quality.

Sale causeways could have long-term effects on salinity, temperature, ice cover, and turbidity over up to 200 km<sup>2</sup>, for a MODERATE LOCAL effect and VERY LOW REGIONAL effect on water quality.

Deliberate discharges are regulated by EPA such that any effects on water quality must be extremely local; water-quality criteria must be met at the edge of the mixing zone established by the EPA-issued discharge permit. Discharge of formation waters--rather than their reinjection into the seafloor--would result in local pollution, with whatever the formation waters contain, over the life of the field, an expected MODERATE

effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality.

**CONCLUSION:** A MODERATE effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality over the lives of the individual fields are likely.

2. **Effects on Lower-Trophic-Level Organisms:** Compared with the base case, the almost threefold increase in oil resources assumed in the high case probably would result in an increased probability of oil spills. Also, the greater number of platforms and wells for the high case would mean a proportional increase in the amount of platform-installation activities and the amount of drilling discharges. The time and space of these increased activities and events are expected to differ from the activities of the base case to represent additional local effects. For a more detailed analysis of the effects of exploration and development and production activities on lower-trophic-level organisms, see Section IV.C.2.

An oil spill contacting areas of the proposed sale area with macroscopic algae would be expected to have a short-term effect on kelp and other macroscopic algae primarily because these communities are subtidal and not likely to be coated by oil. The effect of oil as a result of the high case on phytoplankton and macroscopic algae is expected to be LOW. However, HIGH effects are unlikely but possible for the Boulder Patch community if it were contacted by an oil spill.

Invertebrates of greatest concern in the proposed sale area include zooplankton and nearshore epibenthic invertebrates because of their importance as food resources for fish, birds, and marine mammals. As a result of the extensive distribution of most invertebrates in the Beaufort Sea and the comparatively small area likely to be contacted by an oil spill, the effect of oil on invertebrates is expected to be LOW.

Additional seismic activity associated with the high case would still be with respect to using airguns and waterguns and thus would be expected to result in a VERY LOW level of effects. The effects of formation waters on planktonic and benthic organisms would occur through the development and production phases of the high case, assuming no reinjection. These effects from drilling-fluid discharges, as well as those from the discharge of drilling muds and cuttings, are expected to be LOW.

Additional pipeline construction and associated short causeways for the high case are expected to be localized, and the effects are expected to be LOW.

**CONCLUSION:** For the high case, effects on lower-trophic-level organisms are expected to be LOW.

3. **Effects on Fishes:** Compared with the base case, the almost threefold increase in oil resources assumed in the high case probably would result in an increased probability of oil spills, more platforms and wells with a greater quantity of drilling discharges, and increased construction activities. Therefore, an increased number and extent of site-specific effects are expected compared to the base case. Greater numbers of organisms and a greater extent of habitat are expected to be affected. Oil spills and construction activities in the high case are more likely to cause higher order effects on fishes.

Fishes of greatest concern, due to their abundance, trophic relationships, and vulnerability, are the anadromous species and those species living in the Stefansson Sound Boulder Patch. Under the high case, the most likely number of spills of 1,000 bbl or greater occurring in the Beaufort Sea during the projected life of the field is three. The probability of a spill contacting the river delta or river mouth is still very low. HIGH effects are possible for some anadromous species and capelin if spawning-year individuals, aggregated multiaged assemblages, or a year-class of young were affected; however, the expected level of effects would be MODERATE.

The increased seismic activity from increased production and development activity would not be a concern because the seismic activity would be conducted with airguns and waterguns. The expected level of effects would be LOW.

The effects of the discharge of drilling muds and cuttings and also of formation waters would not significantly affect fish populations. The expected level of effects is expected to be LOW as a result of potential avoidance behavior and extensive population distributions with respect to the more locally defined and smaller scale discharge sites.

Construction activities associated with Sale 124 would include pipeline installation and causeway construction.

Effects of pipeline installation on fishes are expected to be very localized and of temporary duration. Four short causeways or jetties (see Table II-A-1) may be built in conjunction with the pipeline landfalls. Their potential effects are considered in greater detail in Section IV.C.3; they are considered likely to have a LOW effect on fishes due to localized effects on movements and migrations of anadromous species.

**CONCLUSION:** For the high case, effects on fishes are expected to be MODERATE.

4. **Effects on Marine and Coastal Birds:** For the analysis of the effects of the high case on marine and coastal birds, it is assumed that 2,600 MMbbl of oil would be produced from seven platforms and transported to shore through 325 mi of offshore pipelines; for the base-case analysis, it was assumed that 900 MMbbl of oil would be produced from four platforms and transported through 275 mi of offshore pipelines. The most likely number of spills of 1,000 bbl or greater (average of 22,000 bbl) increases from one for the base to three for the high case. (For a discussion of the general effects of oil on marine and coastal birds, see Sec. IV.C.4.)

a. **Effects of Oil Spills:** The probabilities of spill contact to important coastal concentrations and habitats of birds such as those that occur offshore of Point Barrow and Elson Lagoon increase from 13 and 5 percent, respectively, for the base case to 33 and 15 percent for the high case (see Fig. IV-C-4-1). This significant increase in spill-contact probabilities indicates that a larger portion of an oil spill would contact these important habitats and probably affect a much larger number of birds (for one habitat-area lagoon, for example, this could represent an increase of a few thousand for the base case to several thousand-10,000 for the high case). An increase in spill-contact probability also indicates that a greater portion of the coastline and surface area of a habitat such as Elson Lagoon would be covered by the oil slick. In the high case, a substantial reduction in local assemblages of sea ducks such as oldsquaw is expected to occur with perhaps the loss of over a total of 100,000 birds of various species, assuming the oil spill contacted the lagoon. For the high case, an increase in spill-contact probabilities to coastal beaches such as along the Plover Islands and Point Barrow, indicates that a greater percentage of the surface area of the coastline would be contaminated if an oil spill occurred during the open-water season. Such an increase in habitat contamination would increase the number of seabirds, waterfowl, and shorebirds affected by the spill. A greater number of birds could become oiled and/or ingest oiled vegetation or ingest contaminated prey and die as a result. The total loss of seabirds, ducks, and shorebirds easily could exceed 100,000 birds if extensive areas of coastline were contaminated.

Species such as oldsquaw, which have a very abundant regional population, probably would recover from the loss of a few thousand to perhaps 10,000 individuals within one generation (a MODERATE effect); while species with depressed regional populations, such as Pacific brant, are expected to take more than one to two generations to recover the loss of several thousand birds (a HIGH effect).

b. **Effects of Habitat Alteration:** Although the amount of high-case onshore development is assumed to increase over the base-case onshore development, with additional offshore pipeline landfalls and onshore pipelines to TAP at Point Belcher and Oliktok Point, the effects of habitat alteration from pipeline-road construction and shore-base construction on tundra habitats of marine and coastal birds are expected to be similar to those described under the base case. Onshore pipelines and roads constructed are assumed for the high case and for the base case (see Sec. IV.C). Some localized changes are expected in the distribution or abundance of shorebirds and waterfowl (such as tundra swans) within the near vicinity (within about 1 mi) of pipeline-road corridors or near other facilities. Waterfowl and shorebird populations are expected to recover from this habitat loss and displacement within one generation (a MODERATE effect).

c. **Effects of Noise and Disturbance:** The amount of air traffic associated with exploration and development is assumed to increase from 180 and 360 flights per year under the base case to 810 and 1,730 flights per year under the high case. Noise and disturbance of marine and coastal birds are expected to increase somewhat from that described for the base case; however, the level of effect is expected to remain LOW, with localized changes in the distribution of marine and coastal birds associated with air and vessel traffic lasting for only a short period of time (a few minutes to no more than a few days).

**CONCLUSION:** The overall effect of the high case on marine and coastal birds is expected to be HIGH.

5. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** For the analysis of the effects of the high case on pinnipeds, polar bears, and belukha whales, it is assumed that 2,600 MMbbl of oil would be

produced from seven platforms and transported to shore through offshore pipelines; for the base-case analysis, it was assumed that 900 MMbbl of oil would be produced from four platforms and transported through offshore pipelines. The most likely number of spills of 1,000 bbl or greater (average of 22,000 bbl) increases from one for the base case to three for the high case. (For a discussion of the general effects of oil on pinnipeds, polar bears, and belukha whales, see Sec. IV.C.5.)

a. **Effects of Oil Spills:** The probabilities of spill contact to important marine-mammal-concentration areas and habitats, such as the pack-ice front and ice-lead system off Point Barrow, increase from 11 percent under the base case to 28 percent under the high case (Figs. IV-C-5-1 and IV-D-5-1, respectively). This significant increase in spill-contact probabilities indicates that a larger portion of a spill would contact this important habitat and might contact a much larger number of ringed and bearded seals (from perhaps several hundred under the base case to perhaps several thousand under the high case). A significant increase in spill-contact probabilities for ice-front habitats of seals, walruses, and polar bears north of Point Barrow and the Plover Islands under the high case (see Ice/Sea Segments 3, 4, and 5 and Figs. IV-C-5-1 and IV-D-5-1) indicates that a greater portion of the sea surface in this part of the ice front would be covered by an oil slick under the high case. Several thousand walruses as well as seals and perhaps 100 polar bears might be contaminated by oil.

In the high case, assuming extensive oil contact occurs, several hundred to several thousand seals and walruses and some polar bears could be contaminated with oil; and several young seals and walrus calves and a number of polar bears are expected to die as a result of stress associated with hydrocarbon inhalation or ingestion and absorption of hydrocarbons through the skin. Few adult seals or walruses are expected to die from oil-spill contact (see Sec. IV.B.5, general effects of oil pollution on marine mammals). Perhaps 100 polar bears could be lost due to oil ingestion through grooming and eating contaminated prey such as oiled seals. The above losses of young seals, walruses and polar bears are likely to be replaced by the populations within one generation (a MODERATE effect).

An increase--from 1 to 4 percent (base case) to 2 to 12 percent (high case)--in oil-spill-contact probabilities to landfast-ice habitat of denning ringed seals along the Beaufort Sea coast near Point Barrow east to Cape Simpson indicates that some increase in spill coverage of under-ice habitat is likely to occur for the high case (see Appendix G, Table G-16, Land Segments 20-23). The number of ringed seals and ringed seal lairs contaminated with oil would increase somewhat (for the high case, perhaps a few hundred seal pups could be lost due to oil contamination and/or abandonment by adult seals). This loss of seal pups is likely to be replaced within one generation (a MODERATE effect).

b. **Effects of Habitat Alteration:** Although the amount of offshore development for the high case is assumed to increase over that for the base case (four production platforms for the base case versus seven platforms for the high case), the effects of habitat alteration from platform construction and/or installation and pipeline laying on marine-mammal habitats are expected to be about the same as described for the base case (see Sec. IV.C.5). Some very localized changes would be expected in the distribution of some seals, walruses, and polar bears within 1 or 2 mi of the platforms during construction-installation activities (one season), representing a LOW effect.

c. **Effects of Noise and Disturbance:** For the high case, the amount of air traffic is assumed to increase from 180 and 360 flights per year for base-case exploration and development, respectively, and from up to 34 boat trips per year to levels of 810 and 1,730 flights per year during exploration and development, respectively, and 75 boat trips per year. Noise and disturbance of pinnipeds, polar bears, and belukha whales are expected to increase somewhat from that described for the base case, but the level of effect is expected to remain LOW, with very temporary (a few minutes to a few days at most) changes in the local distribution of pinnipeds, polar bears, and belukha whales associated with air- and vessel-traffic disturbance under the high case (a LOW effect).

**CONCLUSION:** The overall effect of the high case is expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales.

6. **Effects on Endangered and Threatened Species:** The effects of the Sale 124 high case on endangered and threatened species are discussed by examining potential effects of exploration and development on the bowhead and gray whales and the arctic peregrine falcon, listed species likely to be present in or near the sale area. Information contained in this section is summarized from the Beaufort Sea Sale 97 FEIS (USDOJ, MMS, 1987a), which is incorporated by reference.

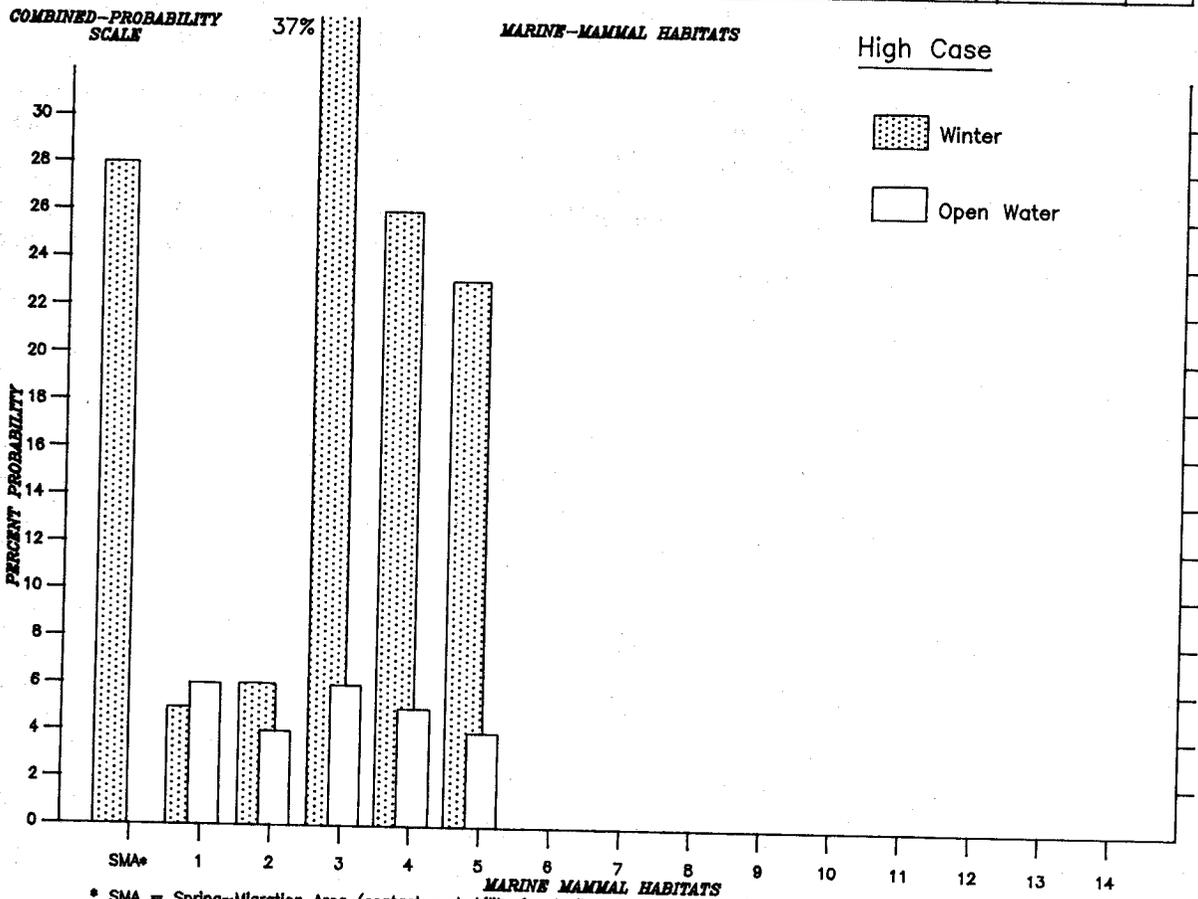
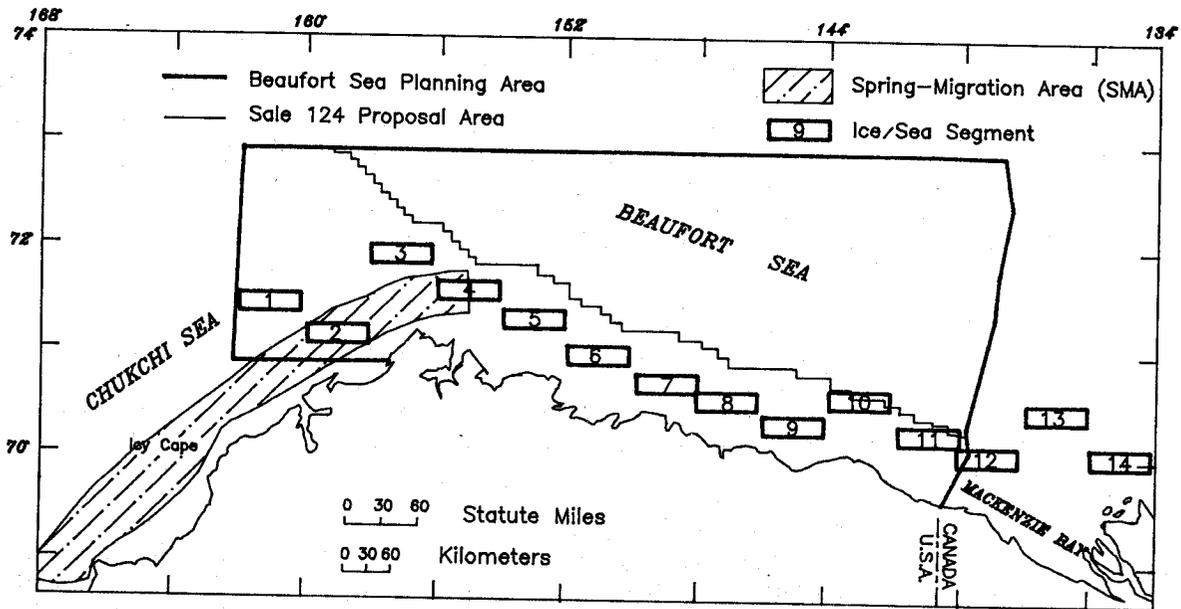


Figure IV-D-5-1. Comparison of Combined Probabilities of Oil-Spill Occurrence and Contact of Marine-Mammal Habitats--High Case

(Combined probabilities of one or more oil spills of 1,000 bbl or greater occurring and contacting marine-mammal habitats (SMA and Ice/Sea Segments) during the entire winter season compared with combined probabilities during the open-water season within 3 days of summer-spill release or meltout of overwintering spills during the expected production life of the lease area--high case.) Taken from OSRA, Appendix G, Tables G-15 and G-17.

a. Effects on Bowhead Whales: The OSRA is used in this analysis to assess the vulnerability of bowhead whale habitat to contact by oil spills. Appendix G, Tables G-15 to G-18, show the combined probabilities of oil-spill risk to given target areas (the probability of one or more spills occurring and contacting identified resource areas). Combined probabilities assume exploration and development and production over the expected life of the lease-sale area. Unless otherwise noted, combined probabilities during the open-water season referenced in this discussion refer to occurrence and contact by one or more oil spills of 1,000 bbl or more during a simulated 30-day period following a spill or after meltout of a winter spill. (Refer to Fig. IV-C-6-1 for descriptions of spill sites and endangered whale-habitat areas.)

Areas of bowhead whale habitat most vulnerable to occurrence and contact by one or more oil spills when bowheads are present would include Bowhead Spring-Migration-Corridors A and B (April through mid-June), a 28- and 17-percent probability of occurrence and contact, respectively (Table G-15); and Bowhead Fall-Feeding-Area A (mid-June through September), an 20-percent probability of occurrence and contact (Table G-17). All other bowhead-habitat areas would have less than a 0.5-percent probability of oil-spill occurrence and contact.

If an oil spill occurs and contacts bowhead whales, effects would occur qualitatively, as described under the base case. Oil-spill effects are likely to be slightly greater under the high case than under the base case because three spills of 1,000 bbl or more are estimated under the high case as opposed to one spill under the base case. Consequently, the probability is greater that whales may be contacted under the high case than under the base case. This increased probability is reflected in the higher OSRA contact probabilities.

The amount of sea-bottom-habitat alteration also would be greater under the high case than under the base case. Under the high case, 36 exploration and delineation wells and 346 production and service wells would be drilled, 7 platforms would be installed, and 325 mi (520 km) of offshore pipeline would be laid. This entails about twice the number of platforms, three times the number of wells as under the base case and a similar length of offshore pipeline. The effects of this habitat alteration are still expected to be relatively minor because bowheads feed primarily on pelagic zooplankton and the areas of sea bottom that are affected would be small in relation to the available habitat.

Noise-producing activities most likely to affect bowhead whales would include aircraft traffic, icebreaking or other vessel traffic, geophysical-seismic surveys, drilling, pipeline construction, and production operations.

Bowhead whale-avoidance reactions under the high case are expected to be qualitatively similar to those discussed under the base case. However, under the high case, noise sources would be more abundant; and bowhead reactions likely would be more frequent. Table II-A-1 lists the activities projected for the high case that include an approximate twofold increase over the base case in the number of platforms, shallow-hazards seismic surveys, and helicopter flights. Most of the increased noise and disturbance would occur during the comparatively brief period of exploration and development, when a considerable number of support vessels may be needed for ice management, seismic surveys, and ferrying supplies. Once production platforms are online, support-vessel traffic likely would be greatly curtailed, and bowhead avoidance likely would be significantly reduced. Despite the increased number of noise sources under the high case, bowhead reactions are expected to entail short diversions of individual swimming paths to avoid closely approaching these sites. These short diversions are not expected to require major expenditures of energy on the part of the whales and should not result in serious adverse effects on individual bowheads or on the bowhead population.

The discussion in Section IV.C.6 of the effects of OCS noise on bowhead whales in the spring-lead system for the base case also would be generally applicable for the high case, as it is unlikely that more than one or two platforms would be located in or near the lead system.

CONCLUSION (Effects on Bowhead Whales): The effects on bowhead whales of activities associated with the high case are expected to be MODERATE.

b. Effects on Gray Whales: The OSRA was used in this analysis to assess the vulnerability of oil contacting gray whale habitat. Appendix G, Tables G-15 to G-17, shows the combined probabilities of oil-spill risk to given target areas (the probability of spills occurring and contacting identified resource areas). Combined probabilities assume exploration and development and production over the expected life of the lease-sale area. Unless otherwise noted, combined probabilities referenced in this discussion refer to contact by spills of 1,000 bbl or more during a simulated 30-day period following a spill or

after meltout of a winter spill.

The Gray Whale Area (Fig. IV-C-6-1) has a low probability (8%) (Appendix G, Table G-17) of being contacted by spilled oil during the summer gray whale-feeding period. This represents a negligible increase in contact probability over the base case. Assuming a spill occurs and contaminates gray whale habitat with spilled oil when whales are present, some gray whales could experience one or more of the following: skin contact with oil, baleen fouling, inhalation of sublethal concentrations of hydrocarbon vapors, a localized reduction in food resources, the consumption of some contaminated prey items, and local displacement from some feeding areas. The effect of oil contact on gray whales would be similar to that previously described for the base case, LOW.

It is assumed that under the high case, 2 to 10 drilling units per year will be used for exploration. If located in a gray whale-feeding area, these units could temporarily occupy a few acres of habitat and could possibly displace a few whales from several hundred yards to a few miles from the drilling units for one season. One or more of the estimated seven oil-production platforms may be located within gray whale-feeding areas. Effects of production platforms on gray whales would be similar to the effects of the drilling units but would last for a greater length of time. A few whales may be excluded from feeding within a few hundred yards of the production platforms. Discharges of fluids from drilling units and production platforms are not expected to significantly reduce gray whale-food resources. Pipeline installation should have little effect on gray whales, since most of the estimated 325 mi of offshore pipeline should be placed east of Point Barrow where few gray whales occur. About 75 mi of offshore pipeline may need to be trenched, but most of this trenching probably would occur east of Point Barrow. Some gray whale seabottom habitat may be disturbed by pipeline trenching, but this would be a small portion of the available habitat.

Noise-producing activities most likely to affect gray whales would include aircraft and vessel traffic, geophysical-seismic surveys, drilling operations, and production platforms. Gray whale-avoidance reactions under the high case are expected to be qualitatively similar to those discussed for the base case. However, under the high case, noise sources would be more abundant; and gray whale reactions likely would be more frequent. Table II-A-1 lists the activities projected under the high case that include an approximate twofold increase over the base case in the number of platforms, shallow-hazards seismic surveys, and helicopter flights. Most of the increased noise and disturbance would occur during the comparatively brief period of exploration and development when a considerable number of support vessels may be needed for ice management, seismic surveys, and ferrying supplies. Once production platforms are online, support-vessel traffic likely would be greatly curtailed; and gray whale avoidance likely would be significantly reduced. Despite the increased number of noise sources under the high case, gray whale reactions are expected to entail short diversions of individual swimming paths to avoid closely approaching these sites. These short diversions are not expected to require major expenditures of energy on the part of the whales and should not result in serious adverse effects on individual gray whales or on the gray whale population.

Considering the combined factors of seismic noise, aircraft and vessel traffic, and noise from drilling units and production platforms and the fact that only a small portion of the gray whale population summers in the proposed sale area, the effects on gray whales under the high case are expected to be LOW.

**CONCLUSION (Effects on Gray Whales):** The effects on gray whales of activities associated with the high case are expected to be LOW.

c. **Effects on Arctic Peregrine Falcons:** If oil were released and contacted coastal areas near peregrine-nest sites or -feeding areas, peregrine falcons might be affected through direct contact by adults (when hunting or via prey caught in the vicinity of the spills) or indirectly through disruption or a reduction in prey organisms (seabirds and shorebirds). The probability of such an event would be related to the probability of spilled oil being present in the vicinity of peregrine-nesting and/or -feeding areas. There is a very low probability that arctic peregrine falcons would contact spilled oil. Peregrines may occur in coastal areas such as the Colville or Canning River Deltas in the fall or near coastal nest sites south of Barrow. Appendix G, Table G-18, shows there is less than a 0.5-percent probability that one or more spills of 1,000 bbl or greater would contact the Colville River Delta (Land Segments 31 and 32) or the Canning River Delta (Land Segment 38) would be contacted within a 30-day period following a spill. Probabilities of spilled oil contacting the coast south of Barrow (Land Segments 1-19) during the nesting season are less than 0.5 percent, except Land Segment 19 at 1-percent. Since these probabilities are greater than the risks to which peregrines actually would be exposed, due to their transient occurrence in the area (and since they do not typically occur in the water), it can be concluded that it is very unlikely that oil spills would contact areas

inhabited by arctic peregrine falcons and thus very unlikely that they would be significantly affected by oil spills. If oil spills affected peregrine-prey populations, then short-term, localized reductions in food availability could occur.

Nesting peregrines could, on rare occasions, be disturbed by aircraft overflights related to the proposed sale that may occur inland from the coast. Nesting sites such as those near Ocean Point on the Colville River, about 25 mi inland, and along the coast south of Barrow may be vulnerable to such occasional disturbance. The extent of such disturbance would depend on future locations of support facilities. Aircraft based in Deadhorse or Barrow would not typically fly over this area. Thus, significant disturbance of peregrine falcons associated with the exploration phase is unlikely. Also unlikely are significant population-level-disturbance effects associated with the development and production phases. It is assumed that the Beaufort Sea portion of the onshore gathering pipeline projected for the production phase will be routed coastward of all peregrine falcon-nesting sites and thus should not adversely affect the species. There also is a gathering pipeline projected for the northeast Chukchi Sea portion of the proposed sale area that may be routed onshore from Point Belcher to TAP Pump Station 2. This pipeline has the potential to pass within close proximity to a number of peregrine falcon-nesting locations. Consultation with the FWS will likely be reinitiated at the time of actual pipeline-corridor planning to ensure that pipeline construction and operation can occur without adverse effects to the species. Gravel mining for any artificial islands associated with Sale 124 is unlikely to affect the peregrine, because extraction is expected to occur near the Beaufort Sea coast where peregrines are not known to nest.

**CONCLUSION (Effects on the Arctic Peregrine Falcon):** The effect on peregrine falcons for the high case is expected to be VERY LOW.

7. **Effects on Caribou:** For the high case, the same four landfalls for offshore pipelines are assumed to occur as for the base case, at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson (Fig. I-2). The amount of onshore pipeline and road construction would be the same as that assumed under the base case. However, the number of exploration drill rigs would double to six (from three under the base case), and the number of production platforms would increase to seven (from four under the base case). An increase in helicopter traffic (810-1,730 flights/year vs. 180-360/year under the base case) to and from the support facilities and the exploration and production platforms could increase the frequency of disturbance of some caribou along the flight paths, but such disturbance events would have short-term (minutes to perhaps an hour) effects on caribou behavior and insignificant effects on caribou abundance or distribution (a VERY LOW effect).

Onshore pipelines and access roads from Point Belcher, Pitt Point, Oliktok Point, and Point Thomson to TAP would result in motor-vehicle-traffic (as much as several hundred vehicles/day) disturbance of some portion (several thousand caribou) of all four caribou herds on the North Slope--WAH, TLH, CAH, and PCH. These caribou would be temporarily disturbed by this traffic and displaced from their summer range within a few miles of the pipeline corridors. This reduction in distribution is expected to subside within one generation (about 2 years) after pipeline and road construction is complete (a MODERATE effect). However, a very local reduction in habitat use by some cows and calves within about 1 mi of the pipeline corridors might persist and would represent a LOW effect. Caribou are likely to successfully cross all four pipeline corridors within a short period of time (a few minutes to a few days) during breaks in the traffic flow, even during construction activities (high periods of traffic), with little or no restriction of caribou movements (a LOW effect). Caribou abundance and productivity are not expected to be affected under the high case.

**CONCLUSION:** For the high case, the effects on caribou are expected to be MODERATE.

8. **Effects on the Economy of the North Slope Borough:**

a. **NSB Revenues and Expenditures:** Under the existing conditions, total property taxes in the NSB and NSB revenues in general are projected to steadily decline, as discussed in Section III.D.1.a. As also discussed in this section, these revenues will be determined by several different factors and, therefore, the revenue projections should be used with the understanding that many uncertainties exist about these factors. The proposed sale is projected to increase property taxes starting in the year 1993. This value is expected to reach a maximum of 30 percent above the declining existing-condition levels in the year 1998. The average percent change in property-tax revenues is expected to be 13 percent for the years 1993 to 2010. Also, under the existing conditions, the two expenditure categories that affect employment--operations and

the CIP--are projected to steadily decline. Of these two categories, only expenditures on operations would be affected by the proposed sale's effects on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be affected.

Sale 124 is projected to increase operating revenues by an average of 10 percent above the declining existing-condition levels. The percent change in operating revenues is expected to range from 1 percent in 1993 to 24 percent in 2010. The population effect of sale-induced employment would affect the NSB revenues by allowing the collection of additional intergovernmental and property-tax-operating revenues that are proportional to the NSB population.

b. Employment: The gains from Sale 124 in direct employment would include jobs in petroleum exploration and development and production and jobs in related activities. The estimated peak employment would be about 2,300 jobs in the year 2000, of which 1,700 would be offshore and 600 would be onshore. Additionally, throughout the production phase, total employment would average about 1,600 jobs, of which approximately 300 would be onshore. All of these jobs, except for the small percentage of headquarters jobs, would be filled by commuters who would work and live at the work sites. Most workers would commute to permanent residences in the following three regions of Alaska--Southcentral; Fairbanks; and, to a much smaller extent, the North Slope. Some workers would commute to permanent residences outside of Alaska, especially during the exploration phase. Because economic effects in other parts of Alaska would be insignificant, only employment increases in the North Slope region are discussed.

The proposed sale is projected to affect employment of the region's permanent residents in two ways: (1) more residents would obtain petroleum-industry-related jobs as a consequence of Sale 124 exploration and development and production activities and (2) more residents would obtain NSB-funded jobs as a result of higher NSB expenditures, as discussed above.

While the proposed sale is projected to generate a large number of industry jobs in the region, the number of jobs filled by permanent residents of the region is not projected to be large. The predominant factor in the decline of employment in both cases is declining NSB expenditures. Total high-case resident employment is expected to be more than 10 percent greater than no-sale-condition employment but less than 20 percent in all years except 2009 and 2010, in which employment is projected to be 21 percent and 13 percent higher than no-sale conditions. Total base-case employment should decline at a slightly slower rate; and, therefore, employment should not decline as far by the end of the projection period as it would under existing conditions. Even so, the increase in employment opportunities may partially offset declines in other job opportunities and, therefore, delay expected outmigration.

Figure IV-D-8-1 presents a comparison of total resident employment for the no-sale case and for the high case. Figure IV-D-8-2 presents total resident Native employment for both the no-sale and high cases. It is assumed that all of the direct industry employment of residents is filled by Natives. As can be observed, most of the sale-induced employment is not with the petroleum industry, and the number of sale-induced petroleum-industry jobs would drop as a percentage of sale-induced employment. In addition to the constraints on industry employment of Native residents discussed in Section III.C, the projected small, sale-induced effect can be attributed to a combination of an already historically high level of industry employment assumed under existing conditions and declining petroleum-related employment in the region (see Fig. IV-D-8-2). As industry employment declines in the region, there probably would be less effort made to recruit and retain Native workers.

As for the case under existing conditions, the unemployment rate for Natives is projected to rise from 0 percent in the year 1985 to 50 percent by the year 2002 and to remain at that level until the end of the projection period in the year 2010. While the unemployment rates are about the same for both cases, the sale case is projected to have a larger number of unemployed and a larger labor force, which results in similar rates. As under existing conditions, non-Native residents who lose their jobs are assumed to leave the region.

**CONCLUSION:** For the high case, the economic effects on the NSB are expected to be HIGH.

9. Effects on Sociocultural Systems: In the high case, it is assumed that exploration and development and production would occur in the proposed lease-sale area. For production, seven platforms are assumed (three more than in the base case), and assumed pipeline landfalls would be constructed at Point Belcher, Oliktok Point, Point Thomson, and Pitt Point, as in the base case. Development and

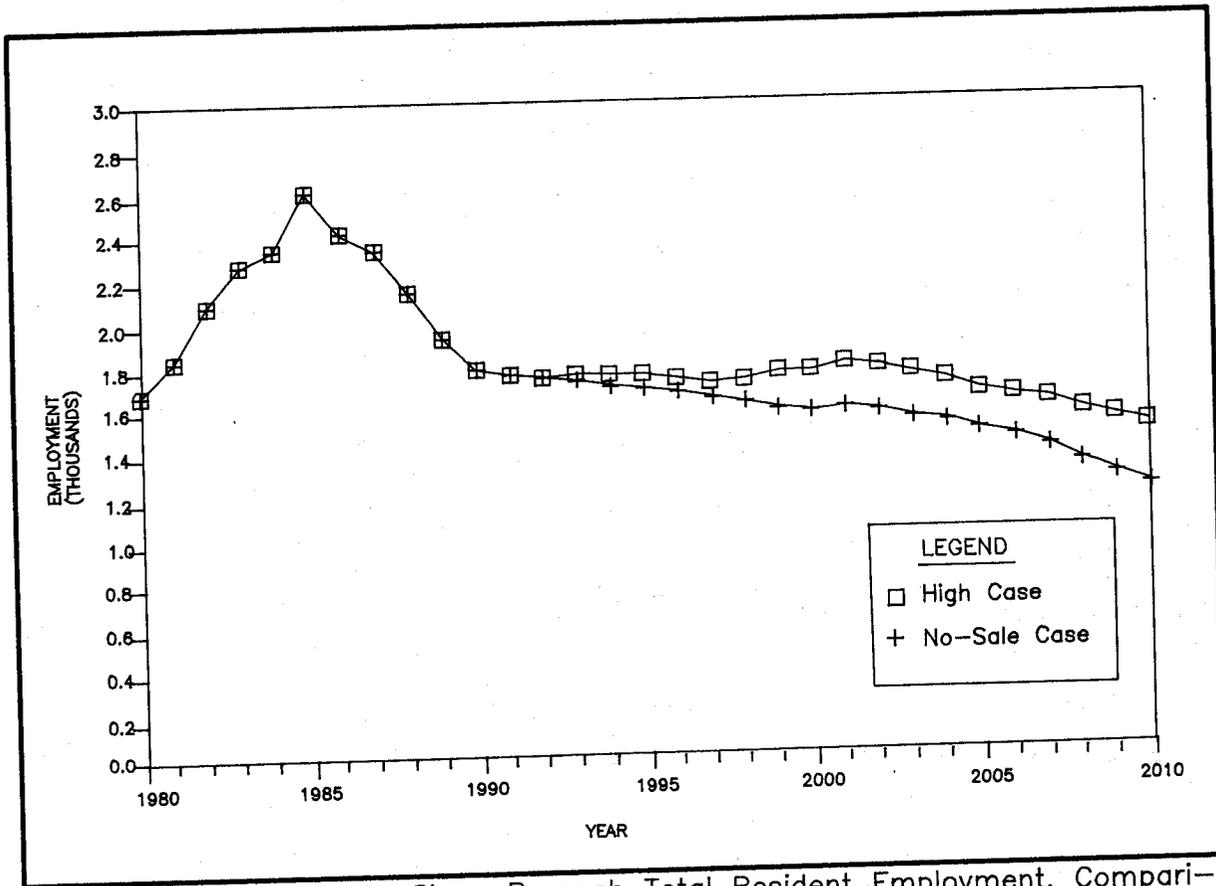


Figure IV-D-8-1. North Slope Borough Total Resident Employment, Comparison of High and No-Sale Cases.

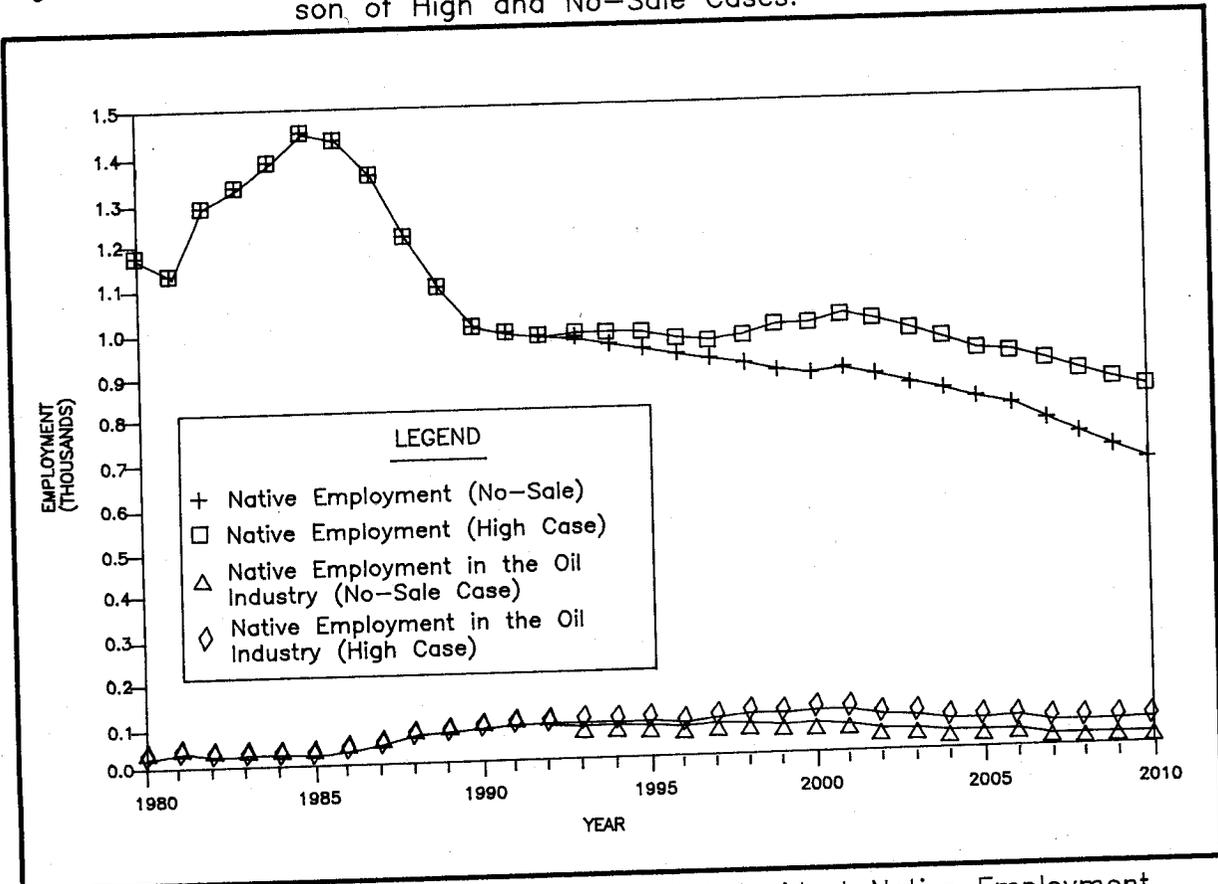


Figure IV-D-8-2. North Slope Borough Total Resident Native Employment, Comparison of High and No-Sale Cases.

production in the Chukchi Sea would be supported by a base at or near Point Belcher; in the Beaufort Sea, Prudhoe Bay would continue to be the primary support base of major construction and operation activities.

a. Effect Agents: The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.2. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level--predominantly by industrial activities, increased population, and increased employment or effects on subsistence-harvest patterns associated with the sale. Potential effects are evaluated relative to the primary tendency of introduced social forces to support or disrupt existing systems of organization and relative to the duration of such behavior (for a detailed discussion of the parameters for the sociocultural-systems analysis, see Sec. IV.C.9). The communities in the proposed sale area that could experience sociocultural effects in the high case are Wainwright, Barrow, Nuiqsut, Kaktovik, or Atkasuk, as in the base case.

(1) Industrial Activities: During the exploration phase (in the high case), any of the communities--Barrow, Wainwright, Nuiqsut, and Kaktovik--could be used for some air support. Prudhoe Bay would be used for primary air support in the Beaufort Sea. Kaktovik has been used in the past for some transportation of freight and personnel to exploration platforms and would most likely continue to be used for future exploration in the eastern Beaufort Sea.

In addition to the production and transportation facilities assumed for the base case (four production platforms, pipelines, and pipeline landfalls at Oliktok Point, Pitt Point, Point Thomson, and Point Belcher), development and production for the high case would include one additional production platform in the Beaufort Sea and two in the Chukchi Sea. The additional Beaufort Sea platform is located northwest of Barter Island and is connected to the pipeline with the landfall at Point Thomson (base case). The production platforms in the Chukchi Sea share a pipeline with a landfall at Point Belcher; a pipeline from this location to TAP has been part of the hypothetical transportation scenarios developed for the oil and gas lease sales in the Beaufort Sea (Sale 97) and Chukchi Sea (Sale 109) Planning Areas. With onshore facilities in place, construction activities at Point Belcher for Sale 124 would be associated with the pipeline to the production platforms. Air support for high-case development and production would be from Prudhoe Bay and may include (1) the communities of Barrow, Kaktovik, and Wainwright and (2) pipeline-landfall sites at Point Thomson, Pitt Point, Oliktok Point, and Point Belcher. As in the base case, sale-related industrial activity would bring workers into the area, potentially causing interactions with local residents. A discussion of these effects follows below.

(2) Population and Employment: As in the base case, the high case for Sale 124 is projected to affect the population of the NSB through two types of effects on employment in the region: (1) more petroleum-industry-related jobs as a consequence of Sale 124 exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.C.8.a). Employment projections in the high case as a consequence of Sale 124 are provided in Section IV.C.8.b. Throughout the production phase, total employment would begin in 1992 at 352, peak in 2000 at 2,424, and in 2010 at 1,857. The average increase would be 41 percent. All of these jobs would be filled by commuters who would work and live at the work sites. Most workers are expected to permanently reside outside of the North Slope. Sale 124 is projected to increase resident employment by 10 percent or more above the declining existing-condition projections between 1993 and 2010. In 2010, resident employment would peak at 23 percent above existing-condition projections.

In the high case as in the base case, the effect on the population of the NSB from increased employment opportunities would partially offset expected declines in other job opportunities and, therefore, delay expected outmigration. In the high case, Sale 124 is projected to increase the NSB population by less than 10 percent above the existing-condition level until 2006, compared to 4 percent in the base case. By 2010, the effect would be 21 percent greater, compared to 7 percent in the base case. The population of the NSB is not expected to decline as a consequence of the sale because of the increased employment opportunities. The Native proportion of the population is not expected to change by the year 2010 (85%; also 85% in the base case), and Native employment is expected to improve as a consequence of Sale 124 (see Fig. IV-D-8-2). Barrow is most likely to benefit from sale-related and sale-induced employment increases. It is expected that the proximity of Nuiqsut and Kaktovik to the shore bases at Point Thomson, Nuiqsut to Oliktok Point and Pitt Point, Barrow to Pitt Point, and Barrow and Wainwright to Point Belcher would encourage more residents from these communities to apply for sale-related jobs (see Sec. IV.C.8). The effect of sale-related changes in population and employment on the sociocultural systems is analyzed below.

b. Effects on Subsistence-Harvest Patterns: Subsistence is important to the Inupiat sociocultural system (see Sec. III.C.3 for a detailed description of subsistence). Overall, HIGH effects are expected on subsistence-harvest patterns in the Sale 124 area in the high case as a result of effects on Nuiqsut's bowhead whale harvest. MODERATE effects are expected in Barrow, Atqasuk, Wainwright, and Kaktovik subsistence-harvest patterns as a result of effects on bowhead whale harvests.

c. Effects on Barrow, Atqasuk, Wainwright, Kaktovik, and Nuiqsut: This section discusses the effect of the high case on the communities whose sociocultural systems may be affected by Sale 124. Effects on sociocultural systems are the same in the high case--MODERATE--in Nuiqsut, Kaktovik, and Wainwright as in the base case because industrial activity is the same, effects on subsistence-harvest patterns are the same, and population and employment are not expected to change significantly. Wainwright, Nuiqsut, and Kaktovik are small, relatively homogenous communities that would not absorb the presence of non-Natives as would a community such as Barrow. Interactions with non-Natives, increased non-Native population, and Natives leaving the community to work in the industrial enclave could lead to a breakdown of kinship networks as well as increase social stress in the community.

A disruption of the social organization could lead to a decreased emphasis on the importance of the family, cooperation, and sharing. Multiyear disruptions of subsistence-harvest patterns--especially of the bowhead whale, which is an important species to the Inupiat culture--could disrupt sharing networks, subsistence task groups, and crew structures and could cause disruptions of the central Inupiat cultural value: subsistence as a way of life. These disruptions also could cause a breakdown in sharing patterns, family ties, and the community's sense of well-being and could damage sharing linkages with other communities. Other effects might be a decreasing emphasis on subsistence as a livelihood, with an increased emphasis on wage employment, individualism, and entrepreneurialism. Wainwright, Kaktovik, and Nuiqsut also may experience an increase in social problems due to the increased presence of oil workers in the community and possible roads connecting Nuiqsut to Pitt Point or Oliktok Point, Kaktovik to Point Thomson, and Wainwright to Point Belcher--enabling easier access to drugs and alcohol and affecting the social health of the community. Effects on the sociocultural systems, such as increased drug and alcohol abuse, breakdown in family ties, and weakening of social well-being, would lead to additional stresses on the health and social services available to Nuiqsut and Kaktovik.

These effects described above would be long-term; and there could be a tendency for additional stress on the sociocultural system but without tendencies toward displacement, resulting in MODERATE effects on sociocultural systems in Nuiqsut, Kaktovik, and Wainwright.

Sale-related increases in population and employment predicted for the high case in the proposed Sale 124 area are most likely to occur primarily in Barrow. As in the base case, although Barrow would be in proximity to industrial activities, would have increases in population and employment, and would experience potential MODERATE effects on one subsistence-harvest resource--the bowhead whale harvest--these changes should not be more significant than those changes that have already been felt in Barrow. Barrow is a much larger community that is more heterogeneous than others on the North Slope, and it could withstand some degree of increased population and employment opportunities. Although these disruptions could be long term, they most likely would not lead to a displacement of existing institutions; and the expected effect on sociocultural systems in Barrow would be MODERATE.

Atqasuk is too distant from onshore industrial activities to be directly affected by this lease sale and is not expected to experience direct, sale-related increases in population and employment. Atqasuk may experience some indirect rises in population and increases in employment, but they are not expected to be significant. Disruptions in Atqasuk would be short term and would not have a tendency toward displacement of existing sociocultural institutions--a LOW effect on social organization as a result of lease-sale activities in the high case.

**CONCLUSION:** For the high case, the effects on sociocultural systems are expected to be MODERATE.

10. Effects on Subsistence-Harvest Patterns: In the high case, landfalls would be constructed at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson if development and production occurred in the Chukchi and Beaufort Seas, the same as in the base case. In the Chukchi Sea, development would be supported by a support base at or near Point Belcher; in the Beaufort Sea, Prudhoe Bay would continue to be the primary support base of major construction and operation activities. Seven platforms would be

constructed in the high case--three more than in the base case.

a. Effects from Oil Spills: In the high case, three oil spills of 1,000 or more bbl each are assumed to occur. However, while the potential effects from an oil spill that might occur and contact subsistence resources would not change in the high case, the probabilities of an oil spill occurring and contacting these resources would change in Subsistence-Harvest-Resource Areas B and C. In Subsistence-Harvest-Resource Area A, there would not be much of an increase in these probabilities in the high case (an increase from a 3-7% chance in the winter and from a 1-3% in the open water season). The probability also would increase very little in the Nuiqsut subsistence area (Land Segments 23-35) (1% increase in the probability of oil occurring and contacting subsistence resources during the winter or open-water season). In Resource Area B from April to June, there would be an increase in probabilities from 7 to 19 percent during winter and from 12 to 31 percent in open water. During the entire winter, the probabilities would increase from 20 to 48 percent. In Resource Area C (Kaktovik's and some of Nuiqsut's subsistence-harvest area), the probability of an oil spill occurring and contacting subsistence resources would remain at less than 0.5 percent.

In the high case, effects on subsistence-harvest patterns from an oil spill would be the same as in the base case. Effects would be MODERATE on the bowhead whale and walrus harvests in Barrow (see Sec. IV.C.10). Whaling activities are localized and occur within a short time period; consequently, an untimely oil spill could disrupt a community's subsistence effort for an entire season. There are so few bowhead whales harvested that a decrease in the harvest in all communities other than Barrow could mean a reduction to zero whales--an elimination of the harvest. Even if an oil spill did not affect the entire population of bowhead whales and only a number of individuals in a localized area were oiled--or even if oil were in the area but did not affect the whales--the bowheads still would be rendered inedible or perceived as such and consequently would not be harvested that year--a MODERATE effect. The walrus harvest also occurs within a short time period--2 weeks. If an oil spill occurred during or shortly before the walrus harvest season, it is likely that no walrus would be harvested that year--a MODERATE effect. This effect most likely would occur only in Barrow. Nuiqsut and Kaktovik do not harvest much walrus, and the probability of an oil spill occurring and contacting the Wainwright subsistence-harvest area is low (3% chance) so that no more than VERY LOW effects are expected on Wainwright's subsistence harvests.

b. Effects from Noise and Disturbance: With the additional platforms, effects from noise and disturbance would be intensified and the probability of effects occurring would be increased in the high case, but they are not expected to increase effect levels. As in the base case, effects from noise and traffic disturbance would continue to be MODERATE on bowhead whale harvests in Wainwright, Nuiqsut, and Kaktovik (see Sec. IV.C.10). Other harvests should experience no more than LOW effects.

c. Effects from Construction Activities: Effects on subsistence harvest from construction activities and development and production would be identical in the high case to those expected in the base case (see Sec. IV.C.10) because there will be no additional shore bases constructed. There will be additional pipelines to the shore bases from the platforms, but this is only expected to intensify the effects, not increase effect levels. Effects would continue to be HIGH in Nuiqsut due to interference with the bowhead whale harvest due to construction of Point Thomson, which is in the vicinity of a key bowhead whale-harvest area at Flaxman Island. Wainwright bowhead whale and walrus harvests and Barrow's walrus harvests are expected to have MODERATE effects due to construction activities at Point Belcher.

SUMMARY: Effects in Barrow, Atqasuk, Wainwright, Nuiqsut, and Kaktovik would not be altered in the high case. Nuiqsut's subsistence-harvest patterns could experience HIGH effects as a result of construction activities and noise and traffic disturbance on bowhead whale harvests near Flaxman Island at Point Thomson. Wainwright bowhead whale and walrus harvests and Barrow (Atqasuk) walrus harvests are expected to have MODERATE effects due to construction activities at Point Belcher. Barrow's (and Atqasuk) subsistence-harvest patterns could experience MODERATE effects on their bowhead whale harvest from an oil spill. Kaktovik's bowhead whale harvest is expected to experience MODERATE effects due to noise and traffic disturbance.

CONCLUSION: The effects of the high case for Sale 124 on subsistence-harvest patterns are expected to be MODERATE in Wainwright, Barrow (Atqasuk), and Kaktovik and HIGH in Nuiqsut; regional effects are expected to be HIGH.

11. Effects on Archaeological Resources: Effects of the high case on archaeological resources

would be produced by activities resulting from the exploration for and discovery of 2,600 MMbbl of oil. Exploration would involve the drilling of 36 exploratory wells and delineation wells. The oil would be produced from seven production platforms within 346 production and service wells. The effects on archaeological resources would be produced by exploration, onshore-facility construction, installation of pipelines to shore from the production platforms, the activities of employees in sale-related activities who visit archaeological sites, and other sale-related activities.

Prehistoric archaeological sites on the OCS may have survived ice gouging in places where these sites are protected from ice keels. They also may have survived ice gouging if they are in sea valleys deeper than these keels can reach (see Sec. III). They may have been pushed aside rather than destroyed, which limits the usefulness of the data that can be collected from the site, or covered by sediments. For details, see the MMS Headquarters and Regional analyses, titled, respectively, Reassessment of Shipwreck Potential and Archaeological Survey Recommendations for Sale 109 Leases, Chukchi Sea, Alaska, and Prehistoric Resource Analysis, Proposed Sale 124, Beaufort Sea (Appendix I, this EIS). Detection of these sites is not possible with present-day methods; however, the landforms that may contain a site can be located, giving a possible location for the site. The probability of survival of such landforms in most of the Sale 124 area is slight in some areas and moderately possible in other areas. Therefore, the probability of damage to such landforms for the high case is LOW.

Historical shipwreck resources may still exist on the OCS. A number of shipwrecks occurred on the OCS in the Sale 124 area. Destruction of these shipwreck remains would mean the loss of some scientific data. The lost data may not be unique; however, since similar data might be found in other similar wrecks in other places. The survival of a completely intact shipwreck on the OCS in the Sale 124 area appears to be unlikely between 25- and about 50-m water depths because of the ice gouging.

A few remains of shipwrecks that have survived for about 100 years have been found nearshore and onshore. Adverse effects on such shipwrecks could occur if oil-spill cleanup took place on or near the beach where these wrecks are located. For the high case, The estimated mean number of spills in the Arctic Ocean is 1.25, with an associated probability of 91 percent (Table IV-A-1-1). The effect of the high case on shipwrecks offshore and onshore is likely to be MODERATE.

**CONCLUSION:** The expected effects of the high case on archaeological resources are MODERATE.

## 12. Effects on Air Quality:

a. Effects on Air Quality Relative to Standards: Air-quality standards, regulations, and procedures are addressed in Section IV.C.12.a. Under the high case, the peak exploration year includes 5 exploration and 4 delineation wells drilled from 6 rigs; and the peak development year includes installation of 3 production platforms, 40 production wells, 167 km (104 mi) of offshore pipeline, and 155 km (96 mi) of onshore pipeline. The peak production year includes installation of 85 production wells and production of 218 MMbbl from 7 platforms.

Under the high-case scenario, exploration would be scattered beyond the 20-m isobath (approximately 19 km or 12 mi offshore), and development and production activities would be focused generally around seven different locations ranging from 42 km (26 mi) northeast of Barter Island to approximately 132 km (82 mi) north northeast of Pt. Belcher. When distributed over these locations, the projected emissions for peak exploration and development and production years would not exceed the exemption criteria (Table IV-C-12-1); concentrations at the shoreline are expected to be less than 5 percent of available national standards or PSD concentration increments; and air-quality standards would be maintained by a wide margin. Consequently, it is not necessary to model the pollutant concentrations at the shoreline.

b. Effects of Air Quality Not Addressed by Standards: For a more detailed discussion of the potential effects of air pollution other than those effects addressed by standards, see Section IV.C.17.b. The coastal-tundra ecosystem has a high susceptibility to acidic pollution. However, because emissions, particularly NO<sub>2</sub> and SO<sub>2</sub>, would be much less than the exemption levels for the high case as well as for the base case, the resulting onshore concentrations would be well below the amounts required to affect the tundra, even on a local or short-term basis.

Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Under the high case, the probability of experiencing one or more blowouts in drilling the 290 exploration and

production wells would be 62 to 71 percent. The emissions from a given gas blowout would be quickly diffused and seldom last longer than a day. For additional information on gas blowouts, see Section IV.C.12.b.

Oil spills are another accidental source of gaseous emissions. In the high case, the most likely number of three spills of 1,000 bbl or greater (average size 22,000 bbl) in the sale area and two spills in Prince William Sound and the Gulf of Alaska would each release between 8,098 and 8,378 bbl or 113 to 117 metric tons of VOC through evaporation. Smaller spills of less than 1,000 bbl occur more frequently than larger spills. The number of small spills projected for the high case is 612. Evaporation from these spills would release 177.5 bbl of VOC over the life of the field. The VOC released by spills would be scattered spatially and temporally and would generally be about 48 km (30 mi) or more offshore. Consequently, the USDOJ exemption criteria for VOC emissions would not be exceeded.

The burning of spilled oil under the high-case scenario would not differ appreciably from the base case. There would be seven production platforms in the high case as opposed to four in the base case. However, the platforms would be widely distributed, and none would be closer to shore than in the base case. Prevailing winds would blow smoke plumes parallel to or onshore for activities east of Barrow. For any given fire, it is expected that any smoke reaching the shore would be of short term, would be limited to a local area, and would disperse.

**CONCLUSION:** For the high case, effects on air quality are expected to be LOW.

13. **Effects on Land Use Plans and Coastal Management Programs:** Increased oil production in the high case is assumed to require only one additional production platform and 60 additional miles of offshore pipeline. The most likely number of oil spills of 1,000 bbl or greater increases from one to three. The increase in the number of oil spills and the increased acreage affected by oil spills exacerbates some of the conflicts identified in the base case of the Proposal. As a result, the potential conflicts with the NSB Land Management Regulations and the ACMP that are identified in the base case are relevant to the high case. These conflicts (see Sec. IV.C.13) are summarized here and modified as appropriate to include new levels of effects identified in the other high-case analyses (Secs. IV.D.1 through 12).

a. **North Slope Borough Comprehensive Plan and Land Management Regulations:** Major land use decisions concerning onshore facilities are comparable to those of the base case. The Offshore Development policy related to vessel traffic during the bowhead whale migration (NSBMC 19.70.040.E) and the policies related to the Transportation Corridor remain relevant. Applicable areawide policies are cited along with the identical NSB CMP policy in the following section.

b. **Alaska Coastal Management Program:** As noted previously, this analysis includes only a summary of the potential conflicts identified in Section IV.C.13(b), augmented as necessary to include changes in levels of effects in other high-case analyses.

(1) **Energy Facilities (6 AAC 80.070):** Conflicts noted in the base case with respect to Point Belcher and to Point Thomson still would be evident in the high case. User conflicts between whalers and those installing the pipeline to Point Thomson would be in conflict with the second factor of the energy-facility policy, which requires facilities to be compatible with existing and subsequent uses. Other potential conflicts associated with pipeline installation are discussed under the policies that follow.

(2) **Subsistence (6 AAC 80.120):** As noted previously, the major conflicts between the proposal and subsistence policies relate to issues of access to subsistence resources and interference with subsistence hunting of bowhead whales. Policies of particular relevance related to access include NSB CMP policy 2.4.3(d) (NSBMC 19.70.050.D), which requires that development not preclude reasonable subsistence-user access to a subsistence resource and NSB CMP 2.4.5.I[b] (NSBMC 19.70.050.J.2), which is a best-effort policy addressing reduced or restricted access to protect user access for subsistence purposes. The short duration of the construction period makes conflict more likely.

The NSB CMP 2.4.3(b) (NSBMC 19.70.050.B), which restricts interference with subsistence activities associated with the bowhead whale hunt, is the policy that applies if bowhead whaling were affected by development activities.

In the high case, effects on birds could be high in the event of an oil spill. However, the decrease in the bird

populations is not expected to deplete the resource below the subsistence needs of the local residents (Sec. IV.D.10). Therefore, no conflict is expected with NSB CMP 2.4.3(a) (NSBMC 19.70.050.A).

(3) Habitats (6 AAC 80.130): The only specific environment in which effect levels rise in the high case is for saltmarsh areas. An increase in spill-contact probabilities to coastal saltmarshes, such as along the Colville River Delta, could lead to contamination of a greater percent of the surface area of the saltmarsh if the spill occurred during the open-water season. This, in turn, would increase the effects on waterfowl and shorebirds. Of particular concern is the Pacific brant, which could take more than one to two generations to recover. Because an oil spill is an accidental discharge into the environment, it cannot be planned for. However, at the time for establishing pipeline routes, avoidance of important wetland habitats will be one of the important siting criteria (6 AAC 80.130 [c][3]).

(4) Air, Land, and Water Quality (6 AAC 80.140): Levels of effect for water quality (Sec. IV.D.1) and air quality (Sec. IV.D.12) remain the same as for the base case. The number of causeways does not increase. Therefore, the level of conflict identified in the base case is comparable in the high case. Likewise, effects from the disposal of formation waters remain the same as in the base case.

(5) Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): The only potential conflict noted in the base case for this standard was with NSB CMP policies 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). These policies protect sites valuable for cultural uses. The potential for conflict with these policies remains the same in the high case.

SUMMARY: Potential conflict between activities assumed for this lease sale and the NSB Land Management Regulations and the Statewide standards and the NSB district policies of the ACMP is comparable to the base case.

The only new area where conflict may arise in the high case is in the wetland habitat. Effects of oil spills on saltmarshes are expected to limit their habitat value for waterfowl and shorebirds. Pacific brant, in particular, may take one to two generations to recover.

CONCLUSION: For the high case for Alternative I, the effects of potential conflicts with land use plans and coastal management programs are expected to be HIGH.

#### **IV.E. Alternative II--No Lease Sale**

Cancellation of proposed Sale 124 would prevent the inventory of potential petroleum resources in more than 22 million acres of the sale area and could reduce future OCS oil and gas production. Such an action might be in conflict with the OCSLA, which declares:

the outer Continental Shelf is a vital national resource held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

Cancellation of the sale also would perpetuate the need for imported oil and gas and/or require the development of alternative-energy sources. Appendix D of this EIS identifies alternative-energy resources and describes their environmental risks and current and projected uses. Briefly, the following energy actions or sources might be used as substitutes: energy conservation; conventional oil and gas supplies; coal; nuclear power-fission; nuclear power-fusion; oil shale; tar sands; hydroelectric power; solar energy; energy imports, oil imports, natural-gas-pipeline imports and liquefied-natural-gas imports; geothermal energy; other energy sources; or a combination of alternatives. It should be noted that some of these actions are not feasible at this time and may not be during the estimated life of this production area. Table II-B-1 shows the amount of energy needed from other sources to replace anticipated oil and gas production from the base case for Alternative I.

In addition, financial benefits from the sale would not be available. Revenues from OCS leasing consist of bonuses, royalties (or profit shares), and rentals, all of which are deposited in the U.S. Treasury. Under amendments of section 8(g) of the OCSLA, a portion of these revenues from certain leases is distributed to coastal states. Also, some of the revenues from OCS leases are credited to the Land and Water Conservation Fund and the Historic Preservation Fund.

The effects on biological resources and social and economic systems as described for Alternative I would not occur and are indicated below.

1. **Effects on Water Quality:** There would be no degradation of water quality as a result of this alternative.
2. **Effects on Lower-Trophic-Level Organisms:** There would be no adverse effects on marine plants and invertebrates as a result of this alternative.
3. **Effects on Fishes:** There would be no adverse effects on fishes as a result of this alternative.
4. **Effects on Marine and Coastal Birds:** There would be no adverse effects on marine and coastal birds in the Beaufort Sea or associated coastal areas as a result of this alternative.
5. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** There would be no adverse effects on these marine mammals in the Beaufort Sea or associated coastal areas as a result of this alternative.
6. **Effects on Endangered and Threatened Species:** There would be no adverse effects on endangered and threatened species as a result of this alternative.
7. **Effects on Caribou:** There would be no adverse effects on caribou as a result of this alternative.
8. **Effects on the Economy of the North Slope Borough:** The effects of proposed Sale 124, analyzed in Section IV.C.8, would not occur. In the absence of the sale, NSB revenues and employment would be as projected in Sec. III.C.1.
9. **Effects on Sociocultural Systems:** There would be no adverse effects on sociocultural

systems under Alternative II. This alternative would decrease employment and population in Barrow, Wainwright, Nuiqsut, and Kaktovik; however, these decreases would not adversely affect the Inupiat sociocultural system.

10. **Effects on Subsistence-Harvest Patterns:** This alternative would eliminate adverse effects on subsistence-harvest patterns in the five North Slope communities considered in the proposed action (Alternative I). However, effects on subsistence-harvest patterns in Barrow, Wainwright, Nuiqsut, Kaktovik, and Atkasuk are expected to be VERY HIGH due to the ongoing presence of barges, vessels, and other traffic in the sale area from possible State leases; from exploration and development and production in the Beaufort and Chukchi Seas (as a result of Sales 87, 97, and 109) and on the coastal plain of ANWR (although exploration or development has not been approved); and from further development that might occur in NPR-A.

11. **Effects on Archaeological Resources:** This alternative would not result in any adverse effects on archaeological resources.

12. **Effects on Air Quality:** In the event that there is no lease sale, there would be no direct or accidental air-pollutant emissions from the projected offshore activities as analyzed for the base case.

13. **Effects on Land Use Plans and Coastal Management Programs:** If Sale 124 were not held, no sale-related activities would occur that could conflict with the Statewide standards or the NSB district policies of the ACMP. Potential conflicts related to other activities of the NSB are assessed in Section IV.I.13.

However, under the No Lease Sale Alternative there will continue to be effects from the existing and proposed actions other than Sale 124. As noted in the cumulative case (Sec. IV.I) it is anticipated that the proposed activity would make a relatively small contribution to the cumulative case.

#### IV.F. Alternative III--Delay the Sale

For this alternative, the proposed lease sale would be delayed for a period of 2 years. Delaying the sale could provide additional time for ongoing research to acquire data that might be used in assessing effects that petroleum exploration, development and production, and transportation might have on the environment. Although additional information would be useful, the MMS considers the existing database adequate to analyze the consequences of petroleum-related activities in the Sale 124 area. Table IV-F-1 identifies potential studies that could be conducted during the 2-year delay; this table is based on the Alaska Regional Studies Program studies list for Fiscal Years 1990 through 1992 (Appendix F, Environmental Studies List). Additional studies are being proposed for the future.

The following sections assess the effects of this alternative on the resources, systems, and programs in and adjacent to the sale area.

1. Effects on Water Quality: Effects associated with this alternative would be essentially the same as those analyzed for the base case (Sec. IV.C.1). In particular, oil spillage is estimated as proportionate to the quantity produced and transported; timing or rate of production does not affect the spillage estimate. No breakthroughs in ability to clean up oil spills at sea are anticipated in the next 2 years that would guarantee that spilled oil would not affect water quality. Four causeways still would be constructed, affecting temperature and salinity in over 200 km<sup>2</sup> of inshore waters.

CONCLUSION: Alternative III is expected to have the same effects on water quality as the effects for the base case--MODERATE for LOCAL water quality and VERY LOW for REGIONAL.

2. Effects on Lower-Trophic-Level Organisms: Effects associated with this alternative are expected to be qualitatively the same as those analyzed for the base case for Alternative I (Sec. IV.C.2). However, the magnitude of the effects could vary depending on the population status of potentially affected species (e.g., species in the Stefansson Sound Boulder Patch) at the end of the delay or upon the initiation of activities.

CONCLUSION: LOW effects are expected under Alternative III--the same as the effects for the base case.

3. Effects on Fishes: Effects associated with this alternative should be essentially the same, qualitatively, as those analyzed for the base case (Sec. IV.C.3). However, the magnitude of the effects could vary depending on the population status of the potentially affected species (e.g., anadromous species, especially arctic cisco) at the end of the delay or upon the initiation of activities. A delay would allow further research or analysis and synthesis of existing data on the effects of causeways on fishes; this might elucidate the degree of effects or could result in more effective mitigation of effects, including design criteria for future structures. Since a delay does not guarantee advances in our understanding, the projected effects of causeways would remain the same as for the base case, LOW.

CONCLUSION: Alternative III is projected to have MODERATE effects on fishes--the same as the effects for the base case.

4. Effects on Marine and Coastal Birds: Effects associated with this alternative would be essentially the same, at least qualitatively, as those analyzed for the base case (Sec. IV.C.4). The magnitude of effects could vary, depending on the population status of affected bird species at the time of the end of the delay or the time when the undesirable effects occur.

CONCLUSION: The effects of Alternative III on marine and coastal birds are expected to be the same as the effects for the base case--MODERATE.

5. Effects on Pinnipeds, Polar Bears, and Belukha Whales: Effects associated with this alternative would be essentially the same, at least qualitatively, as those analyzed for the base case (Sec. IV.C.5). The magnitude of effects could vary, depending on the population status of affected marine-mammal species at the time of the end of the delay, or when adverse effects could occur.

CONCLUSION: The effect of Alternative III is expected to be MODERATE on pinnipeds, MODERATE

Table IV-F-1  
 Studies Pertinent to the Beaufort Sea  
 Planning Area that May Be Conducted During a  
 2-Year Delay of the Sale<sup>1/</sup>

Study Name	FY 90	FY 91	FY 92
Circulation and Trajectory Model	X	X	X
Effects of Production Activities on Arctic Whales	X		
Beaufort Sea Mesoscale Circulation	X		
Arctic Ocean Buoy Study	X		
The Bowhead Whale Book	X		
Remote-Sensing Data Acquisition and Analysis	X	X	X
Monitoring Distribution of Arctic Whales	X	X	X
Archiving of Wildlife Specimens for Future Analysis	X	X	X
Monitoring Beaufort Sea Waterfowl and Marine Birds	X	X	X
Stable Isotope Analysis of the 1987 and 1988 Zooplankton and Bowhead Whale Tissue	X		
Quality-Assurance Program for Trace-Petroleum-Component Analysis	X	X	X
Performance and Compatibility Analysis of Oil-Weathering and Transport-Related Models in the Environmental Assessment Process	X		
Model Verification: Site-Specific Interaction of Acoustic Stimuli	X	X	
Revision of the Alaskan OCS Oil-Weathering Model	X	X	
Importance of Leads to Bowhead Whales	X	X	
Accidental-Oil-Spill Fate and Effects Study	X		
Potential Influence of Environmental and Industrial Factors on Bowhead Whale Hunting	X		
Petroleum Discharges Into Alaskan Waters	X		
Monitoring and Evaluating the Effects on Seabird Colonies in Potential Oil and Gas Development Areas	X		
Potential Impacts of Human Activities on Feeding Behavior, Energetics, and Habitats of Molting Pacific Black Brants at Teshekpuk Lake	X	X	X

Source: USDOJ, MMS, Alaska OCS Region.

<sup>1/</sup> Additional studies are being proposed for FY's 91 and 92 environmental studies.

on polar bears and LOW on belukha whales (the same as the effect for the base case).

6. **Effects on Endangered and Threatened Species:** Effects associated with this alternative would be the same as those analyzed for the base case (Sec. IV.C.6). The magnitude of effects could vary, depending on the population status of affected species at the end of the delay. The gray whale and arctic peregrine falcon populations appear to be increasing gradually; and should this trend continue, a delay of the sale may allow these species to better withstand the potential adverse effects of the lease sale.

**CONCLUSION:** Effects would be the same as those for the base case, MODERATE for the bowhead whale, LOW for the gray whale, and VERY LOW for the arctic peregrine falcon.

7. **Effects on Caribou:** Effects associated with this alternative would be the same, at least qualitatively, as those analyzed for the base case (Sec. IV.C.7). However, the magnitude of effects could vary, depending on the population status of the affected caribou herds when adverse effects could occur.

**CONCLUSION:** The effects of Alternative III on caribou are expected to be the same as those for the base case--MODERATE.

8. **Effects on the Economy of the North Slope Borough:** The effects on resident employment would be less than 10 percent, and the change in NSB revenues would be around 10 percent. Neither of these factors is expected to have adverse effects on employment opportunities for residents or on NSB taxing ability.

**CONCLUSION:** The effects of Alternative III on the economy of the NSB are expected to be MODERATE--the same as the effects for the base case.

9. **Effects on Sociocultural Systems:** The effects of Alternative III on sociocultural systems are expected to be the same as analyzed for the base case--MODERATE--only delayed (see Sec. IV.C.9).

**CONCLUSION:** The effects of Alternative III on sociocultural systems are expected to be the same as the effects for the base case--MODERATE.

10. **Effects on Subsistence-Harvest Patterns:** The effects of Alternative III on subsistence-harvest patterns would be the same as analyzed for the base case, only delayed (see Sec. IV.C.10). Delaying the sale could provide improved technology on oil-spill containment and cleanup and could reduce potential effects on subsistence resources imposed by oil spills.

**CONCLUSION:** The effects of Alternative III on subsistence-harvest patterns are expected to be the same as the effects for the base case--HIGH in Nuiqsut and MODERATE in Barrow (Atqasuk), Wainwright, and Kaktovik. Regional effects on subsistence-harvest patterns are expected to be HIGH.

11. **Effects on Archaeological Resources:** Delaying the sale would delay the effects of the base case on archaeological resources.

**CONCLUSION:** Alternative III would delay any potential effects to the archaeological resources, but the effects would remain the same as those for the base case--LOW.

12. **Effects on Air Quality:** Delay of Sale 124 would cause little change in the effects relative to air-quality standards or on air-pollutant effects other than those addressed by standards. There would be no change in the emissions expected under the base case (see Sec IV.C.12) and, therefore, little effect on changes in existing effects at a later time.

**CONCLUSION:** For this alternative, the effects on air quality would be delayed but are expected to remain LOW, as in the base case.

13. **Effects on Land Use Plans and Coastal Management Programs:** Delaying the sale would defer for 2 years activities assumed to occur for the base case. As a result, the sequence of Sale 124 activities with respect to other likely activities affecting the NSB would shift, and Sale 124-related activities could be placed in a less advantageous position in the cumulative analysis. However, effects and levels of effects are

not expected to change. Policies that were relevant in the base case would remain relevant if the sale were delayed.

**CONCLUSION:** Alternative III would delay the potential conflicts between activities assumed to follow this sale and the NSB Land Management Regulations and the Alaska Coastal Management Program, but it is not expected to reduce potential effects from HIGH.

#### **IV.G. Alternative IV--Barrow Deferral Alternative**

Alternative IV, the Barrow Deferral Alternative, would offer for leasing 3,894 blocks (Fig. IV-G-1); this is 201 blocks--about 412,000 ha--smaller in size than the area of Alternative I. The deleted blocks, located in the vicinity of Point Barrow--Figure I-1--comprise the Barrow Deferred Area. The MMS estimate of the amount of oil that would be leased, discovered, and developed and produced in the area defined by the Barrow Deferral Alternative is 900 MMbbl (Appendices A and B). This estimate is a result of the very low probability assigned for the occurrence of petroleum in the deferred area. However, because of the uncertainty involved in making resource estimates for frontier areas, there remains a very small probability that the deferred area contains petroleum. The types and levels of activities associated with the resource estimate for Alternative IV include (1) drilling of 14 exploration and delineation wells (1992-1996), (2) installing 4 production platforms (1997-1999) and drilling 120 production and service wells (1997-2000), (3) installing 275 mi of offshore pipeline and 325 mi of onshore pipeline (1997-1999), and (4) producing 900 MMbbl of oil (2000-2018). A more detailed discussion of the types and levels of activities associated with the scenario for Alternative IV is presented in Section II.B.2.a.

The blocks comprising the proposed Barrow Deferred Area contain, at various times, significant biological resources and hold important cultural values for the Natives who inhabit the nearby areas. Bowhead whales pass through the deferred area during their spring and fall migrations to and from the eastern Beaufort Sea and, during some years, have been observed feeding within the deferred area. The Inupiat people of Barrow use the deferred area in the spring and fall to hunt bowhead whales for subsistence purposes. The area also contains polar bears, ringed seals, and migratory birds that are hunted for subsistence purposes by people from Barrow and Wainwright.

**Deferred-Area Assumptions and Scenario:** Areas deleted from the sale area would experience a reduction or elimination of effects from petroleum exploration and development and production activities that might occur as a result of the lease sale. To indicate the types of effects that would be avoided in an area deleted from a lease sale, the effects of petroleum exploitation in the deferred area on each of the major environmental resources, social systems, or programs analyzed for the deferral alternative also are analyzed for the deferred area; the analysis for each resource, system, or program is presented at the end of the respective deferral-alternative analysis. These analyses are based on the assumption that economically recoverable oil is leased, discovered, and developed and produced in the proposed deferred area. The hypothetical scenario for these assumptions includes (1) discovering a field that contains an economically recoverable amount of oil; (2) drilling at least one exploration well and two or three delineation wells; (3) installing a production platform and drilling the production and service wells; (4) laying a pipeline to transport the oil from the platform to an onshore pump station (at or near Point Belcher) and then onto TAP; and (5) once during the production life of the field, spilling a quantity of oil that is greater than 1,000 bbl.

1. **Effects on Water Quality:** Alternative IV would not significantly reduce the oil resource, number of wells, number of platforms, number of causeways, or the amount of pipeline estimated for exploration and development and production; therefore, this alternative does not significantly reduce the level of effects on water quality for any of the agents discussed in Section IV.C.1. There would be some local lessening of pollution risks within the deferred area from construction and local, deliberate (permitted) discharges. Oil-spill risk to the deferred area is mostly from spills outside the deferred area.

**CONCLUSION:** The effects of Alternative IV are expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality, the same as for the base case.

**Deferred-Area Analysis:** An oil spill in winter in the lead system within the deferred area--because of the presence of the lead system and Barrow Canyon--is the only location within the sale area where an oil spill could occur and have a significant effect on water quality (see Payne, 1984). A spill in the lead system during a period of rapid ice growth could leach water-soluble aromatics into sinking brine waters. Mixing of brine waters would be restricted by both topography and the high density of the brine. The brine and any dissolved oil could flow down the bottom of the Barrow Canyon farther offshore and form a thin intermediate-density layer at about a 100-m water depth. Stability of the stratified watermass would limit dispersion of the dissolved hydrocarbons and high concentrations of a few ppm, above the acute Federal criterion for hydrocarbons, could be hypothesized to persist for several years. Depending upon the size of

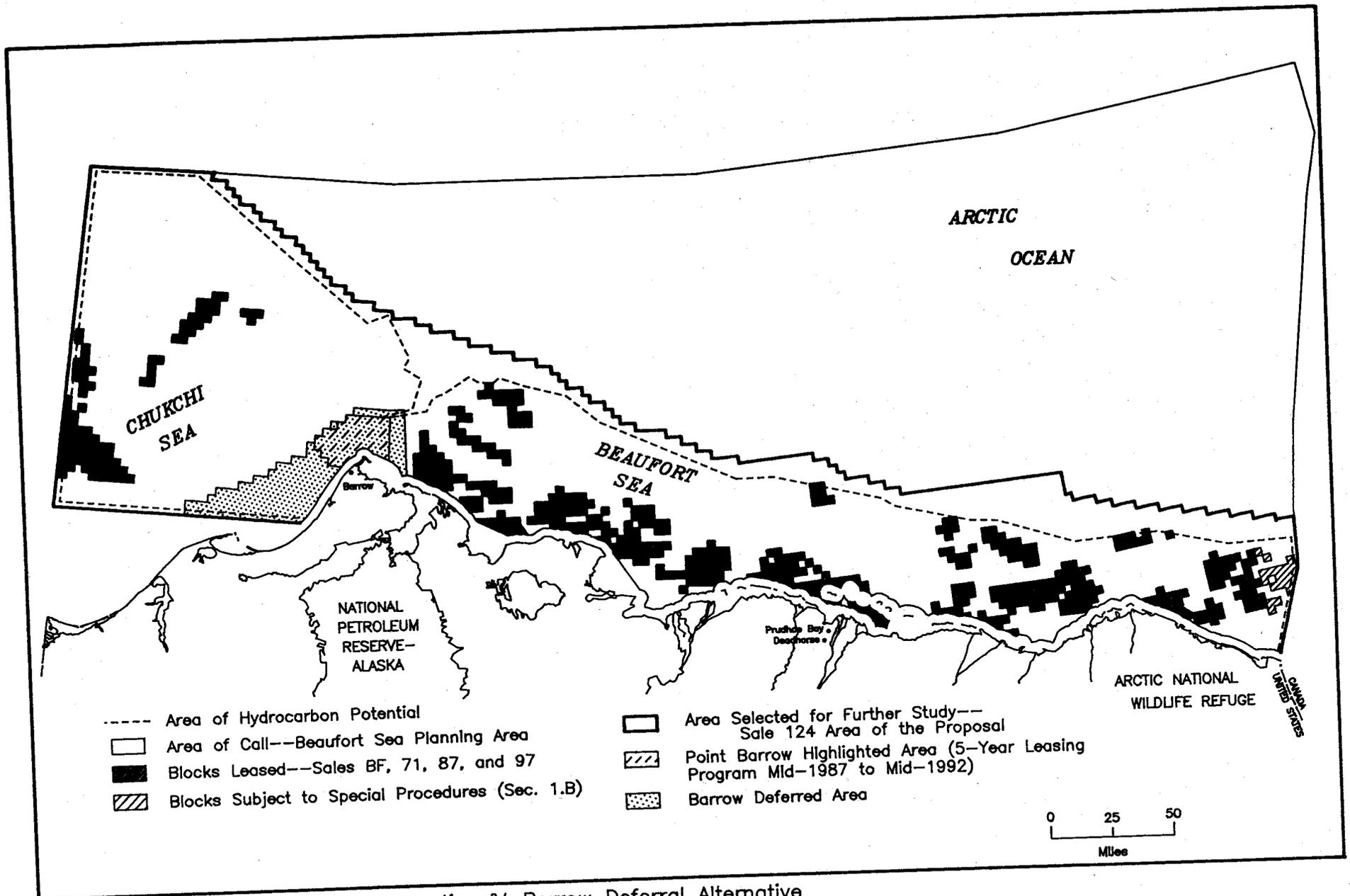


Figure IV-G-1. Map Showing Alternative IV--Barrow Deferral Alternative

the spill, concentrations greater than the chronic criterion of 0.015 ppm could extend in a thin plume over an area greater than 1,000 km<sup>2</sup>.

Exploration discharges of 2,300 metric tons (2,500 English short tons) of drilling muds and 3,000 metric tons (3,300 English short tons) of drill cuttings could occur within the deferred area. Discharge of 20,000 to 30,000 metric tons each of drilling muds and drill cuttings during developmental drilling could occur in the deferred area. Discharge of up to 340 MMbbl of formation water containing up to 27,000 bbl of dissolved hydrocarbons also could occur within the deferred area.

A pipeline to Point Belcher through the sale area and associated construction and causeway effects would occur with or without production within the deferred area: development of portions of the Sale 124 area, outside the deferred area to the west and north and development of Sale 109 leases, would require a pipeline through the deferred area. Turbidity from gathering-pipeline and platform construction for the field within the deferred area would be minor relative to turbidity from the trunk-pipeline construction.

2. **Effects on Lower-Trophic-Level Organisms:** The lower-trophic-level organisms of greatest concern in the Barrow Deferral Alternative--Alternative IV--area due to their abundance or trophic relationships include: (1) planktonic and epontic communities, with special emphasis on primary production and trophic linkages; (2) the abundant epibenthic invertebrates in nearshore waters that are fed on extensively by anadromous and some marine fishes; and (3) the Stefansson Sound Boulder Patch, an apparently unique, kelp-dominated community.

These marine plants and invertebrates are most likely to be adversely affected by oil spills, but the Boulder Patch community also could be vulnerable to effects from drilling discharges and construction activities. However, these latter effects are highly unlikely to occur under either the base case or this deferral alternative because available lease tracts are situated far from the Boulder Patch community. Therefore, deferring the area of Alternative IV is not expected to have any effect on the Boulder Patch community.

Planktonic and epontic communities are widespread in the Alternative IV area, and no single target or specific set of targets identifies areas of concern. The broad distributions of these organisms, in general, make them less vulnerable to severe effects from oil spills. However, the deferred area would include an area of high biomass north and east of Pt. Barrow-Plover Islands where, in the summer, more productive Chukchi water mixes with Beaufort Sea waters. This area coincides with part of the Seabird-Feeding Area (SBA) depicted in Fig. IV-G-4-1 and, according to the analysis in that section (IV.G.4), this alternative does not significantly reduce the risk of spill effects to that area.

For epibenthic invertebrates in nearshore waters, this deferral alternative offers no real advantages, as the combined probability of a spill of 1,000 bbl or greater occurring and contacting land within 10 days in the open-water season does not change from that associated with the base case.

The Stefansson Sound Boulder Patch is best approximated by Land Segment 36; and here as well, combined probabilities do not change relative to the base case.

Alternative IV, the Barrow Deferral Alternative, would not significantly alter the probability of oil spills occurring and contacting marine plants and invertebrates of greatest concern. The expected effect of oil spills on these organisms is viewed to be the same as for the base case, LOW, although HIGH effects are possible for the Stefansson Sound Boulder Patch if it were contacted by oil. Effects from other oil-associated activities should not be appreciably affected by this deferral alternative.

**CONCLUSION:** The level of effects for Alternative IV is expected to be the same as for the base case--LOW.

**Deferred-Area Analysis:** The presence of petroleum exploration, development and production, and transportation facilities in the proposed Barrow Deferred Area could pose a threat to the planktonic, epontic, and benthic communities of this area. These communities are most susceptible to the adverse effects from an oil spill. Contact with spilled oil would result in sublethal to lethal effects on these organisms. However, the widespread distribution of lower-trophic organisms in the planning area precludes destroying a significant part of any of the populations. Discharges from offshore drilling (muds and cuttings) and construction activities are assessed as having limited areal extent and therefore limited effects on the planktonic, epontic, and benthic communities.

3. Effects on Fishes: The fish species of greatest concern in the Alternative IV area are the anadromous fishes that are abundant in the warm, brackish-water nearshore zone during the open-water season and the abundant and trophically important marine species, the arctic cod. The location of oil spills is the factor associated with oil exploration and development and production that is most likely to affect fishes and yet is most likely to be affected by the deferral alternatives.

Anadromous fishes are most likely to be affected in the nearshore zone. Within this zone, the river deltas are viewed as being the most sensitive and important habitat. This deferral alternative does not change, relative to the base case, the probability of an oil spill of 1,000 bbl and greater occurring and contacting land during the open-water season within 10 days. Thus, this deferral alternative offers no advantage to anadromous fishes.

The arctic cod is a marine species with a very widespread and patchy distribution. At times, it can be very abundant in nearshore waters. As mentioned above, this deferral alternative does not change the probability of oil contacting land. Thus, this deferral alternative probably would not significantly alter effects on arctic cod as compared to the base case.

Capelin may be vulnerable to oil spills in nearshore waters as they come into coastal areas to spawn in July and August. Capelin are not abundant in the Alternative IV area. Because the probability of oil contacting land is not reduced, this deferral alternative offers no advantage to capelin.

Alternative IV, the Barrow Deferral Alternative, would insignificantly affect the probability of oil spills occurring and contacting fishes of greatest concern. Thus, the level of effect from oil spills is expected to be the same as for the base case, MODERATE, although HIGH effects are unlikely but possible for anadromous species and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. Effects from other oil-associated activities should not be appreciably affected by this deferral alternative.

CONCLUSION: The level of effects under Alternative IV is expected to be the same as for the base case--MODERATE.

Deferred-Area Analysis: The presence of petroleum exploration, development and production, and transportation facilities in the proposed Barrow Deferred Area could pose a threat to the comparatively few in number but nonetheless significant fisheries resources of this area. Also, the fish are present in the area only during certain periods of the year. The major fish species that might be affected are the arctic cod; arctic cisco; arctic char; broad whitefish; and, to a lesser extent, the smaller and less-important population of capelin. The primary potential adverse effects to fishes are expected from oil spills which may affect fish by (1) disrupting their movements, (2) having toxic effects on their pelagic and benthic macro-organism food supplies, and (3) causing sublethal to lethal effects. To some extent, these fish species concentrate in schools in limited nearshore areas during some periods of the year. These concentrations in limited areas make contact by an oil spill more damaging to the populations. Effects from drilling discharges and from seismic surveys are assessed as having limited areal extent and therefore limited effects on arctic fishes and their habitats.

4. Effects on Marine and Coastal Birds: This alternative would defer all exploration activities associated with the two exploration platforms within most of the high-density SBA near Point Barrow. If development were to occur in the Barrow Deferral Alternative area and an oil spill were to occur near or within the deferred area at or near Spill Site L-27, which is located about 10 mi northwest of Point Barrow (Fig. IV-A-1-1), there is a 28-percent risk of the spill contacting and spreading over a sizable portion of the important SBA located north and west of Point Barrow. There is a 15-percent risk of the spill spreading into Elson Lagoon (Coastal Bird Concentration Area No. 2), an important habitat for several thousand waterfowl and shorebirds (Fig. IV-A-1-1 and Appendix G, Table G-9). These conditional probabilities (conditional means to assume the condition that the spill occurs at a particular location (Spill Site L-27), when compared with the combined probabilities (combined means the overall probability of a spill occurring at several different locations and includes spill rates based on oil-resource estimates), represent a primary source of the combined oil-spill risk to these important marine- and coastal-bird areas.

However, if an oil spill occurred within the proposed sale area but outside and east of the deferred area at Spill Sites L-29, L-30, or L-31 (Fig. IV-A-1-1 and Appendix G, Tables G-9 and G-17), there is an equivalently

high (31 and 25% for the SBA and 16 and 11% for Elson Lagoon Coastal-Concentration Area No. 2) risk of oil-spill contact to these important habitats. This risk also is reflected in the combined probabilities of spills contacting the SBA as shown in Figure IV-C-4-1. Additionally, there is the risk of a spill contacting other important bird habitats such as Simpson Lagoon (Coastal-Concentration Area No. 3) with conditional-contact probabilities of 13 and 56 percent from Spill Sites L-30 and L-31, respectively (Appendix G, Tables G-9 and G-17, Lagoon Area No. 3).

Thus, this alternative does not significantly reduce the overall risks of spill effects on marine and coastal birds neither within the area of the deferral alternative nor the Barrow Deferred Area. An oil spill occurring east of the deferred area would have about the same chance of contacting and affecting important marine- and coastal-bird concentrations as an oil spill occurring within the deferred area. Under this alternative, potential noise and disturbance effects on birds nesting on the Plover Islands and in the Peard Bay area could be avoided or greatly reduced; and bird-habitat alterations due to pipeline construction could be reduced, particularly near Barrow and adjacent to Elson Lagoon. However, birds and their habitats east of Elson Lagoon still would be affected by noise and disturbance and habitat alterations similarly as they would be affected by noise and disturbance and habitat alterations resulting from the base case.

The same transportation scenario used for the base case is assumed for the Barrow Deferral Alternative. Therefore, onshore and coastal-habitat effects on birds from pipelines and associated construction activities would be the same as the effects of the base case.

**CONCLUSION:** The effects of this alternative on marine and coastal birds are expected to be MODERATE, the same level of effect as that for the base case.

**Deferred-Area Analysis:** If development were to occur in the Barrow Deferred Area and an oil spill occurred within the deferred area at Spill Site L-27 (Fig. IV-G-4-1), there is a comparatively high (28%) risk of the spill contacting and spreading over a sizable portion of the important SBA located north and west of Point Barrow and a moderate (15%) risk of the spill spreading into Elson Lagoon (Coastal-Concentration Area No. 2), an important habitat for several thousand waterfowl and shorebirds. Such a spill could result in the death of several hundred to several thousand abundant sea ducks such as oldsquaw and common eider, while less abundant species such as black guillemots and yellow-billed loons are likely to suffer low mortality. Bird populations probably would recover within one generation. Aircraft noise and disturbance of birds nesting on the Plover Islands and feeding in Peard Bay and Elson Lagoon could occur. Some local habitat alteration due to pipeline construction could occur, particularly near Barrow and adjacent to Elson Lagoon. Noise and disturbance from aircraft as well as from supply boats is expected to be brief and have no long-term effect on bird distribution or abundance.

5. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** If development occurred in the Barrow Deferral Alternative area and the oil spill projected for the base case were to occur near or within the deferred area at or near Spill Site L-27, which is located about 10 mi northeast of Point Barrow (Fig. IV-A-1-1), there is a 33-percent risk of the spill contacting and spreading over a sizable portion of the important belukha whale and pinniped Spring-Migration Area (SMA) located north and west of Point Barrow. There are 28- to 31-percent risks of the spill spreading into the pack-ice front (Ice/Sea Segments 1 and 3), an important habitat for tens of thousands of walruses, ringed and bearded seals, and polar bears from Spill Sites L-26 and L-27, the former located southwest of Point Barrow (Fig. IV-A-1-1). However, if an oil spill occurred within the proposed sale area but outside and east of the deferred area at Spill Site L-28 or L-29 (Fig. IV-A-1-1 and Appendix G, Table G-3), there is an equivalently high (34 and 45% for ice-front habitats north and west of Barrow [Ice/Sea Segments 1 and 3, Appendix G, Tables G-3 and G-15]) risk of oil-spill contact to these important seal, walrus, and polar bear habitats. There also is the risk of a spill contacting other important ice-front habitats such as offshore of Elson Lagoon (Ice/Sea Segment 4, Fig. IV-C-5-1), with conditional contact probabilities of 19 and 46 percent from Spill Sites L-28 and L-29, respectively (Fig. IV-A-1-1 and Appendix G, Tables G-3 and G-15).

Thus, this alternative does not greatly reduce the overall risk of oil-spill effects on pinnipeds, polar bears, and belukha whales neither within the area of the deferral alternative nor the Barrow Deferred Area. An oil spill occurring east of the deferred area would have about the same chance of contacting and affecting important pinniped, polar bear, and belukha whale-concentration areas as an oil spill occurring within the deferred area.

Noise and disturbance from air and boat traffic and habitat alterations from oil-related industrial activities

could be noticeably reduced locally in the Point Barrow-Elson Lagoon areas because no drill platforms would occur near these habitats and oil activities would be less likely to interfere with subsistence-hunting activities in the Point Barrow area. However, the combined effects of potential oil spills, noise and disturbance, and habitat alterations on marine mammals occurring east of Point Barrow-Plover Islands would not be appreciably reduced from the effects discussed for the base case.

**CONCLUSION:** The effects of this alternative are expected to be MODERATE on pinnipeds, MODERATE on polar bears, and LOW on belukha whales (the same level of effect as that of the base case).

**Deferred-Area Analysis:** If development were to occur in the Barrow Deferred Area and an oil spill occurred within the deferred area at Spill Site L-27 (Fig. IV-A-1-1), there is a 33-percent risk of the spill contacting and spreading over a sizable portion of the important belukha whale and pinniped SMA located north and west of Point Barrow (Appendix G, Tables G-3 and G-15). There are 20- to 28-percent risks of the spill spreading into part of the pack-ice front, an important habitat for tens of thousands of walruses, ringed and bearded seals, and polar bears. Several hundred to several thousand seals and walruses might come in contact with the oil spill and several hundred or more highly contaminated young seals and walrus calves could die from toxic-hydrocarbon inhalation and absorption through the skin. Such losses are likely to be replaced within one generation (a MODERATE effect).

Noise and disturbance from air and boat traffic and habitat alterations from oil-related industrial activities in the Point Barrow-Elson Lagoon areas could have local effects on seals, walruses, polar bears, and belukha whales.

6. **Effects on Endangered and Threatened Species:** The Barrow Deferral Alternative would defer from petroleum exploration and development/and production the coastal spring and fall bowhead whale-migration corridor from 71° N. latitude in the Chukchi Sea (just north of Peard Bay) north and east to about 22 km east of Point Barrow. Also, the primary gray whale-habitat area is located within the Barrow Deferred Area.

For this deferral alternative, the risk of spilled oil contacting endangered whale habitat would not be reduced substantially. With the alternative, if an oil spill were to occur during the winter season, the highest probability of oil contacting the Bowhead Spring-Migration-Corridors A and B and Bowhead Migration Areas A and B would remain the same as for the base case (Table G-15). By eliminating Spill Site L-26, which is located within the deferred area, the Gray Whale Area would realize a reduction in oil-spill-contact risk for the alternative during the month of October from 25 percent to less than 0.5 percent (Table G-3). The situation is similar for the summer period. With the alternative, bowhead whale environmental-resource areas would realize no significant reduction in contact probability, but the highest contact probability for the Gray Whale Area would be reduced from 25 percent to 8 percent (Table G-9). Should oil contact a whale-habitat area, the effects would be the same as analyzed for the base case (Sec. IV.C.6). A number of whales may briefly contact lightly weathered crude oil as a result of a spill. However, the entire population would not likely contact the oil, because the migration would take approximately 2 months to pass through the area; and an oil slick would likely move out of the whale-migration corridor within a few days.

The Barrow Deferral Alternative also would virtually eliminate the potential effects of noise and disturbance --which could be associated with drilling units, postlease geophysical surveys, artificial-island construction, and/or production platforms--to bowhead whales migrating through the deferred area in the spring and fall. Aircraft disturbance may continue to a lesser degree, because support aircraft may overfly the deferred area from Barrow to offshore units in leased portions of the Beaufort or Chukchi Seas. Similarly, vessel disturbance at a low level may occur, as support vessels enroute to offshore units may traverse the deferred area. However, vessel traffic would most often occur during the summer months when bowheads are absent from the deferred area.

Bowheads migrating through leased portions of the alternative area are expected to experience the same effects as analyzed for the base case--exhibiting temporary disturbance or avoidance of aircraft, vessels, seismic surveys, drilling units, dredges, pipeline-laying equipment, and production platforms. Elimination of most petroleum-industry noise in the deferred area through adoption of the alternative would allow the bowhead migration to occur as it has in the past without the concern for whales diverting their migration paths away from noise sources. As a result, with the alternative, few if any adverse effects to migrating or feeding bowhead whales would occur in the area around Barrow.

Overall, the alternative would decrease noise and disturbance effects to bowhead whales (especially during migration). However, considering the potential effects outside the deferred area as well as the oil-spill effects would remain the same as for the base case, the overall effects to the bowhead whale would be the same as for the base case.

In the event of an oil spill, a few gray whales could contact oil. Effects could occur as described for the base case (Sec. IV.C.6). Postlease seismic activity, drilling units, and production platforms would not occur within the gray whale summer-feeding area offshore of Peard Bay, since it is located in the deferred area. As a result, gray whales would not be displaced from this feeding area; neither would they have their habitat altered by OCS activities. A few gray whales occasionally would be startled and perhaps temporarily displaced by aircraft and vessel operations in the nondeferred area, but this should not result in a significant adverse effect on the population. Because most gray whales found within the Beaufort Sea Planning Area occur within this deferred area, the alternative would offer these whales considerable protection; and the effect of the proposed sale on the gray whale population is expected to be reduced--lowering the expected effects from LOW (base case) to VERY LOW.

Potential effects on the peregrine falcon would remain the same as for the base case.

**CONCLUSION:** The effects of this alternative on endangered and threatened species are expected to be MODERATE on bowhead whales and VERY LOW on gray whales and arctic peregrine falcons.

**Deferred-Area Analysis:** Exploration and development and production activities in the deferred area could result in adverse effects from oil spills and noise and disturbance on bowhead and gray whales in the area near Barrow. In the event of an oil spill occurring at Spill Site L-26 (located within the deferred area), the risk of contacting the Bowhead Spring-Migration-Corridor A during the winter and spring months would be 29 percent and the risk of contacting the Gray Whale Area during October would be 25 percent (Table G-3). There also would be a 29-percent risk that a spill that occurred at Spill Site L-26 during the summer months would contact the Gray Whale Area within 30 days (Table G-9). Noise and disturbance from exploration units and production platforms and aircraft could affect the timing and location of the bowhead migration within the deferred area. Noise from exploration units, production platforms, vessels, aircraft, dredging, and pipeline laying could affect summering gray whales.

7. **Effects on Caribou:** If development were to occur in the Barrow Deferral Alternative area, the same onshore-development scenario is expected to occur as that described for the base case. Pitt Point and Point Thomson would be the landfalls for the pipelines connecting to TAP, with the same pipeline-road corridors being constructed under this alternative. Thus, the effects of onshore-construction activities--vehicle-traffic disturbance of caribou and habitat alteration along the pipeline-road--are expected to be the same as described for the base case (see Sec. IV-C-7).

The deferral of blocks in the Point Barrow-Elson Lagoon area would not reduce the potential oil-spill effects of the base case on caribou, because caribou of the Western Arctic herd (WAH) and of the Teshekpuk Lake herd do not normally use Point Barrow or the Plover Islands (adjacent to the Barrow Deferral tracts) as insect-relief areas. Spill risks to other insect-relief habitats are expected to be the same as for the base case. This alternative also is assumed to include the same onshore-pipeline and transportation systems as the base case; thus, potential onshore disturbance and habitat effects on caribou are expected to be MODERATE, the same as the effect of the base case.

**CONCLUSION:** This alternative is expected to have MODERATE effects on caribou, the same level of effects expected for the base case for Alternative I.

**Deferred-Area Analysis:** If development were to occur in the Barrow Deferred Area, the onshore-development scenario with a pipeline landfall at Point Belcher described for the high case under Alternative I is assumed to occur. Onshore-construction activities--vehicle traffic and habitat alteration along the pipeline-road from Point Belcher to TAP--would occur on the summer range of the WAH. This development is expected to have a short-term (1-2 year), local effect on caribou of the WAH. This herd could be adversely affected if an oil spill contaminated coastal areas near Point Belcher; however, most caribou of the WAH use upland insect-relief areas and thus would not be exposed to the spill.

8. **Effects on the Economy of the North Slope Borough:** The effect of this alternative is

expected to be the same as for the base case. Due to the projected declines in Borough revenues and in resident employment, the economic effects of the base case are not expected to put undue pressure on the economic system. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though they would be less than 10 percent of the projected no-sale conditions.

**CONCLUSION:** The economic effects of this alternative on the NSB are expected to be MODERATE, the same as for the base case for Alternative I.

**Deferred-Area Analysis:** Assuming that economically recoverable oil is leased, discovered, and developed and produced in the proposed deferred area, the effects on the economy of the NSB would be the same as those described for the base case. Due to the projected declines in Borough revenues and in resident employment, the economic effects of activity in the deferred area are not expected to put undue pressure on the economic system. Most of the new, sale-related employment would be filled by commuters from outside the region. Some employment gains would be made by North Slope residents, though they would be less than 10 percent of the projected no-sale conditions.

**9. Effects on Sociocultural Systems:** Alternative IV would not alter the onshore industrial activities and population and employment projections for this sale because the resource estimate for this alternative is the same as for the base case, and the effects on subsistence-harvest patterns would be the same as for the base case (see Sec. IV.G.10). Consequently, the effects of this alternative on sociocultural systems would be the same as for the base case--MODERATE.

**CONCLUSION:** The effects of the Barrow Deferral Alternative on sociocultural systems are expected to be the same as for the base case--MODERATE.

**Deferred-Area Analysis:** Development and production within the deferred area would not alter the onshore industrial activities, population and employment projections, or the regional effects on subsistence-harvest patterns.

**10. Effects on Subsistence-Harvest Patterns:** Effects on subsistence harvests from the proposed lease sale are expected to be the result of oil spills; noise and disturbance; and the placement of exploration, development and production, and support facilities. Alternative IV does not reduce the oil resource, number of wells, number of platforms, or the length of pipeline estimated for exploration or for development and production. However, it eliminates the possibility of platforms and all activity from those blocks near Barrow to the northwest.

For this deferral alternative, the conditional probabilities of an oil spill are identical to those for the base case for the Proposal. Development and production in the deferred area would increase the probability that an oil spill would occur and contact the Barrow subsistence-harvest area; however, an increase in probabilities would not increase the level of effect. On the other hand, subsistence activities occur locally and many--such as Barrow whaling, seal and walrus hunting, and spring bird hunting--occur with high frequency in the area near Point Barrow. An oil spill in the midst of this intensive subsistence activity would disrupt subsistence harvests more than an oil spill that might originate in another part of the sale area. An oil spill occurring outside of the immediate Point Barrow area may be in a more weathered state when it reaches Point Barrow than it would be if it occurred in the immediate area surrounding Point Barrow. Thus, even though oil spills would tend to be carried toward Point Barrow because of the region's currents, deferring this area would offer some mitigation from their effects. However, the probability of an oil spill occurring and contacting the Barrow and Atqasuk subsistence-harvest areas would not increase enough under this alternative to change the MODERATE effect of oil spills on Barrow and Atqasuk's bowhead whale harvest expected for the base case in Alternative I.

Noise and disturbance associated with exploration and development and production activities also would affect Barrow's subsistence activities. While this deferral alternative would not substantially change biological effects to regional populations of subsistence species, it would eliminate nearshore tracts in the immediate vicinity of Barrow and thus might offer some mitigation of noise and disturbance to the Barrow and Atqasuk subsistence harvests. Particularly, noise from the construction and operation of exploration and production platforms would be eliminated from an area used intensively by these hunters; but this mitigation would be only partial. Since most of the sale area lies to the east, barge and other maritime-supply traffic would still pass through the open-water areas at Point Barrow. This might be a particular problem in the spring and

fall when these same areas are used for bowhead whaling, although disruption is likely to be short term and temporary. During a year when the weather and ice conditions are poor and the whalers' ability to harvest whales is limited, the noise disruption could occur during the only brief period when harvesting a whale is possible. Such a curtailment of the whaling season for the year due to noise and traffic disturbance associated with Sale 124 would cause the bowhead whale harvest to be disrupted. In Barrow, because there is spring and fall whaling and the whale quota is about 10, it is likely that while the harvest may be reduced, at least some bowheads would be harvested. This alternative virtually would eliminate exploration and development and production activities from the area used by Wainwright's hunters, thus Wainwright's effects from noise and traffic disturbance would be reduced from MODERATE to LOW.

In the base case and the high-case scenarios, Point Belcher is assumed as a landfall. This alternative also includes Point Belcher as a pipeline landfall site, thus, MODERATE effects on Wainwright's subsistence harvests of bowhead and belukha whales and walrus due to construction activities and noise disturbance in Peard Bay still would be expected. Effects on Kaktovik's subsistence-harvest patterns are expected to be the same as for the base case--MODERATE. According to the scenario for the base case, under Alternative IV, a pipeline landfall and possible support facility still will occur at Point Thomson. For this reason, effects on Nuiqsut's subsistence-harvest patterns are expected to be the same as for the base case--HIGH.

**CONCLUSION:** Effects on subsistence-harvest patterns are expected to remain the same as for the base case for Alternative I--MODERATE--in Barrow (Atqasuk), Wainwright, and Kaktovik; HIGH in Nuiqsut, and HIGH for the region.

**Deferred-Area Analysis:** For the deferred area, development and production would increase the probability that an oil spill would occur and contact subsistence-harvest areas; however, an increase in probabilities would not increase the level of effects. On the other hand, subsistence activities occur locally, and many--such as Barrow whaling, seal and walrus hunting, and spring bird hunting--occur with high frequency in the area near Point Barrow. An oil spill in the midst of this intensive subsistence activity would disrupt subsistence harvests more than an oil spill that might originate in another part of the sale area. An oil spill outside of the immediate Point Barrow area may be in a more weathered state than it would be if it were in the immediate area surrounding Point Barrow. Thus, even though oil spills would tend to be carried toward Point Barrow because of the region's currents, deferring this area would offer some mitigation from their effects.

Noise and disturbance in the deferred area would affect Barrow's subsistence activities. While this deferral alternative would not substantially change biological effects to regional populations of subsistence species, exploration and development and production disturbance in the immediate nearshore tracts in the immediate vicinity of Barrow could disrupt Barrow subsistence harvests. Of particular concern would be noise from the construction and operation of exploration and production platforms in an area used intensively by Barrow hunters. As for Alternative I in the base case, barge and other maritime-supply traffic would pass through the open-water areas at Point Barrow. This might be a particular problem for Barrow and Wainwright whalers in the spring and fall when the open-water areas are used for bowhead whaling, if such traffic caused the harvest to become unavailable. Construction activities associated with a landfall at Point Belcher would affect Wainwright's bowhead and belukha whale and walrus harvests, causing these harvests to become unavailable or substantially decreased for a year or more.

**11. Effects on Archaeological Resources:** The Barrow Deferral Alternative is expected to reduce the effects of the base case from LOW to VERY LOW by reducing oil and gas activity north and west of Barrow (near OSRA Segment 20). Under this deferral alternative, leasing would be prevented on the deferred blocks. The reduction of effects would result from a stoppage of exploration and development and production on the deferred blocks.

**CONCLUSION:** The effects of the Barrow Deferral Alternative, Alternative IV, are expected to reduce the effects on archaeological resources from LOW for the base case for Alternative I to VERY LOW.

**Deferred-Area Analysis:** If leased, the deferred area could produce an unknown quantity of economically recoverable oil. Activity while exploring and producing such oil could affect archaeological resources offshore and onshore southwest of Barrow and as far southwest as Point Belcher. Such disturbance would be modest, given the known archaeological resources and the probability of their survival (see Mitigating Measures, Sec. II.G.2).

12. **Effects on Air Quality:** The exploration and development and production scenario for the Barrow Deferral Alternative is nearly the same as for the base case. The only difference is that an area along the coast of the Beaufort and Chukchi Seas immediately adjacent to Point Barrow would not be leased. This would not affect the locations of activities under the scenario; and, consequently, the effect on air quality is expected to be LOW (see Sec. IV.B.12).

**CONCLUSION:** Effects on air quality for this alternative are expected to be LOW, as for the base case.

**Deferred-Area Analysis:** The effects of exploration on air quality would be similar to those for the base case in the event blocks in the deferred area could be leased. Exploration would remain scattered beyond approximately 19 km (12 mi) offshore within the deferred area with very diffuse concentrations of air pollutants at the shoreline. Development and production could introduce a production platform into the deferred area. The effect on air quality would depend on the distance of the platform from shore. With respect to air-quality standards, the exemption levels for NO<sub>2</sub> and VOC could be exceeded if the platform were within 21 km (13 mi) of shore, but the significance-concentration criteria for these pollutants would not be exceeded. Onshore effects of other emissions, including acidification of vegetation and smoke from fires, would be short term and local.

13. **Effects on Land Use Plans and Coastal Management Programs:** Although the Barrow Deferral Alternative reduces potential negative effects in that area for many resources and for subsistence, effect levels are expected to be reduced only for archaeological resources. The development and transportation scenario also remains the same. As a result, land use changes and potential conflicts with the NSB Land Management Regulations and the Statewide standards and NSB district policies of the ACMP would remain the same.

**CONCLUSION:** For Alternative IV, the effects of potential conflicts with land use plans and coastal management programs are expected to be HIGH--the same as for the base case for Alternative I.

**Deferred-Area Analysis:** Most resources would experience effects similar to those of the base case if activities were to occur within the area deferred by this alternative. The only exception would be for fishes and lower-trophic-level organisms, which would experience lower potential effects with respect to activities in the deferred area. Subsistence effects also remain similar to the base case, although some reduction in conflict could occur because oil entering the subsistence area from a spill outside the deferral area would be in a more weathered state. As a result, potential conflicts with Statewide standards and NSB policies on subsistence and energy-facility siting would be less in this area.

#### **IV.H. Alternative V--Barter Island Deferral Alternative**

Alternative IV, the Barter Island Deferral Alternative, would offer for leasing 3,952 blocks (Fig. IV-H-1); this is 143 blocks--about 290,000 ha--smaller in size than the area of Alternative I. The deleted blocks, located between Barter Island and the Canadian border (Fig. I-1), comprise the Barter Island Deferred Area. The MMS estimate of the amount of oil that would be leased, discovered, and developed and produced in the area defined by the Barter Island Deferral Alternative is 900 MMbbl (Appendices A and B)--the same as for the base case for Alternative I. This estimate is a result of the very low probability assigned for the occurrence of petroleum in the deferred area. However, because of the uncertainty involved in making resource estimates for frontier areas, there remains a very small probability that the deferred area contains petroleum. The types and levels of activities associated with the resource estimate for Alternative V include (1) drilling of 14 exploration and delineation wells (1992-1996), (2) installing 4 production platforms (1997-1999) and drilling 120 production and service wells (1997-2000), (3) installing 275 mi of offshore pipeline and 325 mi of onshore pipeline (1997-1999), and (4) producing 900 MMbbl of oil (2000-2018). A more detailed discussion of the types and levels of activities associated with the scenario for Alternative IV is presented in Section II.B.2.a.

The blocks comprising the Barter Island Deferred Area contain, at various times, significant biological resources and hold important cultural values for the Natives who inhabit the nearby areas. Bowhead whales use this area as part of the fall-migration route and for feeding. The Inupiat residents of Kaktovik use the area to hunt bowheads--as well as polar bears, ringed seals, and migratory birds--for subsistence purposes.

**Deferred-Area Assumptions and Scenario:** Areas deleted from the sale area would experience a reduction or elimination of effects from petroleum exploration and development and production activities that might occur as a result of the lease sale. To indicate the types of effects that would be avoided in an area deleted from a lease sale, the effects of petroleum exploitation in the proposed deferred area on each of the major environmental resources, social systems, or programs analyzed for the deferral alternative also are analyzed for the deferred area and are presented at the end of the respective deferral-alternative analysis. These analyses are based on the assumption that economically recoverable oil is leased, discovered, and developed and produced in the deferred area. The hypothetical scenario for these assumptions includes (1) discovering a field that contains an economically recoverable amount of oil; (2) drilling at least one exploration well and two or three delineation wells; (3) installing a production platform and drilling the production and service wells; (4) laying a pipeline to transport the oil from the platform to a landfall at or in the vicinity of Point Thomson and then onto TAP; and (5) once during the production life of the field, spilling a quantity of oil that is greater than 1,000 bbl.

1. **Effects on Water Quality:** Alternative V would not significantly reduce the projected oil spillage or level of effects on water quality for any of the agents discussed in Section IV.C.1. There would be less likelihood of pollution from artificial-island construction or removal and local, deliberate (permitted) discharges near Barter Island. A causeway would still be needed to move oil ashore at Point Thomson. This alternative would lessen the slight risk of spills occurring or contacting waters of the deferred area because of the westward movement of spills across the sale area.

**CONCLUSION:** The levels of effect for Alternative V are expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality--the same levels of effect expected for the base case.

**Deferred-Area Analysis:** A spill from development within the deferred area would pose most of the spill risk to water quality in the deferred area. Spills occurring to the north or west of the deferred area would tend to move away from the deferred area. The following discharges could occur within the deferred area: (1) 2,300 metric tons (2,500 English short tons) of drilling muds and 3,000 metric tons (3,300 English short tons) of drill cuttings from exploration drilling, (2) 20,000 to 30,000 metric tons each of drilling muds and cuttings during developmental drilling, and (3) up to 340 MMbbl of formation water containing up to 27,000 bbl of dissolved hydrocarbons.

A trunk pipeline to Point Thomson through the deferred area would be needed for development of portions of the Sale 124, Sale 87, and Sale 97 leases outside the deferred area to the east and north and also for development of Sale 87 and Sale 97 inholdings within the perimeter of the deferred area. The gathering-pipeline and platform construction necessary for development within the deferred area would add only a

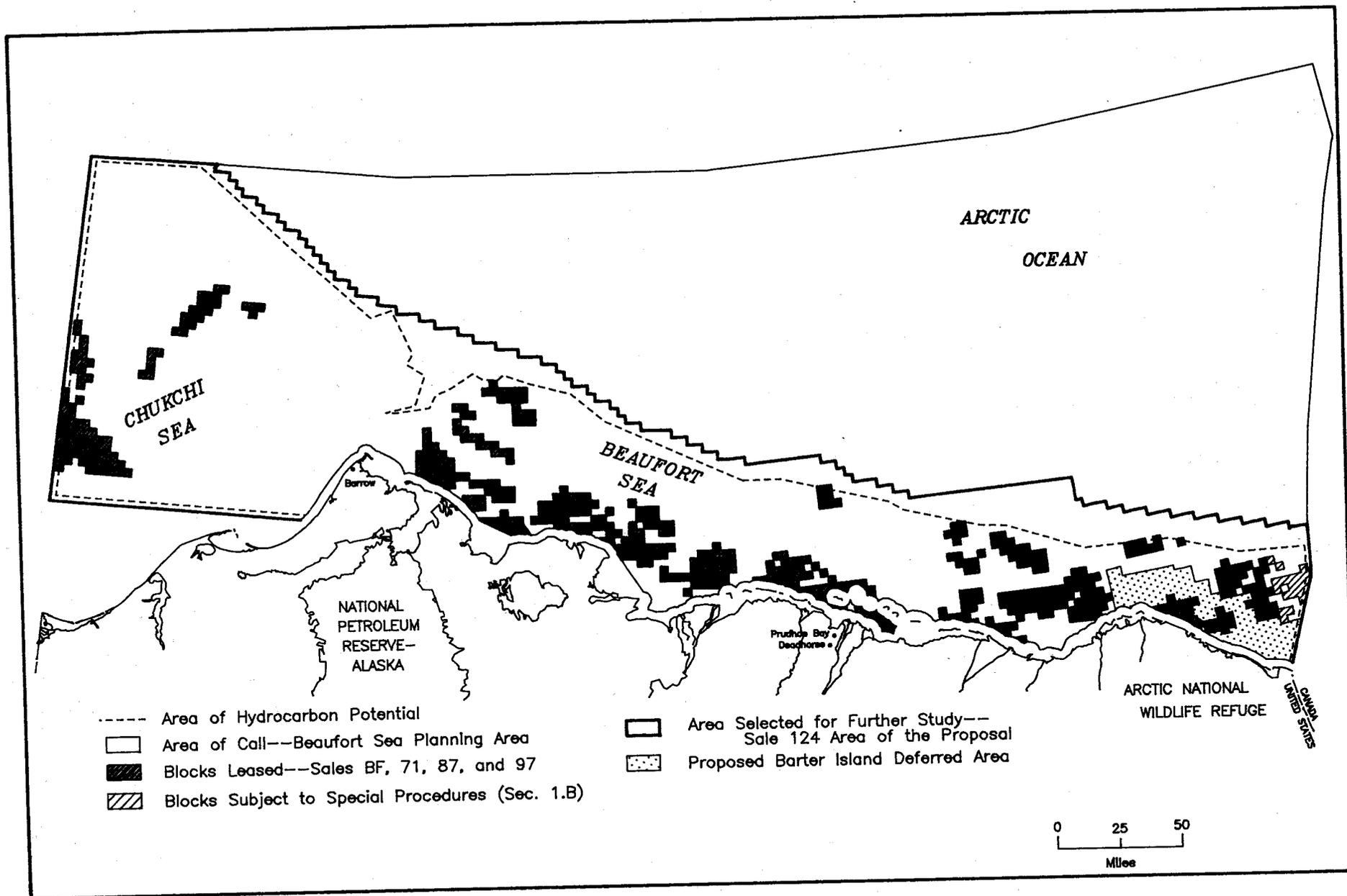


Figure IV-H-1. Alternative V--Barter Island Deferral Alternative

slight amount of additional turbidity to that occurring from construction of the trunk pipeline.

2. **Effects on Lower-Trophic-Level Organisms:** The lower-trophic-level organisms of greatest concern in the Alternative V area due to their abundance or trophic relationships include: (1) the planktonic and epontic communities, with special emphasis on primary production and trophic linkages; (2) the abundant epibenthic invertebrates in nearshore waters that are fed on extensively by anadromous and some marine fishes; and (3) the Stefansson Sound Boulder Patch, an apparently unique, kelp-dominated community.

These marine plants and invertebrates are most likely to be adversely affected by oil spills, but the Boulder Patch community also could be vulnerable to effects from drilling discharges and construction activities. However, these latter effects are highly unlikely to occur under either the base case or this deferral alternative because available lease tracts are situated far from the Boulder Patch community. Therefore, deferring the area of Alternative V is not expected to have any effect on the Boulder Patch community.

Planktonic and epontic communities are widespread in the Alternative V area, and no single target or specific set of targets identifies areas of concern. In general, the broad distributions of these organisms make them less vulnerable to severe effects from oil spills. For epibenthic invertebrates in nearshore waters, this deferral alternative offers no advantage, as the combined probability of a spill of 1,000 bbl or greater occurring and contacting land within 10 days in the open-water season does not change from that associated with the base case.

The Stefansson Sound Boulder Patch is best approximated by Land Segment 36, for which combined probabilities do not change relative to the base case. For other marine plants and invertebrates of concern, the alternative does not change effects significantly. The expected effect of oil spills is viewed to be the same as under the base case, LOW, although HIGH effects are possible for the Stefansson Sound Boulder Patch if it were contacted by oil. Effects from other oil-associated activities should not be appreciably affected by this deferral alternative.

**CONCLUSION:** The level of effects of Alternative V is expected to be the same as for the base case--LOW.

**Deferred-Area Analysis:** The presence of petroleum exploration, development and production, and transportation facilities in the proposed Barter Island Deferred Area could pose a threat to the planktonic, epontic, and benthic communities of this area. These communities are most susceptible to the adverse effects from an oil spill. Contact with spilled oil would result in sublethal to lethal effects on these organisms. However, the widespread distribution of lower-trophic organisms in the planning area precludes destroying a significant part of any of the populations. Discharges from offshore drilling (muds and cuttings) and construction activities are assessed as having limited areal extent and therefore limited effects on the planktonic, epontic, and benthic communities.

3. **Effects on Fishes:** The fish species of greatest concern in the Alternative V area are the anadromous fishes that are abundant in the warm, brackish-water nearshore zone during the open-water season and an abundant and trophically important marine species, the arctic cod. The location of oil spills is the factor associated with oil exploration and development and production that is likely to affect fishes and yet is likely to be affected by this deferral alternative.

Anadromous fishes are most likely to be affected in the nearshore zone. Within this zone, the river deltas are viewed as being the most sensitive and important habitat. With this deferral alternative, the probability of an oil spill of 1,000 bbl and greater occurring and contacting land during the open-water season within 10 days does not change from the base case. Thus, this deferral alternative offers no appreciable advantage to anadromous fishes.

The arctic cod is a marine species with a very widespread and patchy distribution. At times, it can be very abundant in nearshore waters. As mentioned above, this deferral alternative does not change the probability of oil contacting land. Figures for the open-water season are given above. For the entire winter season, probabilities also do not change from the base case. Given the patchy and unpredictable distribution of the cod, this deferral alternative most probably would not significantly alter effects on arctic cod as compared to the base case.

Although capelin are not abundant in the Alternative V area, they may be vulnerable to oil spills when they

come into coastal areas to spawn in July and August. Since the probability of oil contacting land under this deferral alternative does not decline relative to the base case, the risks to capelin would not apparently be reduced. Alternative V, the Barter Island Deferral Alternative, would not reduce the probability of oil spills occurring and contacting fishes of greatest concern. Therefore, the level of effect is expected to be the same as for the base case, MODERATE, although HIGH effects are possible for anadromous species and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. Effects from other oil-associated activities should not be appreciably affected by this deferral alternative.

**CONCLUSION:** The level of effects under Alternative V is expected to be the same as for the base case--MODERATE.

**Deferred-Area Analysis:** The presence of petroleum exploration, development and production, and transportation facilities in the proposed Barter Island Deferred Area could pose a threat to the comparatively few in number but nonetheless significant fisheries resources of this area. Also, the fish are present in the area only during certain periods of the year. The major fish species that might be affected are the arctic cod; arctic cisco; arctic char; broad whitefish; and, to a lesser extent, the smaller and less-important population of capelin. The primary potential adverse effects to fishes could come from causeways, which can alter migrations and habitats. Oil spills also may affect fish by (1) disrupting their movements, (2) having toxic effects on their pelagic and benthic macro-organism food supplies, and (3) causing sublethal to lethal effects. To some extent, these fish species concentrate in schools in limited nearshore areas during some periods of the year. These concentrations in limited areas make contact by an oil spill potentially more damaging to the populations. Effects from drilling discharges and from seismic surveys are assessed as having limited areal extent and therefore limited effects on arctic fishes and their habitats.

4. **Effects on Marine and Coastal Birds:** If development occurred in the Barter Island Deferral Area and the oil spill projected for the base case were to occur within the deferred area at Spill Site L-14 located about 10 mi north of Barter Island (Fig. IV-A-1-1), there is a 30-percent risk of the spill contacting and spreading over a sizable portion of Jago Lagoon, an important waterfowl- and shoreline-habitat area located adjacent to Barter Island and Kaktovik. Jago Lagoon (Fig. IV-A-1-1, Coastal-Concentration Area 5, Appendix G, Tables G-9 and G-17) is an important habitat for several thousand waterfowl and shorebirds. These conditional probabilities (conditional means to assume the condition that the spill occurs at a particular location--Spill Site L-14), when compared with the combined probability (combined means the overall probability of a spill occurring at several different locations and includes spill rates based on oil-resource estimates), do not represent a primary source of the combined oil-spill risk to other important coastal-concentration areas west of Jago Lagoon and Barter Island (Appendix G, Tables G-9 and G-17). There also are some spill-contact risks to Beaufort and Simpson Lagoons if a spill occurs offshore and east of Kaktovik (Fig. IV-A-1-1 and Appendix G, tables G-9 and G-17).

If the oil spill occurs within the proposed sale area but outside and west of the deferred area at Spill Site L-9 or L-10 (Fig. IV-A-1-1), there are 36-percent and 20-percent risks of an oil spill contacting Simpson Lagoon (Appendix G, Tables G-9 and G-17, Coastal-Concentration Area 3), another important habitat area. This alternative potentially reduces the local risks of oil-spill effects on waterfowl and shorebirds that use Jago Lagoon and other local habitats adjacent inshore of the deferred area. An oil spill occurring west of the deferred area would have about the same chance of contacting Simpson or Elson Lagoons and affecting other important marine- and coastal-bird-concentration areas as an oil spill occurring within the deferred area would have of contacting the Jago Lagoon-Kaktovik area.

This deferral alternative could reduce oil-spill risks and potential oil-spill effects of the base case on bird coastal habitats from Kaktovik east, particularly Jago Lagoon (Fig. IV-C-4-1, Coastal-Concentration Area 5). However, potential oil-spill effects on large numbers of birds (greater than 50/km<sup>2</sup>) in Simpson and Elson Lagoons (Appendix G, Tables G-9 and G-17, Coastal-Concentration Areas 2 and 3) would be about the same as those effects described for the base case (Fig. IV-C-4-1). Oil-spill risks and potential effects on other large numbers of birds using Gwydyr Bay and the SBA north of Point Barrow also would be about the same as for the base case (Fig. IV-C-4-1, SBA and Coastal-Concentration Area 4, and Appendix G, Tables G-9 and G-17).

Assuming for this alternative (as for the base case) that offshore pipelines would be built to support oil development and production in the eastern part of the proposed sale area with Point Thomson as a pipeline landfall, this alternative would not reduce onshore habitat and disturbance effects on marine and coastal birds from those effects described for the base case.

**CONCLUSION:** Effects on marine and coastal birds for this alternative are expected to be MODERATE, the same level of effect as for the base case.

**Deferred-Area Analysis:** If development were to occur in the Barter Island Deferred Area and an oil spill were to occur within the deferred area at either Spill Site L-14 or L-17 (Fig. IV-A-1-1), there are 30-percent and 18-percent risks of the spill contacting and spreading over a sizable portion of Jago Lagoon, an important waterfowl- and shoreline-habitat area located adjacent to Barter Island and Kaktovik. Jago Lagoon is an important habitat for several thousand waterfowl and shorebirds. Thus, exploration and development in the Kaktovik-Barter Island area could have local oil-spill effects on waterfowl and shorebirds that use Jago Lagoon and other local habitats adjacent to the deferred area. If an oil spill occurred in Jago Lagoon, a sizable number of birds (25/km<sup>2</sup>) could be killed. However, abundant bird-species populations are likely to suffer the highest losses; and recovery of the populations is likely to occur within one generation. An offshore pipeline would be laid and trenched in the Kaktovik-Barter Island area to support oil development and production with Point Thomson as the pipeline landfall. Onshore habitat and disturbance effects on marine and coastal birds along the pipeline and road to TAP could occur. These effects are expected to be local and short term for the most part, although some long-term loss is expected to occur along the onshore pipeline and road.

5. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** If development occurred in the Barter Island Deferred Area and the oil spill projected for the base case were to occur within the deferred area at either Spill Site L-14 located about 10 mi north of Barter Island or L-17 located about 60 mi northeast of Barter Island (Fig. IV-A-1-1), there are 25- to 45-percent risks of the spill contacting and spreading over a sizable part of the important ice-front-habitat area (Ice/Sea Segments 8-11, Appendix G, Tables G-3 and G-15) north of the Beaufort Sea coast from Gwydyr Bay to Beaufort Lagoon. The oil spill could spread into the pack-ice front, an important habitat for thousands of ringed and bearded seals and polar bears. These conditional probabilities (conditional means to assume the condition that the spill occurs at a particular location--Spill Site L-14 or L-17), when compared with the combined probability (combined means the overall probability of a spill occurring at several different locations and includes spill rates based on oil-resource estimates), do not represent a primary source of the combined oil-spill risk to other important marine-mammal-habitat areas west of Camden Bay (Ice/Sea Segments 1-8, Appendix G, Tables G-3 to G-15). If the oil spill occurred within the proposed sale area but outside and west of the deferred area at, for example, Spill Site L-10 off Flaxman Island or L-12 in Camden Bay (Appendix G, Table G-3 and G-15, and Fig. IV-A-1-1), there are 19- to 52-percent spill-contact risks from L-10 and 14- to 81-percent spill-contact risks from L-12 to these important habitats. There also is the risk of a spill contacting other important ice-front habitats north of Harrison Bay and Smith Bay (Ice/Sea Segments 5 and 6, Appendix G, Tables G-3 and G-15), with conditional-contact probabilities of 25 to 77 percent from these spill sites. Thus, this alternative does reduce some local risks of oil-spill effects on seals and polar bears within the ice front north and east of Kaktovik from Barter Island to Beaufort Lagoon; but an oil spill occurring west of Barter Island and west of the deferred area would have about the same chance of contacting and affecting other important marine-mammal ice-front habitats as an oil spill occurring within the deferred area.

Noise disturbance from air and marine traffic, construction activities, and habitat alterations from drilling platform and pipeline installation also could be reduced in this area. No additional habitat effects would occur east of Kaktovik and Jago Lagoon. This alternative would eliminate further potential disturbance and oil-spill effects on ringed seals and polar bears and their coastal habitats near Kaktovik eastward to Demarcation Bay as described for the base case (other than potential effects associated with existing Sales 87 and 97 leases in this area). However, potential oil-spill, disturbance, and habitat-alteration effects on walruses, bearded seals, belukha whales, and important marine-mammal habitats west of Kaktovik would not be significantly reduced.

**CONCLUSION:** For this alternative, effects are expected to be MODERATE on pinnipeds and polar bears and LOW on belukha whales, the same level of effects as for the base case.

**Deferred-Area Analysis:** If development were to occur in the Barter Island Deferred Area and an oil spill occurred within the deferred area at either Spill Site L-14 or L-17 (Fig. IV-A-1-1), there is a 25- to 45-percent risk of the spill contacting and spreading over a sizable part of the important ice-front-habitat area north of the Beaufort Sea coast from Gwydyr Bay to Beaufort Lagoon. The oil spill could spread into the pack-ice front, an important habitat for thousands of ringed and bearded seals and polar bears. Several hundred or more seals and some polar bears might come in contact with the oil spill, and several highly contaminated young seals and all polar bears that become contaminated could die from toxic-hydrocarbon

inhalation and absorption through the skin. However, such losses are likely to be replaced within one generation.

Noise disturbance from air and marine traffic and from construction activities as well as habitat alterations from drilling platform and pipeline installation also could occur in the Kaktovik-Barter Island area.

These effects are expected to be local and short-term for the most part, although some long-term habitat loss is expected to occur along the onshore pipeline and road.

6. **Effects on Endangered and Threatened Species:** The Barter Island Deferral Alternative would defer from petroleum exploration and development and production an area east and north of Kaktovik used by bowhead whales for feeding and migration during the late summer and fall. For this alternative, oil-spill risks to bowhead whales would be slightly reduced as compared with the base case. The greatest reduction in oil-spill risk for this alternative would occur for the Bowhead Fall-Feeding-Area B. With the deferred area removed by this alternative, the elimination of spills from Spill Site L-14 (located within the subarea removed by the deferral) would reduce the highest probability of contact with the Bowhead Fall-Feeding-Area B within 30 days following a summer spill from 41 percent to 33 percent (Appendix G, Table G-9). The Bowhead Migration-Area B and Spring Bowhead Migration-Corridor B might realize a slight reduction in oil-spill-contact probability as a result of this alternative; however, these environmental-resource areas have greater contact probabilities from spill sites outside the deferred area (Appendix G, Tables G-3 and G-9). If spilled oil were to contact a whale-habitat area, resulting effects would be as discussed under the base case (Sec. IV.C.6). Some bowhead whales (up to several hundred) could experience one or more of the following: skin contact and possible irritation, baleen fouling, inhalation of hydrocarbon vapors, a localized reduction in food resources, and the consumption of contaminated prey items.

Noise and habitat disturbance from drilling units, postlease geophysical surveys, artificial-island-construction activities, and production platforms to bowhead whales feeding in and migrating through the sale area would be reduced because these activities would not take place within the deferred area. However, leases have been granted adjacent to the deferred area as a result of Sales 87 and 97, and aircraft and vessel traffic would cross the deferred area enroute to these leased blocks. This traffic could disturb low numbers of bowheads for a few minutes once or twice per day and cause bowheads to avoid areas near vessel activities. In addition, noise from seismic surveys within leased blocks could be transmitted into the deferred area, although the sound intensity within the deferred area would be at reduced levels and would be unlikely to significantly displace feeding or migrating whales. In the area remaining to be offered for lease, the effect on bowheads would be as described for the base case, with whales avoiding areas within a few miles of vessels, seismic surveys, drilling units, and production platforms. Gray whales are seldom found east of Point Barrow; consequently, the effect of this alternative on gray whales is expected to be the same as for the base case.

The level of disturbance in the deferred area would be less with the alternative than without it; however, bowheads would be subject to the same level of disturbance in the area outside of the deferred area as they would be under the base case and oil-spill effects would not be reduced substantially. Consequently, the overall effect level is expected to remain the same as for the base case--MODERATE. Effects on the gray whale and the arctic peregrine falcon also are expected to be the same as for the base case--LOW and VERY LOW, respectively.

**CONCLUSION:** This alternative is expected to have the same effects on endangered species as the base case, with MODERATE effects on the bowhead whale, LOW effects on the gray whale, and VERY LOW effects on the arctic peregrine falcon.

**Deferred-Area Analysis:** Exploration and development and production activities in the deferred area could result in adverse effects from oil spills and noise and disturbance on fall-feeding and -migrating bowhead whales in the area near Barter Island. In the event of an oil spill occurring at Spill Site L-14 (located within the deferred area), the risk of contacting the Bowhead Fall-Feeding-Area B and Bowhead Migration-Area B within 30 days following a spill during the summer months would be 41 percent and 10 percent (Appendix G, Table G-7). Noise and disturbance from exploration units, production platforms, and aircraft could affect the timing and location of the bowhead migration within the deferred area. Noise from exploration units, production platforms, vessels, aircraft, dredging, and pipeline laying could affect fall-migrating bowhead whales.

7. **Effects on Caribou:** If development were to occur in the Barter Island Deferred Area, the same onshore-development scenario is expected to occur as that described for the base case. Pitt Point and Point Thomson would be the landfalls for the pipelines connecting to TAP, with the same pipeline-road corridors being constructed under this alternative. Thus, the effects of onshore construction activities--vehicle-traffic disturbance of caribou and habitat alteration along the pipeline road--are expected to be the same as described for the base case (see Sec. IV-C-7).

This alternative could reduce potential disturbance of caribou and possible oil-spill effects on caribou using coastal barrier islands and beaches for insect relief between Jago Lagoon (Kaktovik) and Demarcation Bay. However, caribou of the Western Arctic herd and of the Central Arctic herd (CAH) still would be exposed to disturbance sources and habitat alteration associated with onshore-pipeline transportation of oil from leases in other parts of the Sale 124 area. Caribou of these two herds still would be displaced during construction of the onshore pipelines and roads, although their use of summer-forage range is not likely to be greatly affected by the base case or this alternative. Therefore, effects on caribou are expected to be LOW.

**CONCLUSION:** This alternative is expected to have MODERATE effects on caribou, the same level of effects as for the base case.

**Deferred-Area Analysis:** For this alternative, the onshore-development scenario would include Point Thomson as the landfall for the onshore pipeline connecting to TAP. The effect of onshore-construction activities--vehicle-traffic disturbance of CAH caribou and habitat alteration along the pipeline road--is expected to occur. Vehicle traffic along this pipeline is expected to have a short-term (1-2 years) effect on caribou distribution along the pipeline road during construction. This effect is likely to subside after construction is complete (a LOW effect). Possible oil-spill effects on caribou using coastal barrier islands and beaches for insect relief between Jago Lagoon (Kaktovik) and Demarcation Bay could occur. Several hundred or more caribou could become contaminated and die from toxic-hydrocarbon inhalation and absorption through the skin. Habitat alteration associated with construction of the onshore pipeline and road is likely to have a very local effect on caribou rangeland adjacent to the pipeline-road corridor (within about 100 yd). There could be a reduction in habitat use by caribou within this local area.

8. **Effects on the Economy of the North Slope Borough:** The effect of this alternative is expected to be the same as for the base case. Due to the projected declines in Borough revenues and in resident employment, the economic effects of the base case are not expected to put undue pressure on the economic system. Most of the new sale-related employment would be filled by commuters from outside the region; some employment gains would be made by North Slope residents, though they would be less than 10 percent of the projected no-sale conditions.

**CONCLUSION:** The economic effects of this alternative on the NSB are expected to be MODERATE, the same level of effects as for the base case.

**Deferred-Area Analysis:** Assuming that economically recoverable oil is leased, discovered, and developed and produced in the proposed deferred area, the effects on the economy of the NSB would be the same as those described for the base case. Due to the projected declines in Borough revenues and in resident employment, the economic effects of activity in the deferred area are not expected to put undue pressure on the system. Most of the new, sale-related employment would be filled by commuters from outside the region. Some employment gains would be made by North Slope residents, though they would be less than 10 percent of the projected no-sale conditions.

9. **Effects on Sociocultural Systems:** Alternative V would not alter the onshore industrial activities and population and employment projections for this sale because the resource estimate for this alternative is the same as for the base case for Alternative I, and the effect on subsistence-harvest patterns would be the same as for the base case for Alternative I (see Sec. IV.C.10). Consequently, the effect of this alternative on sociocultural systems would be the same as for the base case--MODERATE.

**CONCLUSION:** The effects of this alternative on sociocultural systems are expected to be MODERATE, the same level of effects as for the base case.

**Deferred-Area Analysis:** Development and production within the deferred area would not alter the expected onshore industrial activities, population and employment projections, or the effect on subsistence-harvest patterns.

10. **Effects on Subsistence-Harvest Patterns:** Effects on subsistence from the proposed lease sale could occur as a result of oil spills; noise and disturbance; and the placement of exploration, development and production, and support facilities. Alternative V does not reduce the oil resource, number of wells, number of platforms, or the length of pipeline estimated for exploration, development, and production, however; it removes all activity from those blocks and platforms near Kaktovik.

For this deferral alternative, the conditional probabilities of an oil spill are identical to those for the base case for the Proposal. Development and production in the deferred area would increase the probability that an oil spill would occur and contact subsistence-harvest areas; however, an increase in probabilities would not increase the level of effects. On the other hand, subsistence activities occur locally, and many--such as Kaktovik whaling, seal and walrus hunting, and spring bird hunting--occur with high frequency in the area near Barter Island. An oil spill in the midst of this intensive subsistence activity would disrupt subsistence harvests more than an oil spill that might originate in another part of the sale area. An oil spill occurring outside of the immediate Barter Island Deferred Area may be in a more weathered state when it reaches the Barter Island area than it would be if it occurred in the immediate area surrounding Barter Island. However, the probability of an oil spill occurring and contacting the Kaktovik subsistence-harvest area is less than 0.5 percent. VERY LOW effects from oil spills on Kaktovik's bowhead whale harvest are expected for the base case in Alternative I and would not be altered for this alternative.

Noise and disturbance also would affect Kaktovik's and some of Nuiqsut's subsistence activities. While this deferral alternative would not substantially change biological effects to regional populations of subsistence species, it would eliminate nearshore tracts of a portion of Kaktovik's subsistence-harvest area and thus may offer some mitigation of noise and traffic disturbance to this community's hunters. The areas protected presently are not those most intensely used by Kaktovik for marine-mammal and caribou hunting. However, such protection may be particularly significant, because the western half of Kaktovik's subsistence-harvest area has and will be affected by offshore oil development. This deferral alternative would have a pipeline landfall at Point Thomson. Construction activities associated with this landfall are expected to have HIGH effects on Nuiqsut's bowhead whale harvest.

Barrow's, Atqasuk's, and Wainwright's subsistence-harvest patterns would not be affected by this alternative, and effects are expected to remain MODERATE in these communities.

**CONCLUSION:** The effects of this alternative on subsistence-harvest patterns are expected to be the same as for the base case of Alternative I--MODERATE in Barrow (Atqasuk), Kaktovik, and Wainwright; HIGH in Nuiqsut; and HIGH for the region.

**Deferred-Area Analysis:** Development and production in the deferred area would increase the probability that an oil spill would occur and contact Kaktovik subsistence-harvest areas; however, an increase in probability would not increase the level of effects. On the other hand, subsistence activities occur locally and many--such as Kaktovik whaling, seal and walrus hunting, and spring bird hunting--occur with high frequency in the area near Barter Island. An oil spill in the midst of this intensive subsistence activity would disrupt subsistence harvests more than an oil spill that might originate in another part of the sale area. An oil spill outside of the immediate Barter Island area may be in a more weathered state than it would be if it were in the area immediately surrounding Barter Island.

Although some noise and disturbance would occur even if leasing in this area were deferred, noise and disturbance associated with exploration and development and production in the deferred area would affect all marine-mammal-subsistence activities. For example, noise and disturbance would affect Kaktovik's as well as Nuiqsut's bowhead whale harvests and potentially could make them unavailable for a year or more. The Nuiqsut bowhead whale harvest could be affected by the construction of a landfall at Point Thomson. Construction of this landfall could cause the bowhead harvest to be unavailable for over a year because Flaxman Island, which is the primary bowhead whaling base for Nuiqsut whalers, is offshore of Point Thomson.

11. **Effects on Archaeological Resources:** The Barter Island Deferral Alternative is expected to reduce the effects of the base case from LOW to VERY LOW by reducing oil and gas activity north of Barter Island (near OSRA Segments 41 and 42). The deferred area is not assumed to contain economically recoverable resources; and, because the alternative would eliminate leasing of blocks in the Barter Island Deferred Area, there would be no effect-producing exploration and development and production activities in

these deleted blocks.

**CONCLUSION:** The effects of the Barter Island Deferral Alternative are expected to be reduced from LOW for the base case for Alternative I to VERY LOW.

**Deferred-Area Analysis:** If leased, the deferred area could produce an unknown quantity of economically recoverable oil. Activity while exploring and producing such oil could affect archaeological resources offshore and onshore in the vicinity of Barter Island. Such disturbance would be modest, given the known archaeological resources and the probability of their survival (see Mitigating Measures, Sec. II.G.2.a).

12. **Effects on Air Quality:** The exploration and development and production scenario for the Barter Island Deferral Alternative is nearly the same as for the base case; the only difference is that an area along the coast of the Beaufort Sea immediately north and east of Barter Island would not be leased. This would not significantly affect the activities under the scenario; and, consequently, the effect on air quality is expected to be LOW (see Sec. IV.C.12).

**CONCLUSION:** The effects of this alternative on air quality are expected to be LOW, the same level of effects as for base case.

**Deferred-Area Analysis:** The effects of exploration on air quality would be similar to those under the base case in the event that the deferred area is leased. Exploration within the deferred area would remain scattered beyond approximately 19 km (12 mi) offshore, with very diffuse concentrations of air pollutants at the shoreline. Development and production could introduce a production platform into the deferred area. The effect on air quality would depend on the distance of the platform from shore. With respect to air-quality standards, the exemption levels for NO<sub>2</sub> and VOC could be exceeded if the platform were within approximately 21 km (13 mi) of shore, but the significance-concentration criteria for those pollutants would not be exceeded. Onshore effects of other emissions, including acidification of vegetation and smoke from fires, would be short term and local.

13. **Effects on Land Use Plans and Coastal Management Programs:** Deferring the area west of Kaktovik would slightly reduce the potential effects of oil on biological resources. The reduction is most marked for marine and coastal birds using the area around Jago Lagoon. Although this alternative eliminates one area where potential conflicts could occur with the Statewide standard for barrier islands and lagoon habitat, other lagoon areas remain susceptible to negative effects. Therefore, potential conflict with this policy still could occur. No other potential conflicts are eliminated entirely with this alternative.

**CONCLUSION:** For Alternative V, the effects of potential conflicts on land use plans and coastal management programs are expected to be HIGH--the same level of effects as for the base case for Alternative I.

**Deferred-Area Analysis:** Were development to occur in this area, marine and coastal birds using Jago Lagoon and marine mammals using the deferral area could be affected. These effects could exacerbate conflicts with the Statewide habitat standard for offshore areas and barrier islands and lagoons. Other policy areas that were relevant to the base case also would remain relevant in this deferral area.

## IV.I. Cumulative Case

The analyses of the cumulative case for Sale 124 involve consideration of the potential effects on (1) the physical and biological resources, sociocultural systems, and programs from activities associated with petroleum exploration, development and production, and transportation in the three OCS arctic region planning areas (Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas [Fig. I-1]) and the major projects listed in Table IV-A-4-1 and (2) migratory species from activities over their range including the transportation of Sale 124 oil from Valdez, Alaska, to the West Coast (U.S.) and from industrial activities in the Bering Sea, Gulf of Alaska, and along the Pacific Coast of Canada and the United States--Appendix E. Migratory species include those species or species groups that migrate to and from the Beaufort Sea and adjacent coastal plain of northern Alaska and migratory as well as other species in other areas that might be affected by the transportation of Sale 124 oil--especially oil spilled along the transportation route.

The total amount of oil estimated to be present in the three OCS arctic region planning areas is about 5,480 MMbbl (Appendices A and B). The MMS estimates that exploitation of this amount of oil will include (1) drilling 68 exploration and delineation wells and (2) installing 11 production platforms and drilling 685 production and service wells (Table II-A-1 and Appendix B). The transportation of oil that might be produced as a result of previous lease sales in the Beaufort and Chukchi Sea Planning Areas generally has been hypothesized as being via pipelines from the production platforms to TAP. An alternative mode of transportation includes icebreaking tankers and offshore loading. There have been no OCS oil and gas lease sales in the Hope Basin Planning Area, and thus possible transportation scenarios have not been developed for this area.

For Sale 124, the major projects considered in the cumulative-effects analyses for the arctic region planning areas include past and future SOA and OCS oil and gas lease sales, NSB capital improvement projects, onshore mineral development, and Canadian arctic oil and gas development. These projects are listed in Table IV-A-4-1 and described in Appendix E (Numbers 1 through 18). The location of these projects is shown in Graphic 3.

Tanker transport of oil could potentially affect migratory as well as other species in the event of an oil spill. As noted in Section II.B.2, any economically recoverable oil that might be discovered in the Sale 124 area would be transported through offshore and onshore pipelines to TAP. The Sale 124 oil would be mixed with oil from other production units in Alaska's North Slope and transported through TAP to Valdez, Alaska, where it would be loaded onto tankers for shipment to the West Coast of the United States. For the base case peak-production years--2001 through 2005--MMS estimates Sale 124 oil would be produced at a rate of about 208 Mbbl/day (Table II-A-1). For a mid scenario, the State of Alaska estimates oil production of the North Slope could range from 830 Mbbl in 2001 to 590 Mbbl in 2005 (SOA, Department of Revenue, 1990). Thus, Sale 124 oil would be only a fraction of the oil transported through TAP and loaded onto tankers.

Also, the migratory species could be affected by activities throughout their range and along their migration routes. These activities are listed in Appendix E (Numbers 19 through 27).

Oil exploitation associated with Sale 124 would increase the level of activities affecting these environments and resources. The level of activities associated with potential exploitation of Sale 124 oil has been estimated in Section II.B (and Table II-A-1) and the proportion contributed by these activities to the overall level of activities associated with the present and proposed projects is listed in Table IV-A-4-1 and Appendix E. The amount of oil that might be produced as a result of Sale 124 (Alternative I, base case = 900 MMbbl [0.9 Bbbl]) is very low when compared to the oil (21-25 Bbbl) that is estimated to be produced in areas in and adjacent to the Beaufort Sea Planning Area. Thus, over several decades, some of the activities--such as well drilling, helicopter flights, or tanker transport--associated with exploitation of Sale 124 oil might contribute only a relatively small amount of the total. Overall, the contribution of the Proposal when compared to the cumulative case would be relatively small.

1. Cumulative Effects on Water Quality: Agents that are most likely to affect water quality in the coastal Arctic Ocean are oil spills, causeways, dredging, gravel-construction and -removal projects, and deliberate discharges from platforms.

a. Oil Spills: The oil-spill-trajectory analyses indicate that trajectories in the Beaufort

and Chukchi Seas generally move westward or northwestward (Sale 97 FEIS [USDOJ, MMS, 1987a]; Sale 109 FEIS [USDOJ, MMS, 1987b]). Spills in the Hope Basin also could move south through the Bering Strait into the northern Bering Sea.

In the cumulative case, about 10 spills of 1,000 bbl or greater and about 1,900 smaller spills could occur in the Chukchi and Beaufort Seas over the life of the fields. The smaller spills would total about 27,000 bbl, the equivalent of one to two average spills of at least 1,000 bbl. Large spills (at least 1,000 bbl) are estimated to total 220,000 bbl. There is a significant chance that one of the 1,000-bbl spills also could be greater than 100,000 bbl. In this analysis, one such spill of 100,000 bbl or greater has been assumed to contact the study area. In addition, five spills of median size (6,500 bbl) and four spills of average size (22,000 bbl) are assumed. The spills of less than 100,000 bbl would result in long-term (frequent) but dispersed and localized effects on water quality. The spill of 100,000 bbl or greater could temporarily contaminate waters with hydrocarbons over the chronic standard of 0.015 ppm for several hundred square kilometers for a LOW effect on LOCAL water quality and a VERY LOW effect on REGIONAL water quality.

b. Causeways: Causeways locally affect turbidity through enhanced sedimentation of suspended loads and through redirection of the flow of watermasses carrying the suspended loads. The redirection of flow also changes local temperature and salinity regimes. Four causeways currently exist: at both sides of Prudhoe Bay, at Oliktok Point, and at the Endicott Development; and one has been proposed for the Niakuk Field. Four more causeways are projected for the base case. Other causeways are possible to allow offshore supply of drilling/production operations in ANWR and NPR-A. The effect of these causeways on the water quality of the Beaufort Sea is limited to about a 5-km distance offshore of each causeway, but the total area affected could be greater than 1,000 km<sup>2</sup>. The effect on LOCAL water quality would be long term but MODERATE. The effect on REGIONAL water quality would be LOW.

c. Dredging: The only dredging activity that is expected to significantly affect water quality in the planning area is pipeline trenching for Federal leases. Pipelines from development in State waters would be short and in waters that are already naturally turbid over much of the summer. Only a few square kilometers of water on any single day would have increased turbidity as a result of dredging, and the turbidity at any location would rapidly disappear when the dredge moves or stops excavation. Thus, the effect of dredging in the cumulative case is expected to be LOW on LOCAL water quality and VERY LOW on REGIONAL water quality.

d. Gravel-Construction Projects: The proposed Niakuk causeway and drilling island constitutes the largest known gravel-construction project anticipated. The joint Federal/State Seal Island/North Star oil and gas unit is likely to be developed without causeway construction. Any gravel islands constructed on inshore State leases would require relatively little gravel compared to the above projects as long as causeways were not included. Any of these individual construction projects could be completed within one to two summers, and turbidity effects in the vicinity of the construction activity would be short term and local. Cumulative effects are expected to be LOW on LOCAL water quality and VERY LOW on REGIONAL water quality.

e. Gravel-Island Removal: Fifteen gravel islands, mostly in State waters, have been constructed during past oil and gas exploration of the Beaufort Sea. Once abandoned, artificial islands are left to erode and can result in local but persistent turbidity plumes as the sediments of the islands are reworked by waves and currents. The effect on water quality of leaving the islands to naturally erode is expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality. (Causeways would not similarly erode but would more likely enhance deposition of waterborne materials, decreasing turbidity.)

f. Deliberate Discharges: Discharges of muds and cuttings resulting from continued exploration and additional development would be several times greater than those for proposed Sale 124 alone. Additional muds and cuttings would be discharged in State waters from leases in past or proposed State sales. Discharges from both State and Federal leases during both exploration and development are regulated by EPA. Discharges of muds and cuttings would continue for at most only a few years as production wells are drilled. Cumulative effects of muds and cuttings discharges are expected only within mixing zones, i.e., VERY LOW for both LOCAL and REGIONAL water quality. If formation waters were discharged, the effect on water quality would be local but would last over the life of the field, an expected MODERATE LOCAL effect and VERY LOW REGIONAL effect.

g. Overall Cumulative Effects: The 10 spills projected would temporarily contaminate waters over up to several hundred square kilometers, to levels above chronic standards but below acute

standards, a LOW LOCAL effect and a VERY LOW REGIONAL effect on water quality. Causeways would have a MODERATE LOCAL effect and a LOW REGIONAL effect on water quality. Gravel-island removal and formation-water discharges would have a MODERATE LOCAL effect and a VERY LOW REGIONAL effect. Other agents--dredging, construction projects, and deliberate discharges--would have at most a LOW LOCAL and a VERY LOW REGIONAL effect.

**CONCLUSION:** Cumulative effects on water quality are expected to result in a MODERATE LOCAL effect and a LOW REGIONAL effect on water quality.

## 2. Cumulative Effects on Lower-Trophic-Level Organisms

a. Oil Spills: Since the cumulative-case resource estimates are higher and development and production activities are expected to be greater than for the proposed action alone, potential effects on lower-trophic-level organisms also are more probable. Because the probability of oil spills increases, effects from a spill are more likely.

Multiple oil spills are projected for the cumulative case. Ten spills of at least 1,000 bbl are most likely. Both the increased number and increased magnitude of projected spills increase the probability that a sensitive resource or area would be contacted at a more vulnerable time. The precise effects would vary depending on the extent and timing of the spill, the location and state of marine plants and invertebrates, etc. Most cause for concern in nearshore environments rests with the Stefansson Sound Boulder Patch and those epibenthic invertebrates that seasonally constitute the bulk of the diet of anadromous fishes.

The Stefansson Sound Boulder Patch is located close to Land Segment 36. In the base and high cases, the probability of an oil spill of 1,000 bbls or greater occurring and contacting Land Segment 36 in either summer or winter is less than 0.5 percent; Appendix G, Tables G-16 and G-18. In the unlikely event that a spill did contact the Boulder Patch community (an even less-likely event than a spill contacting the area, given that the community is subtidal), HIGH effects could result.

Epibenthic invertebrates in the shallow, nearshore environments have a somewhat higher probability of being contacted by oil under the cumulative case than under the base case. However, the probability that oil would actually reach the sediments where the animals live is much lower. Even if epibenthic invertebrates in an area were contacted by oil and died or emigrated, anadromous fishes are not expected to be affected much since the areal extent of a spill should be very small (1.8 km<sup>2</sup>; Appendix M, Table M-1), and they do not seem to be food-limited (Moulton, Fawcett, and Carpenter, 1985; Craig and Haldorson, 1981).

Other marine plants and invertebrates of concern are found in the plankton, which is widely distributed throughout the Sale 124 area. The effect of an oil spill on plankton is not expected to change from that of the base case (LOW), even though effects are more likely to occur. Effects are judged to be LOW due to the broad distributions of most constituents of the plankton and the believed ease of recolonization should a local community be affected.

Although oil spills in general are predicted to have LOW effects on marine plants and invertebrates, those species with potential for HIGH effects (e.g., kelp in the Boulder Patch community) are more likely to incur them in the cumulative case.

There is also some increased risk from spills originating from or associated with the Chukchi Sea Planning Area (Sale 109), but this may be relatively slight because trajectories in the Chukchi Sea would tend to move oil westward, away from more vulnerable coastal habitats.

For the cumulative case, the expected effects of oil spills are LOW for marine plants and invertebrates.

b. Shallow-Hazards Surveys: For the cumulative case, a total of 996 mi<sup>2</sup> of seismic surveys are projected (Table II-A-1). The effect of seismic surveys on marine plants and invertebrates was discussed previously and is judged to be VERY LOW for the proposed action. Even though there would be an increased level of seismic surveying under the cumulative case, effects are still judged to be VERY LOW because airguns and waterguns are not known to have lethal effects on marine plants and invertebrates found in the Beaufort Sea.

c. Drilling Discharges: For the cumulative case, discharges of muds and cuttings associated with continued exploration and additional development would be several times greater than those proposed solely for Sale 124. Additional muds and cuttings would be discharged in State waters from leases

in past or proposed State sales. The effects of exploratory-drilling discharges on plankton and benthic invertebrate species and habitats are discussed in Appendix L. The effects of these discharges on marine plants and invertebrates in the Sale 124 area are generally expected to be LOW, given the relative volumes involved, the large sediment loads regularly and normally introduced into the environment, the low toxicity of drilling fluids to marine organisms, and the anticipated localized effects. The Boulder Patch community is viewed as being the most sensitive to potential effects of drilling-fluid discharge, in part because of its restricted distribution. If drilling fluids were discharged nearby and recruitment of kelp were affected, then a VERY HIGH effect is expected to accrue to this community.

In general, the effects of drilling-fluid discharge on marine plants and invertebrates in the Sale 124 area are expected to be LOW, the same as for the base case.

d. Construction Activities: Construction activities, in addition to the discharge of drilling muds and cuttings, could alter habitats of benthic or epibenthic animals and plants. Activities relating to the installation of pipelines and construction of causeways are expected to be very localized but long term. The effects of construction activities would vary depending on the species involved. Some sessile marine organisms would be killed or displaced by these activities and are expected to suffer extremely localized, long-term effects. Three-dimensional structures may provide habitat for refuging fishes or for invertebrates and plants requiring hard substrate for settlement. In general, organisms relying on soft-sediment areas altered or preempted by platforms, pipelines, gravel islands, or causeways would be negatively affected. Due to the relatively few number of such structures expected to be built for oil-related activities, the small area expected to be affected, and the apparently broad distributions of most adult and larval marine organisms in the Beaufort Sea, the effect of such construction activities is expected to be LOW. Regional populations are not expected to be affected; however, the very localized effects expected should be long term for those benthic organisms involved.

Bottom-founded mobile drilling units and floating units are expected to serve as bases for some drilling operations. Although some invertebrates could be killed or displaced by the bottom-founded units, the expected effect on marine plants and invertebrates will be LOW due to the extremely small area that is expected to be affected.

Effects of pipeline installation are expected to be very localized but may be long term for benthic invertebrates, since the pipelines would be in place for years. Since only a very small portion of the benthos would be perturbed (with some organisms killed or displaced), regional populations of marine plants and invertebrates are not expected to be affected, leading to a LOW effect.

SUMMARY: In the cumulative case, effects on marine plants and invertebrates are expected to be LOW from oil spills, drilling discharges, and construction activities, and VERY LOW from seismic surveys.

CONCLUSION: For the cumulative case, the effects on lower-trophic-level organisms are expected to be LOW.

### 3. Cumulative Effects on Fishes

a. Arctic Region Planning Area Species: Species discussed are highlighted in Section IV.C.3. Salmon are not discussed in this subsection since they are uncommon and may be vagrants rather than forming established populations in the Beaufort Sea (see Craig and Haldorson, 1986). Rather, salmon are more appropriately discussed in the following subsection for Prince William Sound and Gulf of Alaska migratory species.

(1) Oil Spills: Since the cumulative-case resource estimates are higher and development and production activities are expected to be greater than for the proposed action, potential effects on fishes also are more probable. Because the probability of oil spills increases, effects from spills are more likely.

For the cumulative case in the Chukchi and Beaufort Seas, the most likely number of spills of 1,000 bbl or greater is 10. This increased number and increased likelihood of larger spills increase the probability that a sensitive resource or area will be contacted at a more vulnerable time. The precise effects would vary depending on the extent and timing of the spill, the location and state of the fish, etc. Fishes that would be most threatened by an oil spill are those species that spawn in nearshore or freshwaters, or in other ways depend on nearshore-water environments during part of their lives (e.g., anadromous fishes and capelin). Thus, although oil spills in general are expected to have a MODERATE effect on fishes because individuals

in a localized area are most likely to be affected for less than one generation, those species with the potential for HIGH effects (anadromous species and capelin) are more likely to incur them in the cumulative case than in the base case. HIGH effects are more likely where spawning occurs in nearshore areas (capelin), where multiple year-classes could be affected by a single spill (most coastal anadromous species), or where stocks are restricted in origin and long-term migration patterns could be affected as well as spawning success (arctic cisco).

There also is some increased risk from spills originating from or associated with the Chukchi Sea Planning Area, but this may be relatively slight because trajectories in the Chukchi Sea would tend to move oil westward, away from more-vulnerable coastal habitats.

Thus, under the cumulative case, the expected effect of oil spills on fishes is MODERATE, but HIGH effects are more likely to occur for anadromous species and capelin than under the base case.

(2) Shallow-Hazards Surveys: For the cumulative case, 996 mi<sup>2</sup> of seismic surveys are projected (Table II-A-1). The effect of seismic surveys on fishes is discussed previously and is judged to be LOW for the base case because of the low levels of mortality of eggs and larvae and the extremely small spatial extent of the mortality. Even though there would be an increased level of seismic surveying under the cumulative case, effects are still judged to be LOW for fishes in the Beaufort Sea, because a limited number of almost point-sources of mortality would be added.

(3) Drilling Discharges: For the cumulative case, discharges of muds and cuttings associated with continued exploration and additional development would be several times greater than those proposed solely for Sale 124. Additional muds and cuttings would be discharged in State waters from leases in past or proposed State sales. The effects of exploratory-drilling discharges on fishes are discussed in Appendix L. The discharge of formation waters also has the potential for affecting fish in the vicinity of the platforms; however, these waters do not appear to be very toxic to fishes (Menzie, 1982). The effect of these discharges on fishes in the Sale 124 area is expected to be LOW based on the following: (1) the mobility of adult fish, (2) the apparent low toxicity of drilling fluids and formation waters to fishes (see earlier discussion), and (3) the apparent very localized smothering of demersal eggs of fishes. The actual area affected should be relatively small although several times larger than that projected for the base case (see Sec. IV.B.1, Effects on Water Quality) and should preclude effects greater than LOW. The effects on prey of fishes also are expected to be localized and therefore are expected to be limited. The mobility of adult fish and the apparent low toxicity of drilling fluids to fishes further reduces the likelihood that adult fish will be significantly affected by discharged drilling fluids. For these reasons, the effects of drilling discharges on fishes are expected to be LOW.

(4) Construction Activities: This section incorporates by reference the information on cumulative effects of construction activities on fishes in Section IV.B.2.b(4) of the EIS for Sale 97 (USDOI, MMS, 1987a). In the base case, no long causeways were projected to be built, but four short jetties or causeways may be built to bring offshore pipelines safely ashore (Sec. II.B.2.a). On State nearshore leases, however, some long causeways probably would be used to connect production islands with onshore facilities.

The construction of long, solid-filled causeways in the nearshore Beaufort Sea has affected anadromous fishes. At the present time, two long causeways--the West Dock and Endicott causeways--have been built in the Prudhoe Bay-Sagavanirktok River area, and another has been proposed (Standard Alaska Production Company, 1988). The two existing causeways and their effects on nearshore-water characteristics are described briefly in Section III.A.3 on physical oceanography. The effects on nearshore water also are summarized by Segar (1989). The West Dock causeway, which extends into 12-ft water depths and has one relatively small 50-ft breach, has altered the surrounding physical oceanographic regime. The Endicott causeway, which extends into 6-ft water depths with one 200-ft and one 500-ft breach, has altered the surrounding regime to a smaller extent. The difference in effects also is related to the siting of the causeways; Endicott is situated between two mouths of the Sagavanirktok River, which allows warm, fresh river water to flow seaward on both sides of the causeway. The sizes of the breaches and water depths at the ends of the causeways probably also affect the extent of watermass changes.

Alteration of the nearshore physical oceanographic regime affects arctic cisco and other anadromous species because these migratory fishes have varying tolerances to temperature and salinity ranges. Creation of discontinuities in the band of relatively warm, brackish water that occurs in the open-water season along the Alaskan Beaufort Sea coast could affect (a) alongshore migrations, (b) individual feeding and growth, and (c) population recruitment.

The effects of causeways in the Beaufort Sea on alongshore movements and migrations of fishes have been examined. The West Dock causeway frequently creates discontinuities in the nearshore band of water that affect movements of arctic cisco (USDOD, U.S. Army COE, 1988). West Dock also affects migrations by delaying arctic cisco, as described by Moulton, Field, and Brotherton (1986). Another independent analysis of the localized movement patterns of arctic cisco and least cisco at West Dock has been prepared by Fechhelm et al. (1989). They concluded that weather conditions probably determine whether there are just temporary localized effects or temporary delays in the population migration. The Endicott causeway monitoring reports include evidence of localized effects on fish movements but no evidence of blockage of migrations (Envirosphere Company, 1987a,b). The Endicott information has been analyzed independently by EPA (1988) and USDOC, NOAA, NMFS (1988). The EPA report documented one example during several years of Envirosphere's Endicott monitoring program when the band of nearshore water became discontinuous. This example may represent one extreme of conditions that can occur. However, the extent, frequency, and degree of change in oceanographic parameters (e.g., temperature, salinity) must be considered in discussing effects on fishes, and it is not unreasonable to assume that a range of altered conditions could affect anadromous fishes. Glass (1988) concluded that within- and between-year variability is so high that population effects are difficult to document. All of this information was recently synthesized by two workshop groups during an MMS conference on causeways and anadromous fish. One workshop group (Allen, 1989) concluded that "there appears to be sufficient information to indicate that the causeways in the Beaufort Sea can and do affect fish movements." "However, there is insufficient information at the present to determine whether they significantly affect fish migrations or movements." The other workshop group (Harville, 1989) "generally agreed that there is no evidence of significant interference by the causeways with movements of young-of-the-year Arctic cisco westward through the area to the Colville River Delta or to other river systems . . ." However, as Harville also notes, EPA (1988) reaches somewhat different conclusions.

The causeways also may affect individual feeding and growth. In 1985, several investigators suggested that growth rates of arctic cisco in the Sagavanirktok River region are slower than for the Colville River, and that the West Dock causeway may retain more fish in the Sagavanirktok River region. Whitmus, Cannon, and Parker (see Envirosphere Company, 1987a,b) collected data on growth and condition of arctic cisco during the summer of 1985 near the Colville and Sagavanirktok Rivers. These data showed no differences among study sites for length-at-age. Comparisons of growth from several years and various study locations along the Beaufort Sea coast likewise show differences that relate to predominant wind direction but not to pre- or postcauseway periods. Further, the growth rates of arctic cisco and broad whitefish in the water, both near and away from causeways, has been examined by English (1989). He measured the highest growth rates of arctic cisco at the study site adjacent to the Endicott causeway. A separate analysis of the data from the Endicott Monitoring Program (BP Exploration, Inc., 1989) found no regional changes in either growth (length-at-age or rate) or in condition (length-weight) of the key anadromous fishes. The data in this analysis suggest, alternatively, that growth in both regions is related positively to the coastal summer water temperatures and that coastal water temperatures have been highest during years with predominately west winds, which blow warm surface water toward the coast.

The effect of causeways on recruitment and overall population levels also has been estimated. The apparent recruitment of arctic cisco into the Colville River as reflected by catch in the Helmericks' commercial fishery has been followed closely for many years, including those before construction of the West Dock and Endicott causeways (Moulton and Field, 1988; Moulton, 1989). The catch-per-unit effort (CPUE) of arctic cisco has fluctuated widely; however, there has not been a trend in CPUE. Specifically, the studies documented unusually high recruitment in 1979 and 1980, unusually low recruitment in 1981 to 1984, and good recruitment in 1985. While the level of recruitment has not varied with the number or type of existing causeways, it does relate closely to the predominant wind direction, with the highest recruitment during years with predominately east winds (Fechhelm and Fissel, 1988). Recruitment also may be influenced by the size of the parent stock in a manner similar to classical density-dependent stock-recruitment relationships (Galloway, Gazey, and Moulton, 1989). For example, because the maturation time and lifespan of arctic cisco is about 7 years, the unusually large 1979 and 1980 year-classes may be partially responsible for the good 1985 recruitment. The U.S. Army's Waterways Experiment Station (WES) analyzed data on the effects of causeways and in their discussion of the Helmericks' data concluded that "The data are probably adequate to show that catastrophic declines on large arctic cisco have not occurred, but the data may not be adequate to detect a slowly changing population" (USDOD, U.S. Army COE, WES [WES], 1989).

Considerable controversy has surrounded the interpretation of data taken in conjunction with causeway monitoring programs (Harville, 1989; Segar, 1989; WES, 1989). At issue is the significance of the observed changes in fish movements and habitats to populations. The monitoring programs have not been designed to

detect population-level effects on fishes (WES, 1989); consequently, not seeing them in such programs does not mean they are not occurring.

Some level of controversy regarding the significance of observed changes may result from whether one views summer or winter habitat to be limiting to the fishes involved (WES, 1989). The WES contends that for those who view winter habitat as limiting, causeways do not pose much threat to anadromous fish populations. If summer habitat is viewed as limiting, then any effects of causeways on the nearshore environments could be affecting fish populations. In actuality, the situation is probably more complicated. For example, movements to overwintering habitat may be affected by causeways, thus linking effects in the nearshore to winter survival. Also, the factor or factors that limit fish populations may vary from year to year (e.g., the extent or quality of overwintering habitat may limit anadromous fish populations in most years; however, in occasional years, food in summer habitats may be limiting).

Thus, even though population-level effects on fishes have not been demonstrated, there is concern that such effects may be occurring and have not been detected, or may occur. The greatest concern has been expressed for broad regional effects such as could appear if arctic ciscoes were adversely affected. However, local temporal or spatial effects could be significant for individual populations if, for example, there were delays in reaching overwintering sites or delays in migrations that caused overcrowding in overwintering sites.

The number of causeways that would be constructed in the reasonably foreseeable future is uncertain. At present there are two long causeways, Endicott and West Dock, and one short causeway, East Dock. Four additional short causeways or jetties are projected to be built under the Proposal. Another causeway at Niakuk has been proposed, and other causeways could be added for development at ANWR (possibly near Barter Island) or the NPR-A (possibly near Barrow). For the purpose of analysis, the causeways described above will be assumed. That brings the total number of causeways assumed for the cumulative case to 10, with 5 of them projected to be relatively short (less than 2,500 ft). Additional long causeways also may be proposed.

Effects on fishes from existing and future causeways could range from LOW to VERY HIGH. As mentioned previously, the particulars of siting and design of causeways can tremendously influence the magnitude of effects on watermass characteristics and the potential for effects on fishes. The length of a causeway, type of construction, amount of breaching, depth of water it extends into, and whether it is located near barrier islands or large rivers are important considerations for degree of effect.

One particular concern, mentioned previously, would be delays or blockages of movements to overwintering habitat. These could cause significant population declines that would be apparent for some time, possibly one generation. A greater effect could be caused by a long causeway in the eastern Alaskan Beaufort, if it systematically deflected the nearshore band of brackish water under east-wind conditions. This could result in the systematic transport or deflection of young-of-the-year arctic cisco offshore, which could affect recruitment to the population over the life of the causeway. We do not know what proportion of the various Mackenzie River stocks of arctic cisco comes each year to Alaska, but it is quite likely that such a systematic deflection and loss of young would be felt in the Mackenzie. This effect, which would persist over the life of the causeway, would constitute a VERY HIGH effect on fish, since it would last for three or more generations (arctic cisco generation time is thought to be 6-10 years; Bond, 1982; Morrow, 1980).

Thus, under the cumulative case, causeways are likely to have a VERY HIGH effect on fishes. If the siting and design of causeways were carefully evaluated prior to construction in order to minimize effects on water quality, circulation, and fishes, then effects on fishes in the cumulative case could be expected to be reduced to MODERATE.

#### **b. Prince William Sound/Gulf of Alaska Migratory Species**

This analysis considers effects on two migratory species or groups of species of fishes that are abundant in Prince William Sound and the Gulf of Alaska. They are being considered here because the transportation scenario involves the tankering of oil from Valdez at the terminus of the TAP through Prince William Sound and the Gulf of Alaska.

##### **(1) Pacific Salmon**

Alaska Pacific salmon resources range through all of the planning areas off Alaska but are not as numerous in the Beaufort and Chukchi Seas and the Hope and Navarin Basins. All five species of Pacific salmon occur in Prince William Sound and the Gulf of Alaska. Under the cumulative case, events or activities that could

affect salmon include commercial and subsistence fishing, State and Federal oil and gas activities, logging, placer mining, dredging and filling, and pollutant discharge. The greatest effects on salmon probably come from fishing activities.

Because of repeating adverse environmental conditions and lack of long-term management, Alaskan salmon populations historically were overexploited and sometimes reduced to dangerously low levels. Current management administration has largely removed the majority of problems; thus the populations now may be at optimum management levels that are consistent with available habitat at sea and in freshwater spawning/rearing areas. Although Alaskan salmon populations are generally at high levels, there are areas where the numbers are below optimum levels. These areas are localized, and the reductions are usually for a single species; for example, the Chignik sockeye salmon run on the southern part of the Alaska Peninsula was reduced from former high levels in 1988 as was the Kodiak Island pink salmon run). Reductions may be felt for successive generations, if there is little variation in the age at which individuals return to spawn.

Commercial fishing for salmon, a major industry in Alaskan waters, has significant effects on salmon population levels. While salmon stocks were once overfished, improved fisheries management now limits overexploitation; and these species are now managed with the intent to provide maximum sustained yield. The illegal and incidental catch of salmon by foreign fleets in the eastern Bering Sea should generally miss Prince William Sound and Gulf of Alaska stocks. Fishing effects on salmon stocks are likely to be MODERATE, because stocks should be replenishing themselves, but effects on particular year-classes may be reflected for a generation.

Logging, placer mining, dredging and filling, and pollutant discharge in waters where salmon migrate, spawn, and grow prior to their seaward migration also may have some adverse effects on salmon populations. Increased siltation from erosion caused by careless logging, placer mining, or construction activities could result in a reduction in egg and fry survival and/or a reduction in available spawning habitat, leading to a decline in overall productivity for affected streams. In Alaska, these types of activities are localized and tend to affect only small segments of the Statewide salmon habitat. Presently, there are no means to accurately quantify these effects, given the limited scope of these operations and their comparatively limited number. The overall cumulative effect of these activities on the salmon populations Statewide are estimated to be LOW. However, they can have severe effects in the limited area where the activity occurs, and particular stocks could incur VERY HIGH effects.

Oil and gas activities from State and Federal lease sales could affect salmon from seismic surveys, oil spills, drilling discharges, pipeline installation, and onshore construction. Seismic-survey activities as a result of existing oil and gas exploration are expected to consist primarily of site-specific, high-resolution surveys or localized, deep-penetration surveys. Other activities that could have some effect on salmon populations would be exploratory drilling on tracts leased in prior lease sales. Currently, there are no immediate plans for companies to drill on leases within the major distribution range of Pacific salmon populations. There are, however, a number of active leases on which oil companies could drill. If drilling does occur, salmon would be most greatly at risk from large accidental oil spills. However, of the more than 8,000 exploratory wells that have been drilled on the OCS, no large accidental oil spills have occurred. If a discovery is made, the risk to salmon would increase during development and production activities.

Oil spills could occur from the transport of oil from the terminus of TAP, at Valdez, via tankers to other locations. Under the current scenario (Table II-A-1), in the cumulative case, 16 spills of 1,000 bbl or greater are assumed to occur in Prince William Sound and the Gulf of Alaska.

To affect salmon, an oil spill would need to contact the fish and/or their food supply. Salmon, both immature smolts and spawning adults, usually occur in marine waters at depths of 1 to 5 fathoms (6-30 ft). Their schools do not constitute closely concentrated bands, but rather separate groups that are constantly changing density and configurations in response to various conditions. Many researchers have studied the direct effects of petroleum hydrocarbons on Pacific salmon and have reported lethal and sublethal responses (Rice, 1979; Malins et al., 1981; Moles et al., 1979; Brocksen and Baily, 1973; Weber et al., 1981).

Salmon are migratory with limited time in a given area; hence, the probability of being contacted by an oil spill for an extended period of time is very low. Even a large oil spill, either offshore or coastal, would contact only a small portion of the pelagic salmon habitat, although effects could be much more severe in coastal waters. Adult pink salmon can become disoriented in the presence of hydrocarbon concentrations ranging from 1.0 to 10.0 ppb (Martin, 1989). This disorientation results from salmon losing the homing cue due to masking or impairment of chemosensory capabilities. If a spill occurred along the spawning migration route or at the mouth of spawning streams, effects on migrations could affect the spawning or recruitment

success of that population. Thus, even though the most likely effect of a spill on salmon is expected to be LOW, a HIGH effect could occur if migrating smolts or adults on spawning migrations were affected.

Drilling discharges also have components that could prove toxic to salmon, with the number of wells drilled releasing large weights and volumes of these materials into ocean waters and to the benthos. While sublethal to lethal effects of these materials also have been substantiated by studies, the benthic area affected by them is not within the depths at which salmon normally migrate; the area contacted by the discharges is comparatively small, usually measured in hundreds of square meters. Effects on salmon from drilling discharges are expected to be VERY LOW.

Pipeline installation requires some excavation/disturbance of the ocean bottom with resultant turbidity. This is a temporary effect that dissipates very rapidly, and the turbidity should not extend to the pelagic waters where salmon migrate and rear. Onshore construction of pipelines, petroleum holding/processing facilities, and support installations could affect salmon spawning/rearing streams; however, development planning can prevent these effects through siting activities and structures away from salmon streams.

The effect of the cumulative case on Pacific salmon is expected to be MODERATE. HIGH effects are less likely but possible if migrating smolts or adult salmon on spawning migrations are affected by oil spills.

## (2) Pacific Herring (*Clupea harengus pallasii*)

Activities that could affect Prince William Sound and Gulf of Alaska stocks of herring include commercial and subsistence fisheries and existing and proposed State and Federal oil and gas lease activities.

The largest existing effects on herring stocks aside from natural mortality factors are probably derived from commercial fishing activities, although subsistence take also reduces herring numbers. Herring stocks in Prince William Sound and the Gulf of Alaska are managed by the Alaska Department of Fish and Game. Of recent concern is the possible effect of the high seas drift-net fishery and other open-ocean, nondiscriminant-gear fisheries on herring and other fish stocks. However, herring from Prince William Sound and the Gulf of Alaska are not likely to be affected by these activities, which are concentrated in the Bering Sea. Fishing is expected to have a MODERATE effect on herring, unless overfishing of a dominant year-class occurs, which could cause a HIGH effect.

Activities or events associated with oil and gas activities that could affect herring include oil spills, construction activities, seismic testing, and the discharge of drilling fluids. A pelagic species such as the Pacific herring is not viewed as being very vulnerable to effects of offshore activities but would be more vulnerable when it comes into nearshore areas to spawn. Eggs and developing larvae attached to benthic substrates in the intertidal and shallow areas would be the most sensitive and vulnerable stages, especially to effects from oil spills. Oil spills are more likely to occur from the tankering of oil than from drilling activities. Under the current scenario (Table II-A-1), in the cumulative case, 16 spills of 1,000 bbl or greater are assumed to occur in Prince William Sound and the Gulf of Alaska. Even though a fuel spill contacting the nearshore zone could cause great mortality to eggs and developing larvae, because adults spawn repeatedly after reaching maturity--and it is most likely that only a portion of the eggs and larvae in Prince William Sound and the Gulf of Alaska would be affected--a MODERATE effect on the herring population would be expected. An oil spill that occurred in more open-ocean areas could conceivably affect herring by affecting the abundance of their prey, but these effects are little studied and would be very difficult to predict and to quantify. Effects to herring from spills in nearshore areas have a much greater likelihood of affecting herring. Other effect-causing agents associated with offshore oil and gas activities that could also affect herring include construction activities, seismic testing, and the discharge of drilling fluids. These are expected to have VERY LOW to LOW effects on herring.

The effect of cumulative activities on herring that spawn in Prince William Sound and the Gulf of Alaska is expected to be MODERATE, based on potential effects from fisheries and oil spills.

**SUMMARY:** In the Arctic Region Planning Area, the largest effects on fishes in the cumulative case are likely to come from the construction of long causeways. Documented effects of causeways on anadromous fishes include effects on local movements of arctic cisco, least cisco, broad whitefish, and arctic char as well as temporary delays in the alongshore migration of arctic cisco. The significance of these effects for fish populations is not known. However, population-level effects could occur, especially if movements into or out of overwintering habitat were affected, or if systematic deflections of young-of-the-year arctic ciscoes occurred. The construction of a long causeway in the eastern Alaskan Beaufort Sea could cause such a systematic deflection of young arctic ciscoes. Such an effect could affect recruitment of arctic ciscoes for

three or more generations, a VERY HIGH effect.

The base case of the Proposal contributes only four relatively short (1,500 to 2,500 ft) causeways (an expected LOW effect), but the overall cumulative effect is likely to be VERY HIGH due to existing and possible long causeways.

Effects from oil spills are expected to be MODERATE, and effects from seismic activity and the discharge of drilling fluids are expected to be LOW. HIGH effects from oil spills are less likely, but could accrue to anadromous fishes and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected.

In the Gulf of Alaska and Prince William Sound, the largest existing effects on the two species groups (salmon and herring) considered here are expected to be derived from fishing activities, both commercial and subsistence. The cumulative effect of activities external to and including the Proposal is expected to be MODERATE for both salmon and herring. However, HIGH effects on salmon are less likely but could occur if migrating smolts or adults on spawning migrations were affected.

**CONCLUSION:** The effect of the cumulative case on fishes in the Sale 124 area is likely to be VERY HIGH, and the effect on salmon and herring in the Prince William Sound/Gulf of Alaska region is expected to be MODERATE. The overall effect of cumulative activities on fishes is likely to be VERY HIGH.

4. **Cumulative Effects on Marine and Coastal Birds:** The additive effects of other ongoing and future development occurring within and beyond the Arctic Region and OCS planning areas in Alaska within the summer and winter ranges of migratory seabirds, waterfowl and shorebirds and cumulative effects on bald eagles are discussed in this section. Migratory seabirds that occur in the Beaufort Sea Planning Area are affected by commercial fishing on their winter ranges in the Bering Sea and in the North Pacific. Migratory waterfowl and shorebirds are affected by onshore development on their winter ranges along the west coast of North America and along the Central Flyway, including development on wetlands in the midwest and southern US. Bald eagles are affected by oil transportation in Prince William Sound. The following development activities could have actual or potential habitat-destruction, environmental-contamination, and/or direct-mortality effects on migratory waterfowl, seabirds, and shorebirds that summer in the Arctic and seabirds and bald eagles occurring along oil tanker routes for arctic oil development.

a. **Oil Spills:** A total of 10 oil spills, each 1,000 bbl or more, is assumed to occur under the cumulative case. The cumulative risk of spill contact to the seabird-feeding area offshore of Point Barrow and to the Simpson Lagoon, Gwydyr Bay, Jago Lagoon, and Beaufort Lagoon Coastal-Concentration Areas (Fig. IV-C-4-1) would be greater than from the proposed action. Cumulative State of Alaska oil-industry activities also are likely to increase oil-spill-contact risks for the Simpson Lagoon, Gwydyr Bay, and Jago Lagoon seabird-Coastal-Concentration Areas (Fig. IV-C-4-1, Areas 3, 4 and 5). Bird habitats east of Jago Lagoon-Kaktovik are at little or no oil-spill risk from the base case or existing oil activities.

Potential oil spills--including a spill of 100,000 bbl or greater--from offshore oil activities associated with Federal, State, and Canadian leases could have the most noticeable effects on birds. Perhaps thousands or tens of thousands of birds, particularly oldsquaw, common eiders, and several species of seabirds, could be killed as a result of oil spills over the life of these projects. The species likely to suffer high mortality rates from oil spills include oldsquaw, common eider, and other sea ducks. The projected eight oil spills are likely to have MODERATE effects on very common species such as oldsquaw, because recruitment of birds from unaffected parts of the regional populations is likely to replace lost individuals within one generation. If a spill contaminated coastal saltmarshes, Pacific brant also may suffer high losses. The cumulative loss of Pacific brant from potential spills contacting coastal wetlands could have a HIGH effect on the regional population of this species because of its current depressed numbers. If an oil spill severely contaminated the Sag River Delta or Mackenzie River Delta, snow geese could suffer high mortalities. A large oil spill of 100,000 bbl or greater in the Mackenzie River Delta during the fall, when staging or molting concentrations of snow geese are present, would have HIGH effects on this species (Dome, Esso, and Gulf, 1982).

Potential future oil-spill effects from tanker transportation of arctic (offshore and onshore development) oil through Prince William Sound from the TAP terminal at Valdez could have serious cumulative effects on Gulf of Alaska and Prince William Sound marine and coastal bird populations. The 1989 tanker spill (11 million gal or 260,000 bbl of oil) probably killed at least 200,000 birds (local nesting seabirds plus overwintering waterfowl, shorebirds, and local raptor-bald eagle populations). Four months after the spill, oil still persisted in coastal habitats--and it remains in a viscous state such that it continues to foul and kill many more coastal birds. The actual level of effect of the spill on various marine and coastal bird populations has

not been determined at this time. The level of effect-recovery time for many Prince William Sound and Kenai Peninsula bird populations will be difficult or impossible to determine because little or no information was available on pre-oil-spill population levels for affected species. The best estimate of effect is that some local or portions of regional populations will experience long-term (several generations) effects (MODERATE to HIGH). VERY HIGH effects on some regional populations of murrelets and auklets are possible. If another large (greater than 100,000 bbl) tanker spill occurs in Prince William Sound, a similar long-term (several generations) MODERATE to HIGH effect on bird populations could occur depending on the season and size of the oil spill and species of birds to suffer the greatest loss.

The direct mortality of seabirds and waterfowl and the mortality of bald eagles from oil spills associated with oil-tanker traffic and other marine-vessel fuel spills (including fishing vessels and barge traffic) in the Bering Sea, Gulf of Alaska, and along the Pacific coast is well documented. The recent tanker spill in Prince William Sound has killed tens of thousands to perhaps over 200 thousand seabirds and seabirds and perhaps several hundred bald eagles. Large tanker spills (100,000 bbl or greater) and smaller oil spills (such as 10,000 bbl) from large fish-processing vessels can kill very large numbers of seabirds (100,000 or more) depending on the location and season. Such spills can have long-term (more than one to several generations) HIGH effects on migratory seabird populations occurring in the Arctic and along arctic oil-tanker-transportation routes in the Gulf of Alaska and in the northern Pacific.

b. Offshore Construction: About 40 exploration units (gravel islands, mobile bottom-founded-drilling platforms, drillships, and ice islands) have been used in the Beaufort Sea (see Table IV-A-4-1), and a total of several million cubic yards of gravel and dredge material have been used in the construction of gravel islands in Federal OCS waters, in State of Alaska waters, and in Canadian waters. The deposition of fill material and dredging activity has had LOW to perhaps MODERATE effects on some benthic organisms in local areas at or near island sites and dredge sites. However, the local loss of some benthic species has had VERY LOW effects on the availability of food organisms to marine and coastal birds that prey on a variety of fishes and invertebrates.

c. Onshore Construction and Development: The construction of hundreds of miles of roads and pipelines associated with oil fields in the Prudhoe Bay-Kuparuk area and future oil fields in the NPR-A, ANWR, and the Mackenzie River Delta would destroy some percentage of the available tundra-nesting habitat of several species of marine and coastal birds. The Prudhoe Bay-Kuparuk development encompasses over 1,000 km<sup>2</sup> of tundra habitats, of which a small percentage was altered or destroyed as a result of the construction of roads, pipelines, and gravel pads and the excavation of gravel quarries. The loss of bird habitat from any one of the development projects listed on Table IV-A-4-1 represents a LOW or VERY LOW effect on the availability of various tundra-habitat types used by nesting and feeding birds on the North Slope. However, the cumulative loss of tundra habitats from all the listed projects, particularly possible NPR-A oil exploration and development in the Teshekpuk Lake waterfowl-concentration area, ANWR oil development, and Mackenzie River Delta oil development in Canada, is likely to represent a MODERATE effect on the availability of tundra habitat for several species and may have a HIGH effect on the distribution and abundance of some species for more than one generation.

Agricultural development, the filling in of wetlands and cultivation of prairie grasslands, and urbanization and industrial development (construction of subdivisions, shopping centers, airports, and factory complexes) on the winter ranges and breeding habitats of North Slope waterfowl populations of the Pacific and Central Flyways has resulted in a very substantial loss of wetlands habitats (over 600,000 acres or more lost per year in the contiguous U.S.) in California, where only 10 percent of the original wetlands remain; in the prairie pothole region of western Canada and the U.S. midwest, where about 50 percent have been lost; and in the Mississippi bottomlands, where over 75 percent have been lost (USDOJ, FWS, 1986). OCS oil development offshore in the Gulf of Mexico has contributed about 8 to 17 percent of the total loss of wetlands along the Louisiana coast from the construction of navigation channels, pipeline canals, and other facilities (Van Horn, Melancon, and Sun, 1988). North Slope and Alaskan waterfowl populations, particularly pintail ducks, mallards, and probably white-fronted geese, have been affected by these habitat losses. The North American population of pintails has declined by over 50 percent in the past 10 years from 6.3 million in the 1970's to 2.9 million in 1985 (USDOJ, FWS, 1986). Waterfowl populations are not expected to recover from such losses for several generations (a VERY HIGH effect). Agricultural and industrial activities on land adjacent to some of the remaining wetlands (including protected wetlands such as wildlife refuges) have resulted in the contamination of these wetlands with high concentrations of toxins such as selenium, which has resulted in the deaths and reproductive failure of waterfowl populations and the long-term (several generations) contamination or poisoning of winter-range habitat. Such contamination reduces the winter survival of Alaskan waterfowl and shorebirds that use these habitats. The effect is expected to last a number of generations (a HIGH effect).

d. Noise and Disturbance: Considerable amounts of air and vessel traffic have been associated with petroleum exploration in the Beaufort Sea. For example, up to 1,200 helicopter trips per year associated with offshore development and an estimated 25 to 30 helicopter and fixed-wing aircraft flights per day have been projected for Canadian Beaufort Sea oil activities (Dome, Esso, and Gulf, 1982). Such high levels of traffic probably would result in some unrestricted low-elevation flights over concentrations of nesting, feeding, and/or molting birds. This disturbance is expected to have LOW effects on some flocks of birds. Considerable amounts of ground-vehicle and air traffic have been associated with onshore oil exploration and development on the North Slope. Several hundred gravel-truck passages per day are associated with the onshore construction of causeways, drill pads, roads, etc., in the expanding oil development around Prudhoe Bay. Most ground-vehicle activity associated with exploration occurs during winter with little effect on birds. However, frequent summer road traffic associated with oil development, particularly during construction periods (e.g. construction associated with the Endicott oil field), can greatly disturb molting waterfowl such as snow geese when they attempt to cross the roads. Although such disturbance events are likely to subside somewhat after construction is complete, some individuals of the species' population would continue to be disturbed by lower traffic levels throughout the life of the field.

During development of the Lisburne field, geese and swans appeared to be tolerant of vehicular traffic on roads during most of the seasons; but during brood rearing, their tolerance of vehicle traffic decreased and they moved farther away from roads, especially roads with heavy traffic (more than 18 vehicles/hour) (Murphy et al., 1988). The Lisburne development activities had no apparent effect on bird use of overall habitats in the area; however, some common species of shorebirds such as Lapland longspur, semipalmated sandpiper, and dunlin occurred in decreased abundance (birds and nests) adjacent to roads as compared to locations away from roads (Troy, 1988).

Noise and disturbance from air, vessel, and ground-vehicle traffic from any one exploration and development project are likely to have a LOW effect on marine and coastal birds. However, cumulative aircraft and ground-vehicle disturbance of snow geese, Pacific brant, and other species associated with NPR-A, Endicott, ANWR, and Canadian Mackenzie River Delta oil development are likely to cause these species to avoid parts of their nesting, feeding, and molting habitats on the arctic slope for less than one to two generations, representing a MODERATE to HIGH effect.

e. Habitat Loss from Agriculture and Other Development: The populations of four species of geese--cackling Canada geese, emperor geese, white-fronted geese, Pacific brant--and dabbling ducks (such as the common pintail) have declined drastically over the past 25 to 30 years (93%, 50%, 84%, and 17% declines, respectively, for the referenced geese populations and a decline of more than 50% for the pintail during the past 10 years) due primarily to the loss and degradation of wetland habitats on the winter range of these populations. The filling in of wetlands and cultivation of prairie grasslands, urbanization, and industrial development (construction of subdivisions, shopping centers, airports, and factory complexes) on the winter ranges and breeding habitats of North Slope waterfowl populations of the Pacific and Central Flyways has resulted in a very substantial loss of wetlands habitats. Over 600,000 acres or more have been lost per year in the contiguous U.S.; in California, only 10 percent of the original wetlands remain; in the prairie pothole region of western Canada and the U.S. midwest, about 50 percent have been lost; and in the Mississippi bottomlands, over 75 percent have been lost (USDOI, FWS, 1986). The OCS oil development offshore in the Gulf of Mexico has indirectly contributed about 8 to 17 percent of the total loss of wetlands along the Louisiana coast due to the construction of navigation channels, pipeline canals, and other facilities (Van Horn, Melancon, and Sun, 1988). North Slope and Alaskan waterfowl populations--particularly pintail ducks and mallards and probably white-fronted geese--have been affected by these habitat losses. The North American population of pintails has declined by over 50 percent in the past 10 years, from 6.3 million in the 1970's to 2.9 million in 1985 (USDOI, FWS, 1986). Waterfowl populations are not expected to recover from such losses for several generations (a VERY HIGH effect). Although there will continue to be abundant nesting habitat for the above geese and duck populations in Alaska, with high recruitment of young birds, the reduction in the amount of winter range and habitat carrying capacity is expected to limit or prevent the recovery of these waterfowl populations. Even reducing hunting pressure on these waterfowl populations is not likely to completely reverse the trend in continued population declines due to loss of winter-range habitats.

f. Increased Hunting Pressure: The hunting of waterfowl--particularly cackling Canada geese, white-fronted geese, emperor geese, and Pacific brant--on both the summer (Yukon-Kuskokwim Delta) and winter range (California) and along the Pacific Flyway (British Columbia, Washington, and Oregon) has increased as these areas have become more populated and the interest in hunting waterfowl has increased. Hunting pressure has undoubtedly contributed to the declines in these geese populations over the

past 25 to 30 years. However, current cooperative management of waterfowl hunting by the Yukon-Kuskokwim Delta villages and FWS has greatly reduced the loss of geese recruitment on the summer range. The excessive mortality of waterfowl due to hunting is likely to be a short-term (less than one generation), LOW effect in the future if cooperative management of hunting in Alaska continues and enforcement of sports-hunting regulations along the Pacific Flyway remains diligent.

g. Environmental Contamination from Industrial Development: Migratory waterfowl and shorebirds that occur in the Arctic can be affected by environmental contaminants (lead, selenium, insecticides, and other toxic organochlorine pollutants) on their winter range. Agricultural and industrial activities in California adjacent to some remaining wetlands (wildlife refuges) have resulted in the contamination of the wetlands with high concentrations of selenium and other toxic substances that have resulted in the deaths of several thousand waterfowl and the long-term (several-generation) contamination or poisoning of winter-range habitat. Such contamination reduces the winter survival of migratory waterfowl and shorebird populations that use this habitat. The effect is expected to last for generations (a HIGH to VERY HIGH effect).

The use of lead shot in the hunting of migratory waterfowl has been a contributing factor in the reduction of waterfowl populations (nesting success) through the ingestion of spent lead shot by the birds in wetland areas. Ingested lead shot is readily absorbed/digested by female ducks during the egg-laying period when they are calcium deficient (lead is taken up to replace the calcium in the bird). Further restriction and the eventual elimination of lead shot in waterfowl hunting should eventually alleviate or eliminate the poisoning problem (an estimated MODERATE effect).

h. Commercial Fishing in the North Pacific: Seabird mortalities due to marine oil spills are additive to the losses of seabirds that occur from the high seas (foreign) driftnet fishery in the North Pacific, Bering Sea, and Gulf of Alaska where an estimated 500,000 or more birds are incidentally killed each year. Such losses occur over a large geographic area in the North Pacific and probably do not seriously reduce the number of seabirds that nest at a particular colony. However, an increase in the intensity of the fishing effort could increase the take of seabirds. The growing exploitation of bottomfish, such as the pollock fishery in the Bering Sea and Gulf of Alaska, could significantly reduce the availability of prey to some seabird populations if pollock stocks were overharvested in the future. The present level of pollock harvest in the Bering Sea and Gulf of Alaska has apparently contributed to the recent drastic decline of northern sea lion populations in the southern Bering Sea and the Gulf of Alaska.

SUMMARY: Direct or indirect loss of several thousand birds from oil spills, including some 100,000-bbl-or-greater spills, is expected to have a MODERATE effect on very abundant species, such as oldsquaw and common eider, because population recovery would take one generation or less. The oil-spill effect on less abundant species' populations, such as Pacific brant, could take one to two generations for recovery (a HIGH effect). Habitat alteration from deposition of fill material and dredging associated with offshore exploration and production platforms and pipelines throughout development in the Beaufort Sea are likely to have LOW or VERY LOW effects on marine and coastal birds because the local loss of a small number of benthic-prey organisms is likely to have little or no effect on the availability of food organisms to all birds that feed on a variety of abundant fish and invertebrates. Cumulative habitat alteration and destruction from onshore-facility activities (such as gravel mining and road, pipeline, and drill-pad construction) are likely to have a MODERATE effect on the distribution or abundance of several species through the loss of several hundred square kilometers of nesting, feeding, and molting habitat. High levels of noise and disturbance from aircraft, vessel, and ground-vehicle traffic associated with cumulative oil development on NPR-A (Teshekpuk Lake area), Prudhoe Bay, Duck Island (Endicott), ANWR, and the Mackenzie River Delta are likely to cause a portion of some species' populations (such as snow geese and Pacific brant) to avoid parts of their feeding and molting habitats on the arctic slope for perhaps one generation, representing a MODERATE effect.

Interregional cumulative effects on migratory waterfowl populations occurring in the Arctic have been and are expected to be VERY HIGH. The primary contributing factors to this effect are the loss of wetlands and other habitats on the winter range of regional populations of geese and ducks and the contamination of some of the remaining wetlands by pollutants (insecticides, selenium, toxic compounds, and toxic trace elements) from adjacent agriculture and industrial development in the Pacific coast states and in the central and southern states. The effect of hunting overharvest of waterfowl on the summer range and fall flyway has been a LOW to MODERATE effect. The cumulative effect on migratory seabirds is expected to be HIGH. The primary contributing factors to this effect are oil spills (tanker, crude oil, and fuel oil) from marine-vessel traffic and mortality from commercial-fishing nets. The contribution of the Proposal to cumulative effects on migratory waterfowl and seabirds from additional noise and disturbance is expected to be

## MODERATE.

**CONCLUSION:** Cumulative effects from activities within the Arctic region combined with other activities within the range of migratory birds are expected to be **VERY HIGH** on migratory waterfowl, **HIGH** on migratory seabirds, and **HIGH** on shorebirds and on bald eagles.

5. **Cumulative Effects on Pinnipeds, Polar Bears, Belukha Whales and Sea Otters:** The cumulative effects of other ongoing and planned projects, as well as those for the base case, on ice seals (ringed, bearded, and spotted seals) and harbor seals; walruses; northern sea lions; sea otters; polar bears; and belukha whales are discussed in this section. Although the probability of any or all planned and ongoing projects reaching developmental stages is generally unknown, this analysis assumes that all the OCS projects (listed on Table IV-A-4-1) do reach developmental stages. These projects could affect marine mammals as a result of oil spills, noise and disturbance, and habitat alteration.

The additive effects of ongoing and future development occurring within the Beaufort, Chukchi, and Bering Seas in the summer and winter ranges of migratory fur seals, sea lions, ice seals (ringed, spotted, and bearded seals), walruses, and belukha whales occurring in the Arctic or occurring along oil-tanker transportation routes in the Gulf of Alaska and the North Pacific also are discussed in this section. The development activities listed below could have actual or potential adverse effects on the abundance or distribution of fur seals, sea lions, ice seals, walruses, and belukha whales.

### a. Effects of Oil Spills

(1) Arctic Region Planning Areas (Beaufort Sea, Chukchi Sea, and Hope Basin): Cumulative oil-spill risks to marine-mammal habitats would increase substantially over the spill risks from the base case, particularly during the winter season (10 oil spills are assumed in the cumulative case). The increase in spill risk to flaw-zone habitats from Camden Bay west to Point Barrow (Ice/Sea Segments 3 through 9, Fig. IV-C-5-1) could be attributed to oil activities associated with Federal OCS Sales 97, 87, 71, and BF and with Duck Island (Endicott) development. Spills that occur during the open-water season (summer) or that occur during the winter and persist in the sale area after meltout pose the highest risk to marine-mammal flaw-zone habitats offshore of Point Barrow and Smith Bay (Ice/Sea Segments 3, 4, and 5, respectively, Fig. IV-C-5-1). During the winter season, nonbreeding ringed seals, bearded seals, and polar bears could be exposed to cumulative oil spills that contact the ice-flaw-zone habitat or the SMA off Point Barrow. During the summer or open-water season, breeding ringed seals, large numbers of bearded seals, migrant ringed and spotted seals, walruses, and belukha whales in the far western Beaufort Sea could be exposed to spills that contact the flaw-zone habitat.

The most noticeable effects of potential oil spills from offshore oil activities associated with Federal (Beaufort Sea, Chukchi Sea, and Hope Basin OCS leases), State, and Canadian leases would be through contamination of pinnipeds--perhaps several thousand--and small numbers of polar bears. These species are likely to suffer low to moderate mortality rates as a result of this contamination; death may occur for several hundred to several thousand very young seal pups, more than 100 polar bears, more than 1,000 walrus calves, and highly stressed adult pinnipeds. These effects from an estimated 10 oil spills are likely to be **MODERATE** on pinniped (walruses and ringed and bearded seals) and polar bear populations; the effects on belukha whales, which are not likely to be affected by oil spills (Sec. IV.C.5), are likely to be **VERY LOW**. Regional populations of these arctic marine mammals are likely to replace within one generation the comparatively small numbers (a few hundred to probably less than a few thousand) individuals lost to oil spills.

Oil spills associated with cumulative oil and gas exploration and development (oil-well blowouts, pipeline spills, and particularly tanker or other marine-vessel fuel spills) in other regions are expected to have **MODERATE** (less than one generation) effects on individuals or groups of ice seals, walruses, or belukha whales that directly come in contact with an oil slick. Biological effects of such contact are expected to be sublethal for adult ice seals, walruses, and belukha whales, although some very young seals and walruses contaminated by the oil could die from physiological stress or from abandonment by the adult females. Oil spills are likely to have short-term (less than one generation), **MODERATE** effects on the abundance of migratory ice seals, walruses, and belukha whales. Oil spills are likely to have lethal effects on northern fur seals through the loss of thermal insulation (a **HIGH** effect is expected).

(2) Arctic Oil Transportation Through Prince William Sound and Gulf of Alaska: Potential future oil-spill effects from tanker transportation of arctic oil from the TAP terminal at Valdez through Prince William Sound could have serious cumulative effects on Prince William Sound and Gulf of

Alaska nonendangered marine mammals, especially sea otters. There also could be local effects on the survival of young harbor seals and perhaps northern sea lions if the spill occurred during the pupping season as did the 1989 Exxon Valdez tanker oil spill (11 million gal or 260,000 bbl of crude oil). Indications from scientific reconnaissance of the effects of the spill suggest that the local sea otter populations or a portion of the sea otter populations in Prince William Sound, Kenai Peninsula, and the Kodiak-Katmai Bay area were substantially reduced. The Prince William Sound sea otter population may have been reduced by at least 20 percent or more (estimated losses were 1,000 or more otters out of an estimated population of 5,000) (Irons, Nysewander, and Trapp, 1988). The Kenai Peninsula and Kodiak-Katmai Bay sea otter populations probably suffered similar losses. It is likely that local assemblages or populations of sea otters in heavily contaminated coastal areas of Prince William Sound will take more than one to two generations or 3 years or more (a HIGH effect) to recover from the spill. The oil spill also adversely affected the survival of harbor seal pups at pupping areas contaminated by oil.

The following effects could occur if one or more large tanker spills (greater than 100,000 bbl) occurred in Prince William Sound: a long-term HIGH (one to two generations), local (portion of a region) effect or a long-term regional (VERY HIGH) effect on sea otter populations and perhaps a short-term (less than or within one generation) effect (MODERATE) on the harbor seal population. Transportation of arctic offshore and onshore oil through TAP and by tanker through Prince William Sound is likely to have a HIGH effect on sea otters and a MODERATE effect on harbor seals.

b. Effects of Noise and Disturbance: In the Beaufort and Chukchi Seas, cumulative noise and disturbance effects on breeding ringed seals from on-ice seismic surveys are expected to have a LOW effect on ringed seals, because only a small percentage of the population (perhaps 3-5%) is likely to be disturbed, and even fewer pups are likely to be lost due to adult abandonment of maternity lairs (see Effects of Geophysical Seismic Activities under the base case, Sec. IV.C.5). Noise and disturbance of belukha whales during spring migration from icebreaker and vessel traffic in the Beaufort and Chukchi Seas could possibly have a MODERATE effect on the whales if spring migration of a portion of the whale population were delayed due to frequent vessel traffic in the ice-lead system, resulting in reduced availability of summer-feeding and -molting habitats (see Effects of Noise and Disturbance under the base case, Sec. IV.C.5). Cumulative noise and disturbance effects on other nonendangered marine mammals occurring in the Beaufort Sea from over 450 helicopter trips per year and perhaps over 200 vessel trips per year are expected to be LOW because the disturbance reactions of pinnipeds, polar bears, and belukha whales would be brief--with the affected animals returning to normal behavior patterns and distribution within a short period of time after the boat or aircraft has left the area--and no long-term development is likely to occur. Disturbance reactions are not likely to be additive. A MODERATE disturbance effect on polar bears is expected (see Effects of Airborne Noise under the base case, Sec. IV.C.5) if all coastal denning areas in Alaska and some maternity dens on the sea ice were abandoned because of noise and human presence near denning areas.

Some polar bears could be killed as a result of human-bear encounters near industrial sites and settlements associated with cumulative oil development. In the Northwest Territories, 15 percent (33 of 265) of the number of polar bears killed as a result of conflicts with humans occurred near industrial sites from 1976 to 1986 (Stenhouse, Lee, and Poole, 1988). Some of these losses are unavoidable and represent a small source of mortality (a LOW effect) on the polar bear population that would be replaced by recruitment within 1 year. Four bears were unavoidably killed after being attracted to offshore platforms in the Canadian Beaufort Sea over a 5-year period of intensive oil exploration (Stirling, 1988). The incidental loss of polar bears due to cumulative oil and gas development in the Arctic is unlikely to significantly increase the mortality rate of the polar bear population due to subsistence harvest and natural causes.

Migratory populations of belukha whales, walrus, and spotted, ringed, and bearded seals occurring in the Arctic have been exposed to oil-exploration activities (seismic surveying; drilling, air and vessel traffic, dredging, and gravel-dumping operations) in the Beaufort Sea and exposed to some of these activities in the Bering and Chukchi Seas. The exposure of the marine-mammal populations to the above activities and to other marine-vessel traffic (oil-field sealift-barge traffic to the North Slope and increased icebreaker activity in support of Chukchi Sea oil exploration) is likely to increase in the near future. These industrial activities are likely to have some short-term (less than one generation), LOW effects on the distribution of migratory seals, walrus, and belukha whales during the seasonal drilling season. If and when oil development occurs, some local changes in the distribution of some portions of the seal, walrus, or belukha whale populations could occur. However, some habituation of seals, walrus, and belukha whales to marine and air traffic, to industrial noise, and to human presence is likely to occur; and the displacement associated with cumulative industrial activities or coincidental to such activities is not likely to result in a significant reduction in the overall abundance, productivity, or distribution of fur seals, ice seals, walrus, and belukha whales in northern Alaskan OCS areas. Thus, the effects of future oil and gas development on migratory pinnipeds

and belukha whales are likely to be LOW.

c. Effects of Habitat Alteration: About 40 exploration-drilling units have been installed or constructed in the Beaufort Sea as a result of past Federal, State, and Canadian oil and gas leases. Several million cubic yards of gravel and dredge-fill material have altered a few square kilometers of benthic habitat in the Beaufort Sea. The cumulative effects of habitat alterations associated with platform construction or installation, dredging, pipeline burial, and causeways are expected to have LOW to MODERATE effects on some benthic organisms and some fish species but are likely to have a LOW effect on the availability of marine-mammal-food sources.

Exploration-drilling units and future production platforms throughout the Beaufort and Chukchi Seas and Hope Basin are expected to have local effects on ice movements and fast-ice formation around the structures. The local changes in ice movements and ice formation are likely to have a LOW effect on pinniped distribution. Natural variation in ice conditions and resulting changes in pinniped, polar bear, and belukha whale distribution are likely to reverse or overcome any local reduction in the distribution of these species associated with cumulative exploration and production platforms.

d. Effects of Other Activities

(1) Effects of Commercial Fishing on Migratory Fur Seals, Ice Seals, Walruses, and Belukha Whales: In the Bering Sea, the actual and potential effects of commercial fishing on fur seals, ice seals, walruses, and belukha whales include the following: (1) direct mortality from entanglement in fishing gear and from other interactions (shooting of marine mammals raiding fishing nets); (2) competition for prey/commercial-fish species that could reduce the availability of prey for marine mammals; and (3) displacement of marine mammals due to noise and disturbance from boats and aircraft associated with intense fishing activities. In Bristol Bay, the entanglement of belukha whales in the salmon gillnet fishery is an additive source of mortality for some pods of belukhas. In the Bering Sea, migratory spotted seals are likely to experience some mortality through entanglement interactions with the herring fishing operations along the coast. In the southern Bering Sea and Gulf of Alaska, entanglement of migratory fur seals in discarded fishing gear, as well as incidental catches of sea lions in bottomfishing trawl operations, are likely to be significant mortality factors in the 20- to 30-year decline of northern fur seal and sea lion populations (a HIGH to VERY HIGH effect).

Competition for fish (particularly pollock) is known to occur between migratory marine mammals and commercial fishing. The rapid increase in the bottom fishery in the Gulf of Alaska and southern Bering Sea is suspected to be the primary cause for the greater than 50-percent decline of northern sea lions in the past 30 years (a VERY HIGH effect). Other migratory pinnipeds have been less affected because they generally prey on smaller fish (smaller age-classes of pollock and other small fish) than those harvested in commercial fishing. At present, migratory ice seals (spotted, ringed, and bearded seals), walruses, and belukha whales occurring in the Arctic during the summer and occurring in the Bering Sea during the winter have experienced only LOW or VERY LOW effects (direct mortality or food-competition effects) from commercial fishing in the northern Bering Sea, which involves a much smaller number of operations (probably a few hundred boats) than operations occurring in the southern Bering Sea and Bristol Bay (thousands of boats and spotter aircraft). These marine-mammal populations are not exposed to such intense fishing activities during the winter months when they migrate to the southern Bering Sea. However, the amount of commercial-fishing activity has increased greatly in the northern Bering Sea, and migratory marine mammals are exposed to an increasing amount of vessels and air traffic associated with expanding commercial-fishing operations. There is no question that temporary displacement (minutes to hours to 2-3 days) of seals, walruses, and belukha whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and in Norton Sound (a LOW effect).

Longer displacement (several days to a few months) of some portions of migratory marine-mammal populations probably is occurring in areas of intense commercial-fishing activity. Up to 33 percent of the walrus herd that seasonally hauls out on Round Island in Bristol Bay apparently has been displaced from the area as a result of the bottom-trawl-fishing operations occurring near Round Island during the summer season (Lowry, 1989, oral commun.). This seasonal displacement of about 6,000 walruses to other haulout sites is not likely to have a significant adverse effect on the productivity and abundance of the walrus population but could represent a HIGH (several-generations) effect on the distribution of a portion of the population if this reduction in habitat use persisted for several years.

The overall effect of commercial fishing (including direct mortality from entanglement in fishing gear,

shooting, competition for prey/commercial-fish species, and disturbance/displacement from air and vessel traffic associated with commercial fishing) on migratory fur seals, ice seals, walruses, and belukha whales occurring has been MODERATE (on walruses, ice seals, and belukha whales) and VERY HIGH (on fur seals). Increases in the number of fishing vessels and related air traffic and increases in fish-harvest rates could result in long-term (several-generations) displacement of some of the other marine-mammal populations (walruses and spotted seals) occurring in the Bering Sea and in the Arctic (a HIGH effect). Such increase also could cause an increase in the direct mortality of some seals and belukha whales that interact with fishing operations in the Bering Sea and result in an increase in competition for prey/commercial-fish species that could result in a long-term (several-generations) effect on the productivity and abundance of part of the seal and belukha whale populations (a HIGH effect). The intense commercial bottom-trawl fishery for pollock and other bottomfish apparently has had a long-term effect on regional northern sea lion populations in the southern Bering Sea and in the Gulf of Alaska (a VERY HIGH effect).

(2) Effects of Hunting/Harvest on the Pacific Walrus Population: The annual harvest of Pacific walruses has more than doubled from the 1970's (3,000-4,000 animals) to the 1980's (6,000 to over 10,000 animals), with a total catch by both Soviet and American hunters at 10,000 to 15,000 per year or 4 to 6 percent of the population (Fay, Kelly, and Sease, 1989). During this same timeframe, scientific data on the productivity of the population indicated that herd productivity and calf survival declined sharply. As a result of the population reaching the carrying capacity of the environment, the increased harvest is occurring at the same time that the population is experiencing a natural decline in productivity (Fay, Kelly, and Sease, 1989).

Harvest/exploitation rates of over 10,000 walruses per year have caused the population to decline by about 50 percent according to Fay, Kelly, and Sease (1989), representing a HIGH effect on the walrus population in the past. A cooperative reduction in harvest rates by Soviet and American hunters would prevent such a population decline. However, some continued decline in the walrus population might continue into the next decade before any reversal or recovery of the population would begin (Fay, Kelly, and Sease, 1989). Optimistically, the international hunting of Pacific walruses still would have a MODERATE effect on the walrus population. International subsistence hunting of other pinnipeds and belukha whales is believed to have no more than a LOW effect on migratory seals and belukha whales.

SUMMARY: In the OCS Arctic Region Planning Areas (Beaufort Sea, Chukchi Sea, and Hope Basin), the cumulative effects on pinnipeds, polar bears, and belukha whales are expected to be MODERATE. In Prince William Sound, the cumulative effects are expected to be HIGH on sea otters and MODERATE on harbor seals. For migratory marine mammals, cumulative effects are expected to be VERY HIGH on northern sea lions, HIGH northern fur seals and walruses, and MODERATE on ice seals (ringed, spotted, and bearded seals).

CONCLUSION: Cumulative effects are expected to be MODERATE on ice seals, harbor seals, polar bears, and belukha whales; HIGH on northern fur seals, walruses, and sea otters; and VERY HIGH on sea lions.

## 6. Cumulative Effects on Endangered and Threatened Species

a. Bowhead Whales: Some effects on bowhead whales may occur from previously held State and Federal offshore lease sales. Generally, bowhead whales remain far enough offshore to be found mainly in Federal waters; however, in some areas (e.g., the Beaufort Sea southeast and north of Kaktovik and near Point Barrow), the whales do come close enough inshore to be present in State waters. If exploration and development and production activities occur on leases from State Sales 52 and 55, noise effects on bowhead whales may occur as described under the low and base cases. These effects could include local avoidance of vessels and drillships and of seismic-survey, dredging, drilling, and production operations that occur within several miles of the whales. Bowheads also may react briefly by diving in response to low-flying helicopters. It is unlikely that there would be any major changes in the overall fall-migration route resulting from noise associated with previous State lease sales.

Should an oil spill occur, effects on bowheads could include those discussed for the proposed action including inhalation of hydrocarbon vapors, a loss of prey organisms, ingestion of spilled oil or oil-contaminated prey, baleen fouling with a reduction in feeding efficiency, and skin and/or sensory-organ damage.

Three additional State oil and gas lease sales are scheduled for the Beaufort Sea in the next 3 years. If these sales occur, additional effects similar to those described for previous State lease sales could occur.

On their summer-feeding grounds in the Canadian Beaufort Sea, the whales may be subject to some noise and disturbance effects from activities associated with offshore oil and gas exploration and development and production. The main area of industry interest to date has centered around the Mackenzie Delta and offshore of the Tuktoyaktuk Peninsula. This area comprises a minor portion of the bowheads' summer range. Possible noise and disturbance effects to bowhead whales from helicopters, vessels, seismic surveys, and drilling would be as previously described. Bowhead whales would be exposed to the risk of oil spills from exploration, development and production, and transportation of oil from the Canadian Beaufort Sea. An estimated mean number of three spills of 1,000 bbl or greater is projected for the Canadian Beaufort Sea. Oil-spill effects on the bowhead whales would be as previously described.

It is expected that there would be very few effects on bowhead whales during their fall migration through the Chukchi and northern Bering Seas and on their wintering grounds in the Bering Sea. Currently, there are no plans for future oil and gas exploration activities in the Navarin Basin on Sale 83 leases. Based on past operation, exploratory drilling would take place most likely during the open-water season when bowheads are not present in the area.

Under the cumulative case, an estimated mean number of 10 oil spills (includes three from the Canadian Beaufort Sea discussed above) would be associated with the production period in the arctic region, and there is a greater than 99-percent probability of one or more spills greater than or equal to 1,000 bbl.

In the event a spill were to occur during the fall bowhead migration through the Beaufort and Chukchi Seas, effects as previously described for the proposed action could occur. These effects would generally be minor and transient unless whales were confined to an area of freshly spilled oil. After bowheads move westward past Point Barrow, they tend to fan out and cross the Chukchi Sea in a broad front. Consequently, this dispersion also reduces the risk of many whales contacting a fresh spill. Of course, if the spill occurred over a prolonged period of time, more individuals could be contacted. A low number of individuals could be killed as a result of prolonged contact with freshly spilled oil, particularly if spills were to occur within ice-lead systems. The probability of an oil spill adversely affecting fall-migrating bowheads in the Hope Basin is very low as most bowheads appear to migrate south within Soviet waters along the coast of the Chukchi Peninsula. If oil is spilled into the spring-lead system, effects may occur as described for the proposed action.

Noise effects on bowheads under the cumulative case could be expected to result from the projected 68 exploration and delineation wells, 11 production platforms, several hundred miles of offshore pipeline, 6,120 helicopter trips, and 605 mi<sup>2</sup> of shallow-hazards seismic surveys within the arctic region planning areas north of the Bering Straits in the U.S. range of the bowhead whale. Behavioral studies have suggested that bowhead whales habituate to noise from distant ongoing drilling, dredging, or seismic operations (Richardson, Wells, and Wursig, 1985; Richardson et al., 1985), but there is still some apparent localized avoidance (Davis, 1987). There is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely affect bowhead use of that area (Richardson et al., 1985b), and there has been no documented evidence that noise from OCS operations would serve as a barrier to migration.

It appears that exploratory activities would continue within the range of the bowhead whale for at least the next 10 to 15 years, and production would continue for about 40 years. Bowheads may encounter from one to several exploratory operations or production platforms along their fall migration route through the Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas. Bowheads would likely make small changes in swimming speed and direction to avoid closely approaching these operations.

Some minor disturbance to bowhead whales on their fall migration might occur in the vicinities of Point Barrow and Point Belcher. Support traffic (helicopters and vessels) would likely travel between Barrow and any exploration units or production platforms in the planning area. Bowheads would dive quickly if helicopters passed low overhead, and they would seek to avoid close approach by vessels. Most activities would occur during the approximate 10-year period of exploration and development. Once the production platforms and pipelines are in place, the whales would have relatively few noise sources to avoid.

In the Norton and Navarin Basin Planning Areas, if future exploration is confined to the open-water period as it has been in the past, there would be no OCS effects on bowhead whales since bowheads are not present during the open-water period. During production and if exploration does occur during the fall-spring period when bowheads may be present, effects on bowhead whales would entail local avoidance, as described previously. Effects to bowhead whales on their spring migration through the Norton and Navarin Basins

would be similar to those previously described for the fall migration.

A non-OCS activity that affects the bowhead whale is the annual subsistence harvest by Alaska Natives. Bowheads are taken in the northern Bering Sea and in the Chukchi Sea on their spring migration and in the Beaufort Sea on their fall migration. A quota of 44 strikes or 41 whales landed was authorized by the International Whaling Commission for 1989. This level of harvest was allowed under the supposition that it would still allow for slow growth in the bowhead population. It was assumed that in future years the bowhead whale population will continue to be monitored and that harvest quotas will be set in order to maintain a healthy bowhead population level.

Whenever vessels are nearby, whales would likely try to avoid being closely approached by motorized hunting boats; however, once the whales migrate out of the Beaufort Sea, there probably would be few whales interacting with hunters during the fall season, and none during the winter. As the bowheads migrate northward through northern Bering, Chukchi, and Alaskan Beaufort Seas during the spring, they are subject to being taken by subsistence whalers. A few whales also may be approached by Natives hunting seals and walrus. These whales would likely attempt to avoid being closely approached.

In summary, the other potential and existing projects within the migratory range of the bowhead whale population are not expected to increase the level of effect to this species above the MODERATE level. The cumulative effects from activities associated with the Proposal and other projects within the arctic region area combined with the other activities within the range of the migrating bowhead whale are expected to have MODERATE effects on the bowhead whale population.

**CONCLUSION:** It is expected that the overall cumulative effects on bowhead whales would be MODERATE.

b. **Gray Whales:** Most likely, cumulative effects to endangered gray whales would include an increase in noise and vessel disturbance and pollution (including oil spills) due to an increase in shipping activity and additional OCS lease sales.

Of concern is the cumulative effect of oil spills and other pollution associated with the projects described in Section IV.A. The cumulative case assumes oil discovery as well as probable development and transportation scenarios. Cumulative effects on gray whales could be significant if oil and gas development takes place throughout Alaskan and Pacific coastal waters, because gray whales are known to migrate through a number of proposed lease-sale areas (i.e., southern and central California, Gulf of Alaska/Cook Inlet, Kodiak, Shumagin, North Aleutian Basin, St. George Basin, Navarin Basin, Norton Basin, Hope Basin, Chukchi Sea, and Beaufort Sea). Effects of oil spills on individual gray whales would be as described in the base case; however, cumulative effects on the gray whale population in the arctic region would be greater because of the mean number of ten spills estimated for the cumulative case as opposed to one spill estimated for the base case. More individuals, therefore, are likely to be contacted. The greatest effects would be expected as a result of spills within gray whale summer-feeding areas when whales are present.

The installation of drilling units and production platforms and the emplacement of oil and/or gas pipelines may disturb or degrade some areas of gray whale benthic or feeding habitat. Some whales may be excluded from feeding within a few hundred meters of drilling units and production platforms. However, areas disturbed would likely be a very small percentage of available habitat, which is expected to result in a small effect on the gray whale population. Discharges of fluids from drilling units and production platforms are not expected to significantly reduce gray whale-food resources.

Cumulative acoustical disturbance from proposed Federal lease sales would affect endangered gray whales, although habituation to some forms of acoustical disturbance is likely. It is believed that responses to the increased ambient-noise levels would be similar to those described in the low and base cases but may last many years for the cumulative case instead of the few years that are expected for the base case. For the gray whale, offshore development associated with the base case would constitute a minor portion of total acoustical stimuli. If several proposed sales yielded large discoveries of oil and gas, the cumulative effects of production activities and resultant increases in human activity, increased localized or shipping-corridor disturbance, pollution, oil spills, or disturbance are expected to result in LOW effects on the gray whale. Cumulative industrial disturbance to migration would appear to be greatest at locations where tanker traffic resulting from several sales may be focused (i.e., Unimak Pass) and may result in alterations of migration routes and/or timing.

Gray whales breed and calve in the various lagoons of Baja California (January to March) and then migrate

to their northern summer-feeding areas in the Bering and Chukchi Seas. The southerly migration to their breeding grounds begins in October. The majority of the gray whale population passes through Unimak Pass during their north and southbound migrations.

Currently, the major effect-producing agents affecting this species are noise and disturbance from vessels and OCS activities, entanglement in gillnets, and the risk of oil spills. Effects from some of these agents exist on the entire length of this species' range.

Whales are known to respond to noise from vessels of any size, typically react when a boat is within a few miles, and actively avoid a vessel within a mile. Gray whales are most sensitive to vessels in their calving lagoons. However, three of five major calving lagoons are designated as National Refuges by the Mexican Government, and vessel traffic is restricted. Noise- and disturbance- effects activities associated with OCS proposed oil and gas exploration in the Alaska/Pacific Regions include geophysical surveys, exploration drilling, and aircraft and vessel support traffic. Whales generally tolerate noise and disturbance associated with the drilling activities within 3 to 5 miles and show avoidance generally within 3 miles. Noise associated with geophysical surveys is potentially the most disruptive of OCS-related noise and disturbance since it is not the chronic, routine noise from a stationary source to which wildlife generally habituate. Miles (1984) reported that 430,000 miles of survey lines were conducted off the Pacific Coast between 1964-1983 with the number of miles of line increasing steadily per year from 2,000 line miles in 1964 to 64,000 line miles in 1983. Approximately half of these surveys were conducted during the whale migration, yet the number of gray whales has steadily increased since 1937. Over the past 15 years, during which time geophysical-survey activity has increased 5 percent, the gray whale population has continued to grow at a rate of about 2.5 percent. Therefore, it appears that, at least at the current level, geophysical operations have had no overall harmful effect on the population.

An undetermined number of whales drown after becoming entangled in gillnets each year. Gillnetting has been documented as the cause of death for several gray whales found stranded on California beaches (1 of 8 in 1983 and 4 of 21 in 1984) (Seagers et al., 1986). Mortality caused by gillnetting entanglement is expected to continue, if not increase, in the future.

The most serious effects of an oil spill on the gray whale would occur on the summer-feeding grounds or winter calving grounds. As tanker routes are well offshore of the calving grounds in Baja Mexico, the chance of an oil spill affecting the calving lagoons is unlikely. Since there is currently no tankering of oil north of the Aleutian Island Chain, there is no chance of an oil spill on the feeding grounds in the Chukchi and Bering Seas. Therefore, the most likely time a gray whale would come in contact with tanker-spilled oil is during migration. Since gray whales have completed a successful migration through the Santa Barbara oil spill and negotiate the natural oil seeps in the Santa Barbara Channel twice yearly, effects on migrating gray whales from a large oil spill from tankering are expected to be MODERATE. The probability of an oil spill from exploration drilling due to proposed lease sales in the Alaska/Pacific Regions is negligible and, therefore, would not produce the same oil-spill-effect potential as oil tankering.

The gray whale is by far the most abundant of the endangered cetaceans and has steadily increased in numbers since it was given protection from whaling. The population is currently estimated at 21,000, which is above precommercial whaling levels (Breiwick et al., in press). This indicates that the current level of cumulative effects to the gray whale is not at a level that threatens population growth.

In summary, the other potential and existing projects within the migratory range of the gray whale population are not expected to increase the level of effect to this species above the MODERATE level. The cumulative effects from activities associated with the Proposal and other projects within the arctic region area combined with the other activities within the range of the migrating gray whale are expected to have MODERATE effects on the gray whale population.

**CONCLUSION:** The overall cumulative effects on gray whales are expected to be MODERATE.

c. **Arctic Peregrine Falcon:** Proposed Sale 124 and other Federal OCS lease sales are expected to contribute only slightly to cumulative factors that may affect the arctic peregrine falcon. Onshore projects have greater potential for adverse effects, but noise and oil-spill effects (such as those described for the base case) from Federal OCS lease sales should have only occasional, brief, adverse effects on the arctic peregrine falcon population. The cumulative effect of all OCS lease sales throughout the range of the arctic peregrine falcon would, however, have slightly greater effects than the proposed action and is expected to result in a LOW effect on the population.

The arctic peregrine falcon nests during the summer in the arctic regions of Alaska and Canada and winters in Central and South America. The population suffered severe declines in the 1960's and 1970's due primarily to reproductive failure attributed to bioaccumulation of pesticide residues (primarily chlorinated hydrocarbons). The Norton Sound local population comprises part of the Alaska west coast population estimated at 20 to 30 pairs. The total Alaska population is estimated at 80 pairs and 120 young. It is a gradually increasing population with lower levels of pesticide contamination (FWS, 1987; Ambrose, 1988, oral commun.).

Primary effect-producing agents are pesticides and other toxic contaminants, habitat destruction, and noise and disturbance. The ban of DDT use in the United States has greatly reduced the bioaccumulation and reproductive failure of the peregrine falcon; however, the continued use of toxic pesticides (including DDT) in Third World countries of Central and South America results in a persistence of the contamination in the peregrine. Large-scale habitat destruction in these countries (clearing of forests for agriculture production) could contribute to a slow recovery for the peregrine falcon. Habitat destruction of wetlands along migration routes and within feeding territories of nesting sites also inhibit the recovery of the species.

Noise and disturbance near nest sites could cause some nestling mortality. A minor threat to the peregrine falcon would be from oil spills. Peregrines tend to capture their prey in flight, and it is unlikely that spilled oil would contact the falcons directly. However, it is possible that peregrines could be oiled while feeding on partially oiled seabirds, waterfowl, or shorebirds. Also, peregrines could be affected by a reduction in prey availability if many birds in the area are contacted by spilled oil and die.

Since the arctic population has been recovering and has been delisted to a threatened status from endangered, the current overall cumulative effects to the species throughout its range have not resulted in the decline of the population nor deterred the gradual recovery of the species.

In summary, the additive effect of the activities associated with the Proposal and other projects within the arctic region are not expected to increase the level of cumulative effect for the arctic peregrine falcon population above the LOW level throughout its range. The cumulative effects from activities associated with the Proposal and other projects within the arctic region area combined with the other activities within the range of the migrating arctic peregrine falcon are expected to have LOW effects on the arctic peregrine falcon population.

**CONCLUSION:** The overall cumulative effects on arctic peregrine falcons are expected to be LOW.

7. **Cumulative Effects on Caribou:** The additive effects on caribou of other ongoing and planned projects, as well as the base case, are discussed in this section. Although the probability of any or all planned and ongoing projects reaching developmental stages generally is unknown, this analysis assumes that all the projects discussed in this section do reach developmental stages. Motor-vehicle traffic along over 500 km of existing pipeline roads and an additional several hundred kilometers of future pipeline roads associated with these projects could disturb and displace caribou and alter or destroy some calving and summer range through facility construction (see Sec. IV.A.4).

Oil and gas activities associated with proposed Sale 124 and the other offshore and onshore projects would subject caribou herds and their summer ranges and calving ranges throughout the North Slope to a variety of oil-development projects (see Table IV-A-4-1). Potential oil spills from offshore as well as onshore oil activities associated with Federal, State, and Canadian leases are likely to have a LOW effect on the caribou herds in general, since comparatively small numbers of caribou are likely to be contaminated or ingest contaminated vegetation and die as a result of oil spills (see Sec. IV.C.7).

a. **Noise and Disturbance:** The primary sources of disturbance of caribou are ground-vehicle traffic, aircraft traffic, and human presence near cows with newborn calves. Disturbance of caribou associated with cumulative oil exploration (particularly by helicopter traffic) is expected to have LOW effects on some caribou (particularly cow/calf groups), with animals being briefly displaced from feeding and resting areas when aircraft pass nearby. During development, the greatest concern from ground-vehicle/road-traffic disturbance of caribou is disturbance associated with roads adjacent to pipelines. Caribou are most hesitant to cross (1) under an elevated pipeline adjacent to a road and (2) when motor-vehicle traffic is present on the road. The success of crossing a pipeline-road complex in the presence of traffic depends on motivation. During the mosquito-oes-trid fly seasons, caribou are highly motivated to seek relief from insect harassment; and the frequency of crossing pipelines in the Prudhoe Bay-Kuparuk area increases (Curatolo, 1984), although increases in the percentage of disturbance reactions tend to reduce crossing frequency. However, caribou do successfully cross pipeline-road complexes and numerous highways in Alaska and Canada with no

apparent effect on herd distribution, abundance, or integrity. Cumulative disturbance of caribou (outside of the calving area) from road traffic (several hundred vehicles/day) associated with pipelines (over 3,000 km in the cumulative case) are expected to cause LOW to MODERATE or short-term disturbance of caribou. Road traffic temporarily delays the successful crossing of pipelines and roads by some animals but has no effect on herd abundance or overall distribution. The only exception to this level of effect may be when disturbance levels are very high and development facilities (drill platforms, pump stations, roads, etc.) on the calving grounds themselves are spaced close together (within about 100-200 m) and cause some displacement--local change in distribution of some cows and calves from within about 4 km of some pipeline roads that cross concentrated calving areas (Dau and Cameron, 1986).

At present, cumulative oil development in the Prudhoe Bay-Kuparuk area (total of 1,797 km of pipelines, 553 km of roads, and 2,847 ha of habitat covered by facilities [Appendix E]) has caused minor displacement of CAH caribou from a small portion of the calving range (estimated 5%) with no apparent effect on herd abundance or overall distribution. The cumulative displacement of cow/calf groups from additional portions of the calving ranges (estimated 25%) with the development of additional oil fields in the Prudhoe Bay-Kuparuk area (see Table IV-A-4-1), in the NPR-A (14% of the Western Arctic herd [WAH] calving range), and as a result of ANWR and Canadian oil development (about 30% of the Porcupine caribou herd [PCH] calving area), could represent a long-term displacement of caribou from available calving habitat and have a HIGH effect on the distribution of one of these caribou herds (or populations).

b. Displacement from Calving Areas: At present, oil development in the Prudhoe Bay-Kuparuk River area has caused displacement of some cow caribou from within an estimated 4 km of some pipelines, roads, and other facilities on the existing Prudhoe Bay and Milne Point oil fields but not on the Kuparuk Oil Field.

There are significantly fewer cow and calf caribou numbers occurring within 4 km of Milne Point facilities (the 11-km-long pipeline and road from Milne Point) in comparison to caribou numbers occurring on habitats beyond 4 km (Smith and Cameron, 1986). This small amount of displacement has had no measurable effect on the abundance or growth of the Central Arctic herd (CAH), which has been increasing annually by about 13 percent. At present, oil development has affected an estimated 5 percent of the calving range of the CAH, and oil-company leases presently include about 25 percent of the CAH calving and summer ranges. Future State oil-lease sales in the Kuparuk Uplands (Sales 47 and 48), Prudhoe Bay Uplands (Sale 51), and North Slope Foothills (Sale 57) will increase the amount of oil leases on the CAH range. If the U.S. Congress allows ANWR oil development, another perhaps 5 to 10 percent of the CAH calving range could be exposed to oil development.

If full-scenario oil development were to occur on NPR-A within the Utukok River calving area, an estimated 14 percent of the WAH's calving range could be exposed to development facilities, while full-scenario oil development within the Teshekpuk Lake area could expose 20 percent of the Teshekpuk Lake herd (TLH) calving range to development (USDOI, BLM, 1983). Oil development on ANWR could expose 78 percent of the core-calving range of the PCH to oil development (Elison, Rappaport, and Reid, 1986). Assuming cow-calf displacement within 4 km of potential ANWR oil-development facilities (several hundred kilometers of roads, pipelines, drill platforms, etc.), an estimated partial displacement (some cows and calves) of over 37 percent of the core-calving area could occur (USDOI, FWS, 1987). The reduction in use of calving and summer range by some cow and calf caribou on 37 percent of the PCH core-calving range, 20 percent of the TLH calving range, 5 to 25 percent of the CAH calving range, and 14-percent of the WAH calving range could occur as a result of the displacement of some cow and caribou within 4 km of oil-development facilities.

Assuming this displacement (reduction in habitat use) persists beyond the construction period and lasts for more than one generation, it is expected to represent a HIGH effect on the distribution of the various caribou herds (WAH, TLH, CAH, and PCH) occurring in the Alaskan Arctic.

The reduction in calving-habitat use within 4 km of oil-development facilities could, in theory, eventually limit the growth of the arctic caribou herds within their present ranges and may prevent the herds from reaching the maximum population size that they could achieve on their present ranges without the presence of development. However, such an effect is unlikely to occur because natural changes in the distribution and productivity of the herds are likely to influence the abundance and growth of caribou herds over and above the reduction in habitat use caused by cumulative oil development. Changes in caribou distribution on and near the above oil-development projects may persist over the life of the oil fields in the Arctic and represent a HIGH effect on caribou distribution.

c. Habitat Alteration and Destruction: Cumulative oil development in the Prudhoe Bay-Kuparuk area encompasses over 800 km<sup>2</sup>, and hundreds of miles of gravel roads cross a major portion of the calving range of the CAH. However, a small (perhaps 1-3%) percentage of the tundra-grazing habitat has been destroyed or altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located. The cumulative loss of range habitat from facility construction in future oil development (such as in the NPR-A and ANWR) also would represent a small percentage of the available grazing habitat of the WAH and the PCH, respectively, and is likely to represent LOW or VERY LOW habitat loss.

d. Roads: The development of more transportation corridors in support of oil development on the North Slope--particularly several hundred kilometers of roads that eventually will be open to the public--would increase human access to the North Slope caribou herds, which would result in increased hunting pressure and perhaps overharvest of some of the herds. Legal hunting of caribou south of the oil fields along the Dalton Highway is not permitted within 5 mi of the highway. Thus, noise and disturbance associated with gunshots/caribou harvest are not likely to have any effect on caribou movements across the Dalton Highway and other North Slope roads. Caribou have continued to cross roads-highways, even when subject to heavy hunting pressure and subject to increased noise and disturbance associated with hunting (Valkenberg and Davis, 1986).

e. Overall Cumulative Effects: Combined onshore oil and gas activities proposed and ongoing in the Prudhoe Bay, NPR-A, ANWR, and Canadian Mackenzie River Delta are likely to have some HIGH effects on the distribution of caribou herds if significant parts of the core-calving areas of either the WAH, CAH, TLH, or the PCH were avoided for one or two generations and resulted in a reduction in caribou distribution (a HIGH effect). Motor-vehicle traffic associated with transportation facilities from Federal and State offshore oil activities are likely to have brief or LOW cumulative disturbance and habitat effects on caribou.

Cumulative reduction in habitat use near facility-construction projects (such as gravel mining, roads, pipelines, and drill pads) and caribou avoidance (cows with calves) of habitat areas with continuous high levels of road (perhaps 50 or more vehicles/hour) and air traffic (of perhaps several hundred flights/day) could have a HIGH effect on the distribution of one or more of the Arctic North Slope caribou herds by displacing some portion of the caribou herds from part of the calving and summer ranges for one or two generations. In theory, a HIGH effect on caribou abundance is possible if the displacement-avoidance of calving habitat caused a long-term reduction in herd productivity, leading to a population decline that lasted several generations. However, such an effect is not evident because present levels of onshore oil development in the Prudhoe Bay area have not demonstratively affected the abundance (a VERY LOW effect) of any caribou herds on the North Slope. The construction of several hundred to perhaps over a thousand kilometers of roads in support of oil development would increase human access to the arctic caribou herds. The resultant increased hunting pressure on the herds could lead to overharvest. However, existing hunting regulations are likely to prevent excessive overharvesting of any of the caribou herds on the North Slope.

The United States and Canada initialled a draft agreement on the conservation of the PCH in December 1986. This agreement would provide for an International Porcupine Caribou Board to share information on the conservation of the herd; assist in cooperative conservation and planning for the herd throughout its range; review available data; and, as necessary, make recommendations to the respective governments concerning matters that affect the herd or its habitat. This agreement could help minimize cumulative effects on the PCH.

CONCLUSION: Cumulative effects on caribou are expected to be HIGH.

#### 8. Cumulative Effects on the Economy of the North Slope Borough

NSB Revenues and Expenditures: Cumulative-case projects could provide additional revenues to the NSB in the form of property taxes and provide additional employment opportunities for residents. Projects that increase NSB property-tax revenues probably would allow increased NSB hiring of residents. Projects that expand employment opportunities in the region without significantly increasing NSB property-tax revenues are likely to generate strong interest in employment from residents. The expected economic effects of the cumulative-case projects are considered by category--existing developments, exploration and potential development, and future lease sales. Most of the existing developments were considered as part of the existing-conditions case. The remainder of the existing developments that were not considered are expected to have VERY LOW economic effects and only marginally increase the economic benefits. Projects under

exploration and potential development are expected to have MODERATE economic effects and moderately increase the economic benefits. Future lease sales would have MODERATE economic effects. Part of this would be due to negative effects to the subsistence economy as discussed for the base case of this Proposal. The total economic effects in the cumulative case are expected to be HIGH.

The overall revenue and employment effects of these projects would be beneficial, but the magnitude and timing of these effects are extremely difficult to estimate. Major uncertainties exist about future world-energy prices; arctic-development technology; scale, timing, and location of developments; and hiring practices. If and when these factors result in a downturn of development activity, households (especially in the smaller communities) may have trouble maintaining standards of living attained during boom periods.

**CONCLUSION:** Cumulative effects on the economy of the NSB are expected to be HIGH.

9. **Cumulative Effects on Sociocultural Systems:** Cumulative effects on sociocultural systems include effects of the proposed action and other ongoing or planned projects on the North Slope and in the western Canadian Arctic. (For a complete list of these ongoing and planned projects, their scenarios and timetables, and the resource estimates involved, see Sec. IV.A, Table IV-A-4-1, and Appendix E.) The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stage.

In the cumulative case in the Beaufort Sea Planning Area, pipeline landfalls and shore bases may be constructed at Point Belcher, Pitt Point, Point Thomson, Oliktok Point, and Bullen Point under proposed scenarios for Sales 87, 97, and 109 and also for proposed Sale 124. In the cumulative case, it is assumed that Wainwright, Barrow, Nuiqsut, and Kaktovik will be used--some communities more than others--as air-support bases for exploration activities; and Wainwright, Barrow, Atkasuk, Nuiqsut, and Kaktovik subsistence-harvest patterns are expected to experience VERY HIGH effects in this case (see Sec. IV.I.10). Also, in the FEIS's for Sales 87, 97, and 109, VERY HIGH cumulative-case effects of displacement of sociocultural systems are described for the communities of Barrow, Wainwright, Nuiqsut, Kaktovik, and Atkasuk. These EIS's are, respectively, for the Diapir Field, Beaufort Sea, and Chukchi Sea (USDOI, MMS, 1984, 1987a, and 1987b, respectively).

As in the proposed action, the effects of projects in the cumulative case on sociocultural systems would occur because of changes in social organization, cultural values, and other issues, such as stress on social systems.

a. **Social Organization:** In the cumulative case, effects on social organization could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the proposed action; however, the level of effects would be increased due to the intensity of activity in the cumulative case. Additional air traffic and growth in the number of non-Natives in the North Slope region would increase the interaction between Natives and non-Natives and could cause additional stress between these groups. Increases in population growth and employment would be long term in the cumulative case and would cause disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence-production and -consumption levels, (2) extended families, and (3) informally derived systems of respect and authority (primarily respect of elders and other leaders in the community). HIGH cumulative-case effects on subsistence-harvest patterns (which also would be long term in the cumulative case) would affect the Inupiat social organization through disruptions to their kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence task groups could cause a breakdown in family ties and the communities' well-being as well as tensions and anxieties, leading to high levels of social discord. In the cumulative case, these disruptions to the social organization would be long term and would cause displacement of the existing social organization.

b. **Cultural Values:** In the cumulative case, effects on cultural values could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the proposed action; however, the level of effects would be higher due to the intensity of activity in the cumulative case. HIGH cumulative-case effects on the social organization would lead to a decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood and to an increased emphasis on individualism, wage labor, and entrepreneurialism. Increased interaction with oil-industry workers in the cumulative case also would result in increased stress and strain on traditional Inupiat institutions. Additionally in the cumulative case, HIGH long-term effects on subsistence-harvest patterns are expected. Chronic, long-term disruptions of subsistence-harvest patterns would affect subsistence task groups, have a tendency to displace sharing

networks, and consequently cause a decrease in the importance of subsistence as a cultural value.

c. Other Issues: Increases in social problems--rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide--also are issues of concern in the cumulative case. The NSB already is experiencing problems in the social health and well-being of its communities; however, additional development (including offshore oil development) on the North Slope would lead to further disruptions of their social health and well-being. Historically, it is suggestive that abuse of alcohol and increased violence seem to be somewhat connected to the increased flow of income into North Slope communities. During the peak of commercial whaling and then again during the height of the fur trade, secondary sources indicate the onset of socially dysfunctional behavior. During the economic declines following these periods, drinking and violence seemed to ebb. Recent evidence of the effects of employment during and just after World War II loosely substantiate this generalization. Lacking clear, incontrovertible evidence, it still could be assumed that the significant social changes encouraged and abetted by the huge cash flows from onshore oil development to date have played at least some role in the expression of these problems. It is also likely that these social changes in the North Slope have contributed to the extremely high rate of suicide among the Inupiat (90.8 per 100,000 for the Inupiat versus 35 per 100,000 among the Yupik [Travis, 1989]). These long-term effects in the cumulative case would cause a displacement of existing sociocultural institutions--a VERY HIGH effect.

Cumulative effects on sociocultural systems would be VERY HIGH in Wainwright, Barrow, Nuiqsut, and Kaktovik because MAJOR (HIGH to VERY HIGH) effects are expected from Sale 97 (Barrow and Wainwright), Sale 87 (Barrow only), and Sale 109 (Wainwright). LOW effects are expected in Atkasuk in the base case. These effects would increase slightly in the cumulative case; however, the overall effect would remain LOW.

CONCLUSION: Cumulative-case effects on sociocultural systems are expected to be VERY HIGH.

10. Cumulative Effects on Subsistence-Harvest Patterns: Cumulative effects on subsistence-harvest patterns include effects of the proposed action and other ongoing or planned projects on the North Slope and in the western Canadian Arctic. (For a complete list of these ongoing and planned projects, their scenarios and timetables, and the resource estimates involved, see Sec. IV.A, Table IV-A-4-1, and Appendix E.) The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stage. As for the proposed action, the effects of these projects on subsistence may occur because of oil spills, noise and traffic disturbance, or disturbance from construction activities associated with the pipelines and the shore-base facilities. Noise and traffic disturbance might come from seismic activities; from constructing, installing, and operating drilling facilities; from supply efforts; or from the tankering of oil from the Canadian Arctic.

a. Oil Spills: The effect of a single oil spill would be the same under the cumulative case as it would be under the base case. However, the probability of a North Slope community experiencing the effects of one or more oil spills is substantially higher in the cumulative case than it is for the proposed action. In the cumulative case, there is a 99-percent chance of an oil spill of 1,000 bbl or greater occurring. Since oil spills associated with the Chukchi Sea Planning Area (OCS Sale 109) tend to move westward (away from the coast), most of the increased probabilities of contact in the cumulative case occur within the Beaufort Sea Planning Area. The most likely number of oil spills of 1,000 bbl or greater increases from one in the base case to eight in the cumulative case. It is estimated that one of these cumulative-case spills would be 100,000 bbl or greater.

For Sale 97, which affects the same area as Sale 124, MODERATE effects are expected from oil spills. In Sale 109, which affects Wainwright, Barrow, and Nuiqsut, MODERATE effects are expected from oil spills. In the base case for proposed lease Sale 124, MODERATE effects are expected to occur on subsistence-harvest patterns.

In the cumulative case as in the proposed action, an oil spill during the winter would adversely affect seal and polar bear hunting. During the spring, the harvests of bowhead whales could be affected; during the open-water period, the harvests of bowhead whales, belukha whales, seals, waterfowl, and anadromous fishes could be affected. Due to the short harvest period, an oil spill during the bowhead whale harvest could cause the harvest to be curtailed for that season, particularly in a year when the harvest period is shortened due to poor weather conditions--a MODERATE effect. Because a harvestable species is more likely to experience the effects of several oil spills in the cumulative case than it is in the proposed action, the likelihood of a higher effect level also is greater. Oil spills also could affect the harvests of fish. As in the proposed action,

spills are not likely to affect the population size of harvestable fish species that migrate up rivers. In the cumulative case, however, the ocean netting of anadromous fish, particularly salmon and capelin, is of concern. An oil spill that contacted areas of subsistence-fish harvests of anadromous fish could eliminate the subsistence harvests of salmon and/or capelin for 1 year or possibly more.

Overall cumulative effects on subsistence-harvest patterns in the Sale 124 area as a result of oil spills are expected to be MODERATE, the same as for the base case.

b. Noise and Disturbance: Short-term effects from the construction of onshore-support facilities and pipelines could cause short-term disruptions to caribou hunting and waterfowl hunting. Noise and traffic disturbance from the construction of such onshore facilities are expected to have short-term and LOW effects on caribou harvests. Landfalls and shore-base facilities may be constructed at Point Belcher, Pitt Point, Point Thomson, Oliktok Point, and Bullen Point under the proposed scenarios for Sales 87, 97, and 109 and also for proposed Sale 124. Wainwright may experience such effects from the construction of a pipeline from TAP to Point Belcher; Barrow and Nuiqsut may experience such effects from the construction of an onshore pipeline from TAP to Oliktok Point and an offshore pipeline from this point to Harrison Bay; Nuiqsut may experience such effects from the construction of a pipeline to Point Thomson; and Kaktovik may experience such effects from the construction of a pipeline to Bullen Point. Certain birds, such as white-fronted geese during their spring migration, are reported to avoid areas where they see movement on the ground. Thus, construction activities could cause them to avoid one or more locations that would otherwise serve as productive hunting sites. However, this effect should be limited to the immediate location of construction activities.

Noise and traffic disturbance from onshore facilities also may affect maritime-subsistence activities. The increased amount of oil-related traffic in the cumulative case makes it likely that subsistence-harvest activities may be occasionally disrupted by boat and air traffic. Since most marine-hunting activities occur within a wide area of ice in open water, normally such interruptions may cause boat crews to hunt longer or take extra trips but may not reduce the overall harvests of marine mammals or waterfowl.

Belukha whales are not as likely as bowhead whales to avoid industrial activities in the Arctic. Although belukha whales can react to active icebreaker noise 35 to 50 km away from the source (Sec. IV.C.5), it is not anticipated that this reaction to noise would cause interference to the belukha whale harvests. Disruptions are most likely to be short term and not expected to affect harvest levels. In the early summer, belukhas are harvested in the pack-ice leads. Vessels--other than icebreakers--probably would not be in the leads at that time because it is too dangerous; however, icebreakers or platforms in the area could cause disturbance (Sec. IV.C.5). In the cumulative case, because the belukha hunting season for Barrow, Wainwright, Nuiqsut, and Kaktovik takes place under two different conditions (in ice leads and in open water) and hunting is possible at different times over a 6-month period, noise and traffic disturbance would be expected to cause some effects but would not cause the harvest to be unavailable (LOW effects) during the belukha hunting season.

Also as explained for the proposed action, because of their short and ice-condition-dependent seasons, bowhead whale harvests are more likely to be affected by noise and traffic disturbance than are other forms of marine-mammal hunting (other than belukha whaling). Construction of a pipeline and landfall at Point Belcher would take approximately 3 years. It is likely that disturbance to the bowhead whale harvest could occur longer than 2 to 5 years; it is less likely that the harvest would not be obtained for more than a year. Already, such activities may have occasionally affected subsistence hunting. For example, Kaktovik whalers related to oil-development activities. Because of its greater intensity, vessel and helicopter traffic is more likely to affect bowhead whaling in the cumulative case than in the base case. Cumulative-case effects on the bowhead whale harvest are expected to remain HIGH, as in the base case.

The amount of seismic surveying would increase substantially in the cumulative case. However, even with this increase, seismic testing is not expected to greatly affect the size of regional biological populations of species used for subsistence purposes. For example, effects on fishes would remain LOW, while effects on nonendangered marine mammals are expected to range from LOW to VERY LOW.

Regional effects from noise and disturbance on subsistence-harvest patterns in the cumulative case are expected to be HIGH.

c. Facility Sitings: Pipelines and their associated roadways may affect caribou harvests over the long term. It is likely that the biological effects from onshore sites on herd size, composition, productivity, or distribution would be concentrated in particular areas and in particular herds. For example,

a pipeline through ANWR may affect the Porcupine caribou herd, harvested by Kaktovik, while a pipeline running from TAP to Point Belcher may affect the distribution of the Western Arctic caribou herd, a herd depended on by hunters from Barrow, Wainwright, and Atkasuk. A landfall at Bullen Point may occur due to Sale 87 and would be located in an area intensively harvested by Kaktovik hunters. This siting of an onshore facility is expected to have MODERATE effects on Kaktovik's caribou harvests, while a landfall in conjunction with the development of ANWR is expected to have HIGH effects on these harvests. Two causeways have been constructed thus far as a result of North Slope oil development, and another is proposed at Lisburne. According to the biological analysis, these causeways may have a MODERATE effect on various species of fishes on the North Slope. Arctic cisco may comprise more than 50 percent of all fishes harvested at Kaktovik, Nuiqsut, and Barrow. In these three villages, as well as in Wainwright to the west, anadromous fish play a central role in the subsistence system and, of the primary subsistence species harvested, are the most reliable and the least subject to large and unpredictable fluctuations in availability from year to year. Thus, the alteration in availability of fishes that may occur with causeway construction could adversely affect the long-term viability of North Slope subsistence systems. In the cumulative case, effects on harvest levels of arctic cisco at Nuiqsut, Barrow, Kaktovik, and (possibly) Wainwright are expected to be HIGH.

**SUMMARY:** At Wainwright, cumulative-case effects on subsistence harvests of belukha whales and bearded seals are expected to be HIGH because of an assumed landfall and onshore-support facility at Point Belcher. Effects on other marine mammals, caribou, and waterfowl are expected to be MODERATE. The combined effects of noise and traffic and of oil spills on bowhead whale harvests may be VERY HIGH but are, as in the base case, expected to be HIGH. Effects on other marine mammals, caribou, and waterfowl harvests are expected to be MODERATE, while--because of causeway construction--effects on the harvests of anadromous fishes, particularly arctic cisco, are expected to be HIGH. In the cumulative case at Nuiqsut, effects on the harvests of anadromous fishes, particularly arctic cisco, are expected to be HIGH due to causeway construction at Prudhoe Bay. As in the proposed action, HIGH cumulative-case effects on Nuiqsut's bowhead whale harvest are expected due to the proposed landfall at Point Thomson. At Kaktovik, effect levels also may be the same except for caribou: because of an assumed landfall at Bullen Point and possible oil development in ANWR, the effect on caribou harvests at Kaktovik is expected to be HIGH.

**CONCLUSION:** In the cumulative case, the effects on subsistence-harvest patterns are expected to be HIGH for Wainwright, Barrow (Atkasuk), Nuiqsut, Kaktovik, and the region.

11. **Cumulative Effects on Archaeological Resources:** The cumulative effects of other private, State, and Federal projects (see Table IV-A-4-1), together with the effects of the base case, are expected to result in a MODERATE cumulative effect on archaeological resources. The effects of some of these projects were analyzed in the FEIS's for Sales 87 (USDOI, MMS, 1984) and 97 (USDOI, MMS, 1987a). The arctic region OCS planning areas--Beaufort Sea, Chukchi Sea, and Hope Basin--are estimated to produce 5.48 Bbbl of oil obtained by drilling 48 exploration and 20 delineation wells, installing 11 production platforms, and drilling 685 production and service wells (see Sec. II.A). The effects on land segments with many important archaeological resources (shown in USDOI, MMS, 1987a, Table H-3, Appendix H) are summarized as follows: The overall cumulative effects on archaeological resources are expected to be MODERATE.

**CONCLUSION:** The overall cumulative effects on archaeological resources are expected to be MODERATE.

## 12. Cumulative Effects on Air Quality

a. **Cumulative Effects on Air Quality Relative to Standards:** For the cumulative case, there would be 11 production platforms located in the OCS arctic region. Overall cumulative production would be approximately sixfold that of the total base-case production and more than twofold times the mean annual high-case production. The balance of the offshore oil and gas activities could be evenly distributed or to some degree clustered along the arctic OCS. If activities were well scattered, it is expected that the cumulative effects would be very low, as for the proposed action. However, if activities were clustered, cumulative effects with respect to air-quality standards could be as much as HIGH (would exceed available air-quality standards or PSD-concentration increments for  $\text{NO}_x$  in an existing attainment area), depending on the relative locations of activities. For example, if the seven production platforms (in addition to the four specified in the base case) were clustered within a few kilometers of each other 5 km (3 mi) offshore, the exemption levels for VOC and  $\text{NO}_x$  would be exceeded (Table IV-I-12-1); and 100 percent of the available incremental allowance for PSD Class II for  $\text{NO}_x$  would be taken, at least locally. In such a circumstance, the significance increment for  $\text{NO}_x$  would be exceeded (Table IV-I-12-2). Under these conditions, BACT would

Table IV-I-12-1  
 Estimated Uncontrolled Emissions and USDOJ Exemption Levels for  
 Cumulative-Case Production, Beaufort Sea Sale 124

	Pollutant (metric tons per year) <sup>1/</sup>				
	CO	NO <sub>x</sub>	TSP	SO <sub>2</sub>	VOC
Peak Production Year <sup>2/</sup>	747.6	1005.4	57.8	8.4	191.8
Exemption Levels at 5 km <sup>3/</sup>	6,416.0	90.6	90.6	90.6	90.6

Source: USDOJ, MMS, Alaska OCS Region. Computed from factors in Form and Substance (1983).

- <sup>1/</sup> CO - Carbon Monoxide
- NO<sub>x</sub> - Nitrogen Oxides (assumed predominately NO<sub>2</sub>)
- TSP - Total Suspended Particulates (includes most particulate matter less than 10 microns in aerodynamic diameter)
- SO<sub>2</sub> - Sulfur Dioxide
- VOC - Volatile Organic Compounds (excluding nonreactive compounds such as methane and ethane)
- <sup>2/</sup> Assumes nine production platforms grouped offshore and two platforms located as in the base case. Production per platform assumed to roughly approximate base-case production per platform.
- <sup>3/</sup> Exemption levels based on USDOJ exemption criteria accounting for distance from shore (30 CFR 250.45).

Table IV-I-12-2  
 Comparison of Model Air-Pollutant Concentrations with  
 Regulatory Limitations (Cumulative Case)  
 (measured as micrograms per cubic meter)

Pollutant and Averaging Time <sup>1/</sup>	USDOJ Singificance-Concentration Increment <sup>2/</sup>	Maximum Modeled Concentration Onshore <sup>3/</sup>	Air-Quality Standards	PSD-Increment Limits
Peak Production (annual) NO <sub>x</sub>	1.0	16.08	100 <sup>4/</sup>	2.5 <sup>4/</sup>
Peak Production TSP (annual) (24-hour)	1.0 5.0	0.57 3.40	60 <sup>4/</sup> 150 <sup>5/</sup>	5.0 <sup>4/</sup> 10.0 <sup>5/</sup>

Source: USDOJ, MMS, Alaska OCS Region, 1988.

- <sup>1/</sup> NO<sub>x</sub> - Nitrogen Oxides
- <sup>2/</sup> TSP - Total Suspended Particulates
- <sup>3/</sup> Increases in concentration above the significance-concentration increment triggers a requirement for reduction of emissions by application of BACT.
- <sup>4/</sup> Pollutant concentrations at the shore attributable to clustering of offshore platforms under the cumulative case as calculated by the OCD model.
- <sup>4/</sup> Annual arithmetic mean.
- <sup>5/</sup> Maximum allowable 24-hour-average concentration.

Table IV-I-12-3  
Control Measures for Major Offshore Oil- and Gas-Emission Sources

Emission Source	Location <sup>1/</sup>	Major Pollutant	Control Measure	Emission Reductions	Possible Measure In Use	Other Controls
Diesel Engines	Drilling vessel Marine tanker	NO <sub>x</sub>	Injection-timing retard	10-20%	Yes <sup>2/</sup>	Exhaust gas recirculation
			Intake air cooling	30%	Some engines	
Gas Turbines	Platform OS&T	SO <sub>x</sub>	Low-sulfur fuel	Variable		Fuel-injection retard SCR on exhaust gas
		NO <sub>x</sub>	Water injection	70-80%	Yes <sup>3/</sup>	
Flares	Drilling vessel Platform OS&T	ALL	Waste-heat recovery <sup>4/</sup>	26%	Yes <sup>3/</sup>	
		VOC	Vapor recovery	95%	No	
Valves, Flanges, Compressor Seals, Pumps	Platform OS&T	VOC	Inspection & maintenance	50-75%	No	Double mechanical seals on compressors and pumps; connect compressor pumps to vapor-recovery system
Storage Tanks	Platform	VOC	Use of floating roof or vapor recovery on fixed roofs	75-95%	Yes <sup>5/</sup>	
Oil Tanker Loading	Platform OS&T	VOC	Vapor recovery	95%	Yes <sup>5/</sup>	
Gas Processing	Platform OS&T	SO <sub>x</sub>	Tail-gas treatment (e.g., Stretford) sulfur-recovery unit (e.g., Claus)	95-99%	Yes <sup>7/</sup>	

Source: Form and Substance, Inc., 1983.

<sup>1/</sup> OS&T = Offshore Storage and Treatment.

<sup>2/</sup> Pacific OCS.

<sup>3/</sup> Used on Exxon Platform Hondo, Texaco Platform Habitat; some problems noted.

<sup>4/</sup> Can eliminate need for external-combustion-process heaters.

<sup>5/</sup> Exxon Platform Hondo.

<sup>6/</sup> Onshore facilities.

<sup>7/</sup> Exxon Platform Hondo, Chevron Platform Grace, Union Platform Gilda (if H<sub>2</sub>S is encountered).

be required for equipment. Some techniques that may be employed in BACT are given in Table IV-I-12-3. Because the distribution of facilities in the cumulative-case scenario is not known, the potential effects on air quality are not readily predictable.

b. Effects on Air Quality Not Addressed by Standards: If offshore activities are clustered approximately 5 km offshore, effects of air quality other than those addressed by standards could include a local concentration of deposited sulfurous pollutants and acidification of the tundra vegetation during the period of oil production and beyond. Emissions from any blowouts or oil-spill fires would be short term and localized. The VOC evaporated from cumulative-case oil spills would not be significantly different than the VOC from base-case oil spills. The effects not addressed by air-quality standards (especially acidification) from air pollution could be local and long term.

CONCLUSION: Because emissions of air pollutants under the cumulative case could exceed the available air-quality PSD concentration increment for  $\text{NO}_x$  in an existing high-quality (attainment) area and local long-term effects on vegetation could occur, the overall effects on air quality may be HIGH, depending on the location of offshore oil and gas facilities.

### 13. Cumulative Effects on Land Use Plans and Coastal Management Programs

a. Land Use Plans: The NSB previously has approved a Master Plan for the Duck Island Unit (Endicott) project and issued development permits for activities, contingent upon conditions to mitigate potential adverse effects and to foster beneficial effects. If future developments lead to greater levels of adverse effects on onshore resources (see Sec. IV.I.7), more stringent conditions may be imposed to mitigate conflicts.

Many of the projects included in the cumulative case could occur on Federal lands, including the OCS, as well as lands covered by the NSB Land Management Regulations (LMR's). Because the LMR's areawide policies are the same as those developed by the NSB for the NSB CMP, the areawide policies of the LMR's are incorporated into the section on coastal management. Policies reviewed in this section are those related to offshore development in the portion of the Beaufort Sea within the NSB boundary and to development in transportation corridors.

Drilling in State waters is included in the cumulative case. As a result, the Offshore Development policies of the LMR's would have greater applicability. Drilling in State waters would be allowed only from bottom-founded structures (NSBMC 19.70.040.A). Drilling above threshold depth may occur year-round; drilling below threshold depth can be done only during winter (November 1 through April 15) and must be completed as early as practicable (NSBMC 19.70.040.B and C). Some types of drilling can continue until June 15 (NSBMC 19.70.040.D). Boat, barge, and air traffic associated with drilling is limited during the whale migration to only that which is essential. Essential traffic must be coordinated with the Alaska Eskimo Whaling Commission and is restricted to avoid disrupting the whale migration and subsistence activities (NSBMC 19.70.040.E). Once a proposed development has followed the steps necessary to be rezoned to the Resource Development District, drilling can occur year-round (NSBMC 19.70.040.F). These policies reflect the current State seasonal drilling restriction; therefore, no conflict is anticipated with these policies.

From the outset, effects on the Porcupine caribou herd could lead to a stringent interpretation of the Transportation Corridor policies. This could occur because this herd is subject to effects of developments that are outside the jurisdiction of the NSB LMR's and negative effects on the herd could reach higher levels in spite of the land management policies. However, significant conflict with the the Transportation Corridor policies is not anticipated.

b. Coastal Zone Management: Cumulative effects may lead to changes in the level of effects or may involve policies that were not relevant to the base case. These differences are the focus of this analysis.

(1) Energy Facilities (6 AAC 80.070) and Transportation and Utilities (6 AAC 80.080): Along the Chukchi Sea coast, development assumed in the proposed action for Sale 124 occurs in conjunction with activities associated with Sales 109 and 97. Potential use conflicts identified in the base case are accentuated in the cumulative case both because the likelihood of development increases and the magnitude of potential development is greater. As a result, development is more likely to conflict with ACMP policies 6 AAC 80.070(b)(1) and (2) that require adverse environmental and social effects to be minimized while satisfying industrial requirements and that development be compatible with existing and subsequent uses.

Along the Beaufort Sea coast, free passage of fish becomes a major concern in the cumulative case because additional causeways may be constructed. The ACMP standard 6 AAC 80.070 (12) requires that causeways be sited and designed to allow free passage of fish and wildlife with due consideration for migration patterns. Studies now under way should help the NSB and Federal and State agencies to make informed decisions on causeways. However, given this past experience, conflicts with ACMP 6 AAC 80.070(b)(12) and NSB CMP 2.4.4(i) (NSBMC 19.70.050.I.9) are likely.

The effects of pipelines and roads also are magnified in the cumulative case. An extensive network of pipelines and associated roads would extend east from TAP Pump Station 1 to the Canadian border, west from Pump Station 1 along the Beaufort Sea, west from Pump Station 2 to the Chukchi Sea, and south from Pump Station 1 to Valdez. If these networks were to bisect important calving areas, effects would be greater, thereby increasing the potential for conflict with 6 AAC 80.070(b)(1)(2) and (13) and NSB CMP 2.4.5.1(g) (NSBMC 19.70.050.J.7).

(2) Subsistence (6 AAC 80.120): In the base case, effects on subsistence in Nuiqsut were HIGH because of potential conflict between the whalers and those conducting offshore activities related to this sale. In the cumulative case, effects increase because of potential effects on belukha whales. Noise and disturbance could affect the harvests at Wainwright, Barrow, and Kaktovik. The duration of possible interference with subsistence activities and potential loss of access and resources would accentuate potential conflicts with the Statewide standard that guarantees opportunities for subsistence use of coastal areas and resources and the NSB CMP policies that were addressed in Section IV.C.13.6. The duration of the potential user conflicts may cause subsequent developments to fall into a more restrictive policy category. Rather than considering subsistence access reduced or restricted (NSB CMP 2.4.5.1[b]) (NSBMC 19.70.050.J.2), it may be considered precluded and be subject to NSB CMP 2.4.3(d) (NSBMC 19.70.050.D) instead. However, at no point in the resource discussion is it evident that resources would be depleted below the subsistence needs of local residents (NSB CMP 2.4.3[a] and NSBMC 19.70.050.A).

(3) Habitats (6 AAC 80.130): All habitats noted as at risk for the proposed action are more likely to be adversely affected in the cumulative case and, therefore, lead to conflict with the ACMP Statewide standard and the NSB CMP habitat policies identified in Section IV.C.13.7.

One policy that likely will be implemented with greater scrutiny in all habitats is that which curtails vehicles, vessels, and aircraft activity when and where it may affect concentrations of sensitive populations (NSB CMP 2.4.4[a] and NSBMC 19.70.050.I.1). Potential effects resulting from noise and disturbance on birds, mammals, and caribou all increase in the cumulative case.

In the offshore habitat, increased effects relate to the increased number of oil spills and the construction of additional causeways. The NSB CMP policy 2.4.4(i) (NSBMC 19.70.050.I.9), identified previously under transportation, deals with causeway installation and also will receive greater attention with respect to the offshore habitat.

Development of State leases included in the cumulative case increases the likelihood that barrier islands and lagoons would be affected. Disruptive activities and requests for altering shores are probable because this habitat is within the area leased by the State for oil and gas exploration and development.

To some extent, the base case depicts development from Sale 124 as an add-on to the extensive development that precedes it. However, in the cumulative case, all development is included. As a result, this analysis must look at all the tundra wetlands that would be subject to infilling. Adverse effects on tundra and wetland nesting, feeding, and staging areas, particularly in the Teshekpuk Lake waterfowl-concentration area, the ANWR oil-development area, and the Mackenzie River Delta, are likely to represent a MODERATE effect on the availability of tundra habitat for several species and a HIGH effect on the distribution and abundance of some species for more than one generation.

Pipeline and road crossings and gravel extraction would increase in riverine areas that are used extensively by anadromous fishes. Although this could lead to greater conflict with the riverine-habitat policy, development probably would be modified if conflict with this policy became evident.

(4) Air, Land, and Water Quality (6 AAC 80.140): Greater adverse effects for water quality relate to problems associated with the erosion of gravel islands. Artificial islands left to erode could result in local but persistent turbidity plumes. This would create a conflict with the ACMP Statewide standard and district policies only if it were not consistent with Federal or State water-quality standards.

Air quality in the cumulative case could exceed air-quality standards if development is clustered. Local, long-term effects on vegetation could occur as a result of the deposition of sulfurous pollutants and the acidification of the tundra vegetation. Were this to occur, conflict with NSB CMP policies also would occur. The NSB CMP 2.4.3(h) (NSBMC 19.70.050.H) also requires that development comply with Federal and State air-quality standards. The NSB CMP 2.4.4(c) (NSBMC 19.70.050.I.3) identified airborne emissions specifically as needing to meet the standards. Acidification of tundra vegetation is not covered under air-quality standards but would be covered under several elements, either in the facility-siting standard or the wetland-habitat standard.

(5) Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): Numerous sites along the coast of the NSB have been identified as culturally important sites. Because of the vast areal extent susceptible to development in the cumulative case, opportunities for culturally important areas to be violated are increased significantly.

SUMMARY: Policies that are most likely to conflict with development assumed for the cumulative case include those for energy-facility siting, transportation and utilities, habitat, and subsistence. Many of the conflicts would pertain to the siting and construction of pipelines, the associated roads and causeways, and the noise and disturbance that would accompany these developments. Such extensive construction projects could infringe on cultural sites, thereby causing a conflict with the policies protecting culturally important areas (NSB CMP 2.4.3(e), 2.4.3(g), 2.4.3(f), and 2.4.5.2(h) and NSBMC 19.70.050.E, 19.70.050.G, 19.70.050.F, and 19.70.050.K.8). Effects of oil spills would create a conflict with several habitat policies and the water-quality standard. However, these conflicts could only be determined with hindsight.

CONCLUSION: For the cumulative case, the effects of potential conflicts with land use plans and coastal management programs are expected to be HIGH.

## IV.J. Unavoidable Adverse Effects

1. **Water Quality:** The only unavoidable adverse effects on water quality anticipated from the proposed action are expected to be the input of large quantities of hydrocarbons through accidental spillage. If toxic, drilling muds and formation waters both could be reinjected into wells rather than discharged. Directional drilling, subsea-pipeline landfalls, and elevated pipelines or elevated causeways could be substituted for solid-fill causeways. Although an obvious impairment of the pristine water quality of the study area, spillage is judged an insignificant, long-term, LOW LOCAL and VERY LOW REGIONAL effect for water quality.

2. **Lower-Trophic-Level Organisms:** Accidental oil spills are considered to be unavoidable adverse effects. Their effects on marine plants and invertebrates in the Beaufort Sea are described in Section IV.C.2. The possible effects include the death of organisms in localized areas, with consequent changes in species composition, alterations in primary and secondary production, reduced reproduction and/or recruitment, and a variety of sublethal effects. Long-term changes could result if sediments become contaminated and if migration, reproduction, and/or recruitment were reduced in affected areas. In general, unavoidable effects are expected to be LOW for marine plants and invertebrates; however, HIGH effects are possible for the Boulder Patch community if in the unlikely event it were contaminated by oil.

3. **Fishes:** Unavoidable adverse effects are expected to result from accidental oil spills. The overall effect of such spills on fishes in the Beaufort Sea Planning Area is described in Section IV.C.3. Possible effects include the death of eggs, larvae, and adults; sublethal effects; and delays in migrations, perhaps leading to reductions in fecundity. In general, unavoidable adverse effects are expected to be LOW for fishes; however, MODERATE effects are possible for capelin and anadromous species if spawning-year individuals, aggregated multiyear assemblages, or a year-class of young were killed.

4. **Marine and Coastal Birds:** In this discussion, most oil spills are considered unavoidable, while most human disturbance of nesting seabirds and most nesting waterfowl and shorebirds is considered avoidable through voluntary compliance with the proposed recommendations on air and boat traffic in the proposed Information to Lessees on Bird and Marine Mammal Protection (see Sec. II.G.2.b).

The oil-spill-trajectory analysis indicates that the coastal habitats near Elson and Simpson Lagoons are at some risk from oil spills that may be associated with the proposed action. However, oil-spill-cleanup efforts could provide for protection of these lagoons by possibly diverting an oil spill away from the lagoon entrances and away from saltmarshes.

If a large spill occurred within the unconsolidated pack ice of the Beaufort Sea, it would be very difficult to contain and clean up with present oil-spill-cleanup technology. Such an oil-spill event would unavoidably affect some seabird flocks that might happen to be in the area of the spill. An unavoidable spill is expected to result in LOW to MODERATE effects on some bird populations.

Assuming oil development occurs throughout the proposed sale area, oil spills and local-habitat alterations near platform and facility sites are estimated to have an unavoidable MODERATE effect on birds, depending on the extent and nature of hydrocarbon development, oil-spill occurrence, and efficiency of oil-spill cleanup.

5. **Pinnipeds, Polar Bears, and Belukha Whales:** In this discussion, most oil spills are considered unavoidable, while most human disturbance of nonendangered marine mammals is considered avoidable through voluntary compliance with the proposed recommendations on air and boat traffic in the proposed Information to Lessees on Bird and Marine Mammal Protection (see Sec. II.G.2.b).

The oil-spill-trajectory analysis indicates that the lead system and ice-flaw-zone habitat from Point Barrow to Camden Bay is at risk from oil spills that could be associated with the proposed action. However, oil-spill-cleanup efforts could provide for some reduction in spill contact to marine mammals.

If a large spill occurred within the unconsolidated pack ice of the Beaufort Sea, it would be very difficult to contain and clean up with present oil-spill-cleanup technology. Such an oil-spill event is expected to affect some seals, walruses, and polar bears if they happened to be in the area of the spill. An unavoidable spill is expected to result in a MODERATE effect on regional marine-mammal populations.

Assuming oil development occurs throughout the proposed sale area, oil spills and local-habitat alterations near platforms and other facility sites could have an unavoidable MODERATE effect on nonendangered marine mammals, depending on the extent and nature of hydrocarbon development, oil-spill occurrence, and efficiency of oil-spill cleanup.

6. **Endangered and Threatened Species:** In the event of production, the probability of an oil spill occurring and contacting certain areas indicates that bowhead and gray whale-migration and -feeding areas may be subject to at least localized risk. Unmitigated, uncontrolled noise and other forms of disturbance associated with the proposed action (i.e., noise due to vessel activity or aircraft overflight, or related geophysical activities) are expected to cause temporary behavioral responses.

The responses to unmitigated activities are not expected to preclude migrations or to disrupt feeding activities on a long-term basis. Such disturbance-related effects would be most likely to occur on bowhead whales during periods when they are migrating and in the summer-feeding areas used by gray whales. A number of mitigating measures are available to reduce possible adverse effects; however, unavoidable adverse effects are expected to remain MODERATE for the bowhead whale and LOW for the gray whale. Unavoidable adverse effects on the arctic peregrine falcon as a result of the proposed lease sale are expected to be VERY LOW.

7. **Caribou:** Most sale-related land-vehicle disturbance of caribou and caribou-habitat alterations probably are unavoidable. Unavoidable adverse effects of oil and gas exploration are expected to be MODERATE. Unavoidable MODERATE disturbance effects on caribou from development and production are expected.

8. **Economy of the North Slope Borough:** Increased population, minor gains in revenues, and potential oil spills could cause disruptions to subsistence harvests and, in turn, village economies in both the short and long terms. Unavoidable adverse effects on the economy are expected to be MODERATE.

9. **Sociocultural Systems:** Government- and community-supported social programs with adequate funding would mitigate many of the sociocultural consequences of Sale 124. One area of unavoidable adverse effects involves the potential repercussions to the sharing of subsistence resources. Unavoidable MODERATE effects are expected as a result of effects on subsistence harvests.

10. **Subsistence-Harvest Patterns:** Oil-spill incidents that are unavoidable could lead to the localized, direct loss of small numbers of belukha whales, seals, walruses, polar bears, fishes, birds, and caribou; however, none of these losses--except for the bowhead harvest--could lead to elimination of any subsistence harvest. Some of the risk to bowheads from oil spills can be mitigated. Only oil-spill effects on bowhead and belukha whales and walruses would lead to a reduction of total annual harvests. HIGH effects on bowhead whale harvests due to noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing effects from noise and traffic disturbance to LOW.

11. **Archaeological Resources:** Accidental sale-related occurrences such as pipeline breaks or blowouts could increase response activities onshore. These activities are expected to have a LOW effect on archaeological resources if carried out according to the National Historic Preservation Act and Executive Order 11593.

12. **Air Quality:** An increase in emissions of air pollutants would occur as a result of the proposed action. Except in the cumulative case, the additional emissions would not be significant. In the event that any emissions are significant (such as VOC and NO<sub>x</sub> in the cumulative case), they may be reduced by existing methods as necessary. For the proposed action, air-quality-standards limitations onshore would not be approached. LOW effects on air quality are expected.

13. **Land Use Plans and Coastal Management Programs:** The scenario for Sale 124 assumes transportation networks are already established between Point Belcher and TAP Pump Station 2 and between sites on the Beaufort Sea coast and TAP Pump Station 1. Development from Sale 124 extends these already existing networks. As a result, unavoidable adverse effects related to major changes in land use are not anticipated, nor are they expected as a result of disturbance; disturbance typically is considered an avoidable effect. Unavoidable adverse effects that are related to Sale 124 usually are caused by an oil spill. To the extent that facilities are sited to minimize the effects of an oil spill on the environment, conflicts with the Statewide standards and the NSB policies of the ACMP are avoidable; therefore, unavoidable conflicts are expected to be VERY LOW.

#### **IV.K. Relationship Between Local Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity**

In this section, the short-term effects and uses of various components of the environment in and adjacent to the Beaufort Sea Planning Area for oil and gas Lease Sale 124 are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparatory activities (seismic-data collection and exploration drilling) of oil and gas development and ending when natural environmental balances might be restored.

In general, short term refers to the useful lifetime of the proposed action as determined by the base case for Alternative I; some even shorter term uses and effects also are considered. Long term refers to that time beyond the estimated lifetime of the proposed action. The producing life of the field development in the Sale 124 area has been estimated to be about 19 years; this estimate is based on the base-case-resource estimate for Alternative I. In other words, short term refers to the total duration of oil and gas exploration and production, whereas long term refers to an indefinite period beyond the termination of oil and gas production. The definitions for short term and long term as used in this section differ from those used in Sections IV.B through IV.I and IV.M and IV.N; also, see Table S-2.

Many of the effects discussed in Section IV are considered to be short term (being greatest during the construction, exploration, and early production phases), which could be further reduced by the mitigating measures discussed in Section II.G.

Water pollution from onshore activities is a long-term but local effect. Offshore, a potential long-term decrease in water quality may be considered an appropriate compromise for obtaining oil and gas resources.

Oil-spill pollution and habitat alteration caused by noise disturbance and construction activities will have potential short-term effects on the biological populations and their habitats and might have long-term effects. Effects will vary with the type and magnitude of the various activities.

Short-term, localized, adverse effects on biological populations and habitats are expected if, in the unlikely event, an oil spill occurs in either the marine or terrestrial environments. These potential effects include mortality of individuals, physiological stresses in surviving individuals, reduction in the number of species or species populations in the affected area, changes in the distribution of species or individuals, and changes in behavior or migration patterns. Long-term, cumulative, oil-pollution effects also might occur if recovery from the short-term effects extends beyond the estimated useful life of the proposed action. Some species might have difficulty repopulating physically altered habitats and could be permanently displaced.

The potential effects of marine- and terrestrial-habitat alteration may include the same general types of short-term, localized effects that the biota would experience as a result of an oil spill--mortality, stress, population or species decreases or redistribution, and changes in survival patterns. Long-term effects also might occur if recovery from the short-term effects extends beyond the estimated useful life of the proposed action. Also, long-term biological productivity could be lost from those areas that have been assumed as facility sites in support activities of the proposed action.

The redistribution or reduction of species populations in the short term could affect regional subsistence-harvest patterns. Such short-term effects on subsistence-harvest patterns from the proposed action would not be expected to have long-term consequences, except as a source of social disruptions, or unless chronically imposed on the resource base of the region. Habitat destruction also might cause a local reduction in subsistence species, which could threaten the regional economy.

Increased population and industrial activity, minor gains in revenues, and the consequences of potential oil spills that might occur as a result of the proposed action all contain the potential for disrupting Native communities in the short term. In addition, changes brought about by the lease sale could be a participating factor in long-term consequences for Native social and cultural systems.

Improved accessibility to remote areas from increased construction is a short-term and possible long-term consequence of the proposed action if development occurs. However, the overall wilderness value of developed areas is expected to decrease from increased land use. Archaeologic and historic finds discovered

during development would enhance long-term knowledge. These finds might help to locate other sites, but destruction of artifacts would represent long-term losses.

Land use changes would occur at shore-base sites and along pipeline routes. In potentially affected areas, short-term changes include a shift in land use from subsistence-based activities to industrial activities throughout the life of the proposed action. Zoning for the affected areas could change from Conservation District to Resource Development District. This could be a short-term change if, after production ceased, use of the land reverted to previous uses. Long-term effects on land use could result if use of the infrastructure or facilities continued after the estimated useful life of the proposed action. Potential users could be other resource developers or residents or nonresidents who had become accustomed to the convenience of using existing facilities, such as roads.

The production of oil and gas from the Beaufort Sea Planning Area would provide short-term energy and, perhaps, provide time either for the development of long-term alternative-energy sources or substitutes for petroleum feedstocks. Economic, political, and social benefits would accrue from the availability of oil and gas. Most benefits would be short term and would decrease the Nation's dependency on oil imports. Regional planning would aid in controlling changing economics and populations and, thus, in moderating any adverse effects. If additional supplies were discovered and developed, the proposed production system would enhance extraction. However, consumption of this offshore oil and gas would be a long-term use of nonrenewable resources.

After completion of oil and gas production, oil spills and their effects would not occur and the marine environment is generally expected to remain at or return to its normal long-term productivity level. To date, there has been no discernible decrease in long-term productivity in OCS areas where oil and gas have been produced for many years. In areas that have experienced apparent increases in oil pollution, such as the North Sea, some long-term effects appear to have taken place. Populations of pelagic birds have decreased markedly in the North Sea in recent years--prior to the beginning of North Sea oil production. However, until more reliable data become available, the long-term effects of chronic and major spillage of hydrocarbons and other related discharges cannot be accurately projected. In the absence of such data, it must be concluded that the possibility of decreased long-term productivity exists if chronic spills or a major oil spill occurred as a result of the proposed action.

#### **IV.L. Irreversible and Irretrievable Commitment of Resources**

1. **Minerals Resources:** The unleased, conditional, economically recoverable resources that are estimated to be leased, discovered, and developed and produced as a result of Beaufort Sea Planning Area Sale 124 are estimated to be 900 MMbbl of oil. (It is assumed that natural gas also will be discovered but will not be economical to produce for the foreseeable future [Sec. II.A.1].) Should these resources be discovered and produced, they would be irretrievably consumed.
2. **Biological Resources:** General industry activities--such as increased ship traffic, seismic-exploration activities, aircraft noise, and land-based activities--could displace marine and coastal birds and mammals (particularly ringed seals and caribou) into less favorable environments. This eventually would result in reduced population levels. This displacement could become irretrievable if changes to the environment and habitat were permanently altered by man.
3. **Endangered Species:** For the proposed action, it is possible that endangered whales could be subjected to direct and indirect effects of oil spills, disturbance due to noise and other human activities, or losses and/or deterioration of habitat due to facility developments. It is unlikely that such effects would lead to permanent (irreversible) losses of whale resources (see Sec. IV.C.6, Effects on Endangered and Threatened Species).
4. **Social Systems:** Many important aspects of Inupiat society and culture are centered around subsistence activities (see Sec. III.C.3). Virtually every family on the North Slope participates in the hunting of the bowhead whale and the sharing of its meat. In the event that oil spills or offshore noise and pollution permanently disrupt the harvesting of bowhead whales, there would be an irreversible and irretrievable loss to Inupiat social and cultural values. The activities associated with the taking of seals, walruses, birds, and fishes are less important to the integration of the region as a whole, but they are of equal importance to the social organization of each community as well as to the domestic economies of most households. As with the bowhead whale, the inability to harvest sufficient quantities of these resources would be a loss to the Inupiat diet, to Inupiat values of sharing and reciprocity, and to the fundamental aspects of Inupiat identity. The contribution of Sale 124 to the cumulative consequences of offshore and onshore energy development in conjunction with other processes of social change may in the long term lead to the irretrievable loss of Inupiat language and other cultural behaviors.
5. **Archaeological Resources:** Irretrievable material products of prehistoric culture such as archaeological sites may be lost through looting and indiscriminate or accidental activity on known and unknown sites. The orientation program and the archaeological resource stipulations (Sec. II.G.2.a) would help protect against some such losses.

#### **IV.M. Effects of Natural Gas Development and Production**

Natural gas also may be discovered in the Sale 124 area during exploration drilling. Although gas resources are not considered economic to exploit at this time (Mast et al., 1989), they may be developed and produced in the future; natural gas production probably would not occur until after oil production has begun. Thus, leases containing nonassociated natural gas that may be recoverable in the future probably will be retained by the leaseholder. (Associated and dissolved gases that are recovered along with the crude oil are expected to be reinjected or used as fuel, depending on the amount recovered.) Hence, the effects of potential gas development and production on the environment of the Sale 124 and adjacent areas that are in addition to the effects associated with oil development and production are described in this section.

Additional facilities and infrastructure would be needed if and when the nonassociated natural gas is developed and produced. The gas could be produced through wells drilled from gas-production platforms.

A large-diameter pipeline would be installed to transport the produced gas from the production platforms to an onshore gas-processing facility; the gas pipeline would be separated from any existing oil pipelines to the extent necessary to minimize risks that occur during installation and operation. No offshore booster-pump stations would be required between the platforms and the gas facility. Both the offshore and onshore sections of the gas pipeline would be buried.

A new facility would be needed to process gas produced from offshore reservoirs. Onshore, the gas pipeline would parallel the oil pipeline assumed in the base case to take advantage of the hypothetical road system. Because gas from offshore production would be taken into account in the final design of the Alaska Natural Gas Transportation System or the Trans-Alaska Gas System, the pipeline to market would be appropriately sized to accommodate the offshore production of gas. The gas would be refrigerated before it is pumped into the pipeline; at the refrigerated temperatures, there would be no significant threat to the permafrost.

The effects of natural gas development and production on the biological resources, social systems, and physical regimes of the Sale 124 and adjacent areas might be caused by gas blowouts; installing offshore pipelines and gas-production systems; drilling gas-production wells; installing onshore pipelines and a gas-processing facility; marine-, surface-, and air-traffic noise and disturbance; construction activities; and growth in the local economy, population, and employment.

Accidental emissions of natural gas could be the result of a gas-well blowout or a pipeline rupture. In the unlikely event that it occurred, a gas-well blowout probably would not persist for more than 1 day and would release perhaps 20 metric tons of gaseous hydrocarbons; as noted in Section IV.C.12, 60 percent of all blowouts since 1974 have lasted 1 day or less. From such a blowout, a hazardous plume of gas could extend downwind for about a kilometer but would quickly dissipate once the blowout ceased. The amount of VOC released by such a blowout would be less than that evaporated from an oil spill of 1,000 bbl or greater.

The rupture of a gas pipeline would result in a short-term (less than 1 hour) release of gas. A sudden decrease in the gas pressure would automatically initiate procedures to close those valves that would isolate the ruptured section of the pipeline and thus prevent further escape of gas.

The primary air pollutant would be VOC, of which more than 90 percent can be controlled by existing technology. The emissions from gas-production platforms and storage-and-treatment facilities would be analogous to those discussed in Section IV.J.6 of the Norton Basin Sale 100 FEIS (USDOJ, MMS, 1985). The emissions from any gas blowouts (principally VOC) would be quickly evaporated or burned and dissipated by winds with minimal effect on air quality (USDOJ, MMS, 1985).

1. **Effects on Water Quality:** The risk to water quality from gas blowouts during natural gas development and production would be less than the risk from oil spills due to oil development and production. The effects of gas-pipeline trenching on water quality would be the same as for oil pipelines. Because of gas-production-well drilling, additional drill cuttings and drilling muds would be discharged; some of the drilling muds would be recycled between oil and gas wells on the same platform. Production of an associated gas cap above an oil zone would result in no additional discharge of formation waters or causeway construction beyond that anticipated for oil development.

The levels of effects resulting from natural gas development and production are expected to be MODERATE on LOCAL water quality and VERY LOW on REGIONAL water quality.

2. Effects on Lower-Trophic-Level Organisms and Fishes: If a natural gas blowout occurred, with possible explosion and fire--marine plants, invertebrates, and fishes in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site but is not expected to be hazardous for more than 1 km downwind or for more than 1 day. It is not likely that the plume would affect any marine plants, invertebrates, and fishes except individuals present in the immediate vicinity of the blowout. In order to affect these organisms, the blowout would have to occur below or on the surface of the water.

Trenching activities associated with laying a gas pipeline would have localized effects on marine organisms. For mobile animals like fishes, virtually no adverse effects are expected; however, longer term but extremely localized effects over a small area are possible for benthic organisms.

The level of effects on lower-trophic-level organisms and fishes resulting from natural gas development and production is expected to be LOW.

3. Effects on Marine and Coastal Birds: The most likely effects associated with natural gas development and production on marine and coastal birds would include some habitat alterations and noise and disturbance from air-support traffic and road traffic along the gas-pipeline route, at the production-platform sites, and at the gas-processing-facility site. These effects would be similar to those noise and disturbance and habitat-alteration effects associated with oil development and production (LOW to MODERATE).

If there were a natural gas blowout with explosion and fire, birds in the immediate vicinity would be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is not likely that fumes would affect birds or their food sources except those very near the source of the blowout.

The additional short-term and local effects of noise and disturbance and blowouts indicate that the level of effects on marine and coastal birds resulting from natural gas development and production is expected to be MODERATE.

4. Effects on Pinnipeds, Polar Bears, and Belukha Whales: The most likely effect of natural gas development and production on pinnipeds, polar bears, and belukha whales would come from air traffic to and from the production platforms and the support facility (probably at Deadhorse) and from platform and offshore-pipeline installation. The air traffic associated with gas production would be an additive source of noise and disturbance of marine mammals. However, the effect of this noise and disturbance is likely to be very brief and result in only a temporary displacement of some marine mammals along the flight paths (a LOW effect).

The effect of installing gas-production platforms and laying gas pipelines would be similar to the effect of installing oil-production platforms and laying oil pipelines. These activities would temporarily (one to three seasons) alter the availability of some food organisms of marine mammals near the gas-production platforms and along the pipeline routes. Although this effect could be additive to the habitat alterations associated with oil development, the changes in availability of some food organisms of marine mammals are expected to be short term and local (a LOW effect).

If a natural gas blowout occurred, with possible explosion and fire, marine mammals in the immediate vicinity of the blowout could be killed, particularly if the explosion occurred below the water surface. Natural gas and gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site; it is not likely that these pollutants would affect any marine mammals except individuals present in the immediate vicinity of the blowout (a LOW effect). For any marine mammals to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or on the surface of the water, not from the top of the platform or gravel island.

The short-term and local effects of blowouts, noise and disturbance, and platform- and pipeline-installation activities indicate that the estimated level of effect is expected to be LOW on pinnipeds, LOW on polar bears, and LOW on belukha whales resulting from natural gas development and production.

5. Effects on Endangered and Threatened Species: Should natural gas development and production occur, effects described for oil exploration and development and production (see Sec. IV.C.6) would occur. In addition, trenching for the gas pipeline would disturb a small amount of habitat that may support benthic invertebrates, a primary food source for gray whales and a secondary food source for bowhead whales. However, the amount of seafloor disturbed would be insignificant when compared with the habitat available. Endangered whales may avoid approaching within a few kilometers of the vessels involved in trenching or pipelaying operations. The fall bowhead migration might be affected to a minimal degree by these activities.

If a natural gas blowout occurred--with possible explosion and fire--endangered whales in the immediate vicinity probably would be killed, particularly if the explosion occurred under the water surface. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site. It is not likely that they would affect any endangered whales except individuals present in the immediate vicinity of the blowout; and, in the case of a platform blowout, it is not expected that endangered whales would often be found near a platform.

For any endangered whales to be exposed to high concentrations of gas vapors or condensates, the blowout would have to occur below or at the surface of the water, not from the top of the production platform. It is conceivable, although unlikely, that a gas blowout under ice cover would result in the formation of gas pockets under the ice. Should bowheads surface and breathe in these gas pockets, they would be exposed to concentrated gas vapors. After several minutes of repeated inhalation, whales might become sufficiently disoriented to impair their ability to find an uncontaminated breathing hole. The threat would decrease over a period of weeks or months as the gas percolated through brine channels in the ice and was released into the atmosphere (Milne, 1977). The greatest vapor concentrations would likely occur if a blowout occurred during the winter months, but bowheads are unlikely to be present at this time. During the spring when bowheads would be present, the rate of gas dissipation through the ice would be most rapid and would tend to reduce the time period when such exposure might occur (Geraci and St. Aubin, 1986). Also, gas pockets could be more prevalent under landfast ice rather than under moving ice, through which bowheads would be expected to migrate.

Any effects of natural gas development and production are expected to be limited to potential disturbance of a few migrating arctic peregrine falcons for a single season during construction of the gas pipeline. However, effects on the falcon population would likely be VERY LOW because it is expected that any gas pipelines would be buried and would parallel oil pipelines to take advantage of existing roads.

The short-term and local effects of pipeline installation and blowouts indicate that the level of effects on endangered and threatened species resulting from natural gas development and production is estimated to be LOW for bowhead whales and VERY LOW for gray whales and arctic peregrine falcons.

6. Effects on Caribou: The most likely effects of natural gas development and production on caribou would come from motor-vehicle traffic and construction activities associated with installing the onshore part of the pipeline systems that connects the production platforms with the onshore-processing facility. Onshore, the gas pipelines would run parallel to the oil pipelines and would be serviced by the same roads. The gas pipelines probably would be buried. Road-traffic disturbance of caribou along the gas-pipeline routes would be most intense during the construction period, when motor-vehicle traffic is highest, but would subside after construction is complete. Caribou are likely to successfully cross the pipeline corridor within a short period of time (perhaps within a few hours or no more than a few days) during breaks in the traffic with little or no restrictions in general movements and no effect on overall caribou distribution and abundance. As with construction of the oil pipeline, the construction of the gas pipeline would alter only a small fraction of caribou range.

The level of effects on caribou resulting from natural gas development and production is expected to be MODERATE.

7. **Effects on the Economy of the North Slope Borough:** Both the onshore pipeline and the gas-processing facility would generate additional property-tax revenue for the NSB. However, the additional revenues would not be sufficient to reverse the long-term downtrend in revenues resulting from declining production from the Prudhoe Bay area. The long-term downtrends in population and employment would not be reversed.

The estimated level of effects on the economy of the NSB resulting from natural gas development and production is expected to be LOW.

8. **Effects on Sociocultural Systems:** Effects on sociocultural systems would be due to changes in employment and population and effects on subsistence-harvest patterns. In the event of natural gas development and production in the Beaufort Sea for Sale 124, there would be a slight increase in employment and population in the region adjacent to the Sale 124 area. However, these increases in employment and population are expected to be limited to an insignificant number and would most likely not have more than LOW effects on sociocultural systems. Effect levels of gas development and production on subsistence-harvest patterns in and adjacent to the Sale 124 area are expected to be HIGH; thus, there could be some disruption to the sociocultural system as a result of effects on subsistence harvests, similar to those expected if oil and gas development occurred.

The level of effects on sociocultural systems resulting from natural gas development and production is expected to be MODERATE.

9. **Effects on Subsistence-Harvest Patterns:** Effects on subsistence-harvest patterns from natural gas development and production could occur from natural gas blowouts, noise and traffic disturbance, and construction activities. These effects of natural gas development and production on the biological resources harvested for subsistence use are discussed in the above Sections IV.M.1 through 6. If a natural gas blowout occurred, the subsistence harvest of any species in the vicinity could be affected. Additionally, if a natural gas blowout occurred--with possible explosion and fire--subsistence resources in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site (1 km downwind for about 1 day) and would affect only those species in the immediate vicinity of the accident. While such an effect would be relatively short term and localized and would not be likely to measurably affect the regional population of any species, it could cause disruption to subsistence harvests in the area of the blowout. However, this disruption would not cause any species to become locally unavailable for more than one season (a MODERATE effect).

The effects of installing and constructing gas-production platforms, laying gas pipelines, and activities associated with constructing onshore pipelines to connect the offshore-production platforms with the onshore-processing facility would be similar to the effects of installing and constructing oil-production platforms and pipelines. As with construction activities associated with oil development and gas production, effects are likely to be short term, occurring only during the period of construction. However, such disruption could interfere with subsistence harvests for the entire season in the vicinity where those activities were occurring. If this were to occur for more than one year during construction activity, harvests could be disrupted for more a year or more--a HIGH effect.

Air and boat traffic--as well as road traffic along the pipeline route--associated with natural gas development and production would be additional sources of disturbance to subsistence harvests. However, the estimated level of noise and traffic disturbance is not expected to be greater for natural gas development and production than the level estimated for oil development and production.

Thus, the short-term and local effects of blowouts, noise and disturbance, and construction activities indicate that the level of effects on subsistence-harvest patterns resulting from natural gas development and production is expected to be HIGH.

10. **Effects on Archaeological Resources:** Offshore archaeological resources could be affected by activities associated with potential gas-production-platform installation and pipeline installation. Such activities would require surveying of the area if there were a medium or high probability of finding archaeological resources. However, there would not be a need to survey for prehistorical resources in the Sale 124 area because of extensive ice gouging in the area--see Regional Analysis defined below (Appendix I). Offshore shipwrecks are more likely to be affected by activities associated with gas-production-platform

installation and pipeline installation than prehistoric resources. The area northwest and northeast of Barrow would be the most likely known offshore area where shipwrecks could be disturbed. For details on shipwrecks and survival of shipwrecks, see the MMS Headquarters and Regional analyses, titled, respectively, Reassessment of Shipwreck Potential and Archaeological Survey of Recommendations for Sale 109 Leases, Chukchi Sea, Alaska, and Prehistoric Resource Analysis, Proposed Sale 124, Beaufort Sea (Appendix I, this EIS).

Onshore archaeological resources would be affected by activities associated with gas-processing-facility and gas-pipeline installations; disturbance of onshore archaeological resources could occur at the time of construction activity. Disturbance also might occur as a result of onshore activity associated with accidents such as a blowout or explosion. Cleanup after such accidents could result in disturbance by graders or bulldozers being transported overground to the accident site.

The level of effects on archaeological resources resulting from natural gas development and production is expected to be LOW.

11. Effects on Air Quality: The primary air pollutant would be VOC, of which more than 90 percent can be controlled by existing technology. The emissions from gas-production platforms and storage-and-treatment facilities would be analogous to those discussed in Section IV.J.6 of the Norton Sound Sale 100 FEIS (USDOJ, MMS, 1985). The emissions from any gas blowouts (principally VOC) would be quickly evaporated or burned and dissipated by winds with minimal effect on air quality (USDOJ, MMS, 1985).

The development drilling and platform and pipeline installation associated with natural gas resources would result in additional emissions of CO, SO<sub>2</sub>, NO<sub>x</sub>, and VOC. These emissions would be from the same kinds of sources as in oil-development and -production activities. On an energy-equivalent basis, production and offshore processing of natural gas emits fivefold fewer of the air pollutants than does oil production and processing. The amount of activity and emissions is expected to be less than for oil-related activities (a LOW effect).

The level of effects on air quality resulting from natural gas development and production is expected to be LOW.

12. Effects on Land Use Plans and Coastal Management Programs: Natural gas development and production are assumed to occur on leases in the same area and follow the same transportation routes as oil production resulting from Sale 124. No additional conflict is anticipated. The greatest disruptions would occur during construction of the gas pipeline; these effects would be comparable to those of the base case.

The effects of potential conflicts with land use plans and coastal management programs are expected to be HIGH.

#### IV.N. Low-Probability, High-Effects, Very Large Oil-Spill Event

The potential effects are analyzed for a very large oil spill from a pipeline in the Beaufort Sea Planning Area. The size of the spill is assumed to be 160,000 bbl, similar in size to the largest of the 20 OCS-pipeline or -platform spills of at least 1,000 bbl that have occurred since 1964 (160,638 bbl). The probability of one or more spills of at least 1,000 bbl in the Beaufort Sea Planning Area is assumed to be zero in the low case, 68 percent in the base case, and 91 percent (most likely number of three spills of at least 1,000 bbl) in the high case. In the arctic cumulative case (Hope Basin to Canadian Beaufort Sea), there is a greater than 99-percent chance of a spill of at least 1,000 bbl with a most likely number of 10 spills of at least 1,000 bbl.

Spill trajectories in the Beaufort Sea generally move east to west, parallel to shore, but with some offshore divergence. The location of the spill is assumed to be in about 30 m of water at Spill Site L-10 (Fig. IV-A-1-1). In the EIS scenario for the base case and the high case, this spill site is the one closest to Point Thomson on the trunk pipeline coming ashore at that location. Based on conditional probabilities, this location provides a relatively high risk to the various environmental resources of concern. Spills from this location could contact land in the Point Barrow area but not Barter Island. There is no spill site in the OSRA from which both Barter Island and Point Barrow would be contacted by the same spill.

Pipeline-Spill Scenario: During a November storm, an unusually deep keel of an old, multiyear-ice ridge crosses the 73,000-bbl-per-day trunk pipeline, damages a weld between two lengths, and causes a small leak of 635 bbl per day. Because the height of sails of older, multiyear ridges are eroded by surface melting and ablation, passage of this multiyear ridge through the area does not raise any suspicions; and the leak--equivalent to less than 0.9 percent of pipeline throughput--is not detected until July 22 the following summer, a week after breakup. The pipeline operator locates the leak, fills the pipeline with a diesel pill, shuts the line down, and makes temporary repairs pending replacement of the ice-damaged pipeline. A total of 160,000 bbl of Prudhoe Bay-like crude is lost over the 249 days of leakage.

Spill Behavior: During the winter, the spill would spread as a ribbon, approximately 100 m wide and 0.2 mm thick. This oil thickness would be insufficient for separate oil droplets or small pools to coalesce or flow into hollows underneath the ice (see Appendix M). The oil would freeze into the ice, essentially unweathered, in a matter of 5 to 10 days. Over the 249 days, the ribbon would increase in length at an average rate of 5 km per day, reaching a total length of 1,245 km. The ribbon, however, would not remain intact in the moving ice pack. The ice pack constantly deforms, and dispersion of individual ice flows in the winter is at least as great as for dispersion of surface oil in open waters.

The spill location is covered at times by both multiyear- and first-year-ice floes. In late spring and summer, the unweathered oil melts out of the ice at different rates depending on whether it is encapsulated in multiyear or first-year ice and on when the oil was frozen into the ice. In first-year ice, most of the oil spilled at any one time would percolate up to the ice surface over about a 10-day period (see Buist, Pistruzak, and Dickins, 1981). The oil spilled in December would surface on the ice in mid-June, oil spilled in April would surface in late June, and oil spilled in May would surface in early July. About mid-July, the oil pools would drain into the water among the floes of the opening ice pack. Thus, in first-year ice, oil would be pooled on the ice surface for up to 30 days before being discharged from the ice surface to the water surface. The oil spilled earlier would surface on the ice at a much greater distance from the spill site. Oil spilled under multiyear ice would melt out more slowly over the entire (partially) open-water season, with about 10 percent of the oil not surfacing until a second summer.

For the spill scenario assumed here, the pools on the ice surface would concentrate the oil, but only to about 2 mm thick, allowing evaporation of 21 percent of the oil, the portion of the oil comprised of the lighter, more toxic components of the crude (Table IV-N-1). By the time the oil is released from the melt pools on the ice surface, evaporation has almost ceased, with only an additional 3 percent of the spill evaporating through an additional 30 days on the water.

After 30 days into the open-water season, 31,000 bbl or 19 percent of the spill volume will be left on the sea surface as individual tarballs rather than as a discrete slick. The tarballs will have dispersed discontinuously over 44,000 km<sup>2</sup> (Table IV-N-2). Through 1,000 days, about 15 percent of the tarballs would sink (Butler, Morris, and Sleeter, 1976, as cited by Jordan and Payne, 1980), with 16 percent of original slick volume persisting in the remaining tarballs. Because of drift of the oil over distances of thousands of square

Table IV-N-1  
 Mass Balance of Oil Through Time for a Hypothetical 160,000-Barrel Spill  
 of Prudhoe Bay-Like Crude in the Beaufort Sea Planning Area (in bbl)<sup>1/</sup>

Day <sup>2/</sup>	Slick	Evaporated	Dispersed	Sedimented	Onshore
0	125,000	34,000 <sup>3/</sup>	0	1,600	0
3	79,000	34,000	33,000	1,600	9,800
10	49,000	36,000	38,000	1,700	20,000
30	31,000	39,000	42,000	1,800	23,000

Source: USDOJ, MMS, Alaska OCS Region; based on ocean-ice oil-weathering model of Kirstein and Redding, 1988, assuming 249 spillets of 643 bbl each.

- <sup>1/</sup> Assuming oil pools on ice to 2 mm at 32 °F for 0 to 30 days, depending on when it was spilled, and melts out into 50 percent broken ice at 33 °F, with 11-kn winds.
- <sup>2/</sup> Days after meltout of winter spilled oil (97% of total spillage) or summer spillage (3% of total spillage).
- <sup>3/</sup> Evaporation on day 0 attributable to evaporation during oil pooling on ice surface prior to oil release to the water (=meltout).

Table IV-N-2  
 Areas of Discontinuous and Thick Slick from a Hypothetical Spill of  
 160,000 Barrels in the Beaufort Sea Planning Area (in km<sup>2</sup>)

Day	Discontinuous Area	Area of Thick Slick
Initial Spill Area		125
Area During Oil Pooling on Ice Surface		12
Days After Spill Reaches Water Surface: <sup>1/</sup>		
3	2,300	27
10	11,000	42
30	44,000	62

Source: USDOJ, MMS, Alaska OCS Region.

- <sup>1/</sup> Calculated from Ford (1985) and Kirstein and Redding (1988) for 249 spillets of 643 bbl each.

kilometers during the slow process of sinking, individual, sunken tarballs would be extremely widely dispersed in the sediments. The "average" levels of local or regional contamination in sediments would be insignificant. Oil mixed into the shoreline and then dispersed offshore would locally elevate hydrocarbon levels in nearshore sediments.

How much oil reaches specific shorelines or other environmental resources is best estimated from the conditional probabilities for a spill from Spill Site L-10. Tables G-1 through G-12 in Appendix G provide the winter and open-water-season probabilities of contact for a spill originating at Spill Site L-10. Table IV-N-3 provides a summary of the probabilities from these tables that a spill would contact individual land segments or environmental resources within 3, 10, and 30 days of the early summer spillage or summer meltout of the spillage during the winter. A very important consideration is that this spill is both very large and of a very long duration. In such cases, the interpretation of conditional probabilities must change (see Sec. IV.A.1). The probabilities in Table IV-N-1 should be taken as representing what percentage of the spill contacts an individual land segment or environmental resource rather than how likely that contact is.

Eleven percent of the spill, less evaporation and dispersion, would contact isolated stretches of coastline totaling 120 km from about Cape Simpson (Land Segment 23) to the Sagavanirktok River Delta (Land Segment 35), but mostly in the vicinity of Prudhoe Bay (Land Segment 34) within 3 days of the open-water season. Within 30 days, 36 percent of the spill would be on the beaches from Peard Bay (Land Segment 20) to Point Thomson, on land segments totaling a length of 480 km. The amount of oiled shoreline could be greater than this estimate because land-segment lengths are measured as straight lines and do not account for shoreline roughness such as islands, small headlands, and bays (e.g., Dease Inlet, Land Segment 22).

1. **Effects on Water Quality:** Following the spill, most of the more volatile compounds in the slick, particularly aromatic volatiles, will have evaporated while the oil is pooled on the ice surface. Over the first 10 days of a spill, only about 5 percent of a slick can be expected to dissolve (Butler, Morris, and Sleeter, 1976, in Jordan and Payne, 1980). Larger quantities of the slick will disperse as stable, small droplets within the water column (Table IV-N-1). The average dispersed oil concentrations underneath the discontinuous oil slick would be 0.20 ppm over 2,300 km<sup>2</sup> after 3 days into the open-water season, 0.050 ppm over 11,000 km<sup>2</sup> after 10 days, and 0.013 ppm over 44,000 km<sup>2</sup> after 30 days (Table IV-N-4).

Thus, concentrations above the chronic standard for hydrocarbons of 0.015 ppm would persist for less than 30 days, but the standard would be exceeded over more than over 11,000 km<sup>2</sup>. The acute standard of 1.5 ppm hydrocarbons would not be exceeded.

**CONCLUSION:** The effects of a very large oil spill are expected to be LOW on both LOCAL and REGIONAL water quality.

2. **Effects on Lower-Trophic-Level Organisms and Fishes:** As described, the size of the very large oil spill is assumed to be 160,000 bbl, resulting from a leak in the trunk pipeline near Point Thomson. The spill is assumed to occur under the ice in November and last for 249 days or until about July, as described. The spill is expected to move from east to west and generally parallel to the shoreline in about 30 m of water. The oil is initially encapsulated in the ice and eventually melts out into pools on the surface of the ice. The oil may be contained in this manner in melt pools for up to 30 days, during which time most of the more volatile or toxic constituents have evaporated.

The populations of phytoplankton and zooplankton within the water column would be exposed to concentrations of as high as 0.20 ppm after 3 days and, as a result of continuing evaporation and dispersion, the concentration is estimated to be about 0.013 ppm after 30 days. These concentrations are less toxic than might be expected due to the additional weathering process that proceeds the release of the oil into the water column. These populations of planktonic organisms are typically patchy and occur throughout most of the Beaufort Sea, thus reducing the vulnerability of these populations to a major oil spill and also providing important recruitment stocks as needed. The effects are expected to be LOW.

The Boulder Patch has a very low probability of being contacted by a spill; the closest land segment, number 36, has only a 1-percent probability of being contacted. If the spill were to contact the area of the Boulder Patch, MODERATE effects would result, because the population is restricted and reproduction and/or recruitment could be affected. The effects expected on other communities, including pelagic, epontic, and benthic, are expected to be LOW due primarily to the generally broad regional distribution of these communities.

Table IV-N-3  
 Summary of the Percentage of the Spill Projected to Contact  
 Individual Land Segments and Environmental Resources

Land Segment/ Environmental Resource	Day 3	Day 10	Day 30
20	n	1	2
21	n	1	1
22	n	1	1
23	1	1	1
24	n	n	1
26	n	n	1
27	n	1	2
28	n	2	4
29	n	2	3
30	n	1	2
32	n	n	1
33	1	1	1
34	8	11	11
35	1	4	4
36	n	1	1
37	n	2	2
Land	11	29	36
Subsistence-Resource-Area B	3	8	10
Subsistence-Resource-Area C	18	18	18
Bowhead Fall-Feeding-Area A	6	6	8
Bowhead Migration-Area A	2	4	5
Bowhead Migration-Area B	21	21	21
Gray Whale Area	n	n	1
Seabird Offshore Area	1	6	8
Lagoon Area 2	1	3	4
Lagoon Area 3	13	19	20
Lagoon Area 4	2	3	3
Ice/Sea Segment 3	n	n	4
Ice/Sea Segment 4	n	3	5
Ice/Sea Segment 5	3	6	7
Ice/Sea Segment 6	3	3	7
Ice/Sea Segment 7	n	2	3
Ice/Sea Segment 8	2	3	4
Ice/Sea Segment 9	n	1	1

Source: Tables G-7 through G-12, Appendix G, this EIS.

n = less than 0.5 percent.

Table IV-N-4  
 Water-Column Concentrations of Dispersed Oil  
 Beneath a Discontinuous Slick  
 for a Spill of 160,000 Barrels  
 in the Beaufort Sea Planning Area

	After Day		
	3	10	30
Average concentration if all dispersed oil in the water column is in the upper 10 meters (ppm) <sup>1/</sup>	0.20	0.05	0.013

Source: USDOI, MMS, Alaska OCS Region.

<sup>1/</sup> Calculations based on Ford (1985) and Kirstein and Redding (1988) models for 249 spillets of 643 bbl each.

The variability in timing of movements of different species of fishes and their respective age groups reduces the probability that fish populations would be significantly affected by a major oil spill. The broad dispersal of anadromous species in the nearshore zone and the variation in the timing of these populations and variation in the movement of these populations are expected to result in a LOW level of effects. However, in the unlikely event that a large spill contacted the nearshore zone (Table IV-N-3), MODERATE effects could occur for some anadromous fishes and capelin.

**CONCLUSION:** The effects of a very large oil spill on lower-trophic-level organisms and fishes are expected to be LOW.

3. **Effects on Marine and Coastal Birds:** The potential effect of a very large (pipeline) oil spill (160,000 bbl) on marine and coastal birds could be substantial and result in long-term contamination of coastal wetlands (saltmarshes). Within 30 days of spill release from the sea ice, 36 percent of the spill (58,000 bbl) would contact over 480 km of coastline from Peard Bay (Land Segment 20, Fig. IV-A-1-1) to Point Thomson. A substantial portion of the spill (20% or 32,000 bbl) is estimated to contact and oil Simpson Lagoon (Table IV-N-3), an important concentration area for waterfowl and shorebirds with flocks of thousands of birds per square kilometer. The spill contact could result in the loss of 10,000 or more waterfowl and shorebirds with predominant mortality among common species such as oldsquaw and common eider representing a MODERATE effect, because such loss probably would be replaced within one generation. Approximately 2 to 4 percent of the oil (3,000-6,400 bbl) would contact the Colville River Delta tidal and saltmarsh habitats, contaminating important waterfowl and shorebird habitats (Table IV-N-3, Land Segments 28-30). This contamination is expected to have a long-term (degradation of more than one to two generations) effect on the suitability of these wetlands to some waterfowl populations (a HIGH effect).

An estimated 8 percent (13,000 bbl) of the spill is likely to contact the important seabird-foraging area offshore of Point Barrow (Table IV-N-3). This habitat has an average density of 38 birds/km<sup>2</sup>. The 160,000 bbl spill would sweep over a discontinuous area of 44,000 km<sup>2</sup>. If 8 percent of this spill-affected area were included in the seabird-feeding area offshore of Point Barrow, at least 130,000 seabirds could be contacted and killed by the spill. The loss of less abundant species such as the black guillemot or yellow-billed loon could take one to two generations to recover (a HIGH effect).

**CONCLUSION:** The effects of a very large oil spill on marine and coastal birds are expected to be HIGH.

4. **Effects on Pinnipeds, Polar Bears, and Belukha Whales:** The potential effect of a very large (pipeline) oil spill (160,000 bbl) on young seals, walrus calves, and polar bears could be severe, while the effect on adult walruses, seals, and belukha whales is expected to be LOW (see discussion of the general effects of oil on these marine mammals, Sec. IV.C.5). Within 30 days of spill release from the sea ice, 36 percent (58,000 bbl) would contact over 480 km of coastline from Peard Bay (Land Segment 20) to Point Thomson (the site of the spill). A substantial portion of the ringed seal-pupping habitat in shorefast ice (representative of the 480 km of shoreline) could at least partially be exposed to oil-spill contamination at the end of the pupping season in June. Prior to that time, most of the oil is expected to be encapsulated in the ice.

After meltout of the oil spill in mid- to late June, an estimated 2 to 11 ringed seals/nmi<sup>2</sup> (or about 4,000-24,000 ringed seals) could be contaminated by the spill (seal numbers and densities taken from the ranges of densities and total numbers of ringed seals hauled out along the ice from Flaxman Island to Point Barrow as reported by Frost et al., 1988). This contamination could result in the death of several thousand young ringed seals through inhalation and absorption of toxic hydrocarbons in the oil fouling the seals' fur (such an effect apparently occurred with young harbor seals contaminated by the Prince William Sound oil spill). This loss of ringed seals could take more than one generation (4-5 years) but probably less than two generations for population recovery (a HIGH effect).

About 16 percent (or 26,000 bbl) of the oil spill is estimated to contact walrus, seal, and polar bear ice-front habitats offshore from Cape Halkett to just west of Point Barrow (represented by Ice/Sea Segments 3-5 in Fig. IV-A-1-1 and in Table IV-N-3). Several thousand walruses and bearded seals and perhaps several hundred (300-560) polar bears (assuming a bear density of one bear/78-130 km<sup>2</sup> and a total surface area of 44,000 km<sup>2</sup> swept by the discontinuous oil slick from the 160,000-bbl oil spill) could be contaminated by the oil spill. Assuming that all young walrus calves, young bearded seals, and all polar bears contaminated by the oil died because of absorption (through the skin), inhalation, and/or ingestion of toxic hydrocarbons in the

oil, this loss could take these marine-mammal populations more than one to two generations to recover (a HIGH effect). Although some belukha whales might encounter some of the spill during the summer west of Point Barrow, few if any whales are likely to be adversely affected (a LOW effect).

**CONCLUSION:** The effect of a very large oil spill is expected to be HIGH on pinnipeds, HIGH on polar bears, and LOW on belukha whales.

5. **Effects on Endangered and Threatened Species:** As described at the beginning of this section (Sec. IV-N), a very large oil spill (160,000 bbl) resulting from a leak (643 bbl/day) in a trunk pipeline near Point Thomson (Spill Site 10 in Fig. IV-A-1-1) would occur under the ice in November and last for 249 days (up to July 22). The OSRA probabilities should be considered as the percentage of the total spill contacting a particular environmental-resource area rather than how likely that contact would be. The highest percentages of total contact for the whale areas affected by the spill would be the Bowhead Migration-Area B (Fall) at 21 percent; Bowhead Fall-Feeding-Area A, 8 percent; Bowhead Migration-Area A (Fall), 5 percent; and the Gray Whale Area, 1 percent (Table IV-N-3). Also, the Bowhead Spring-Migration-Corridor B would receive an estimated 14 percent of the spill (Table G-3). Twenty-one percent of the oil spill would evaporate from the surface of the ice, where it would pool for at least 30 days prior to discharge during ice melt.

As discussed in the base case, the major concern for a bowhead whale/oil-spill situation is in the spring ice-lead system, where bowheads could be concentrated (see Sec. IV-C-6 for a detailed discussion). In this large-spill scenario, the lead system would receive 14 percent of the spill. The toxic hydrocarbons would be evaporated before the oil enters the water and therefore would not be available to potentially cause respiratory distress to bowheads surfacing to breathe. The spill would not be continuous over the entire lead system, and it is doubtful that it would block migration--as a large, continuous, recent spill could. The oil should have accumulated along the downwind or downcurrent edge of the lead and would not cause an impediment to the migration. The migrating whales could come in contact with oil as they migrate through the lead, but such contact likely would be brief unless the whales stopped in the lead system, which is unlikely. Effects of oil contacting bowheads either in the spring-lead system or in other areas would be as described previously in the base case--baleen fouling, ingestion of oil or oil-contaminated prey, and irritation of skin or sensitive tissues. Overall, this spill in the extreme case could impede spring migration to a limited extent and could cause death to a few individual bowhead whales (a MODERATE effect).

There would be a minimal 1-percent contact for the Gray Whale Area and, therefore, effects on summering gray whales would be VERY LOW.

The shoreline/coastal effect of the spill would be high, and the resulting effect on associated arctic peregrine falcon-prey species (shorebirds and waterfowl) would be HIGH. A limited number of peregrine falcons on hunting flights from inland nesting areas, and also during both spring- and fall-migration period, could take oil-contaminated prey. Direct oiling of peregrines would be doubtful, because peregrines take their prey in-flight and do not scavenge, as do eagles. This could result in the death of a few arctic peregrine falcons (a MODERATE effect).

**CONCLUSION:** The effects of a very large oil spill are expected to be MODERATE for the bowhead whale and arctic peregrine falcon and VERY LOW for the gray whale.

6. **Effects on Caribou:** The potential effect of a very large pipeline oil spill (160,000 bbl) on caribou is likely to be limited to caribou groups occurring during insect-relief periods in coastal waters near shorelines with extensive oil contamination. Although the oil spill is estimated to contact over 480 km of shoreline from Point Thomson to Peard Bay, the majority of the coastline contamination would occur between Pitt Point and the Colville River Delta and in the Prudhoe Bay area (Land Segments 27-30 and 34-35, respectively, Table IV-N-3 and Fig. IV-A-1-1). Caribou groups that belong to the Central Arctic Herd (CAH) and Teshekpuk Lake Herd (TLH) are the assemblages of caribou likely to encounter oil while in coastal waters or on the beaches.

Heavily oiled caribou might die from absorption and/or inhalation of toxic hydrocarbons. Several hundred caribou of the CAH and TLH could die from the oil spill. This loss would represent a MODERATE effect, with population recovery taking place within one generation.

**CONCLUSION:** The effects of a very large oil spill on caribou are expected to be MODERATE.

7. Effects on the Economy of the North Slope Borough: The potential effects of a very large oil spill on the economy of the NSB could be substantial and result in long-term adverse effects. Because the economy of the NSB is highly dependent on subsistence resources, many of the adverse effects would be the result of losses in these resources. In addition, the local government would be burdened due to an increased demand for social services (see Sec. IV.N.8) and increased pressure on infrastructure due to the influx of spill-cleanup workers.

As discussed in Sec. IV.N.9, the effects of a very large oil spill would cause VERY HIGH effects on subsistence-harvest patterns. By one estimate, 76 percent of the NSB households obtain greater than 50 percent of their meat and fish from subsistence resources (Social Indicators, 1988). An event that caused VERY HIGH effects to subsistence-harvest patterns would translate into a substantial decline in household income. Because there are limited job opportunities in the NSB, substitution of market activities for nonmarket activities would be limited. The exception to this would be jobs in cleanup activities. Some residents may find work cleaning up the spilled oil; many cleanup-related jobs were generated as a result of the Exxon Valdez oil spill in Prince William Sound. These jobs, however, would be relatively short term (one or two seasons), while the effects to the various subsistence species are expected to be long term (4-5 years).

In addition, the cost of harvesting subsistence resources could be greatly increased in two ways. First, subsistence users may have to venture farther to obtain the harvest because of population decreases in traditional hunting and gathering areas. Second, equipment used in the harvest of resources may become fouled by the spilled oil. Both of these factors would directly reduce household income.

Indirect costs of an oil spill could result from an increase in demand for social services. As discussed in Sec. IV.N.9, the loss of access to subsistence practices could manifest itself in social pathologies that could result in an increased demand for social services. The cost of these services would most likely be borne by the government of the NSB, which would have to redirect funds from other budget items. Increased costs to local government also would result from an influx of oil-spill workers, Federal and State officials, and the media representatives, which would put strains on infrastructure such as housing, airports, and roads. These increased costs for the NSB would result in increased employment in related activities; however, this also would mean that other types of Borough-funded employment would have to be cut. This would most likely result in job losses to local residents because they might not be qualified to fill some of the spill-induced jobs, especially specialized jobs in social-service provision.

CONCLUSION: The effects of a very large oil spill on the economy of the NSB are expected to be VERY HIGH.

8. Effects on Sociocultural Systems: A very large oil spill could affect sociocultural systems in a number of ways. First, overall effects on subsistence-harvest patterns are expected to be VERY HIGH for a number of subsistence resources. As discussed in Section IV.C.9, VERY HIGH effects on subsistence-harvest patterns would cause disruption that could lead to a breakdown of kinship networks and sharing patterns as well as increase social stress in the community. Participating in the oil-spill cleanup--as local residents did in the Prince William Sound oil spill in 1989--could cause residents to: (1) not participate in subsistence activities, (2) have a surplus of cash to spend on material goods as well as drugs and alcohol, and (3) not seek or continue employment in other jobs in the community (since oil-spill-cleanup wages are higher than average). While no studies have been completed as of the publication of this EIS, early indications are that the sudden dramatic increase in income as a result of working on oil-spill cleanup as well as being unable to pursue subsistence harvests due to the Prince William Sound oil spill caused a tremendous amount of social upheaval--particularly seen in increases in depression, violence, and substance abuse (Anchorage Daily News, September, 26, 1989; New York Times, September 18, 1989).

A disruption of the kinship networks, i.e., social organization, could lead to a decreased emphasis on the importance of the family, cooperation, and sharing. Multiyear disruptions of subsistence-harvest patterns--especially the bowhead whale, which is an important species to the Inupiat culture--could disrupt sharing networks, subsistence-task groups, and crew structures and could cause disruptions of the central Inupiat cultural value: subsistence as a way of life. These disruptions also could cause a breakdown in sharing patterns, family ties, and the community's sense of well-being and could damage sharing linkages with other communities. Other effects might be a decreasing emphasis on subsistence as a livelihood, with an increased emphasis on wage employment, individualism, and entrepreneurialism. Effects on the sociocultural

system, such as increased drug and alcohol abuse, breakdown in family ties, and weakening of social well-being, would lead to additional stresses on the health and social services available. These effects described above would be for 2 to 5 years with a tendency for additional stress on the sociocultural system and tendencies toward displacement, resulting in HIGH effects on the sociocultural system.

**CONCLUSION:** The effects of a very large oil spill on sociocultural systems are expected to be HIGH.

**9. Effects on Subsistence-Harvest Patterns:** A very large pipeline oil spill (160,000 bbl) potentially could threaten subsistence-harvest patterns. The oil spill would contact Nuiqsut's, Barrow's, and Wainwright's subsistence-harvest areas.

The spring bowhead whale harvest would have already occurred in Wainwright and Barrow by the time the oil is assumed to have surfaced in mid-June. However, the oil would cause MODERATE biological effects on bowhead whales (see Sec. IV.N.5) because they migrate through the Beaufort Sea during June. It is possible, although not very likely, that Nuiqsut and Kaktovik would not be allowed to harvest the bowhead whale as the bowhead migration moved east through the Beaufort Sea in the fall (see Sec. IV.C.10 for the discussion on suspension of the bowhead whale harvest in the event of an oil spill). If there were concerns about effects on the bowhead whale population, it is also likely that the IWC would curtail the subsistence harvest of bowhead whales until further research indicated a subsistence harvest would not threaten the bowhead whale stock. Such an assessment could take more than a year or two. However, the likelihood of the bowhead whale harvest in Nuiqsut and Kaktovik being curtailed is not very great, given that the bowhead whale population has been increasing, and biological effects on bowhead whales are not expected to be more than MODERATE. If the harvest is not curtailed or reduced, it would be expected that Nuiqsut's and Kaktovik's bowhead harvest would not have more than LOW effects from this assumed oil spill. However, it also is possible that while the bowhead whale harvest might not be curtailed, the quota could be reduced for more than 2 years--resulting in a VERY HIGH effect on the bowhead whale harvests of Wainwright, Barrow, Nuiqsut, and Kaktovik.

Belukha whales are expected to experience LOW biological effects as a result of the assumed oil spill (see Sec. IV.N.4). Belukha harvests should not experience more than LOW effects, since most belukha would have been harvested either prior to the spill in late spring or later in the fall.

HIGH biological effects on seals, walrus, marine and coastal birds, fishes, and polar bears (see Secs. IV.N.2, 3, and 4) (extensive reductions in these resources) would cause harvests of these resources to be reduced as the result of the oil spill. Wainwright's, Barrow's, and Nuiqsut's walrus and bearded seal harvests are likely not to occur at all for that season because the oil would be spilling during the primary harvest period. In following years, harvests would be expected to occur in greatly reduced numbers for 4 to 5 years--a VERY HIGH effect. Marine and coastal birds would have been harvested during the spring, but Barrow's and Nuiqsut's fall harvests could be reduced. Wainwright's, Barrow's, and Nuiqsut's fish harvests--particularly in the Colville River Delta, Peard Bay, and along the coast--would be expected to be available but in reduced numbers for 1 year--a MODERATE effect. It is also likely that for all subsistence resources there could be reluctance to harvest any marine resources because of perceived tainting from oil.

**CONCLUSION:** Overall effects on subsistence-harvest patterns from a very large oil spill are expected to be VERY HIGH.

**10. Effects on Archaeological Resources:** Offshore archaeological resources in the sale area only would be affected by oil distributed in the water column that reaches the bottom sediments and contacts the resources. If this occurred, shipwrecks and other cultural resources would require additional cleanup due to the oil; and, although carbon-dating techniques could continue to be used to date archaeological resources, more elaborate laboratory processes would be required. The disturbance and modification of a very large spill on offshore archaeological resources is expected to be MODERATE.

Oil from a very large spill could adversely affect onshore archaeological resources and shipwrecks. For a very large spill, Land Segments 18 to 21 at Barrow and 40 to 42 at Kaktovik, particularly, could be contacted by 3 percent and 2 percent, respectively, of the oil remaining after 30 days. Historic onshore hunting sites for birds, whales, and seals would be oiled, resulting in diminished value as historic sites. Previous experience has shown that such spills require Federal and State consultation prior to beach cleanup, with concurrence on acceptable cleanup procedures. Archaeological resources may be significantly altered by cleanup activities. It is expected that the effects of a very large spill on onshore archaeological resources would be HIGH.

**CONCLUSION:** The effects of a very large oil spill on archaeological resources are expected to be HIGH.

11. **Effects on Air Quality:** A very large oil spill is an unplanned accident not generally accommodated by air-quality standards. Consequently, the effects of such an oil spill on air quality are similar to those described for effects not related to standards for accidental oil spills under the base case (Sec. IV.C.12.b). Under the scenario for a very large pipeline spill, the primary effect on air quality would be evaporation of gaseous hydrocarbons from the slick. It is not expected that crude oil would easily burn in sizable fires after being spilled gradually in sea ice, transported within the ice over a large area, and released gradually in small parcels from the ice. Mass-balance-weathering calculations (Payne et al., 1984a; Kirsten and Redding, 1988) indicate that of 160,000 bbl spilled (approximately 21,850 metric tons), evaporation would account for 4,186 metric tons within 30 days after each of the parcels of oil was released from the sea ice during the arctic summer. Evaporation thereafter would be negligible. The amount of hydrocarbons released to the atmosphere corresponds to approximately 419 metric tons of VOC. Under the scenario, the VOC would be carried generally west-southwest by the prevailing winds. Although the VOC may be carried toward land, the locations of the evaporating VOC would be thinly and widely scattered over the Beaufort Sea and would be released slowly throughout the summer. Consequently, the VOC would disperse quickly, and the USDOJ exemption level for VOC emitted at a distance of 5 km (3 mi) from shore would not be exceeded at any location. No measurable effects from air quality other than addressed by standards are predictable on even a short-term or local basis under the scenario.

**CONCLUSION:** Because no measureable effects relative to air-quality standards, nor other short-term or local effects would occur, the effects on air quality are expected to be VERY LOW.

12. **Effects on Land Use Plans and Coastal Management Programs:** In the event of a very large oil spill, biological resources would have higher levels of effects; shorelands, especially saltmarshes and river deltas, would be more heavily oiled; and cultural and archaeological resources would be damaged. However, the policies that were relevant for the base-case analysis remain those that are relevant for this analysis--a spill of the magnitude estimated in this case accentuates rather than expands the potential policy conflicts. Although policies related to oil spills do not differentiate between low and high probabilities for oil spills, the distinction often is evident in the mitigation that is deemed necessary for different types of projects. Development such as that proposed for Sale 124 probably would be reviewed from the perspective that a large-magnitude spill is possible, and this view would form the basis of the mitigation analysis.

**CONCLUSION:** Potential conflicts between effects assumed to follow a very large oil spill and NSB Land Management Regulations and the ACMP are expected to be the same as for the base case--HIGH.

**SECTION V**

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**REVIEW  
AND  
ANALYSIS  
OF  
COMMENTS  
RECEIVED**

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#### Section V Acronym List

The acronyms or initialisms used in this section have not been identified in the text. Please refer to this list for clarification.

ABSORB	Alaska Beaufort Sea Oilspill Response Body
ACS	Alaska Clean Seas
ADF&G	Alaska Dept. of Fish and Game (State)
AEWC	Alaska Eskimo Whaling Commission
ANWR	Arctic National Wildlife Refuge
AOSC	Alaska Oil Spill Commission
AOGA	Alaska Oil and Gas Association
APD	Application for Permit to Drill
ARBO	Arctic Region Biological Opinion
ARCO	ARCO Alaska Inc.
BOM	Bureau of Mines
BP	BP Exploration (Alaska) Inc.
CDU	Conical Drilling Unit
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHE	Chevron USA, Inc.
CMP	Coastal Management Policy
CZM	Coastal Zone Management
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FWS	Fish and Wildlife Service (U.S.)
ITL	Information to Lessees
IWC	International Whaling Commission
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NAEC	Northern Alaska Environmental Center
NEPA	National Environmental Policy Act
NRC	National Research Council
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NSB	North Slope Borough
OCS	Outer Continental Shelf
OCSEAP	Outer Continental Shelf Environmental Assessment Program
OCSLA	Outer Continental Shelf Lands Act
OSCP	oil-spill-contingency plan
OSRA	Oil-Spill-Risk Analysis
OSRD	oil-spill-response drill
PHS	Public Health Service
RSFO	Regional Supervisor/Field Operations
SDR	Seasonal Drilling Restriction
SID	Secretarial Issue Document
TAP	Trans-Alaska Pipeline
USCG	U.S. Coast Guard
USDOI	U.S. Dept. of the Interior
USDOT	U.S. Dept. of Transportation
USGS	U.S. Geological Survey

## **V. REVIEW AND ANALYSIS OF COMMENTS RECEIVED**

### **A. Introduction**

During the DEIS comment period, written comments and oral testimonies were provided by various governmental agencies, petroleum companies and related associations, environmental organizations, and individuals. A total of 23 letters were received; 9 were from Federal agencies, 1 from the State of Alaska, 2 from local governments, 6 from petroleum companies, 3 from environmental organizations, and 2 from private individuals. Public hearings were held in the NSB communities of Barrow, Kaktovik, and Nuiqsut and in Anchorage. A total of 99 testimonies were presented at these hearings: 56 in Barrow, 14 in Kaktovik, 19 in Nuiqsut, and 10 in Anchorage. The mayors of each of the NSB communities presented a statement at the hearing in their respective communities, and representatives of the NSB presented statements at the Barrow hearing. An Inupiaq language translator was available at each of the hearings in the NSB communities.

Most of the comments on the DEIS addressed concerns regarding (1) oil spills and oil-spill-cleanup technology; (2) effects of oil spills and industrial activities on the environment, biological resources, and subsistence harvesting; (3) adequacy of environmental information; (4) mitigating measures; (5) alternatives and deferral areas; and (6) adequacy of petroleum-industry technology to operate in the Arctic marine environment.

All of the written and oral comments on the Sale 124 DEIS were reviewed, and responses were prepared for approximately 370 comments. Where comments warranted changes or presented new, substantive information, the text of the EIS was revised accordingly; a reference to the revised section(s) is made in the responses to the specific comments.

The following substantial changes were made to the text:

- The scenarios for exploration, development and production, and transportation were revised to reflect new resource estimates for the Beaufort Sea Sale Area.
- The cumulative-effects analysis was expanded to include the effects on migratory species throughout their range along the west coast of North America from California to Alaska.
- The water-quality, lower-trophic-level organisms, and fishes analyses for the Proposal and the deferral alternatives were expanded to include the effects from causeways.

### **B. Letters, Comments, and Responses**

The following section presents a reproduction of all letters received during the DEIS comment period. Specific comments in each letter are bracketed and numbered. The MMS responses to the specific comments follow each letter.

#### **Commenter and Letter Designation**

##### **Federal Agencies**

##### **Executive Branch--Departments**

##### **Commerce**

National Oceanic and Atmospheric Administration - NOAA

Human and Health Services - PHS

##### **Interior**

Bureau of Mines - BOM

Fish and Wildlife Service - FWS

Geological Survey - USGS

State (No response required)

##### **Transportation**

U.S. Coast Guard (No response required)

**Independent Establishments**  
Environmental Protection Agency - EPA

**Boards, Committees, and Commissions**  
Marine Mammal Commission - MMC

**State and Local Governments**

State of Alaska  
Office of the Governor - AK  
North Slope Borough - NSB  
City of Nuiqsut - N

**Petroleum Companies and Related Associations**

AMOCO Production Co. - AMO  
Alaska Oil and Gas Association - AOGA  
ARCO Alaska, Inc - ARCO  
BP Exploration - BP  
Chevron USA, Inc. - CHE  
Exxon Co. USA - EXX

**Environmental Groups**

Greenpeace - GRE  
Northern Alaska Environmental Center - NAEC  
Trustees for Alaska - TFA

**Individuals**

John Luther Mohr - MOHR  
Harry E. Wilson - WIL



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Office of the Chief Scientist  
Washington, D.C. 20230

May 25, 1990

Mr. Alan D. Powers  
Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Mr. Powers:

Enclosed are comments to your Draft Environmental Impact Statements for the proposed 1991 Outer Continental Shelf Oil and Gas Lease Sale 124 in the Beaufort Sea. We hope our comments will assist you. Thank you for giving us an opportunity to review the document.

Sincerely,

*David Cottingham*  
for David Cottingham  
Director  
Ecology and Environmental  
Conservation Office

Enclosure

cc: Director, MMS

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JUN 27 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION  
PROPOSED 1991 OUTER CONTINENTAL SHELF OIL AND  
OIL AND GAS LEASE SALE 124 IN THE BEAUFORT SEA

The Alaska Region of the National Marine Fisheries Service (NMFS) and the Alaska Office of the National Ocean Service (NOS) have reviewed the subject document and found it to be a thorough, well prepared assessment of the resources of Alaska's arctic coast and the potential impacts which could result from the proposed lease sale. The statement fairly reflects the current state of knowledge regarding the physical and biological environments at issue. Some important data gaps exist however, which are not always clearly identified or discussed in proper context.

General Comments

There is a paucity of data regarding the offshore (shelf) marine ecosystem and the life histories of fishes outside of the nearshore brackish water zone.

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While the DEIS provides a thorough analysis of the potential impacts of noise on marine mammals, particularly the bowhead whale during the open water seasons, little information or analysis is presented for ice cover. It now appears that significant movement by bowheads occurs under ice during their spring and fall migrations. Certainly, the acoustical environment under ice is not that of open water, and the behavior and sensitivities of bowhead whales may be much different than observed during other periods. Echolocation and the importance of certain frequencies of sound may be critical concerns under ice-cover conditions, as migrating whales maintain communication between individuals or groups and as they navigate and locate thin ice or leads for breathing. The DEIS largely fails to discuss this issue or analyze the potential impact that drilling activity could present.

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NMFS has been concerned with the construction of causeways along Alaska's northern coast, and has identified significant changes to the nearshore marine environment and associated fishery resources attributable to their presence. The DEIS states that causeways may be necessary to connect subsea pipelines to shore, but dismisses any adverse effects to fish because these structures would be "very short". We believe the site-specific effects of these causeways should be analyzed more completely within the Final EIS. The DEIS does present a competent discussion of the cumulative impact of OCS-related causeway development on the arctic marine environment.

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The proposed lease sale area encompasses some 22 million acres extending from the U.S.-Canada border in the east to and including areas of the northeastern Chukchi Sea in the

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west, in water depths ranging from 20 m to 1,000 m. Because of its vast expanse which transcends different environmental regimes, the lease sale area includes biologically, oceanographically and physiographically diverse regimes. From what is known about the region as a result of the Outer Continental Shelf Environmental Assessment Program and other studies, physical environment and biological resources of the Beaufort Sea are markedly different both meridionally and bathymetrically; extrapolation of data from a few, intensely studied parts of the coastal Beaufort Sea, e.g., the Prudhoe Bay region, would not be appropriate or meaningful.

The DEIS in general, and on the assessment of potential effects on the biota in particular, reads as if the lease sale would be held in coastal areas shoreward of the 20 m isobath. There is virtually no discussion of the biological populations or processes that exist in parts of the Beaufort Sea deeper than 50 m. As such the document is deficient in presenting information on the affected environment and on nature of environmental effects of the proposed action.

#### Scientific Basis For the Determination of Effects

The DEIS repeatedly refers to numerous environmental studies conducted as part of the OCS leasing program. Appendix F provides a listing of studies containing more than 200 citations. There is little documented evidence that results from these studies were indeed incorporated in the description of the affected environment or in the determination of potential effects. The burden to review and judge the suitability of the studies data to statements on the DEIS is left to the reader. We at NOAA and those at other cognizant agencies, who are familiar with the studies, have little problem in grasping the basis of conclusions or inferences made in the DEIS. But such a task would be burdensome and virtually impossible for an ordinary citizen or organization. It is worth pointing out that Section 102(2)(C) of the National Environmental Policy Act requires the EIS to be a "detailed" statement. Further, the EIS must be a self-contained document written in language that is understandable to the layman yet allows for meaningful consideration by decision makers and scientists, and it "must also be responsive to opposing opinions, and of sufficient depth to permit a reasoned choice."

#### Sea Ice Hazards

The DEIS provides a descriptive account of sea ice morphology and distributional features. Very little information is presented with which to evaluate potential sea ice hazards to structures, vessels and facilities. There is virtually no discussion of ice material properties, the interaction of ice and structures resulting in large-

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scale forces, or local forces on fixed systems or ships. We do not believe it is sufficient to state that because the petroleum industry has operated in the Canadian Beaufort Sea and other areas with sea ice, safe operations can be expected in the Beaufort Sea. The sea ice environment in the Canadian Beaufort Sea operating fields is vastly different from most parts of the proposed Sale 124 area. The statements in the DEIS notwithstanding, even the petroleum industry is less confident of becoming able to operate successfully in the region of pack ice in the near future.

The report of a panel of experts meeting at Sandia National Laboratories, New Mexico, in 1980 provides a summary of major technical and engineering issues and information needs for safe development and recovery of oil and gas in the arctic offshore. An Office of Technology Assessment (OTA) report, commissioned in 1984 at a joint request of the House Committee on Interior and Insular Affairs and the House Committee on Merchant Marine and Fisheries, also provides some information on technological requirements (and existing constraints) for oil and gas recovery in hostile environments. The Beaufort Sea is certainly one such environment. It is important that a technically sound and realistic account of present-day technology be included in the DEIS to permit the reader to judge the feasibility of oil and gas development in the proposed sale area.

#### Effect of Noise on the Bowhead Whale

The effect of proposed oil and gas development on the bowhead whale and other endangered species is described as "low" or "very low." It is not clear how this determination was made. During a recent review of studies of the bowhead whale, including those to determine the effect of industrial activities on its behavior, it was reported that environmental disturbances would cause significant reactions by whales (Fifth Conference on the Biology of the Bowhead Whale, Anchorage, AK, April 1990). Such reactions may include: cessation of feeding, changes in respiration or diving cycles, or change in the migratory path (avoidance reaction as far as 20 km from the source), among others. Many of the studies represented at this meeting were funded by the Minerals Management Service.

The inferences about behavioral reactions are derived from short-term experiments and have unknown significance (or relevance) to the long-term well-being of individuals or the population as a whole. In many cases, experimental sound projected from underwater equipment had poor fidelity to actual industrial sounds (also, most sound projectors cannot emit low frequency sounds).

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A panel of researchers to discuss the behavior and interaction of the bowhead whale with offshore industrial activity was unable to categorize potential or probable adverse impact on the bowhead whale. The panel appeared to determine that there was "good evidence now that a fair proportion of the bowhead whales" when approached by a seismic vessel "will show strong avoidance reactions" if the vessel comes within several kilometers. For several reasons the panel was not able to elucidate the long-term deleterious effect of avoidance or other behavioral aberrations at the population level. Given this background, we do not agree with the categorization of potential effects on the bowhead whale as "low" or "very low" (both terms have implications of the magnitude of impacts at the population level) as stated in the DEIS. It should be mentioned that the Endangered Species Act requires protection of species from "present or threatened destruction, modification or curtailment of [its] habitats and range" and not merely from a decline in the population of an endangered species.

#### Fisheries Resources

The DEIS provides a good description of what is known about the fisheries resources of the area. The analysis of potential vulnerabilities of fish to activities or events associated with petroleum development includes both the anadromous and marine species. In recent years, the anadromous fish species have received considerable attention, particularly with reference to adverse modification of their feeding habitats due to the presence of solid-filled causeways in the vicinity of Prudhoe Bay. These species include: Arctic char, Arctic cisco, broad whitefish, and least cisco. According to some agencies (e.g., the Environmental Protection Agency, and the Army Corps of Engineers) there is substantial risk of significant population level impact on anadromous fish over the life of the causeways. However, data on the population dynamics of the species are lacking, both spatially and temporally, to make more accurate predictions. We, therefore, find it difficult to accept the categorization of population-level impacts on fish as "very low" or "low." In the case of marine fish of the area, data on population dynamics are simply lacking; even data on population abundance are scanty. We also question the validity of statements such as "If some adults are killed, recruitment in the population might not be affected, since for marine species having planktonic larvae there is little correlation between the size of adult population and recruitment." For some species it is known that recruitment success is established by the number of juvenile fish surviving to the age of six months and not on larval abundance or survival.

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#### Specific Comments

Page I-11 (3) Causeways  
The DEIS states that the construction and use of causeways will be not analyzed as a separate issue (p. I-11). This does not appear to be consistent with an earlier position taken by MMS regarding the this important, and controversial, issue. In April 1989, the MMS sponsored a meeting of nearly 100 scientists and other participants to review and synthesize data pertaining to causeways constructed along the Beaufort Sea coast. At that time, the MMS had expressed a "direct interest in the adequacy of environmental information concerning causeways" as causeways might be an important means of bringing petroleum hydrocarbons ashore from OCS development. The meeting and publication of a "summary of proceedings," reportedly cost \$250,000 but were largely unsuccessful in attaining the stated objective. This failure does not, however, preclude an assessment of impacts from the construction, presence and abandonment of causeways that might be necessary in the event of commercial exploitation of petroleum hydrocarbon resources offshore.

The potential scenario for the base case has two production platforms connecting via an onshore gathering system with landfalls at Point Thompson and Pitt Point. The high scenario would add pipeline crossings at Oliktok Point and Point Belcher. The construction of causeways or jetties in the nearshore zone could have significant effects. An excellent overview of the causeway issue is presented in Section IV.I, page IV-I-6 of the DEIS. Studies of the existing causeways in the Beaufort Sea have shown these structures can deflect the movement of water masses, creating changes in salinities and temperatures with resultant impacts to fish habitat. A case by case analysis would be required to properly assess the impact of additional causeways. What factors would determine the length of such causeways? The anticipated maximum length of 2,500 feet does not in itself guarantee that impacts would be insignificant. A causeway at Point Thompson could have serious impacts by deflecting the easterly movements of waters from the McKenzie River, which would otherwise determine the habitat quality within the barrier island system to the east (Flaxman Island). We believe causeways or short jetties constructed for this Federal lease may be a significant source of impact and should be thoroughly reviewed and assessed in the FEIS.

Page II-19-29

In the Base Case description of the vulnerability of polar bears to effects of the OCS oil and gas activities, it is stated that due to the sparse population it is believed that only 50 - 100 animals would be affected. Therefore, at this level of activities there would be low effects on the polar

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bear (II-19). However, for the High Case (II-29), no mention is made as to whether effects on the polar bear, specifically, would be high, moderate, or low. Some statement should be made as to whether the probable effect on this animal changes when you go from Base Case to High Case.

Page II-62 Effectiveness of ITL No. 7

The second sentence in this paragraph suggests that a jeopardy situation regarding development and production operations would be avoided through the results of additional information and new technologies. While the NMFS will consider such information, there is no assurance that a jeopardy situation can be avoided with respect to drilling activities in the spring lead system.

Page III-A-4

With reference to environmental information and assessment of impacts, the DEIS repeatedly refers to information presented in the FEISs for OCS Sales 87 and 97, and states that new information has been added to the current DEIS. Yet there is little evidence that new information has actually been included in (or considered in the preparation of) this document. For example, in the case of ocean circulation (p. III-A-4, paragraph 3a), the DEIS does not even mention the Beaufort Sea Mesoscale Circulation Study, a three-year study which was started in 1986. This study, whose final report was submitted in April 1989, yielded a comprehensive data set and a much improved understanding of circulation on the Beaufort Sea continental shelf. Among its many findings is the occurrence of the Beaufort Undercurrent, a strong, nominally eastward flow which is located 40-50 m beneath the sea surface. This flow often shows reversals to the west. Further, the study noted that at least below the upper mixed layer, the shelf circulation is primarily forced by large-scale oceanic events rather than by the local wind. This new information has important implications regarding oil spill trajectory calculations and modeling.

A similar lack of new data and information can be seen in most other sections of the DEIS dealing with marine environmental information.

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Page III-A-6

Line 7 of the last paragraph, the sentence "The offshore flow ... (Segar, 1989)" is incorrect. Even though it is attributed to Segar, it should be changed. All winds with a southerly component do not enhance offshore flow. A northeast wind and a northwest wind both have a southerly component, however only the former would enhance offshore flow of fresh and brackish water. The latter would promote an enhance onshore flow.

Page III-B-1

The DEIS reflects the spotty nature of the current environmental data base. There are no data on biological productivity, primary or otherwise, to demonstrate the relative biological significance of different parts of the proposed lease sale area. The major reference on phytoplankton and productivity (Horner 1984) is largely based on pre-OCSEAP data.

The statement "Levels of primary productivity are positively correlated with light levels." (P. III-B-1; Section 1,a,(1)) is simply incorrect. Phytoplankton in the Arctic Ocean, including the Chukchi and Beaufort Seas, has been demonstrated to be shade-adapted and to exhibit photoinhibition of photosynthesis at high light intensities. There is presumption of fact in the statement "It is not clear why a spring bloom [of phytoplankton] does not occur" and the statement is not consistent with Horner's (1984) statement "Perhaps there is no large, single pulse of phytoplankton..." The bottom line is that, due to funding and logistical constraints, no systematic effort has been undertaken in this region to study primary productivity. Virtually all available data are from the "open water season," a little too late to observe the spring onset of primary productivity.

Page III-B-16

The eastern part of the U.S. Beaufort Sea, from Camden Bay to the Canadian border, has long been recognized as an important feeding ground of bowhead whales during their fall migration. Feeding whales, often in groups of 30 or more, are seen every year during the fall in the area between Kaktovik and the U.S.-Canada border. It is also reported that on a single day in September 1982, 128 bowhead whales were counted north of Demarcation Bay. In addition, there are data to suggest that nearshore waters along the Beaufort Sea may flow eastward and westward from a divergence located near Barter Island. The evidence for such a divergence stems from sea ice gouges on the sea floor (ice keels ploughing east to west on the Alaska sector, and

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predominantly west to east on the adjacent Canadian sector), some hydrographic data, prevailing wind regimes, and a few drifter tracks.

In 1985, MMS initiated a study to establish the importance of this area to the existing stocks of the bowhead whale. This was done after considerable discussion on the subject among different agency staffs (including NOAA and MMS) and at the urging of the North Slope Borough (NSB). The NSB considered (and probably still considers) this region to be very important to the continued existence of the species, and wanted this area to receive special management consideration as provided for in the Endangered Species Act (16 USC 1533).

Given this background, it is disappointing that the DEIS does not consider results of the MMS-administered study or related studies on the subject in any detail; it merely states "Areas to the east of Barter Island appear to be used by many bowheads for feeding briefly as they migrate slowly westward across the Beaufort Sea." (p. III-B-16). Clearly, this statement is insufficient to determine whether the area between Camden Bay and the Canadian border is important or essential to the conservation and welfare of the species. The MMS-administered study - including its operative hypothesis, sampling procedures, data analysis, and "integration and conclusions" - has not met wide acceptance. In fact, a committee of sixteen (16) well-recognized experts in pertinent disciplines, which reviewed the final report, found it lacking in several aspects and did not accept conclusions made by the investigators (see a report of the Science Advisory Committee of the North Slope Borough, SAC-OR-109, December 1987, 53 pp.). While we neither endorse nor dispute the findings of the Science Advisory Committee, it is imperative that this important issue must be addressed in detail in the DEIS, including an analysis of relative environmental sensitivity and marine productivity of the eastern Beaufort Sea as required under Section 18 of the OCS Lands Act (43 USC 1344).

Page IV-A-9

The first four paragraphs contain the statement that effects of an oil spill would very likely be limited to a narrow tidal band. If tides are the only spill transporting mechanism considered, then these statements might be correct. However, waves and storm surges cannot be neglected (especially since the "with wave" condition is much more prevalent than the "without wave" condition). Since waves and storm surges must be considered, these statements drastically understate the amount of area likely to be affected by a spill. With seas of several feet superimposed on a surge of only 1 m (with 1-3 m surges possible) the area likely to be affected increases

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tremendously, especially in the low coastal areas in and around the lagoons. Couple seas with a 3 m storm surge and hundreds of square kilometers could be impacted. These possibilities must be addressed in the effects section.

Page IV-B-11 paragraph 3

The discussion does not state if drilling or other OCS operations could occur in the spring lead system, or would be specifically prohibited. As stated in the paragraph 4 on this page, data are presently being gathered which will provide further insight into potential impacts to bowhead whales. The Arctic Region Biological Opinion bases its non-jeopardy conclusion on the assumption that exploratory activities will not occur in the spring lead system. Any such activities will require renewed consultation with NMFS.

Page IV-B-12 Summary

We believe this summary should reflect that all observations of the interactions of bowheads and OCS noises have been made on animals in open water or in ice leads. Presently no data exist on the potential effects of drilling noise on animals moving through ice, nor the impacts of infrasonic noise on communication or echolocation.

Page IV-C-4 b. Dredging

While suspended sediments have very low direct toxicity values, the composition of sediments should be tested prior to assessing the potential impacts from dredging. In Norton Sound, for example, nearshore sediments contain high background levels of mercury and other metals. Dredging activities may resuspend such materials and make them available to aquatic organisms, with resultant adverse effects. The FEIS should provide data on the chemical composition of nearshore sediments for the Beaufort and Chukchi Seas.

Page IV-C-45 paragraph 3

Please reference the statement that the zooplankton-filtering ability of bowhead whale baleen would return to normal hours after contacting spilled oil.

Page IV-C-45 and 46

Several references are made to the short life of toxic or aromatic vapors as a component of spilled oil (e.g. "volatile compounds would be lost within 24 to 48 hours of weathering"). Please provide a reference for these statements. What effect, if any, would low air and water temperatures have on this process?

Page IV-C-45, last sentence

Extrapolation of oil ingestion effects on rats to cetaceans seems unwarranted. A major criticism of the document concerns the cumulative effects section, which begins on page IV-I-1. The potential for a tanker spill between the TAPS terminal at Valdez

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and ports in the Lower 48 states is not included in the introductory paragraphs as a general consideration, even though the potential consequences of oil spills in Prince William Sound are discussed in the subsections on marine birds and mammals.

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Page IV-I-13, paragraph 3

A large spill in Prince William Sound could produce more than a local effect. The Exxon Valdez spill affected biota along several hundreds of kilometers of coastline outside the sound, as well as within the sound.

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Page IV-I-15

The discussion of effects on endangered and threatened species is restricted to bowhead whales and gray whales. What about humpback and finback whales, which occur in the Gulf of Alaska and Prince William Sound?

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Page IV-N-5

It is pointed out that the young of pinnipeds and all ages of polar bears are vulnerable to the toxic effects of oil when the substance is absorbed through the skin or ingested. There should also be some discussion of the probability that the scavenging by polar bears of oiled carcasses of other animals may be a major factor in the impact of spilled oil on these predators.

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#### Conclusion

The DEIS is well prepared in terms of its editorial quality and graphics. Appendix M provides a realistic description of what, if anything, can be done in response to an oil spill in ice-infested waters. The analysis of environmental issues and the results thereof are highly subjective and often questionable in terms of background scientific information, which may or may not have been incorporated. In our opinion, a fatally flawed EIS is not necessarily characterized by a few inaccuracies in statements or inadvertent errors in the analysis of issues but, more significantly, by sweeping conclusions unsupported by facts, vagueness as to important issues, cursory treatment of issues of primary concern (including cumulative effects), and failure to include significant information on the determination of the nature and severity of environmental impacts. The DEIS for Sale 124 needs very considerable modification to avoid such pitfalls.

## Responses to Comments in the Letter from the National Oceanic and Atmospheric Administration

### NOAA-1:

Information on the offshore marine ecosystem was elaborated to a much greater extent in appropriate sections of the Sale 97 FEIS (USDOJ, MMS, 1987), which is incorporated by reference in the Sale 124 FEIS. Also, some information on the life histories of marine fishes is given in Section III.B.2.c of the Sale 124 FEIS.

### NOAA-2:

The text has been amended to include discussions on ice cover, bowhead migration under ice, and potential effects. Also, see Response N-11.

### NOAA-3:

Further discussion and analysis of possible causeway effects associated with the Proposal have been added to various sections of the EIS. Also, see Response EPA-5.

### NOAA-4:

Please see Response NOAA-1. Very little research has been done in the deeper waters of the Beaufort Sea (50 m and deeper), which makes it quite difficult to assess the effects of offshore oil and gas activities that might impinge upon those environs. Oil spills are more likely than other agents or activities to contact the farther offshore regions; and modelled trajectories from spill points suggest that spilled oil would tend to move in a northwesterly direction, taking it farther offshore. Thus, your concern is recognized, but the paucity of data for those areas makes appropriate analysis speculative.

### NOAA-5:

The list of studies shown in Appendix F has been included to substantiate the accomplishments and the ongoing efforts of the studies program. All appropriate studies were used in the preparation of this EIS. The studies list is not meant to be a bibliography. When information from any of the studies listed in the appendix, or from any other source, is used in the EIS, the source is cited and the citation is listed in the bibliography. The MMS considers this to be an appropriate way of referencing material that is used in the descriptions and the analyses in the EIS and should not be a burden to the reader. Furthermore, MMS considers the EIS to be prepared in a manner that meets all the requirements of the NEPA.

### NOAA-6:

The general features of the Beaufort Sea Planning Area sea-ice regime are described in Section III.A.4. The general relationship of sea ice as a constraint to petroleum exploitation and the strategies and technologies used or being developed to mitigate the effects of this constraint are discussed in Section IV.A.3. The EIS discussion of sea ice is descriptive because, as noted in Section IV.A.3, many factors influence the magnitude of the forces that ice can exert on any structure. The technologies that have been and are being developed to operate in the Beaufort Sea ice environment are discussed in Section II.B. Furthermore, some of the information needed to evaluate the capability of a manmade structure is proprietary and thus not available to the public; this information is contained in the exploration and development and production plans submitted to MMS for approval. This format should provide the reader with general background information concerning sea ice and technologies.

Through regulations contained in 30 CFR 250, standards are set for (1) the design, fabrication, and installation of platforms for other structures and (2) all drilling and production activities. The regulations require the lease operator to submit evidence that the drilling unit is capable of withstanding the oceanographic, meteorologic, and ice conditions for the proposed area of operations. Also, all new bottom-founded platforms shall be subject to review under the Platform Verification Program. Hence, the design, fabrication, and installation of these units must be reviewed by an independent third party, a Certified Verification Agent, who has the technical expertise to make the necessary evaluations and judgments. The effects that sea ice might have on vessels and offshore facilities are evaluated when exploration and development and production plans are submitted (in accordance with 30 CFR 250.33 and 250.34, respectively) for MMS approval.

Statements noting past petroleum-industry activities in the Beaufort Sea are not meant to exclude other considerations regarding capabilities or constraints. The statements are intended to indicate a certain level of operational experience and that strategies and technologies have been developed to overcome some of the environmental constraints.

### NOAA-7:

As discussed in Section II.B, the technologies that might be used to explore for petroleum in the Sale 124 area are based mainly on drilling units, support vessels, and associated facilities that already have been used to drill exploration wells in the Beaufort Sea. The technologies that might be used to develop and to produce and transport any economically recoverable oil are based on likely concepts of facilities that might be used. These concepts in turn are based on past operating experiences in other areas and knowledge of the Beaufort Sea environment.

### NOAA-8:

The primary discussion of noise and disturbance effects on bowhead whales is found in the low case (Sec. IV.B.b.). Also, note that the Beaufort Sea Sale 97 FEIS, which is summarized and incorporated by reference in the Sale 124 EIS, contains an extensive discussion and analysis of noise and disturbance effects. Reactions such as diving changes and diversion around noise sources are discussed in the analyses in both EIS's. These reactions could result in distributional changes (no lethal effects) affecting a low number of bowhead whales but not a population decline (lethal effects). Therefore, the noise and disturbance effects are expected to be VERY LOW, or LOW (see effects definitions, Table S-2). As noted in Response to N-6, the combined or overall effects on the bowhead whale have been changed to MODERATE.

### NOAA-9:

Population-level effects, as well as other concerns such as distributional, changes are factors in the effects definitions created by MMS to facilitate review of this complicated document (see Table S-2). The MMS analyses address the possible effects of localized noise and disturbance to bowhead whales and conclude that such factors could result in localized distributional changes. Through ESA Section 7 consultation procedures, MMS determined through their biological-evaluation analysis that Sale 124 "may affect" endangered and threatened species and subsequently requested formal consultation with NMFS and FWS for biological opinions (see Appendix K). The resulting opinions provided recommended measures to protect these species, and proposed mitigating measures (Sec. II.G.2.) were

developed in response to the recommendations in the biological opinions to protect the species from noise and disturbance effects. Also, see Responses N-13, AK-1, and AK-2.

NOAA-10:

The analysis of the effects of construction activities, including causeways, on fishes has been revised, which resulted in an increased effect level. The conclusion, as you have suggested, is based much more on the potential effects on anadromous fishes, as they are viewed as being more vulnerable (due to known life-history considerations). We agree that the data for marine fishes is scanty and consists primarily of some abundance data and some observations of life history.

In regard to your comment about recruitment; your comment does not negate the intent or validity of the sentence you quoted from the EIS.

NOAA-11:

See Response EPA-5.

NOAA-12:

See Response EPA-5.

NOAA-13:

The text has been changed in response to this comment.

NOAA-14:

The wording in ITL No. 7 specifically states "that development and production on leases in this area may be constrained or precluded." In addition, ITL No. 7 has been amended to inform lessees that reinitiation of consultation with NMFS will be required for any activity proposed for the spring-lead system.

NOAA-15:

The first paragraph of Section III of the Sale 124 EIS notes that descriptions of the physical characteristics of the Beaufort Sea Planning Area from the Sales 87 and 97 FEIS's were incorporated by reference and that a summary of the description was augmented by additional material—not new material as the comment notes and appears to want to emphasize. Additional material now has been added to the text of Section III.A.3, Beaufort Shelf Water Characteristics, Circulation, and Mixing. This additional material is in Section III.A.3.b, Inner Shelf; and, as noted in the citations, contains information that became available after the Sale 97 FEIS was published (June 1987).

The text of Section III.A.3.a has been revised to include information about the Beaufort Undercurrent as noted in the Beaufort Sea Mesoscale Circulation Study. However, it should be noted that the eastward transport of subsurface waters overlying the Beaufort Sea continental shelf and slope was mentioned in Section III.A.3.a; this information came from a previous study by one of the authors of the Mesoscale Circulation Study. The text also has been revised to include information on circulation of the shelf water below the mixed layer.

NOAA-16:

The referenced sentence has been deleted from the text.

NOAA-17:

The text has been revised to address your concerns.

NOAA-18:

The bowhead fall-feeding area and the referenced study are discussed in further detail in the Beaufort Sea Sale 97 FEIS, which is summarized and incorporated by reference (see Response MMC-17). In addition, the feeding area was identified in the Sale 124 DEIS oil-spill-risk analysis as an important bowhead whale environmental resource area, and the probabilities of contact by spilled oil relating to oil effects on bowhead whales are discussed in various sections of the EIS (see Secs. IV.B.2 and 3 and IV.F.3).

NOAA-19:

The "without wave" condition is prevalent in the Beaufort Sea Planning Area, with 0- to 0.5-m waves occurring 78 percent of the time in the open-water season (Brower, Baldwin, and Williams, 1988). Waves greater than 2.5 m occur less than 1.3 percent of the time. The empirical model (Ford, 1985) used to estimate the extent (length) of shoreline oiling is based on regression of spill statistics on climatic averages, not climatic extremes and, thus, is appropriately calculated in the EIS. If shoreline contact occurred during a storm surge or a period of extreme waves, a band of shoreline broader than the tidal range could be contaminated. This latter point has been clarified in Section IV.A.2.

NOAA-20:

The Proposal cases are discussed as to the possibility of industry actions occurring, such as drilling in the spring-lead system, without mitigating measures; the mitigating measures are analyzed separately. We have amended the text in Sections IV.B.6 and II.A.2 to inform the reader that we do not anticipate any activities within the spring-lead system. The ITL No. 7 has been amended to inform the lessees that exploratory activities cannot occur in the spring-lead system until consultation is conducted with the NMFS (see Responses N-13, AK-1, and AK-2).

NOAA-21:

The text has been amended to address this concern.

NOAA-22:

The trace-metal composition of Beaufort Sea Planning Area sediments is presented in Section III.A.5. The trace-metal concentrations fall within the typical range for worldwide coastal sediments (Table III-A-2). Unlike Norton Sound, mineralized deposits are not in evidence onshore or offshore; and local, anomalously high, trace-metal values are not found. Generally, trace-metal analyses of sediments are not required by permitting agencies prior to dredging unless sediment contamination is suspected.

NOAA-23:

The referenced citations are found in the Beaufort Sea Sale 97 FEIS, which is incorporated by reference (see Response MMC-17).

NOAA-24:

See Responses NOAA-23 and MMC-20.

NOAA-25:

See Response NOAA-23 for the concerns on the oil-ingestion study. The cumulative-effects analysis has been amended to include effects on endangered and threatened species that are migratory. Oil spills originating from Valdez tankering are only one of the many causal agents considered along each species' migratory paths.

**NOAA-26:**

The EIS recognizes that another spill in Prince William Sound could have local or regional effects. See Section IV.I.5.b, paragraph 2.

**NOAA-27:**

The bowhead and gray whale and the arctic peregrine falcon were the endangered and threatened species identified during the ESA Section 7 consultation process for possible effects from proposed Sale 124 (See Appendix K). Also, see Response NOAA-9.

**NOAA-28:**

The loss of polar bears from eating contaminated seals or other prey is covered under losses due to oil ingestion.



DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control  
Atlanta GA 30333  
April 25, 1990

Mr. Richard W. Roberts  
EIS Coordinator  
Minerals Management Service  
949 East 36th Avenue, Room 110  
Anchorage, Alaska 99508-4302

Dear Mr. Roberts:

We have completed our review of the Beaufort Sea Planning Area Oil and Gas Lease Sale 124 Draft Environmental Impact Statement (DEIS). We are responding on behalf of the U.S. Public Health Service.

The writers of this document have done a very good job of identifying potential impacts, both short-term and long-term. Our major concerns with the proposed oil and gas exploration involves impacts associated with potential oil spills and socio-cultural effects. Although these and other concerns have been addressed in the DEIS, we do offer several comments.

Prevention and mitigation efforts for potential oil spills are planned and are adequately discussed in the DEIS. We agree that oil-spill response preparedness and appropriate contingency planning are essential with a project of this type to offset a variety of related adverse impacts.

Potential impacts are adequately described regarding potentially serious long-term impacts upon socio-cultural aspects of Native Alaskan communities. The document, however, fails to adequately address possible or planned mitigative measures that may be implemented in an effort to ameliorate expected adverse impacts. The only reference to mitigation is that it is suggested that certain "government and community-supported programs, if funded," would serve as possible mitigation (page IV-J-3). Without mitigation, there is an excellent chance for irretrievable loss of Native Alaskan culture in this area. Although we recognize that growth in this area and influences from other similar projects may enhance some changes in the Native culture, an effort should be made by each new project to identify mitigating measures designed to assist in preserving this natural human resource. We suggest that the Final EIS identify possible efforts that may be worthwhile (alluded to regarding community programs) and identify efforts in support of these potential mitigation measures.

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Thank you for the opportunity to review and comment on this DEIS. Please insure that we are included on your mailing list for Final EIS and future DEIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

Kenneth W. Holt, M.S.E.H.  
Environmental Health Scientist  
Center for Environmental Health  
and Injury Control

PHS-1:

The MMS has been reluctant to propose mitigating measures to protect against "irretrievable loss of Native American culture" (other than the Orientation Program stipulation, which should provide some sensitivity to Native culture), primarily because Native culture is changing rapidly even without those changes as a result of the oil industry and associated non-Native cultural influences in these areas (changes in education, in- and outmigration, television, migrating work force, substance abuse, cash economy, etc.). It also would be difficult to develop appropriate mitigating measures to protect Native culture from sociocultural change.



United States Department of the Interior

BUREAU OF MINES

Alaska Field Operations Center
201 E. 9th Avenue
Suite 101
Anchorage, Alaska 99501

April 4, 1990

5. I-11(3) Causeways: The construction and use...will not be not analyzed.... Delete the second "not". BOM 3

Robert B. Hoekzema
Robert B. Hoekzema
Chief, Anchorage Branch

cc: Director, Minerals Management Service
Paul Gates
Millie Gloster

RBH:klr:4/2/90:2166M

Regional Director, Minerals Management Service
Alaska Region
949 East 36th Ave.
Anchorage, AK 99508-4302

Re: Review of Beaufort Sea Planning Area Oil and Gas
Lease Sale 124, Draft Environmental Impact Statement

Thank you for the opportunity to review the Draft Environmental Impact
Statement referenced above. This document is generally well written
and quite complete. A few recommended changes/additions follow.

- 1. The potential use of onshore gravel resources should be summarized
for each alternative. Quantities of gravel needed for individual
projects are mentioned sporadically but it is difficult to
ascertain total requirements.
2. No mention was made of whether gravel sources would be required
for construction of the onshore pipeline or airstrip(s).
3. Extensive coal resources have been identified onshore. Although
effects are unclear at this time, development of oil and gas
resources in the region might impact future coal development on
the North Slope.
4. Construction of onshore facilities associated with offshore oil
and gas development will likely be impacted by the recent
Memorandum of Agreement between the Corps of Engineers (COE) and
the Environmental Protection Agency which "clarifies" Section 404
of the Clean Water Act. Future permits will likely reflect a
stricter wetlands policy which will require avoidance, mitigation,
and/or compensation of wetland values.

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BOM-1:

Information concerning the amount of gravel that might be needed to construct a typical facility is presented
to provide the reader some indication of the quantities that may be required. While estimates of the
amount of gravel that might be needed to construct the facilities noted in the hypothetical scenarios would be
useful, the purpose of the EIS is to analyze the potential environmental effects of activities that might result
from the lease sale. The effects of habitat alteration and destruction caused by gravel mining and
construction activities can be analyzed without knowing the exact volume of gravel that might be used or the
extent of potentially affected areas.

If development occurs as a result of this lease sale, plans showing the locations of facilities, the amount of
gravel required, and the gravel mining sites will have to be submitted to the appropriate regulatory agencies
for review and approval.

BOM-2:

In the discussion of onshore facilities used in with the development of offshore resources, gravel is mentioned
in association with roads--built in conjunction with onshore pipelines, airfields, and support bases. The EIS
also notes that gravel would be obtained from existing mining areas.

BOM-3:

The sentence has been revised.



IN REPLY REFER TO:

# United States Department of the Interior



FISH AND WILDLIFE SERVICE  
NORTHERN ALASKA ECOLOGICAL SERVICES  
101 12th Ave., Box 20, Room 232  
Fairbanks, AK 99701  
May 16, 1990

Raymond R. Emerson  
Chief, Arctic Unit  
Minerals Management Service  
949 East 36th Avenue, Room 110  
Anchorage, Alaska 99508-4302

Re: Draft Environmental Impact  
Statement, Oil and Gas  
Lease Sale 124

Dear Mr. Emerson:

The Fish and Wildlife Service (Service) has briefly reviewed the draft Environmental Impact Statement (DEIS) for Oil and Gas Lease Sale 124 in the Beaufort Sea Planning Area. Due to limited staff availability, we are not providing detailed comments on the DEIS. However, we previously provided comments on Lease Sale 97 for much of the same area (our letter dated January 5, 1987, copy attached); the comments offered below draw upon these earlier comments. We are pleased to note that many of the concerns addressed in our Lease Sale 97 comments have been addressed in the Lease Sale 124 DEIS (e.g., the treatment of marine and coastal birds usually refers to species rather than to groups of species).

The Service recommends that the areas identified as the Barrow Deferral and the Barter Island Deferral be deleted from the proposed lease sale, because of the high fish and wildlife values and subsistence use of the areas. In both areas, the potential for recoverable reserves and economic development is considered low; in fact, the types, levels, and schedule of exploration, development and production, and transportation activities estimated for the deferral alternatives were assumed to be the same as for the base case for Alternative I. As a result, all expected impacts (with the exception of archaeological resources) are identical for the base case and the deferral alternatives (Table S-1).

As stated in our Lease Sale 97 comments, a major problem concerns the size of the geographical area under consideration and the scale of reference used in evaluating potential impacts. The proposed lease sale would encompass approximately 8.95 million hectares of the Beaufort Sea (deleting the Barrow and Barter Island deferrals would

reduce this area by 412,000 ha and 290,000 ha, respectively). This issue is addressed in the DEIS (page I-10) where it is dismissed as insignificant "...because MMS successfully has evaluated the potential environmental effects associated with proposed leasing of the areas for Sale 97, about 19.4 million acres, and Sale 87, about 17.2 million acres, in the Beaufort Sea Planning Area." Despite the assurance that such an evaluation can be successfully conducted, it is also true that such an approach has significant limitations when evaluating effects of the proposed lease sale on various resources. Specifically, potentially severe environmental impacts on a local level are diluted by being considered in the context of extremely broad regional evaluations.

Examples of the problems resulting from an extremely large scale of reference occur throughout the DEIS. For example, potential effects of causeways are dismissed as being local in nature and, therefore, insignificant, despite the ongoing debate regarding the significance of impacts from existing causeways. Potential losses of 30 mi<sup>2</sup> of onshore habitats due to placement of gravel fill are likewise dismissed (page II-19) with a statement that such a loss of habitat would "...represent a small portion of the available tundra habitat. Thus effects on birds from onshore development are expected to be LOW." Similar statements are made throughout the text. This approach ignores the significance of specific types of habitats, potential impacts on local populations, and the differing habitat needs of different species (it is unclear whether the assessment of LOW impacts to birds from onshore development refers to marine and coastal birds, or to all birds, including shorebirds and passerines which would be most affected by onshore impacts).

Regarding impacts of a potential oil spill on marine and coastal birds, the DEIS states (page IV-C-29 and elsewhere) that "...species (such as murres and auklets) with low reproductive rates or species with low population levels are unlikely to suffer high mortality ...since murres and auklets are not abundant in the sale area and loon populations are not concentrated." This statement addresses the probability of contact with an oil spill but ignores the potential significance of the contact. For example, yellow-billed loons have a limited localized breeding distribution, concentrated in the Colville River delta; although the likelihood of contact with spilled oil may be low, any such contact could cause a substantial reduction in the number of yellow-billed loons on the North Slope. Similar situations exist for snow geese and, potentially, brant. Furthermore, direct mortality need not occur for significant impacts to occur, particularly if significant habitat resources (such as Howe Island for snow geese, the Colville River delta for yellow-billed loons and brant, and certain offshore islands supporting large proportions of the area's common eiders) are impacted. The effects of oiling of such areas could potentially persist for several years, rendering the habitat unavailable with resultant decreases in productivity without causing direct bird mortality from oiling. This deficiency in the analysis results primarily from the definitions of effects (Table S-2) which are based exclusively on populations without considering habitat. Finally, an oil spill contacting a shoreline when birds are

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concentrated during fall migration has the potential for affecting much more than a localized population of birds, since the entire arctic population of some species may pass through an area within a period of a few days or weeks.

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The Service concurs with the stipulation recommended by the Alaska Department of Fish and Game (see attached copy of their memorandum from ADF&G to Alaska Division of Governmental Coordination) intended to mitigate the effects of exploratory and production drilling on polar bears. In addition, we suggest that the following information be added, either to ADF&G's proposed stipulation, or in the Information to Lessees:

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Lessees are advised that information on polar bear den sites, as well as technical assistance for dealing with emergencies involving polar bears or with nuisance bears, may be obtained from the Fish and Wildlife Service's Marine Mammals Management office in Anchorage (907-786-3363). It is recommended that lessees petition the Fish and Wildlife Service for the promulgation of small take regulations as described within the Marine Mammals Protection Act, Section 101(a)(5).

As mentioned above, the Service has not conducted an in-depth review of the DEIS for Lease Sale 124. We will provide more detailed comments on specific future proposals associated with oil and gas exploration, development, and production activities in the Beaufort Sea as well as other Outer Continental Shelf planning areas. We appreciate this opportunity to comment. Please contact me (456-0327 Comm.; 870-0327 FTS) if you have any questions on our comments.

Sincerely,



Patrick J. Sousa  
Acting Field Supervisor

cc: Scott Schliebe, FWS, Anchorage  
Rosa Meehan/MaryLynn Nation, FWS, Anchorage  
Regional Director, NPS, Anchorage  
Ron Morris, NMFS, Anchorage  
Jean Hanson, EPA, Anchorage  
John Wharam, ADNR-DO&G, Anchorage  
Warren Matumeak, NSB, Barrow  
Elizabeth Benson, DGC, Fairbanks  
Al Ott, ADF&G, Fairbanks  
Pete McGee, ADEC, Fairbanks  
Greg Zimmerman, ADNR-DL&WM, Fairbanks

PJS/pjs

Attachments

FAIRBANKS FISH AND WILDLIFE ENHANCEMENT OFFICE  
ECOLOGICAL SERVICES/ENDANGERED SPECIES BRANCH  
Room 222, Federal Building, Box 20  
101 12th Avenue  
Fairbanks, Alaska 99701-6257  
January 5, 1987

Regional Director, Alaska OCS Region  
Minerals Management Service  
Attention: Dick Roberts  
949 East 26th Avenue, Room 110  
Anchorage, Alaska 99508-4302

Re: Beaufort Sea Sale 97 DEIS

Dear Mr. Roberts:

We have reviewed the draft Environmental Impact Statement (DEIS) for the Beaufort Sea Lease Sale 97, proposed for January 1988. In general, we found the information presented to be comprehensive, well prepared, and thorough. However, we noted a few significant deficiencies, which are outlined in the following comments.

A major problem with the Sale 97 DEIS is the size of the geographical area covered in one assessment. The result is that the significance of potential severe environmental impacts on a local level is diluted by being considered in the context of broad regional evaluations. One way this problem surfaces is shown in the summary of effects for the proposal and deferral alternatives (Table S-1). This summary shows little significant difference in expected impacts between the various deferral alternatives and the proposal alternative (in fact the effects of the Yaktovik deferral are shown as being identical to the proposal), even though the deferral areas were clearly selected to offer protection to certain biological and subsistence resources. This causes some doubt as to whether the method and criteria used for assessing degree of impact are adequate, or whether a sufficient range of alternatives was examined.

We are very concerned about the predicted MAJOR cumulative impacts to fish in all alternatives, MODERATE impacts to marine and coastal birds in all alternatives, MODERATE cumulative impacts to Bowhead and Gray whales in all alternatives, MODERATE cumulative impacts to caribou in all alternatives, MAJOR cumulative impacts to North Slope sociocultural systems and subsistence in all alternatives, and MODERATE cumulative impacts to water quality in all alternatives.

Since Alternative II (no sale) has been omitted from Table S-1, there is no indication of whether the cumulative effects, which appear to be identical for all alternatives, would also be the same under the "no sale" alternative. For example, are cumulative effects on fish expected to be major, regardless of whether this sale is held?

In the "Description of the Affected Environment", we are particularly concerned by the very minimal attention to marine and coastal birds. The discussion is superficial and overly generalized, with over 150 species and thousands of individuals included in generic statements about "birds". The only species mentioned by name are in paragraph 1 on p. III-23. The four species listed here could be considered the most common in marine habitats, except that red-necked phalaropes are more common than red phalaropes in the eastern Beaufort area. However, it should be emphasized that many additional species that are more common in coastal wetlands could be potentially affected by this lease sale. At least the more common and the more sensitive of these other species should be addressed specifically in the discussion; the reviewer should be informed of the more common species (of ducks, geese, and swans) which are being referred to by the general statements about "waterfowl", and the more common species (of sandpipers, plovers, and phalaropes) which are being referred to by the general statements about "shorebirds". Some important species groups, such as loons and passerines, are totally absent from this discussion. The incorporation by reference of the information in the Sale 87 FEIS does not greatly improve the discussion, since that information is outdated and also extremely generalized.

It would be appropriate to identify unique species having limited localized breeding distributions, such as the snow goose colony on Howe Island and the yellow-billed loon nesting population in the Colville delta. The importance of the Teshekpuk Lake area to molting brant and other waterfowl is also worthy of attention.

The oil spill risk analysis indicates that the chance for an oil spill of 1,000 bbl or greater to occur and contact land within 10 days is almost a certainty (77% during open water season and 90% during winter; Table IV-A-5). Yet the potential effects of oil spills on marine and coastal birds are judged to be only MODERATE, because "the death of several thousand oldsquaw... or other abundant species would not have major regional effects on regional populations of those species, because natural recruitment within abundant species populations such as oldsquaw would probably replace such losses in one or two generations" (p. IV-B-28 first para.). We believe the emphasis on oldsquaw as a basis to assess severity of oil spill impacts to be inappropriate. While this species is by far the most abundant marine bird species in the Beaufort Sea and is widely distributed, conclusions drawn about oil spill effects on oldsquaw are not necessarily applicable to other species, some of which have much more limited populations and distributions, or more critical or narrow habitat requirements that would render them more vulnerable to oil spill effects.

Although "bird species with low regional populations... are not likely to suffer high mortality due to an oil spill in the Beaufort Sea" (p. IV-B-31), the fact that fewer birds would be killed would not necessarily mean that the impact would be insignificant. For example, the Howe Island snow goose colony consists of only 40-50 nesting pairs; however, loss of these birds would eliminate the only nesting colony in the U.S. Likewise, an oil spill contacting a single barrier island (Cross, Pole, Egg, or Thetis) could eliminate 20-30% of the season's production of common eiders for the region. Also, an oil spill contacting a shoreline when birds are concentrated there during fall migration has the potential for affecting much more than a localized population of birds, since the entire arctic population of some species may pass through an area within a period of a few days or weeks. For these reasons, we believe that there is potential for MAJOR impact to some species of birds from the Sale 97 lease offering.

Another major deficiency in the Sale 97 DEIS is in the treatment of onshore impacts. Figure IV-1 shows the hypothetical offshore transportation routes used in the effects assessment, but we can find no figure illustrating the proposed onshore transportation routes. It would be appropriate to include such a figure in the DEIS. While we find the treatment of potential offshore effects of development of this lease sale to be fairly thorough, the discussions of onshore effects appear somewhat incomplete. For example, the potential effects of a network of pipelines and roads running east-west across the entire North Slope coastal plain on caribou herds could certainly be more than MINOR, since portions of the migration routes of all four major arctic herds would be affected. Conclusions drawn from studies of the Trans-Alaska Pipeline (TAP) and Prudhoe Bay may not be applicable to other areas and other herds on the North Slope. Likewise, depending on the routing of these roads and pipelines, the direct and indirect effects on migratory birds and fish and their habitats could be significant. We also wonder if it is realistic to assume that such a road network would remain permanently closed to public access.

The assumption that the infrastructure at Prudhoe Bay will be used to support major construction and operation activities for the development, production, and transportation of crude oil across the entire North Slope seems very speculative and even somewhat unrealistic. The impacts associated with support camps and gravel sources necessary for the construction of several hundred kilometers of onshore pipeline and associated roads and other support facilities do not appear to be addressed in the DEIS.

The Sale 97 DEIS does not address potential impacts on the Arctic National Wildlife Refuge; the issue is avoided by showing undersea pipelines from the eastern sale area coming ashore at Mullen Point. However, we can assume that if the ANWR coastal plain is opened for oil and gas development, any offshore development would logically tie into the onshore infrastructure. This probability, and the potential cumulative environmental effects, should be fully addressed in the Sale 97 EIS.

We are pleased to see that MMS has acknowledged that the "obvious transportation scheme" includes transportation by offshore subsea pipelines (p. IV-A-3, para. 3); however, before this assumption is used in the effects assessment there should be some assurance of industry willingness to use subsea pipelines rather than solid-fill causeways. To date, industry has shown considerably greater interest in construction of causeways than subsea pipelines. Given the major effects of causeways on the nearshore physical regime and fish migration, as summarized on p. IV-B-24, it would seem appropriate for MMS to enforce their preference for subsea pipelines by including a statement in Stipulation No. 5 (p. II-19) prohibiting the construction of causeways and requiring the use of subsea pipelines for any offshore development resulting from this lease sale.

In conclusion, we suggest that the Sale 97 EIS should include an alternative which would incorporate all three of the proposed deferral areas, and that this should be the preferred alternative. We believe the proposed deferrals would significantly reduce the major potential impacts associated with this lease sale offering, particularly impacts to whale migration and feeding areas, impacts to the seabird feeding area near Barrow, and impacts on subsistence activities and communities. These deferrals would also greatly reduce the potential onshore impacts by reducing the potential road/pipeline network from 550 km traversing the entire arctic coastal plain, to about 70 km. The Ektovik deferral would also minimize the vulnerability of the ANWR shorelines (and associated fish and wildlife species) to the risk from the predicted oil spills from offshore wells and subsea pipelines.

The Chukchi Sea deferral should more appropriately be addressed in a separate lease sale and EIS. The Sale 97 DEIS focuses heavily on the resources and impacts in the Beaufort Sea area, and does not adequately address the significant differences of the Chukchi area. Also, the potential effects of the major onshore construction activity associated with the pipeline that would be required for development of the Chukchi area is not adequately addressed in this DEIS.

We have the following additional specific comments:

p. II-20: ITL No. 1

It should be noted that North Slope weather frequently prevents total compliance with flight altitude limitations suggested in this ITL due to over-riding safety considerations. Thus it is unlikely that the level of aircraft disturbance would be reduced to NEGLIGIBLE by this ITL.

p. II-22: ITL No. 2

We suggest that the Colville River delta be included in the list of areas of special biological sensitivity, because of its importance to nesting and staging waterfowl, to anadromous fish, and to subsistence uses. Also, we would suggest including Cross, Pole,

Egg, and Thetis Islands, as these four islands support 70% of the common eiders nesting on barrier islands between the Colville and Canning Rivers (USFWS data).

Additional ITL's

We suggest that it would be appropriate to inform potential lessees of the land status of the Arctic National Wildlife Refuge which is adjacent to part of this lease sale area. A portion of the ANWR coastal plain (west of the Aichilik River) is currently designated as Wilderness. There is the potential that the remainder of the ANWR coastal plain could be designated as Wilderness, depending on the outcome of the decision by Congress on the 1002 area. If so, lessees should be aware that such designation would preclude any construction of onshore facilities in this area to support offshore development.

There is also potential that the 1002 area will be opened to oil and gas leasing by Congressional action. In this case, lessees should be aware that onshore support facilities would be subject to stipulations developed in conjunction with the 1002 actions. (See pp. 145-147 of the draft ANWR Coastal Plain Resource Assessment, report to Congress (USDI 1986) for proposed stipulations for the 1002 area.)

v. III-14

Locations of benthic macrophyte communities other than the Stefansson Sound Boulder Patch are not identified. The extreme scarcity as well as the high productivity of benthic macrophyte communities in the Beaufort Sea warrants their thorough investigation, delineation, and protection, even though none may be as extensive as the Boulder Patch of Stefansson Sound.

p. III-23: para. 3, sentence 2; para. 5, last sentence:  
The Canning River delta should be included in these lists of important bird nesting and fall concentration areas.

Graphic 3

It is unclear why tundra swan concentration areas are only shown for the Arctic National Wildlife Refuge. The highest nesting densities of tundra swans on the North Slope are found in the Colville River delta. Relatively high densities of nesting swans are also found in the Prudhoe Bay area (between Colville and Sag Rivers), the Smith Bay area, and around Dese Inlet. Also, because of the high nesting densities of many bird species on the Canning River delta, it should probably be shown as a "high sensitivity area".

Graphic 4

More recent data on polar bear denning habitat for the North Slope should be available that could be included on this map. (See attached map of polar bear denning areas on ANWR.)

Graphic 5

Since most of the "summer movement" arrows point away from the coast, this map does not indicate the importance of coastal areas as

insect relief habitat for caribou. It is stated on p. III-31, para. 3, that "during the post-calving period in July and August, caribou generally attain their highest degree of aggregation ... cow/calf groups are most sensitive to human disturbance during this period." Thus it would seem appropriate to show these post-calving aggregation areas, in addition to the calving areas, on graphic 5.

Graphic 6

This map is inaccurate, and should be updated to reflect the current State of Alaska 5-year plan for proposed lease sales. Specifically, Beaufort Sea (52) is now scheduled for 1989; North Slope Foothills (57) is now scheduled for 1990; and Icy Cape (53), Offshore Icy Cape (58), Point Franklin (60), and White Hills (61) have been eliminated from the current 5-year leasing schedule. Also, the Prudhoe Bay Uplands (51) lease area is not as shown on the map, as only the northern half is currently being offered.

p. IV-B-2 and B-3

The discussion of potential oil spill effects on macrophytes focuses on the probability of an oil spill contacting the Boulder Patch of Stefansson Sound, and does not consider the probability of contacting other known kelp communities.

p. IV-B-32: para. 5

The loss of "thousands or tens of thousands of birds... as a result of oil spills over the life of these projects" might not result in a significant decline in the oldsquaw population, but could result in MAJOR impacts to other species. Other species besides those mentioned which would be likely to suffer high mortality rates from an oil spill would be: Pacific, red-throated, and yellow-billed loons (which feed in coastal lagoons throughout the breeding season); glaucous gulls and arctic terns (which nest on barrier islands); Ross' gull (during fall migration at Pt. Barrow); red and red-necked phalaropes, dunlin, and sanderling (most common shorebird migrants on barrier islands in August and September); and other species of eiders and scoters (which are included in the term "sea ducks").

p. IV-B-64: para. 3

We believe that considerably more than 10 km of pipeline would be needed to connect Bullen Point to TAP, since the distance is at least 50 km. Please clarify.

p. IV-B-55 and 46

Please clarify the discrepancy between the total amounts of onshore pipeline indicated in these paragraphs, with the total given in Table II-A-1:

- a) Bullen Pt. to TAP: 10 km (correct to 50 km, see above)
- b) Milktok Pt. to TAP: 20 km
- c) Pt. Belcher to TAP: 480 km (Pt. Belcher to NPRA: 140km)

Total: 550 km

Total given in Table II-A-1: 160 km for Sale 97 (360 km total for Beaufort Sea).

We appreciate the opportunity to comment on the DEIS for the OCS Sale 97 Lease Sale. If you have any questions regarding these comments, please contact Kate Maitoret at 456-0209.

Sincerely,

Tony Rooth  
Acting Field Supervisor

cc: Chief, ES, FWS, Washington, D.C.  
REG, FWS, Washington, D.C.  
Glenn Plinson, Refuge Manager, ANWR, Fairbanks,  
Ann Rappoport, USFWS, Anchorage  
Ron Morris, NMFS, Anchorage  
Rich Sumner, EPA, Anchorage  
Jim Siedl, FWS, Anchorage  
John Warren, BOAG, Anchorage  
Warren Matusek, NSR, Barrow  
Jan Sorice, DCC, Fairbanks  
Al Ott, ADPSC, Fairbanks  
Paul Bateson, ADEC, Fairbanks  
Larry Dietrick, N. Slope Dist. Office, ADEC, Fairbanks  
Rick Smith, ADLUM, Fairbanks

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RECEIVED APR 30 1990

Elizabeth Benson

-2-

April 26, 1990

MEMORANDUM

State of Alaska

To: Elizabeth Benson  
Project Review Coordinator  
Division of Governmental Coord.  
Office of Management & Budget  
Date: April 26, 1990  
File No:  
Telephone Number: 451-6192

From: Alvin G. Ott  
Regional Supervisor  
Habitat Division  
Department of Fish and Game  
Subject: OCS Sale 124

The Department of Fish and Game has reviewed the DEIS for proposed OCS Oil and Gas Lease Sale 124 (Beaufort Sea). The department has several general recommendations regarding the Barrow and Kaktovik Deferral Areas, improved subsistence provisions, and polar bear stipulations. First, the department recommends that MMS delete from the sale the area identified as the Barrow Deferral (Alternative IV) because of the high fish and wildlife resource values and subsistence use of the deferral area. The fish and wildlife values in the Barrow Deferral area are especially high because (a) it encompasses the northern part of the spring lead system (Chukchi Polynya), and (b) it encompasses the area north and east of Pt. Barrow-Plover Islands, where during summer the more productive Chukchi Sea water mixes with the Beaufort Sea water to create an area of greater trophic biomass and diversity. Although the risk of impacts caused by exploratory drilling would be minimized by the adoption of stipulation no. 8, this protection does not extend to production where, in the "preferred alternative-high case" scenario, two production platforms would be located in or near the polynya and a landfall and staging area would be located at Pt. Belcher. These facilities increase the potential for chronic disturbance of northward-migrating bowhead and belukha whales, and increase the risk of oil spills from up to 80 production wells and two subsea pipelines anticipated in the "preferred alternative-high case" scenario. In contrast, the anticipated economic benefits of retaining the Barrow Deferral area in the sale are considered low (p. II-32 of the DEIS). Therefore, the Barrow deferral area should be deleted from Sale 124.

Second, the department recommends adoption of the Barter Island Deferral (Alternative V) if a separate EIS for production will not be prepared. The reasons for this are as follows: Although adoption of either the MMS (stipulation no. 8) or State's current seasonal drilling restriction will reduce the probability of exploration activity adversely affecting subsistence whaling, nevertheless, as the DEIS states in Table S-1, effects of the action on Kaktovik's overall subsistence use range from MODERATE to HIGH. Presumably, this is because subsistence activities other than whaling would be adversely affected. There are no stipulations equivalent to stipulation no. 8 or the state's SDR that address the cumulative impacts of exploration and production on other subsistence activities in the Kaktovik area. However, the department would withdraw its recommendation in favor of Alternative V if MMS would formally commit to preparing an EIS for the production phase, and that the issue of cumulative impacts on subsistence uses near all the affected North Slope communities would be addressed at that time.

Third, the department recommends that stipulation no. 6 be expanded to include all subsistence activities in the sale area, not just whaling. Performance standards, such as evaluating whether seasonal harvest activities have been disrupted by oil and gas activities associated with this sale, should be adopted to measure the success of the stipulation. Specific measures such as establishing a process for subsistence harvesters to register complaints and for industry to respond to these complaints, should also be included. This process should involve the North Slope Borough Fish and Game Management Committee. The logical outcome of the process should be specific measures that the RSFO would apply to the lessees to correct the situation.

Fourth, the department recommends an additional stipulation to mitigate potential impacts of bottom-founded exploratory drilling and production activities on polar bears. Polar bears may be attracted to these activities, become a threat to human safety, and may be killed in defense of life, similar to the case this past winter at the "Stinson" exploratory site. Because the Beaufort Sea polar bear stock is thought to number only 2,000 animals and is stable, loss of even a few females of reproductive age could have serious long-term consequences. Polar bears have been attracted to drillsites and production areas because (a) bears are very curious about novel stimuli in their environment and will investigate these stimuli especially if food or cooking odors are also present; and (b) at drill sites located in the transition ice zone, the ice deformation caused by the drilling structure can result in localized concentrations of ringed seals, the bear's chief prey. Therefore, the department recommends that the following stipulation be added:

"Lessees shall, as part of their environmental orientation program for employees, include a section discussing the potential impacts of their activities on polar bears, and mitigation methods adopted by the lessee. Topics shall include a summary of the life history of Beaufort Sea polar bears; provisions of the Marine Mammal Protection Act of 1972 relevant to "take" of bears; and precautions to minimize encounters between polar bears and project personnel. In addition, the lessee shall prepare and implement an approved Polar Bear Interaction Plan to minimize conflicts at the site between polar bears and humans. At a minimum, the plan should include measures to: (a) minimize the attraction of bears to the site; organize the layout of buildings and work areas to minimize bear/human interactions; (c) warn site personnel of bears in the area and on the site, and proper precautions to take; (d) if authorized by the U.S. Fish and Wildlife Service, deter bears from the site; (e) provide contingencies in the event that bears cannot be deterred; (f) properly store materials (e.g., ethylene glycol) that may be toxic to bears and other mammals; and (g) provide a systematic record of bears observed on site or in the immediate area."

Specific comments on the DEIS are enclosed (Enclosure 1). If you have any questions or comments about our comments, please contact Dick Shideler at 451-6192.

cc: Frank Rue, ADF&G, Juneau  
Dave Germann, NSB, Barrow  
Kris O'Connor, ADN/DOAG, Anchorage  
Mike Wheeler, ADEC, Anchorage  
Patrick Sousa, USFWS, Fairbanks  
Scott Schliebe, USFWS-Marine Mammals, Anchorage

AG/ORTS

## ENCLOSURE I

### Specific Comments

Table S-1 and Elsewhere: It is difficult to imagine that the effects of oil and gas exploration and development on bowhead whales will be the same with or without the Barrow and Kaktovik deferrals. This is especially so in light of the NMFS 1989 Arctic Biological Opinion which specifically emphasized that production activities in the spring lead system (e.g., Alternative I-high case) are likely to jeopardize the population. Furthermore, NMFS notes that several drill-sites operating during the migration, even in open-water years, could form an acoustic barrier to whale migration. Although stipulation no. 8 would reduce exploration drilling during the fall migration, production activities are not included. Given the MMS decision to waive the equivalent stipulation in Sale 97, there are no assurances that both exploration and production activities would not be occurring simultaneously across the Beaufort Sea on Sale 97 and Sale 124 leases. Therefore, we recommend that the effects be upgraded to HIGH for Alternative I-High Case, MODERATE for Alternative I-Base Case, and LOW for Alternative I-Low Case.

ITL No. 2: Add Flaxman Island area to the list of Areas of Special Biological and Cultural Sensitivity. The lagoon system around Flaxman Island is an important waterbird use area, and Flaxman Island has been used recurrently as a polar bear denning area. Furthermore, Leffingwell's Cabin is a National Historic Site.

Pages II-C-13-30: MMS should check with the North Slope Borough Planning Department and Department of Fish and Game, Division of Subsistence for the most current land use and harvest data for Nuiqsut and Kaktovik. We also believe it is inappropriate to cite information from sources not available for public review -- i.e., Steven R. Braund and Associates 1989a and b.

## Responses to Comments in the Letter from the Fish and Wildlife Service

### FWS-1:

As noted in Section II.A.2, the resource estimates for the Sale 124 area were revised after publication of the DEIS. The amount of oil estimated to be present in the sale area for the base case for Alternative I is 900 MMbbl; for each of the deferral alternatives, Alternatives IV and V, the amount also is estimated to be 900 MMbbl.

For additional information on consideration of the deferral alternatives, see Response MMC-5.

### FWS-2:

The EIS for Sale 124 does pertain to a large geographical area. However, the analyses consider the potential environmental effects from OCS petroleum activities on smaller areas in several ways. Small areas within and adjacent to the sale area have been classified as marine-mammal habitats (Fig. IV-C-4-1), seabird-feeding and coastal-concentration areas (Fig. IV-C-5-1), endangered whale-habitat areas (Fig. IV-C-6-1), and land and boundary segments (Fig. IV-A-1-1). The probability of oil contacting these areas or segments is given in Appendix G; the probability of oil from a spill of 1,000 bbl or greater contacting the land segments is shown in Figures IV-A-2-2 and IV-A-2-3. Thus, the effects of oil on biological resources in areas that might be contacted by spilled oil are analyzed.

Also, the scenarios include locations where facilities associated with exploration, development and production, and transportation activities might be located; these include Point Thomson, Oliktok Point, and Point Belcher. The effects of activities in these areas on the biological resources and the social systems are analyzed in the EIS.

The analyses of the effects of petroleum activities also include a general discussion of the effects that a number of events—including oil spills, noise and disturbance, and habitat alteration or destruction—might have on various biological resources.

The analyses of the potential environmental effects from OCS petroleum activities is based, in part, on estimates of potential resources; oil-spill probabilities, trajectories, and contacts; and hypothetical locations of exploration, production, and transportation facilities. Such an approach is necessary because the location of possible exploration and production sites (if economically recoverable quantities of oil are discovered) and transportation routes are unknown.

After a sale is held and leases are granted, an exploration plan must be submitted to MMS for approval (30 CFR 250.33) prior to exploration drilling. If economically recoverable oil is discovered, a development and production plan must be submitted to MMS for approval before a production platform can be installed and oil produced (30 CFR 250.34). These plans must address the potential effects of activities or events associated with exploration or development and production. Since the exploration and production sites are known, potential local effects can be more realistically addressed at that time.

### FWS-3:

Consideration of scale is an important and sometimes problematical part of analysis. It is for this reason that definitions rely on attributes that have meaning for a particular resource, subject, or class of organisms. For example, biological definitions depend on the extent of spatial and temporal effects to populations. However, because the distributions and life histories of a class of organisms, such as

fishes, can vary, the determination of effects of a proposal as broad as that for this EIS must take the broad view as well as using site-specific data or effects. As stated in the explanation of "significantly" as used in NEPA, both context and intensity must be considered. Context "means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant" (Federal Register 1508.24).

The problem with looking at possible causeway effects is that much of the data has been gathered to look for local, project-specific effects. The analysis has been revised somewhat, and the potential for problems is not viewed as being insignificant (see Sec. IV.I.3, Cumulative Effects on Fishes).

The text in Section IV.C.4 has been changed in response to this comment. (A LOW effect was increased to a MODERATE effect in the summary of Section II to reflect the analysis in Section IV.C.4.c.) The species of birds potentially affected by the Proposal are described in Section III.B.3.

### FWS-4:

The OSRA indicates that the chance of a spill contacting the coastline of the Colville River Delta is less than 0.05 percent during the open-water season when the loons and other birds would occur there (see Fig. IV-A-2-2). There is essentially no chance of a spill contacting the delta nesting habitat of the yellow-billed loon or that of Pacific brant and snow geese. The effects of a spill on habitat are discussed in Section IV.C.4a(1) (General Effects of Oil Spills) and IV.C.4a(2) (Site-Specific Effects of Oil Spills). The definitions in Table S-2 do factor in habitats. The definitions consider effects on the distribution of bird populations. A reduction in the distribution of a bird population is directly the result of the loss or contamination of habitat.

Although a population or a large portion of a bird population moves through a coastal-habitat area of the Beaufort Sea, the population does not rely on only one lagoon or saltmarsh that may be contaminated by a spill for their feeding or staging activities. Thus, the contamination of a local coastal area by a spill is not likely to affect an entire population.

### FWS-5:

See Response AK-7.



# United States Department of the Interior

GEOLOGICAL SURVEY  
RESTON, VA. 22092

MAY 4 1990

In Reply Refer To:  
WGS-Mail Stop 915

## Memorandum

To: Regional Director, Alaska Region,  
Minerals Management Service

From: Chief Geologist, Geological Survey

Subject: Draft Environmental Impact Statement (EIS) for the  
Proposed 1991 Outer Continental Shelf Oil and Gas Lease  
Sale 124 in the Beaufort Sea

We have reviewed the geology section and the appendix section on estimates of quantities of undiscovered resources in the subject EIS as requested by memorandum of March 8, 1990. We have no major problems with these sections and believe they are generally well written and accurate. Minor comments on each section are given on the attached lists.

Thank you for the opportunity to review this draft.

*William R. Green*  
Benjamin A. Morgan

## Attachments

Copy To: Director, Minerals Management Service

## COMMENTS ON GEOLOGY SECTION

- |   |           |
|---|-----------|
| 1. <u>Page III-A-1, paragraph 3, lines 2-3:</u> Figure III-A-1 is confusing. The hinge line referred to here, for example, is not shown and the number/letter codes are not referred to. It shows only the Outer Arctic Platform, while the text refers to the Arctic Platform in general. (The Hinge Line is shown on figure III-A-5.) | USGS<br>1 |
| 2. <u>Page III-A-2, paragraph 2, line 5:</u> (Reimnitz, Graves, and Barnes, 1985). This reference is old. Should refer to USGS I-Map published by the same three authors in 1988.   | USGS<br>2 |
| 3. <u>Page III-A-2, paragraph 4, line 10:</u> (Reimnitz, Barnes, and Phillips, 1982). Not sure what publication this refers to but believe it should be 1984 rather than 1982. In any case, the draft EIS should make it clear that the phenomena described would be an important consideration in any proposed development.            | USGS<br>3 |
| 4. <u>Page III-A-2, paragraph 5, USGS Map I-1182-H:</u> by Barnes, Reimnitz and Rollyson (in press) shows much lower erosion rates east of the Canning River than indicated in figure III-A-4. The average rates for that eastern region have been presented in various abstracts by P. Barnes et al.                                   | USGS<br>4 |

### USGS-1:

The Hinge Line has been added to Figure III-A-1. Figure III-A-1 shows the petroleum provinces that are part of the Arctic Platform—Chukchi Shelf, Barrow Arch, and Outer Arctic Platform.

### USGS-2:

The citation has been revised.

### USGS-3:

The publication citation is Reimnitz, Barnes, and Phillips (1983).

Consideration of the effects that the mass movement of sediments might have on petroleum development is discussed in Constraints and Technology, Unstable Sediments, Section IV.A.3.b(5).

### USGS-4:

The referenced publication was not available when the response to this comment was prepared.

### Response to (1) Comments on Section on Estimates of Quantities of Undiscovered Resources and (2) Editorial Changes.

Appendix A is a document that has been prepared for inclusion in all MMS oil and gas lease sale environmental impact statements. The USGS comments on this appendix for the Sale 124 EIS are being reviewed by MMS for consideration in subsequent revisions to the appendix.

RECEIVED  
MAY 10 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

COMMENTS ON SECTION ON ESTIMATES OF QUANTITIES OF UNDISCOVERED RESOURCES

1. Page A-3, paragraph 2, last sentence: Awkward. The word "risk" is used twice.
2. Page A-3, paragraph 3: The term "sample probability density curve" sounds pretty technical and is likely to scare off most readers. Additional explanation might be helpful here.
3. Page A-4, paragraph 1, last sentence: A leap in logic occurs. In the preceding sentence, PRESTO is called "a computer program" and in this sentence it is called "a model." The layman may have trouble following this without additional information.
4. Page A-4, paragraph 5: The use of the term "zone" which has not been previously defined ought to be clarified for use in the next page.
5. Page A-5, last paragraph: The abbreviation BOE should be explained or the reader should be referred to the definition on page A-10.
6. Page A-13, paragraph 2, last sentence: Very long and the term "Subject matter experts" is awkward and unclear in meaning.
7. Pages A-9 and A-11: Tables labeled "Undiscovered, economically recoverable resource estimates-Beaufort planning area" and "Undiscovered economically recoverable resource estimates-Beaufort sale area" are so similar that the reader may very well be confused. The difference should be carefully included in the captions. Also, the numbers in the table on page A-9 evidently differ from those on the USGS-MMS national assessment. These differences should be clearly stated and explained.
8. Page A-16: The use of the term "cumulative" is confusing and possibly inappropriate. The term "cumulative" has already been used earlier in the text with an entirely different meaning. We recommend the substitution of the term "aggregate" for "cumulative" all through page A-16. This change will conform with more conventional statistical usage.
9. Page A-17: There is an apparent error on the table. If the mean conditional value for oil (3.82) is multiplied by the marginal probability (0.22), the result should be 0.84 and not 0.82 as listed for the risked mean for oil.

EDITORIAL CHANGES

1. Page A-2, paragraph 2, line 1: The Minerals Management Service (MMS) develops estimates of the FEDERAL OFFSHORE undiscovered . . . .
2. Page A-2, paragraph 3, line 6: . . . evaluating SPECIFIC actions. In the . . . .
3. Page A-3, paragraph 1, lines 6-9: Should read, THESE CONDITIONAL ESTIMATES CAN BE USED TO ASSESS THE FULL RANGE OF POTENTIAL ENVIRONMENTAL IMPACTS IN AN AREA IF LEASING, EXPLORATION, DEVELOPMENT, AND PRODUCTION WERE TO OCCUR.
4. Page A-3, paragraph 2, line 8: . . . are then said to be FULLY risked . . .
5. Page A-3, paragraph 3, line 5: RESOURCES, since it reflects both . . . .
6. Page A-3, paragraph 3, line 16: . . . estimate with a 1-in-20 CHANCE that . . . .
7. Page A-4, paragraph 2, lines 7-9: . . . The model PROVIDES RESULTS OVER a wide range of uncertainty since our knowledge of offshore petroleum provinces varies from considerable DOWN to general regional knowledge.
8. Page A-4, paragraph 3, line 6: . . . numerically model all KNOWN potential . . . .
9. Page A-5, paragraph 4, line 1: PRESTO CALCULATES estimates of . . . .
10. Page A-7, paragraph 5, line 3: . . . cannot be added or subtracted BUT MUST BE AGGREGATED STATISTICALLY. Risked . . . .



United States Department of State

Bureau of Oceans and International  
Environmental and Scientific Affairs

Washington, D.C. 20520

6 April 1990

Mr. Alan Powers  
Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Mr. Powers:

Thank you for the opportunity to review the DEIS proposal prepared for the 1991 Outer Continental Shelf Oil and Gas Lease Sale 124 in the Beaufort Sea.

We find that the proposed action does not appear to have any impact on the foreign relations of the United States, nor on international environmental issues. The Department of State therefore has no further comments at this time.

Sincerely,

Deborah M. Odell  
Office of Ecology, Health  
and Conservation

cc: Barry A. Williamson  
Director  
Minerals Management Service  
Department of the Interior

No Response Required.

RECEIVED

APR 13 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

U.S. Department  
of Transportation  
United States  
Coast Guard



Commandant  
United States Coast Guard

Washington, D.C. 20593-0001  
Staff Symbol: C-HPS-1  
Phone: (202) 267-0504

16600

04 MAY 1990

Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Dear Sir:

This is in response to your letter of March 8, 1990, transmitting the draft Environmental Impact Statement (EIS) for the proposed 1991 Outer Continental Shelf Oil and Gas Lease Sale 124 in the Beaufort Sea. We have no comments to offer.

Thank you for providing the opportunity to review the draft Environmental Impact Statement (EIS).

Sincerely,

K. P. PARMENTIER  
Commander, U.S. Coast Guard  
Chief, Port Operations Branch  
Port Safety and Security Division  
By direction of the Commandant

Copy: Director, Minerals Management Service

No Response Required.

RECEIVED

MAY 7 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA



May 11, 1990

REPLY TO  
ATTN OF: WD-136

Barry Williamson, Director  
Minerals Management Service  
Department of Interior  
Washington, D.C. 20240

Dear Mr. Williamson:

The Environmental Protection Agency (EPA) has reviewed the draft environmental impact statement (EIS) for the **Alaska Outer Continental Shelf (OCS) Beaufort Sea Planning Area Oil and Gas Lease Sale 124**. Our review was conducted in accordance with the National Environmental Policy Act (NEPA) and our responsibilities under Section 309 of the Clean Air Act.

EPA has been involved in this project as a cooperating agency since September, 1989. EPA and the Minerals Management Service (MMS) agreed that EPA's role as a cooperating agency would involve the preparation of an appendix for the EIS dealing with the fate and effects of deliberate exploratory phase oil and gas drilling discharges. EPA agreed to be a cooperating agency because we will have a NEPA compliance responsibility for any National Pollutant Discharge Elimination System (NPDES) permits issued for oil and gas drilling discharges in accordance with Section 511(c)(1) of the Clean Water Act (CWA).

This Section of the CWA indicates that EPA must comply with NEPA when issuing an NPDES permit for the discharge of any pollutant by a new source. Final promulgation of NPDES effluent guidelines for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category are expected by the 1991 lease sale date. The proposed regulation will include New Source Performance Standards (NSPS) covering oil and gas discharges. The NPDES permit that EPA Region 10 will develop for this particular lease sale will regulate new sources that are subject to the NSPS. As a cooperating agency, EPA plans to adopt the final EIS for this sale to meet our NEPA compliance responsibility for our NPDES permit. This should prevent a duplication of effort by EPA and MMS and prevent undue delays in the issuance of our NPDES permit relative to the Lease Sale.

This draft EIS is comprehensive in its assessment of the resources of the Beaufort Sea and analysis of the potential effects that could result from the lease sale. Overall, the draft EIS reflects the current state of knowledge about the physical, chemical, and biological characteristics of the Arctic coast. We have also noted a number of changes and improvements in this EIS compared to the EISs prepared for past Beaufort Sea and Chukchi Sea lease sales. However, we have several concerns that are summarized in the paragraphs that follow. These concerns are fully described

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in the enclosed detailed review comments. We are providing these comments in an effort to improve the information presented in the draft EIS and to clarify issues that are important for making decisions on the leasing options for the proposed lease sale.

Many of the proposed stipulations and Information to Lessees (ITLs) presented in the draft EIS have been included in a number of past Alaska OCS lease sales. The discussions of the effectiveness of these stipulations in mitigating adverse effects could be improved if they provided a historical perspective on how well these mitigating measures have actually performed in the past. EPA continues to be concerned that the proposed action does not incorporate the protective stipulations described in the draft EIS. We object to the proposed leasing without inclusion of protective environmental stipulations.

The draft EIS includes a stipulation dealing with the transportation of hydrocarbons. This stipulation encourages consideration of the use of subsea pipelines for the transportation of oil. The draft EIS analysis of effects assumed pipelines would be the method of transporting oil in the sale area. Causeways would be used to bring these pipelines ashore. We believe that the discussion of the effects resulting from existing causeways does not fully represent the findings of interagency review panels that have reviewed several years of monitoring data for the Endicott and West Dock causeways. The effects of proposed causeways, needed to bring subsea pipelines ashore, are dismissed because these structures would be "very short". The draft EIS does not provide convincing data to support this conclusion. We believe that these proposed causeways could cause adverse effects to the nearshore environment alone or in conjunction with the existing causeways.

The cumulative effects analysis is comprehensive and adequate for species that reside in the three arctic planning areas. For migratory species, the analysis should be expanded to include past, present, and future activities and projects occurring throughout the entire migratory range.

Additional explanation of how MMS analyzes the effects from the various activities associated with this lease sale is needed. Some species found in the Beaufort Sea could encounter a combination of lease sale activities or repeatedly encounter the same activity, which represents a variation on cumulative effects. The definition for cumulative impacts indicates there is an additive component to the evaluation process. An explanation of how MMS incorporates this additive process for assessing cumulative effects is needed.

With regard to the selection of a preferred alternative, EPA strongly supports selection of a combined deferral alternative that includes the blocks considered for deferral in Alternative IV - Barrow Deferral Alternative and Alternative V - Barter Island Deferral Alternative. Each of the deferral alternatives provides some reduction of the risk of spilled oil contacting biological resources and important habitat. Deferral of blocks would also eliminate or reduce noise and disturbance effects. Both deferral alternatives provide localized protection to endangered bowhead whale migration paths and feeding areas. The probability of finding hydrocarbon resources in the deferral

areas is "quite low" and deferring the blocks has not reduced MMS estimates of hydrocarbon resources for the sale.

In conclusion, the draft EIS has identified environmental consequences associated with the proposed action. We believe that adverse effects could be reduced by implementation of the two deferral alternatives in conjunction with implementation of appropriate mitigation. Due to uncertainty about whether stipulations will be included in the sale, the long term disturbance effects on the spring migration of bowhead whales if leasing is allowed in the deferral areas, and the potentially significant adverse water quality effects and associated impacts to fish and fish habitat from existing and proposed causeways, we are rating the proposed action EO-2 (Environmental Objections-Insufficient Information). The insufficient information rating is based on the need for additional information or clarification on the effects of existing and proposed causeways, the effectiveness of stipulations to lessen impacts, cumulative effects on migratory species, and how the analysis adds the effects from exposure to several effect producing activities.

Thank you for the opportunity to review this draft EIS. If you have any questions about these comments, you may contact Sally Brough, in the Environmental Review Section at FTS 399-4012.

Sincerely,

  
for Thomas P. Dunne  
Acting Regional Administrator

Enclosure

cc: MMS Alaska OCS Region

U.S. ENVIRONMENTAL PROTECTION AGENCY  
BEAUFORT SEA PLANNING AREA OIL AND GAS LEASE SALE 124  
DRAFT ENVIRONMENTAL IMPACT STATEMENT  
DETAILED REVIEW COMMENTS

### Introduction

The draft EIS is well written and contains current information about the environment and the biological resources in the area. This draft EIS contains many changes and improvements compared to the previous EIS for lease sale 97 in the Beaufort Sea planning area. The most notable change is the preferred alternative. The range in potential exploration and development scenarios (low, base, and high case) included in Alternative I represents a realistic approach to the uncertainty and speculative nature of estimating oil and gas resources in the lease sale area. Although this approach expands the evaluation of environmental consequences, it gives the EIS reviewer the full range of potential effects.

As noted in our letter we have a number of concerns about the proposed action. We offer the following comments in an effort to develop a project with a minimum of delay and environmental harm. Our objections with the proposed action are focused on the effects of existing and proposed causeways, the selection of a preferred alternative, clarification on the effectiveness of many stipulations and information to Lessees (ITLs), the lack of commitment to environmentally protective stipulations, cumulative effects, and the combined effects of activities associated with this lease sale. Our concerns are outlined below.

### Stipulations

The draft EIS presents and discusses several lease sale stipulations that are designed to mitigate potential adverse environmental consequences. The draft EIS states that the decision to include any or all of these mitigation measures will be made at the final Notice of Sale stage in the overall leasing process. The Notice of Sale occurs several steps after the final EIS has been reviewed. Thus, uncertainty exists about the nature of mitigation for this proposal. Our major concern regarding the stipulations is that unrestricted leasing could occur in biologically sensitive offshore habitats. Many of these sensitive habitats could be protected either through deletion (deferral) of those areas from the sale or through the inclusion of protective stipulations in the terms of the leases.

Many of the proposed stipulations have been included in past lease sales in the Beaufort Sea and Chukchi Sea planning areas. However, the discussion of the effectiveness of many of the stipulations does not provide a historical perspective for how well they have worked in the past. Does a "track record" exist for stipulations that have been included in past lease sales, to use as a basis for the analysis of the effectiveness of these mitigating measures?

For example, how effective has the Orientation Program been in making petroleum-industry personnel "aware of the unique environmental, social, and cultural

values of the North Slope Inupiat residents and their environment? Has this stipulation resulted in the protection of environmental resources and cultural values? Stipulation No. 5 ( Industry Site-Specific Bowhead Whale-Monitoring Program) states that the "effectiveness of this stipulation depends on the quality of the information it contributes to the consultation and regulatory actions governing exploratory-drilling activities". What kind of information on bowhead whales was collected for exploration drilling in the Chukchi Sea last summer and was this information useful for consultation and regulatory purposes?

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EPA supports the proposed stipulations and Information to Lessees (ITLs) presented in the draft EIS. We will consider these mitigation measures in light of any new information presented in the final EIS.

**Causeways**

Stipulation No. 4- Transportation of Hydrocarbons encourages the use of subsea pipelines to bring oil to shore. Causeways/jetties would be needed to protect the pipeline as it approaches the coastline. The draft EIS assumes that pipelines would be the method used for transporting oil. We are concerned with the draft EIS discussion of the effects of existing and proposed causeways. First, the discussion of monitoring information from the Endicott causeway is misleading and does not adequately state the interagency conclusions on the effects of existing causeways. Second, we disagree that the effects of proposed "short" causeways or jetties would have insignificant effects.

Existing Causeways

The paragraph on page IV-I-7 that describes EPA's report on causeways at the March 6, 1989 meeting of the Endicott Monitoring Advisory Group (EMAG) misrepresents EPA's position on the effects of causeways. We have several specific concerns about this discussion in the draft EIS.

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First, the wording in the paragraph implies that EPA was doing the monitoring. We presented one example that came from three years of EnviroSphere's Endicott monitoring data that was collected under the direction of the Corps of Engineers (COE) permit with the advice of the Technical Committee.

Second, the discussion implies that the conditions depicted in the example had only occurred once during "several years of monitoring". As we described in detail at the EMAG meeting, the process, illustrated so well by the example chosen for our report, occurs to some degree whenever the wind blows from the east for more than a few hours. This is a common condition during the summer in the vicinity of Prudhoe Bay. Thus the result, a discontinuity, does not occur in only "extreme" conditions but rather on a frequent basis under normal conditions.

Third, we believe that the draft EIS has selectively presented information from this meeting and that a full accounting of the meeting results is warranted. The final

EIS should present the recommendations of each of the member agencies, whether the information presented by the project proponent resulted in any member agency changing their preliminary recommendations, and the final EMAG recommendation to the District Engineer of the Alaska District COE. The impression from the draft EIS discussion is that causeways have little effect on fish and fish habitat in the nearshore environment. Based on our review of the monitoring data we disagree with this premise.

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The third paragraph on page IV-I-8 identifies "another source of information for the cumulative case". The Lisburne document that is referenced was not a draft EIS. It was a draft of the project proponents own environmental review document (ERD). It's conclusions were never accepted by any agency, including the COE. This document as well as the extensive detailed agency comments on it are not reasonably available to the public. We object to the use of this type of document.

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There are several problems with the information cited in the Lisburne ERD. First, the argument put forward that Arctic cisco mortalities would represent only a small percentage of the Colville River population was seriously questioned and never accepted by the interagency review panel. This was also true for the "modeling" on which the argument was based, in part because the project proponent's estimates of the degree of water quality effects that would result from the Lisburne causeway were also not accepted. (Many agency comments on these draft chapters of the report predicted much greater water quality impacts from the causeway.)

Second, there is no known spawning of Arctic cisco in the Colville River. Thus, there is no "Colville River population." The Lisburne ERD actually discussed the project proponent's estimates of mortality to a portion of the overall Mackenzie River population that overwintered in the Colville River. This estimate was also not accepted by the interagency review panel. The relative importance of the Colville River as an overwintering area for the Mackenzie spawning population is not well understood. It is possible that the Colville River is the single most important overwintering area which would have different implications than the discussion presented in the draft EIS.

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The draft EIS evaluates the effects of the existing causeways in the context of the cumulative case analysis. It concludes that the level of effect on fish and fish habitat, resulting from existing causeways and the other activities and projects in the cumulative scenario, will be MODERATE. This conclusion is based, in part, on selective information from the EMAG meeting and use of information from the draft Lisburne ERD that contained disputed information and conclusions. EPA disagrees with the draft EIS conclusion on the level of impact to fish and fish habitat (MODERATE) from activities in the cumulative case (including causeways). We believe the duration of the adverse effects from causeways alone could result in a HIGH or VERY HIGH impact conclusion. A HIGH effect level is supported by the following facts:

- 1) The District Engineer (under whose direction the majority of the causeway monitoring data have been collected) declared the impacts of the Endicott causeway to be unacceptable based on habitat effects.

2) The majority of the agencies on the EMAG, after having gone through a detailed review process which included the project proponent, reaffirmed their conclusions that additional breaching was necessary at Endicott to mitigate adverse effects on water quality, fish, and fish habitat.

3) The final recommendation of the Deputy District Engineer (chair of the EMAG) was that the impacts of the causeway should be mitigated by installing the full 1,300 feet of additional breaching called for in the COE permit.

4) The oceanographic effects of the West Dock causeway are much greater than those of Endicott and at least two agencies have provided formal mitigation recommendations regarding West Dock to the COE.

We believe it would be more reasonable for the final EIS to fully describe the types of effects that causeways can cause and note that they remain a subject of great controversy that will not be resolved in the lease sale EIS.

Proposed Causeways/Jetties

The draft EIS states that subsea pipelines will be used to bring oil to shore. At landfill sites the pipelines must be protected from the effects of waves and currents, sea ice, and unstable sediment or soil conditions—including possible freeze/thaw cycles. Causeways may be necessary to safely connect subsea pipelines to shore based facilities however, these causeways would be much shorter than the existing Endicott or West Dock causeways. Because these structures would be short the construction and use of causeways were dismissed as having no adverse effect on fish in the nearshore environment and were not analyzed as a separate significant issue in the draft EIS.

Our first concern is that the draft EIS does not provide a clear definition of "short" regarding causeways. The draft EIS states that a very short shore-approach causeway or jetty would be built in conjunction with a subsea pipeline. The draft EIS anticipates that the maximum length would be 2,500 feet. The proposed Niakuk causeway has been referred to as a "short" or "stub" causeway and it is 1.6 miles long. The length of the proposed Niakuk causeway and the description in the draft EIS of causeway size appear to represent a broad range. The final EIS should provide some clarification on this issue. What factors are important in determining the length of the pipeline causeways? Is the maximum length of 2,500 feet realistic?

Our second concern is that a causeway 2,500 feet long does not necessarily mean that the impacts would be insignificant. Causeways of this length, depending on their location, could deflect water masses and result in temperature and salinity changes that would adversely affect fish habitat in the nearshore environment. The final EIS should either present data to support the draft EIS conclusions that short causeways would not appreciably alter water mass characteristics or fully evaluate and disclose the effects of these causeways on the nearshore area at Point Thompson and

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Pitt Point for the base case as well as Oliktok Point and Point Belcher for the high case scenarios.

Third, significant effects to the nearshore marine environment have occurred as a result of the existing causeways. The short jetties or causeways proposed as part of this lease sale could, depending on their location, exacerbate the existing nearshore situation. The final EIS should fully evaluate the cumulative effects of the existing causeways in conjunction with the proposed causeways/jetties.

Cumulative Effects

The cumulative case evaluation is based on a comprehensive list of past, present and future projects in the three arctic planning areas; Beaufort Sea, Chukchi Sea, and Hope Basin. This evaluation of environmental consequences is appropriate for species that reside year round in the three arctic planning areas. However, many migratory species spend only a part of the year in the arctic region. The cumulative effects analysis should include activities and projects from the full range and distribution of these species.

Bowhead whales spend part of the year in the Bering Sea, therefore, the cumulative effects analysis should include activities in the Bering Sea as well as the Beaufort Sea, Chukchi Sea, and Hope Basin. Gray whales migrate from southern California to the Beaufort Sea and the analysis of cumulative effects should include activities and projects throughout their migratory range. Marine and coastal birds found in the arctic during the summer migrate from diverse locations around the world. Development projects in flyways, nesting, and brood rearing areas should be factored into the cumulative effects analysis.

This type of information and analysis were presented in the 5-Year OCS Leasing Program, Draft Supplemental EIS dealing with the cumulative impacts on migratory species. At a minimum, the final EIS for this lease sale should summarize the information and evaluation from the supplemental EIS.

Derivation of Impact Conclusions

Biological populations and individuals of populations can be exposed to a combination of effect producing activities. The effects analysis should cover (1) effects from a combination of activities associated with this lease sale and (2) effects from a combination of activities from the 18 past, present and future projects identified in the cumulative effects assessment (Appendix E).

For example, marine and coastal birds would likely be exposed to the following effect producing activities from this proposed lease sale: spilled oil; disturbance from aircraft, boat traffic, and drilling activity; and habitat alteration from offshore and onshore pipeline construction. Not only would the marine and coastal birds be exposed to these activities from this lease sale, they would also be exposed to a similar combination of activities from past federal and state lease sales, future federal

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and state lease sales, and existing and future pipelines. The cumulative case includes more activities with a greater spatial distribution. Fish populations would be exposed to spilled oil, seismic surveys, drilling discharges, causeways, construction of drilling islands, and pipeline construction. The cumulative case for fish would also involve more activities with a broader distribution.

The Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA provide a definition of cumulative effects (40 CFR 1508.7) This definition states that the cumulative impact is "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions..." This implies that there is an additive component in the effects evaluation process. It would seem reasonable to apply this additive concept to the cumulative effects assessment as well as the assessment of effects resulting from exposure to a combination of activities associated with this lease sale.

We are concerned that the draft EIS evaluation of impacts resulting from exposure to multiple effect producing activities assumes that the combined or cumulative effect will be no greater, or less, than the effect from the most severe individual effect producing activity. The effect from all activities to which an organism is exposed could possibly exceed the sum of the effects from each individual activity. The final EIS should provide a description of the analytical approach used by MMS technical staff to determine the levels of impact and the "incremental contribution". The analysis of the "incremental contribution" should apply to resident species exposed to a combination of activities from this lease sale and from the 18 projects in the cumulative case and to migratory species that encounter a broader range of activities throughout their migratory range.

## Alternatives

### Barrow Deferral Alternative

This area was highlighted in the 5-year OCS leasing program for further consideration since it would provide additional protection to endangered bowhead whales and their use by subsistence populations. The blocks deferred from leasing are important to bowhead whales during their spring migration. This area is also important for subsistence whaling activities. The Biological Opinion for the previous lease sale (Sale 97) concluded that the Barrow deferral alternative was a reasonable and prudent alternative that would avoid the "likelihood of jeopardy" to the bowhead whale population. This alternative would reduce noise and disturbance effects on Wainwright's and Barrow's subsistence harvest activities.

The deferral of these blocks would provide some degree of protection to birds and marine mammals. Deferral would lessen activity in the high density seabird feeding area near Point Barrow, provide some reduction in oil spill risk, lessen noise and disturbance effects to the Plover Islands and Peard Bay areas and reduce bird habitat alterations due to construction activities. For marine mammals, deferral would reduce oil spill risk to ringed, bearded and spotted seals, beluga whales and walrus.

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This alternative would lessen noise and disturbance from air craft and boat traffic and interference with subsistence hunting and harvesting activities.

### Barter Island Deferral Alternative

The blocks deferred in this alternative would provide localized protection to bowhead fall feeding and fall migration areas. This alternative would reduce noise and disturbance effects to subsistence hunting areas east of Kaktovik. This alternative would reduce oil spill risks and noise and disturbance to bird habitat east of Kaktovik including Jago and Beaufort lagoons. Deferral would reduce disturbance effects on ringed seals and polar bears.

### Selection of a Preferred Alternative

Barrow and the Barter Island deferral alternatives (Alternative IV and Alternative V respectively) were formulated to provide protection to endangered bowhead whales and their migration route, to protect the habitat of significant biological resources, and to protect cultural activities and values. Further, the draft EIS concludes that the probability of a major discovery of hydrocarbons in the deferred blocks of either deferral alternative is quite low. Deferral of the blocks in these two alternatives has not resulted in a decrease in MMS estimates of the hydrocarbon resources in the lease sale area.

EPA strongly supports both deferral alternatives and believes that they deserve special consideration. Each provides some reduction of the risk of spilled oil affecting biological resources and habitat. Deferral of blocks in both areas would also reduce noise and disturbance effects. Since both deferral alternatives provide some degree of local protection to biological populations, habitat, and subsistence harvesting activities without a reduction in projected oil and gas resources, consideration should be given to selecting a combination of the two deferral alternatives as the preferred alternative.

### Stefanson Sound Boulder Patch

The draft EIS states that the Stefanson Sound Boulder Patch community is vulnerable to the effects from oil-related activities since it is spatially restricted. We agree with this statement. Since this type of habitat is not prevalent along the American Arctic coast, we believe that any contact with oil and/or oil related activities could result in a change to a rare and unique community which is a HIGH level of effect.

## Responses to Comments in the Letter from the Environmental Protection Agency

### EPA-1:

In addition to existing laws and regulations that apply to OCS leases, mitigating measures for a lease sale include stipulations and IIL's that are approved by the Secretary of the Interior. Stipulations imposed on leases become part of the conditions governing the activities on those leases. The effectiveness of the stipulations is based on a reasonable assumption that lessees will comply with the requirements of the stipulations as well as the requirements of other laws and regulations. The IIL's provide the lease operators with notice of special concerns in or near the lease area; they are advisory in nature and generally do not have specific requirements that the USDO I can impose. Thus, the effectiveness of the IIL's is based on the positive benefit that comes with creating a greater awareness of those issues addressed by the IIL's.

Although there is no formal method for measuring the effectiveness of the potential mitigating measures addressed in the Sale 124 EIS, support for including these measures in the lease sale has been received from some of those individuals, organizations, and governmental agencies—including the EPA—who have commented on the DEIS for Sale 124 as well as the DEIS's for past lease sales in the Beaufort Sea Planning Area. This support indicates that the measures are perceived as being effective.

There is no specific information on how effective the Orientation Program has been in making the petroleum industry personnel "aware of the unique environmental, social, and cultural values of the North Slope Inupiat residents and their environment" or how successful this stipulation has been in protecting the environmental resources and cultural values. However, the Orientation Programs have been excellent, particularly the ones created more recently, and are rigorously given to all workers. The text has been amended to address this concern.

Section II.G.2 has been amended to address the "historical perspective" concern for Stipulation No. 5.

### EPA-2:

The text in the EIS has been revised to address some of your concerns. As you point out in your comment, the extent and extremity of changes in oceanographic parameters near causeways will vary with meteorological conditions, and this has been mentioned in the EIS. However, not all of these changes will result in a discontinuity. Winds of shorter duration and less magnitude can lead to upwelling near the tip of the causeway, and this could have effects on fish, but the effects are presumably less than under more extreme conditions.

The EIS is not the appropriate place to present and evaluate the recommendations and actions of the EMAG (Endicott Monitoring Advisory Group).

The discussion of the potential significance of changes in the nearshore habitat for anadromous fishes has been elaborated.

The cumulative-effects section (Sec. IV.I) has been amended to include the effects on migratory species.

### EPA-3:

The paragraph in question has been deleted. References to the questioned document and use of particular information

from it were deleted from the text. We agree there is no known Colville River population of arctic ciscoes.

### EPA-4:

The cumulative case has been revised to reflect the importance of the duration of potential effects, and this contribution to an increased effect level. Also, information from the draft Lisburne ERD was not used in the revised assessment.

### EPA-5:

The effects of causeways are analyzed in the EIS in relation to the resources that might be affected in terms of habitat alteration. Habitat alteration is a major scoping issue for fishes, birds, and marine mammals (Sec. I.D.1). This is the reason the effects of causeways were not analyzed as a separate significant issue and not, as suggested in the comment, because the causeways would be short and have no adverse effects on fishes in the nearshore environment.

The scenarios discussed in the EIS are hypothetical and are presented to provide a common basis for the analyses of the potential effects of the lease sale. The location, orientation, type, and size of any causeway that might be used in conjunction with activities associated with this lease sale would depend, as noted in Section II.B.2.a(4), on many site-specific factors and the characteristics of the produced oil. An attempt was made to estimate the length of such a causeway, but without site-specific information this estimate is highly speculative. The effects of a hypothetical causeway on the circulation, salinity, and temperature could be simulated by a circulation model. However, without specific information about its construction, length, orientation, and location, an analysis could show effects that are different from those of a causeway that might actually be proposed.

If causeways are used in the transportation of discovered oil to shore facilities, site-specific effects are more appropriately addressed in the development and production plans that the lessees must submit to MMS for approval in accordance with 30 CFR 250.34. Before the plans are approved, regulatory and/or permitting agencies may require the potential effects of the causeways on watermasses to be assessed by modelling of the nearshore circulation.

The EIS for Sale 124 analyzes the potential effects of petroleum exploitation in a relatively large region where the location and amount of the oil and gas resources are unknown; a geographical approach is one of the ways a major Federal action requiring the preparation of an EIS may be evaluated (40 CFR 1502.4). Significance varies with the setting of the proposed action (40 CFR 1508.27); for a large area, the significance of a proposed action usually would depend on the effects in the region rather than at a specific site. Thus, the evaluation of hypothetical causeways in the Sale 124 EIS includes an analysis of general site-specific effects on water quality and affected biological resources within the context of the regional analysis.

In addition to causeways, pipelines that cross the shoreline may be set in the marine sediments and terrestrial soils along the route either through burial in a trench or placing in a directionally drilled hole. Recent guidance from the U.S. Army Corps of Engineers indicates that permits to construct solid-fill causeways used to access hydrocarbon reservoirs in the Beaufort Sea will not be approved unless other alternatives are found to be impracticable and a particular proposal fully meets the requirements of Section 404(b)(1) of the Clean Water Act.

#### EPA-6:

Additional discussion on the cumulative effects on migratory marine and coastal birds and migratory seals, walrus, and belukha whales has been added to the text in response to this comment. The cumulative-effects analysis for endangered and threatened species has been revised to include effects from projects and activities throughout the migratory ranges of bowhead and gray whales and the arctic peregrine falcon.

#### EPA-7:

In the EIS, the approach is to use a systematic method of examining the individual potential effects on a species or species group from each effect-producing activity (oil spills, noise/disturbance, drilling discharges, etc.) and then to examine the potential effects from these activities in the aggregate. With this method, the conclusion for any species or species group can be no lower than the highest rating from any of the effects produced by any individual effect-producing activity. The variety of effect-producing activities are further considered in the oil-spill-risk and cumulative-case analyses for each resource. Most effect-producing activities are short term, localized, and usually not additive; therefore, they are not working together. The probability of any two effects occurring at the same time, at the same place, and to the same individuals in the population is extremely remote. Also, not all the species or species groups are going to be affected by all the projects listed for the cumulative case.

The approach, per se, that the analysts use in analyzing the data is of lesser importance than is their consideration of relevant scientific data and other information in their analyses. Therefore, MMS does not believe it necessary to describe the analytical approaches used by the analysts. The data and information used to analyze the potential environmental effects of petroleum activities in the Beaufort Sea Planning Area are discussed and cited in the EIS. The review process should scrutinize this data and information--and the conclusions--and not analytical approaches.

The cumulative-effects analysis on marine and coastal birds and the analysis on marine mammals does factor in the combination of effects of oil spills; noise from aircraft, boats, and drilling activities; and habitat alteration from various development projects on the North Slope and in the Beaufort and Chukchi Seas, see Sections IV.C.4 and IV.C.5.

MARINE MAMMAL COMMISSION  
1625 I STREET, N.W.  
WASHINGTON, DC 20006

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8 May 1990

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REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Mr. Alan D. Powers  
Regional Director, Alaska Region  
Minerals Management Service  
949 East 36th Avenue  
Anchorage, AK 99508

Dear Mr. Powers:

By letter of 8 March 1990, the Deputy Director of the Minerals Management Service asked the Marine Mammal Commission to forward comments to you on the Draft Environmental Impact Statement for the Beaufort Sea Planning Area Oil and Gas Lease Sale 124. In response, the Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the document and offers the following comments and recommendations on its assessment of the possible effects of the proposed sale on marine mammals.

#### General Comments

The Draft Environmental Impact Statement (DEIS) assesses possible impacts associated with a proposal to lease up to 4,095 blocks (approximately 22.1 million acres) of submerged lands in the Beaufort Sea between 5 and 260 kilometers (3 to 140 nautical miles) off the North coast of Alaska for the purpose of oil and gas exploration and development. The Sale is tentatively scheduled for April 1991. The DEIS also considers four alternative actions, including two track deletion alternatives. It also considers various mitigating measures to reduce the type, occurrence, and extent of possible impacts.

The DEIS indicates that bowhead whales and gray whales are the endangered marine mammals most likely to be affected by the proposed action. Conclusions in the DEIS indicate that the Service expects that there would be no effect on bowhead or gray whale populations from which recovery to pre-lease conditions would not occur within one to three years and within one year, respectively. Consultations have been initiated with the National Marine Fisheries Service pursuant to section 7 of the Endangered Species Act on the effects of the lease sale on endangered whales. While results of these consultations were not available for inclusion in the DEIS, they are expected to be

included in the FEIS. The DEIS notes that the National Marine Fisheries Service prepared an Arctic Region Biological Opinion on offshore oil and gas-related activities in 1988 and that it includes several recommended actions. The Opinion is not appended to the DEIS with other section 7 correspondence and the DEIS does not identify the recommended actions. This frustrates careful consideration of the proposed action. The FEIS should include the Arctic Regional Biological Opinion, as well as the sale specific opinion, and should identify the extent to which any recommended actions have been incorporated into the proposed action. Where they have not been incorporated, the reasons why should be explained.

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A number of potential stipulations and "information to lessees" notices are identified in the DEIS to reduce possible impacts on marine mammals. These measures should provide useful protection for marine mammals and other species and, as discussed below, we recommend that they be modified and adopted as part of the proposed action.

In this regard, the Commission recommends that Stipulation No. 5 for an Industry Site-Specific Bowhead Whale Monitoring Program be expanded or an additional lease stipulation be identified and included as part of the proposed action. The revised or new stipulation should require lessees to report all observed approaches or interactions between marine mammals and field facilities and operations to the lease manager. For example, lease operators should be required to file a report each time a polar bear enters or approaches a drilling site and any interactions between the bear and field equipment, supplies, or personnel. Such a reporting requirement would enable the development of wildlife interactions records for individual facilities and help ensure that lease managers have an adequate basis for assessing, monitoring, and responding to potentially adverse interactions between marine mammals and oil and gas operations. For the reasons noted below, the Commission recommends that the Service consult with the National Marine Fisheries Service and Fish and Wildlife Service to identify appropriate procedures and requirements for planning, conducting, and reviewing results of industry site-specific monitoring and reporting programs for bowhead whales and other species of special concern likely to occur near or interact with offshore facilities and activities.

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The DEIS analyzes the effects of two alternatives to delete blocks off Point Barrow and Barter Island from the proposed sale to protect certain important wildlife habitats. Because wildlife in these areas could be affected by spills and activities outside the deferral areas, the Service has concluded that the deletions would offer no increased protection. As discussed below, the analyses are incomplete. They do not assess the extent to which the deletion alternatives would reduce the overall risk of oil

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spills or other activities affecting the important wildlife habitats of concern nor do they consider that oil reaching these areas from points outside of the deferred areas likely would pose less of a threat due to weathering and entrapment of oil along the path between the spill site and the habitats of concern. These factors suggest that the deletion alternatives could significantly reduce the overall probability and effect of spills and activities likely to affect important marine mammal habitat. Therefore, a more complete analysis of such benefits should be included. If the analysis suggests that the deletions would provide substantial additional protection, as we suspect, we recommend that both track deletion alternatives be adopted.

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As discussed below, the Marine Mammal Commission also recommends that the DEIS be modified to: a) consider effects on polar bears and other wildlife possibly resulting from their attraction to activities, lights, smells, or other factors associated with facilities and their operations; b) reassess analyses and conclusions regarding cumulative effects on pinnipeds, polar bears, and beluga whales and, as appropriate, indicate that the expected cumulative effects on these species would be high; c) better indicate the crucial role of the Service's Environmental Studies Program in detecting and mitigating possible unforeseen impacts; and d) ensure that all statements regarding the status of marine mammals and studies of the effects of pollutants on marine mammals are supported by data and analyses or references cited in the document, rather than by other documents "incorporated by reference."

Specific Comments

Page i, Environmental Effects: The second sentence of this section notes that the risk of environmental impacts is due to possible accidental or chronic spills and industrial-noise disturbances. As noted below and elsewhere in the DEIS, possible environmental impacts also may occur due to factors other than oil spills and noise-related disturbances. Therefore, the end of the second sentence would be more accurate if it were revised to read something like "...may result from accidental or chronic oil spills, noise, physical alterations, and other perturbations resulting from industry facilities, equipment, and activities."

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Page ii, Alternatives to the Proposed Action: This section notes that four alternative actions were considered including two possible track deletion alternatives. This and other sections in the DEIS should note that the two track deletion alternatives are not mutually exclusive. In addition, either this section of the summary sheet or the section describing the proposed action should explain why the two track deletion alternatives were not selected. In this regard, we note that the DEIS indicates that neither track deletion would reduce the estimated recoverable

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resource. Also, as discussed below, factors not addressed in the DEIS indicate that protection of important marine mammal and other wildlife habitat could be significantly improved by both track deletion alternatives.

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Page I-I, Leasing Process: This section notes that the Minerals Management Service's Environmental Studies Program plays a vital role in developing information on potential effects of oil and gas activities and refers readers to Appendix F for additional information. The Commission strongly agrees. Moreover, as noted in Appendix F, the Environmental Studies Program also is responsible for meeting the Outer Continental Shelf Lands Act mandate for post-sale monitoring studies to detect actual changes in environmental conditions. In this regard, there is an important distinction between developing information to assess potential effects and monitoring to verify predictions and detect unforeseen effects. Given uncertainties concerning possible direct and indirect effects, monitoring is essential to provide confidence that unforeseen effects will be detected in time to take corrective action.

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This important point should not be relegated to the Appendix and we recommend that something like the following be added after the fourth sentence of the section or to paragraph 13 (Lease Operations) on page I-5:

"The Environmental Studies Program also supports activities to detect and measure post-sale changes in environmental conditions, thereby providing a basis for mitigating unforeseen or inaccurately predicted effects."

Page II-38, Mitigating Measures That Are Part of the Proposed Lease Sale: This section notes that "[l]aws and regulations that provide mitigation are considered part of the proposed sale." A cited example is the Outer Continental Shelf Lands Act, which grants the Secretary of Interior broad authority to control lease operations. As indicated above, one of the most important things that can be done to avoid or minimize adverse environmental effects is to ensure that lease managers have the information necessary to make informed decisions with respect to controlling lease operations. In this regard, section 20 of the Outer Continental Shelf Lands Act requires the Secretary to conduct environmental studies, including post lease sale monitoring studies, to detect and monitor changes in the environment. Appendix F of the DEIS references work done in Alaska to address this monitoring requirement. Given the importance of effective monitoring, the Commission recommends that something like the following be inserted after the words "to control lease operations" in the second sentence of the section:

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"...and to undertake environmental monitoring studies (see also Appendix F) to detect possible adverse environmental effects in time to minimize or mitigate them;..."

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II-39 to II-63, Potential Mitigation Measures: This section discusses potential stipulations and notices to lessees to reduce possible impacts on marine mammals and other resources. The Marine Mammal Commission recommends that these measures be modified and adopted as part of the proposed action and leasing alternatives. As noted earlier, the Commission recommends that a new stipulation be added to require reporting of all marine mammal interactions with facilities or that Stipulation No. 5 (an industry site-specific bowhead whale monitoring program) be modified to include such a requirement.

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Page II-42, Fourth Complete Paragraph: This paragraph discusses the effectiveness of Stipulation No. 2 to protect biological resources. It notes that the Arctic Region Biological Opinion suggests additional conservation measures and that the Minerals Management Service will consider these measures and use its authority to keep areas used by bowhead whales free from spilled oil and noise disturbance when bowhead whales are present. It is not clear what additional conservation measures have been suggested or the extent to which they are addressed by the proposed stipulations. This paragraph should be expanded to discuss these points more fully. In addition, the referenced Biological Opinion should be included in Appendix K with the other correspondence regarding section 7 consultations.

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Pages II-42 to II-43, Orientation Program: This section discusses a potential measure requiring lessees to provide an orientation program at least once a year for all personnel involved in field exploration, development, or production activities. Its purpose, in part, is to ensure that workers are aware of the need to avoid harassing wildlife, and of pertinent lease sale stipulations and lease provisions. Elsewhere (page II-38), the DEIS notes that existing laws and regulations that provide mitigation are considered part of the proposed lease sale. Thus, prohibitions on taking and penalties under laws, such as the Marine Mammal Protection Act, are part of the proposed action. To ensure that the provisions of this and other key wildlife protection measures are addressed in orientation programs and that workers are made aware of them, something like the following should be added as the last sentence of the first paragraph of the stipulation:

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"The program also shall include information on prohibitions on taking and penalties under relevant laws and regulations to protect marine mammals and other wildlife."

In addition, the section on "Effectiveness of Stipulation No. 2" should note the importance of ensuring that field workers are familiar not only with important environmental, social, and cultural values in the Beaufort Sea area, but also the provisions and penalties of relevant laws pertaining to their protection.

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Pages II-44 to II-47, Industry Site-Specific Bowhead Whale Monitoring Program: This section identifies a proposed stipulation to require lessees of certain tracts to conduct a site-specific monitoring program during certain months to determine when bowhead whales are in the vicinity of exploratory drilling activity and what effects it has on whale behavior. The relationship between this stipulation and stipulation No. 8 (Seasonal Drilling Restriction) is not self-evident and should be explained. That is, as we understand it, the latter stipulation, which applies to the same tracts during the same time periods, is intended to prohibit exploratory drilling and other down-hole activity when whales are likely to be migrating through lease areas in the vicinity of drilling operations. Thus, the function of assessing effects on the behavior of whales would seem to be obviated by the stipulation to suspend seasonal drilling when whales are present. If this is not the case, the reason should be explained along with a discussion of any interrelationships between the two stipulations (e.g., is information from site-specific monitoring programs to be used to determine when seasonal drilling restrictions would go into effect).

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In addition, although the stipulation requires monitoring programs to be approved by the Minerals Management Service's lease manager, it does not describe the type of monitoring efforts (e.g., aerial, platform observers, sonobouys, etc.), program requirements (e.g., requirements for using trained behaviorists, the distance around sites to be monitored, etc.), or reporting schedule (e.g., reporting results daily, monthly, or annually) that would be needed to meet this requirement. Thus it is not possible to assess the potential effectiveness of the measure. Such details should be included in the FEIS and, if it has not already been done, the Commission recommends that the Minerals Management Service consult with the National Marine Fisheries Service and the Fish and Wildlife Service to identify appropriate procedures and requirements for planning, conducting, and reviewing results of the monitoring program.

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Also, as noted earlier, the Commission recommends that this stipulation be expanded or a new stipulation be developed to establish a general site-specific wildlife monitoring and reporting requirement applicable to all marine mammals and other species of special concern. The purpose of the measure would be to help identify and assess interactions. For example, such a stipulation would provide a basis for determining the extent to which polar bears and other wildlife are attracted to and interact with drilling and other activities, and the

effectiveness of any mitigation measures that may be instituted. It also may help identify: a) specific facilities in need of special site-specific mitigation measures and b) opportunities to study the behavior of wildlife in the vicinity of offshore operations.

Pages II-50 to II-54, Seasonal Drilling Restriction: This section discusses a possible seasonal drilling restriction for certain blocks during bowhead whale migration periods. The stipulation allows the lease manager to waive the restriction if it is determined that continuing drilling is necessary to prevent loss of control of the well or to ensure human safety. The second paragraph on page II-52 notes that eight waivers have been granted since 1985. Elsewhere, the document notes that 21 wells were drilled between 1981 and mid-1989. This suggests that waivers of this restriction have been requested and received for a substantial percentage of drilling operations. To provide a better understanding of the likely effectiveness of this provision, the section should be expanded to indicate the percentage of past drilling operations within the area subject to this restriction that have requested and received waivers of this stipulation and why the waivers were requested and granted.

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Pages II-54 to II-56, ITL No. 1, Information on Bird and Marine Mammal Protection: This section describes information to the lessee on measures and laws pertaining to the protection of birds and marine mammals. The sixth paragraph of the section notes that, when planning transportation routes, lessees should consult with the Fish and Wildlife Service and the National Marine Fisheries Service on the location of major wildlife concentration areas. To ensure that orientation programs required under Stipulation No. 3 include complete, accurate, and up-to-date information on the provisions of relevant laws and precautions to avoid impacting marine mammals and other wildlife, this ITL should be expanded to note that lessees also should consult with those agencies when preparing or updating orientation programs. In addition, the list of areas of particular concern in the carry-over paragraph on pages II-55 to II-56 should include the importance of offshore islands, mainland coasts, and shorefast ice for denning polar bears from October to April.

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Page III-14, Second Complete Paragraph: This paragraph compares information on polar bear dens in the Alaska coastal zone and other Arctic areas. It notes, among other things, that polar bear dens appear to be less concentrated on the Alaskan Beaufort coast than other areas such as Wrangell Island, James Bay, and Hudson Bay. While this may be true, it is important to note that denning in these other areas does not contribute to maintenance of the Alaska population and that this does not mean that denning areas on the Alaskan Beaufort coast are unimportant.

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Pages IV-A-12 to IV-A-13, Effectiveness of Oil Spill Cleanup At Sea: The last paragraph of this section states that recovery efforts usually range between 5 percent and 15 percent of the amount spilled. It then cites the Exxon Valdez spill as an example and notes that 0.01 percent of that spill was recovered during the first three weeks following that spill. This obviously does not support the referenced statement. Moreover, usual recovery rates undoubtedly would not apply to the Beaufort Sea sale area because of its very remote location and the complicating factors of poor weather and ice conditions. This section should note that there is no demonstrated capability of effectively containing and cleaning-up a large spill, particularly in ice-covered areas, and the capabilities that may exist would probably be rendered even less useful, if not useless, by the particularly remote, adverse conditions found in the Beaufort Sea.

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Pages IV-B-1 to IV-B-22, Alternative I, Low Case: This section summarizes information on the status of marine mammals and possible effects of pollutants and activities associated with oil and gas exploration and development. Certain facts and findings are not supported by data or analyses and readers are referred to other documents "incorporated by reference" for this information. This approach frustrates careful review because referenced documents are not readily available and it is unrealistic to expect reviewers to search through other reports to locate the basis for certain statements. Therefore, statements on the status of species and study findings regarding effects should be supported with data and analyses or proper literature citations. This comment also applies to corresponding sections for the Base Case, and High Case as well as the other alternative actions.

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Page IV-B-7, Effects of Offshore Installation: This paragraph notes that the one or two platforms expected in the low case scenario could create noise and disturbance that would temporarily displace polar bears, seals, and belukha whales one to three kilometers causing a low level of impact. It should be expanded to consider the potential for polar bears being attracted to platforms and being shot or injured in the course of efforts to protect platform workers, equipment, or supplies.

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Page IV-B-7, Endangered Species Consultations: This section notes that the Minerals Management Service has initiated section 7 consultations on Sale 124 with the National Marine Fisheries Service and that the results will be included in the FEIS. The section also references an Arctic Region Biological Opinion prepared by the National Marine Fisheries Service on 23 November 1988. As noted above, that Opinion should be included in Appendix K along with the Sale 124 Opinion and the FEIS should be expanded to indicate whether and how recommended mitigation measures have been incorporated into the proposed action.

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Pages IV-C-1 to IV-C-4, Oil Spills: This section discusses the possible effects of oil spills on water quality. It notes, among other things, that most volatile toxic compounds are lost in less than three days. It should be expanded to discuss the extent to which toxic compounds normally vented into the atmosphere would persist or dissolve into the water column if a spill were to occur under ice cover. For example, would under ice spills result in greater water quality problems than open water spills? Also, the effects of cold temperature on the rate of evaporation of toxic compounds should be discussed.

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Page IV-C-1, Fourth Paragraph: Presumably the last sentence of this paragraph should be rewritten to indicate that "regional" effects refer to effects encompassing 1,000 kilometers or more, while "local" effects rarely extend beyond a few square kilometers.

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Page IV-C-3, Third Complete Paragraph: This paragraph notes that Prudhoe Bay crude oil remained toxic to zooplankton in freshwater tundra ponds for 7 years after an experimental spill. A reference for this finding is not provided. As noted above, such statements should be supported by a citation indicating the source of this information.

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Page IV-C-10, Third Complete Paragraph: The meaning of the acronym "WSF" is not self-evident.

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Page IV-C-13, First Complete Paragraph: This paragraph notes that amphipods have disappeared in some areas as a result of oil spills and that, although they are important in the diets of some fish, effects on fish are not expected to be significant because fish also feed on other benthic invertebrates. This rationale seems highly questionable. It assumes that other available benthic invertebrates will be unaffected. In addition, although fish may eat other prey, it is not self-evident why it is believed other prey would be sufficiently abundant or available at a particular time and place to sustain those predators. If that were the case, there presumably would be more fish.

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Page IV-C-34, Third and Fourth Complete Paragraphs: The third paragraph states that although effects of oil contact on belukha whales are uncertain, studies of hydrocarbon effects on dolphins as representative odontocetes by Geraci and St. Aubin provide "sufficient" insights concerning potential effects of oil spill contact on belukha whales. The fourth paragraph states that effects of oil contact are likely to be short-term with recovery in a few days. While the referenced studies, which were conducted under laboratory, rather than natural conditions, provide some insights, it is an overstatement to indicate that they provide "sufficient" insights into possible effects on different species of odontocetes. In this regard, we note several killer whales appear to have disappeared from pods in

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Prince William Sound following the Exxon Valdez oil spill. This disappearance may have been related to the spill and may suggest that killer whales are more sensitive or react differently to oil than would be expected based on the referenced experiments. It is also possible that the referenced experiments were insufficient to identify all possible effects of oil on odontocetes or that effects may vary by species, age, sex location, time of year, etc. Because of such uncertainties, we do not agree that these laboratory studies offer "sufficient" insights. We therefore recommend that the word "sufficient" be deleted.

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Page IV-C-35, Indirect Effects: This section notes that, if a major spill occurred during a heavy ice year, the short term loss of plankton and benthic invertebrates could locally reduce marine mammal food sources during a critical period. It also notes that seals, walruses, and belukha whales are opportunistic feeders and would be capable of moving to other areas of prey abundance. It assumes that there always will be alternative feeding areas nearby and that these areas are unoccupied or the influxes of additional animals can be accommodated without damaging the food supply.

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Also, as noted earlier, it is not clear whether potential lethal effects might occur over more than "local" areas because of particularly high levels of dissolved toxic components being trapped under the ice and carried by under-ice currents. Under such circumstances, effects of a major spill on food supplies for marine mammals might extend over a substantial portion of an important feeding area.

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In addition, as noted on page IV-C-13, the timing and synchronization of planktonic cycles is exceedingly important and effects coinciding with seasonal pulses may be particularly significant. If a major spill coincided with the occurrence of particularly sensitive larval stages of important food sources for marine mammals, it is possible that "short-term" losses could affect food availability for an entire season or longer. If food resources were depleted for an entire season throughout a major portion of an important feeding area, it could cause a significant decline in marine mammal populations that would take many years to rebuild. Such effects would constitute a moderate or high level of impact on marine mammals, rather than the low level stated in the last sentence of the paragraph.

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Page IV-C-35 to IV-C-36, Carryover Paragraph: The referenced figure (IV-C-5-1) does not indicate the marine mammal habitats discussed in this paragraph.

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Page IV-C-36, Third Complete Paragraph: This paragraph discusses the effects of an oil spill on benthic species eaten by walrus. It notes that the amount of benthic prey contaminated by

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scattered tar balls from a spill is likely to be very small or insignificant. The discussion does not, but should, consider the possible effects of dissolved toxic components of a spill, whose timing and size might affect significant concentrations of sensitive seasonal planktonic larval stages of benthic invertebrate prey species.

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Page IV-C-36 to IV-C-37, Carryover Paragraph: This paragraph notes that the effects of an oil spill would be low considering the average density of one bear per 78 to 130 sq. km. and that even if 20-30 bears were killed due to oiling from an oil spill, the loss would represent a low level of impact. This paragraph should be expanded to note that concentrations of polar bears around certain open water areas for feeding or around large marine mammal carcasses are not uncommon. It is also possible that polar bears may be attracted to marine mammal carcasses killed by an oil spill thereby increasing the number of bears exposed to oiling. The paragraph also does not consider migratory movements or other movements of polar bears that could bring bears into contact with a spill that could remain on, in, or under the ice for a period of months. Such factors could lead more than 20-30 bears to come into contact with a large oil spill. In addition, the paragraph does not consider the effects of clean up efforts and chemicals on polar bears.

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With respect to assessing the level of impact, it should be noted that the North Slope Borough Fish and Game Management Committee and the Inuvialuit Game Council signed a Beaufort Sea polar bear management agreement in 1988 which limits annual Native subsistence harvests of polar bears to no more than 35 animals in each of the Alaska and Canadian portions of the Beaufort Sea. The agreement also precludes taking females with cubs. Harvests in excess of this level were considered inappropriate given the low reproductive capacity of the population. If 20, 30, or more bears, including females and cubs, were killed by an oil spill in addition to annual subsistence harvests, we believe that the impacts on the population would be moderate to high. Thus, the assessment of possible impacts in this paragraph should be expanded to better indicate factors affecting the likelihood of polar bears being affected by a spill or spill cleanup efforts and the effect of possible losses given existing subsistence harvesting.

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Page IV-C-41, First Paragraph: This paragraph notes that noise from aircraft forced to fly low by fog or other weather conditions may cause individual walrus, particularly calves, to be killed or injured by adults stampeding into the water. It notes that the number of animals affected would depend on the number of disturbance incidents, but that, because walrus nursery herds are widely distributed along the ice front and leads during the spring migration, it is not likely that a major portion of the calving population would be affected.

The fact that walrus are widely distributed along the ice front may not assure that the major portion of the calving population would be unaffected. That is, migration or movement of animals through a particular area may expose a large number of animals to such effects. Moreover, given similar effects from other activities, including oil and gas development in other lease sale areas off Alaska, a substantial portion of the population not already exposed to such effects may be exposed due to activities from this sale. Therefore, this paragraph should be expanded to better discuss factors possibly affecting the number of nursing calves exposed to aircraft noise due to the proposed action and compare that number to the proportion of the population not already at risk from such effects due to existing activities. It also should consider the possible cumulative effect of such activities occurring each year over the life of the field.

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The paragraph also discusses effects of aircraft disturbance on spotted seals. It notes that disturbance of small groups of spotted seals is not likely to result in the death or injury of large numbers of seals although increases of physiological stress might reduce longevity of some seals. The analysis does not seem to recognize that spotted seals occur in concentrated breeding groups. Frequent disturbance of preferred pupping and breeding areas could cause more than a few pups to be killed by adults stampeding into the water. In addition, the analysis does not consider the possibility that frequent, repeated disturbances by aircraft could cause spotted seals to abandon preferred haul out areas.

Page IV-C-42, Effects of Offshore and Onshore Construction: These two sections note that polar bears and other marine mammals could be displaced from habitat near facilities constructed as a result of this sale. They do not, but should, consider possible effects from animals being attracted to facilities. For example, polar bears may be attracted to drilling sites by lights, food odors or other smells, discarded trash, or other factors. Once near platforms or other facilities, they may be injured attempting to "investigate" equipment or supplies, or be killed or injured to protect workers. Similarly, whales, seals, and/or walrus may be attracted to marine life attracted by lights on, or ice-free areas created by, drilling platforms or other offshore work stations and thereby could be exposed to higher levels of pollutants or predation.

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Pages IV-C-42 to IV-C-44, Summary: The points noted above should be reflected in the summary of impacts on polar bears, walrus, seals, and belukha whales expected as a result of the base case scenario.

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Page IV-C-45, Last Paragraph: This paragraph notes that based on studies of rats, it appears unlikely that a cetacean would accidentally ingest a sufficient quantity of oil to be at risk. The basis for such a comparison seems highly questionable and should be explained. In addition, a reference for the study should be cited.

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Page IV-C-46, First Paragraph: This paragraph states that pelagic zooplankton is generally considered to be largely unaffected by oil spills. As noted above, a large spill occurring in a major feeding area at a time when pulsed zooplankton life cycles may be passing through a particularly sensitive larval stage could affect zooplankton abundance.

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The last sentence of the paragraph states that "...there is evidence to indicate that bowheads may be capable of metabolizing and excreting low levels of petroleum hydrocarbons." No reference is provided and, as noted above, such statements should not be included without supporting data and analyses or literature citations.

Page IV-C-47, First Paragraph: This paragraph suggests that within several hours to several days after a spill affecting an ice lead, oil should have accumulated along the down wind or down current edge of the lead and should no longer pose an impediment to migrating bowhead whales. This analysis seems quite speculative and incomplete. It does not, but should, consider the likelihood of shifting wind or ice causing spilled oil to move back and forth across an ice lead.

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Page IV-C-48, Second Complete Paragraph: This paragraph of the summary of impacts on bowhead whales states that "[i]f an uncontrolled, uncontained spill were to occur, a few bowhead whales..." could contact oil or be affected in certain other ways. As noted in the first paragraph on the preceding page of the DEIS, "a substantial number of bowheads could contact oil if individuals, driven by the migratory urge, attempted to swim through (an) oil-covered lead." Therefore, the words "a few bowhead whales in the fourth sentence should be changed to something like "a substantial number of bowhead whales."

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Page IV-C-72, Last Paragraph: This paragraph discusses the effects of an oil spill on subsistence hunting of bowhead whales. It notes that even if bowhead whales within the area of a spill do not come in contact with oil, the perception of possible contamination may prevent Native subsistence hunting. It should be noted that this perception also may affect hunting efforts further along the migratory corridor of bowhead whales. In addition, it should note that noise and disturbance from clean-up activities, if not the spill itself, may significantly alter the migratory path of bowhead whales and thereby make them unavailable or more available to Native subsistence whalers at

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points along the migratory corridor past the spill area. These comments also apply to the discussion of impacts on Native subsistence hunting of belukha whales, walrus, and seals.

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Page IV-C-75 to IV-C-76, Carryover Paragraph: The first sentence of this paragraph states that belukha whales may avoid oil. The rationale supporting this conclusion should be provided or the statement should be deleted.

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Page IV-C-80, First Complete Paragraph: This paragraph states that "the low probability of an oil spill occurring... indicates that VERY LOW effects on walrus hunting are expected." Here and elsewhere in the discussion of subsistence effects, the DEIS incorrectly suggests that a low probability of an event occurring supports a conclusion that the level of the effect, should one occur, also would be low. This is a non-sequitur. As illustrated by the Exxon Valdez oil spill, the probability of an event occurring is independent of its effect and this and similar conclusions here and elsewhere in the discussion of subsistence effects should be revised to reflect more appropriate analyses.

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Page IV-C-81 to IV-C-82, Polar Bears: This section concludes that oil spills and aircraft disturbance would have a low effect on subsistence harvests of polar bears. If, 20 to 30 polar bears were killed due to an oil spill, as considered elsewhere in the DEIS, or if large areas were disturbed by efforts to clean-up a large spill, responsible management authorities may find it necessary to curtail all or a substantial portion of the Alaska Native polar bear subsistence harvest (up to 35 animals per year in the Alaska Beaufort Region) for a year or more. This would be more than a low level effect on subsistence hunting of polar bears.

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Page IV-G-6, Effects on Pinnipeds, Polar Bears, and Belukha Whales: This section compares the effects of the proposed action with the effects of an alternative to delete 201 blocks containing areas used as a migratory corridor by bowhead whales and certain other marine mammals. It indicates that the deferral alternative would not greatly reduce the risk of oil-spill effects on non-endangered marine mammals because the risk of a spill contacting important habitat areas for these species would be as great if a spill occurred adjacent to the deferred area as from within the deferred area. This analysis is incomplete. It fails to consider the extent of the area for which drilling poses a comparatively high risk of affecting important marine mammal habitat. That is, the overall risk to important marine mammal habitat would be significantly reduced if the deferred area represented a substantial portion of the leasing area from which spills would have a high probability of contacting the important habitat area.

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In addition, because the deferred area is closer to particularly sensitive habitat, oil spilled in the deferred area likely would pose a greater threat. That is, given comparable spills within and outside the deferred area, the volume of spilled oil reaching sensitive habitat areas protected by the deferral alternative would be smaller from a more remote spill site outside the deferred area because of weathering and stranding of oil closer to the spill site. Moreover, the more weathered oil which does reach the sensitive habitats would pose less of a threat because of its reduced viscosity, more dispersed distribution, and reduced toxic components. As an example, it seems likely that effects of the Exxon Valdez oil spill were greater in Prince William Sound than in lower Cook Inlet.

These additional factors should be considered in this section as well as all other sections concerning the possible effects of the deletion alternatives on marine mammals and other wildlife. In this regard, we believe that the deferral alternatives pose a significantly lower risk to marine mammals and other wildlife and, for that reason, should be the preferred alternative. We recommend that this reduced risk be reflected in Table S-1 and that consideration be given to making alternatives IV and V the proposed action.

Pages IV-I-12, Cumulative Effects on Pinnipeds, Polar Bears, and Belukha Whales: This section concludes that the cumulative effects of the proposed action and other ongoing and planned projects on non-endangered marine mammals would be "moderate." The analysis of the proposed action (base case) alone projects a "moderate" level of impact, implying that the Service has concluded that the effects of all other ongoing and planned offshore oil and gas development in the Beaufort Sea, Native subsistence hunting, and other activities are expected to have no impact on these species. This seems highly improbable and either the basis for this conclusion should be provided in this section or the conclusion should be revised to indicate that cumulative effects on these species are expected to be "high."

Page IV-I-13, Effects of Oil Spills Associated with Arctic Oil Transportation Through William Sound and the Gulf of Alaska: The first paragraph of this section notes that the Exxon Valdez oil spill in Prince William Sound may have reduced the number of resident sea otters by 1,000 animals (perhaps 20%). The only reference in support of this estimate was published before the spill occurred. The source of this estimate should be cited. In addition, it is our understanding that there are several estimates of proportion of animals lost. Given uncertainty as to the exact number of animals killed and the pre-spill size of the Sound's sea otter population, it would seem more appropriate to cite the range of estimates regarding this point. In addition, this section should be expanded to discuss effects of oil spills on Steller sea lions, which were recently

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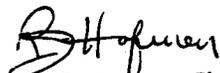
listed on an emergency basis as threatened under the Endangered Species Act.

Page IV-I-13 to IV-I-14, Effects of Noise and Disturbance: This section concludes that disturbance of pinnipeds, polar bears, and belukha whales by regular helicopter flights to drilling sites are not likely to be additive. This conclusion is questionable and it is not supported with data or analyses in the DEIS. In our opinion, regular flights over certain seal haul-out areas might force some seals, such as spotted seals, to abandon preferred pupping and haul-out areas.

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I hope these comments and recommendations are helpful. If you or your staff have questions, please let me know.

Sincerely,

  
Robert J. Hoffman, Ph.D.  
Scientific Program Director

cc Mr. Barry A Williamson

## Responses to Comments in the Letter from the Marine Mammal Commission

### MMC-1:

The MMS considered including the ARBO in the DEIS appendix concerning endangered-species consultation. Since we had not received the sale-specific NMFS biological opinion and were unsure if it might change the ARBO, we opted to omit the ARBO. It is MMS policy to publish the biological opinion in the FEIS. However, the DEIS did identify the ARBO-recommended actions under the "Effectiveness" section for each proposed mitigating measure. This FEIS includes the ARBO as well as the Sale 124 opinion and the proposed mitigating measures directly attributable to recommendations. The potential mitigating measures analyzed in this EIS would become part of the lease agreement between MMS and the lessee if the Secretary decides to conduct the lease sale (Sec. I.A.9 through 12) and approves any or all of the measures. Many of the potential measures analyzed in this EIS have been adopted for leases granted as a result of previous OCS oil and gas lease sales in the Beaufort Sea Planning Area (Sales BF, 71, 87, and 97). It is the responsibility of the EIS to demonstrate the possible environmental mitigation offered with such options.

### MMC-2:

The FWS and NMFS have reviewed the proposed stipulations and other mitigating measures in the DEIS and have not recommended the suggested requirements. These agencies will review specific exploration plans submitted by the lessees after the sale, at which time scientific observers could be required.

In addition, NMFS will have the opportunity to review and provide input to the Industry Site-Specific Bowhead Whale-Monitoring Programs as part of their regular review of exploration plans submitted by industry for review and approval by MMS. Also, see Response MMC-1.

### MMC-3:

The analyses of the Barrow and Barter Deferral Alternatives indicate that there would not be a significant reduction in overall oil-spill-contact risk to marine-mammal populations that occur in the proposed sale area. The net movement of potential oil spills during both the open-water and ice seasons is to the west. The OSRA indicates that spills that originate east of the Barrow Deferral pose as much risk to marine-mammal populations occurring in the Barrow area lead system as do potential spills occurring within the deferral area. In fact, a potential winter spill that originates, for example, near Point Thomson (see Sec. IV.N) and/or originates in Harrison Bay that is encapsulated in the ice is likely to be released in the spring-summer as unweathered oil from the ice in the lead system offshore of Point Barrow within the Barrow Deferral Area, while winter spills that originate within the Barrow Deferral Area would not be released into the lead system. Because almost all marine-mammal populations that occur in the proposed sale area are migratory and move east and west through the sale area, spills that might occur in any part of the sale area pose a similar risk of contacting these marine-mammal populations, whether the spills occur within the Barter Deferral Area or within the Barrow Deferral Area.

As presented in the analysis for both the Barrow and the Barter Island Deferral Alternatives, the oil-spill risks for bowhead and gray whales are not reduced appreciably from the base case. The analysis discusses reductions of noise and disturbance effects, but the combined effects (considering no real decrease in oil-spill risks) are expected to remain the

same as for the base case.

### MMC-4:

The sentence has been revised.

### MMC-5:

A statement summarizing the procedure for selecting the area to be offered for leasing has been added to Section I.A.11.

The deferred areas analyzed in this EIS are selected on the basis of information obtained during the scoping process, Section I.A.5, and not on potential petroleum resources. Estimates of the petroleum resources for each of the deferral alternatives are obtained after the deferred areas have been determined; and, until exploration and delineation wells are drilled, these resource estimates remain very speculative. The revised resource estimates for the Sale 124 area speculate that each of the deferral alternatives contains about 900 MMbbl of oil—the same amount as for the base case.

Even though the deferred areas might contain only negligible or small amounts of petroleum resources, exploration drilling could occur in these areas if they are offered for lease; and, if a discovery is made, development and production might follow. The analyses of the potential environmental effects of the lease sale take into consideration the possibility of some level of petroleum-industry activity in the deferred areas. Because the deferred areas may be important for a variety of biological and sociocultural reasons, the elimination of possible exploration and development and production activities from these areas by deleting them from the lease sale could be significant.

### MMC-6:

The suggested statement has been added to the text of Section I.A.13.

### MMC-7A:

The sentence has been revised.

### MMC-7B:

Comments regarding modifications to the potential mitigating measures are addressed in the Responses to Comments, MMC-8 through MMC-14.

The potential mitigating measures analyzed in this EIS would become part of the lease agreement between MMS and the lessee if the Secretary decides to conduct the lease sale (Sec. I.A.9 through 12) and approves any or all of the measures. Many of the potential measures analyzed in this EIS have been adopted for leases granted as a result of previous OCS oil and gas lease sales (Sales BF, 71, 87, and 97) in the Beaufort Sea Planning Area.

See Response MMC-2 for a response to MMC's recommendation that a new stipulation be written or that Stipulation No. 5 be modified to require the reporting of all marine mammal interactions with facilities.

### MMC-8:

All Section 7 consultation correspondence and the ARBO and other biological opinions are appended to the FEIS. Each proposed mitigating measure for the FEIS that was developed due to conservation recommendations provided by NMFS or FWS in their respective biological opinions is identified and discussed in each measure's "Effectiveness"

section. Also, see Response MMC-1.

MMC-9:

The Orientation Program stipulation notes that the program shall be formulated to ensure that personnel understand the importance of avoidance and nonharassment of wildlife resources. To accomplish this, the program presently includes a summary of environmental and cultural resource-protection requirements for the Beaufort Sea. This summary notes that all activities in areas leased are subject to the provisions of the MMPA, which prohibits the harassment of marine mammals; ESA, which makes it unlawful to take endangered species; and some international treaties, which prohibit the harassment of species of international importance such as migratory waterfowl and marine mammals. The MMS believes the content of the present program is adequate in making the workers aware of the laws protecting wildlife and does not believe the statement suggested in the comment needs to be added to the stipulation. In addition, MMS prefers to have as much of the program as possible presented in a positive manner and therefore does not believe a discussion of penalties that might be imposed for failure to comply with the wildlife-protection laws would be appropriate.

MMC-10:

As noted in Response MMC-9, the Orientation Program includes a summary of pertinent laws protecting the wildlife; MMS assumes the workers will obey these laws in the same manner that we incorporate the mitigating effects of other laws and regulations affecting petroleum-industry activities on the OCS into the analyses of the potential environmental effects of petroleum development. The genuine effectiveness of the Orientation Program stipulation mainly lies in presenting to the petroleum workers, in a positive manner, the concerns the Inupiat people have about the protection of their unique environment and their social and cultural values. In the discussion of the effectiveness of the Orientation Program stipulation, we have chosen to emphasize the increased awareness of the workers to the concerns of the Inupiat people. Therefore, we do not believe it necessary to include a statement regarding knowledge about the provisions and penalties of relevant laws protecting wildlife to the discussion of the effectiveness of the stipulation.

MMC-11:

The NMFS ARBO did not require a seasonal drilling restriction (Stipulation No. 8) but recommended a site-specific monitoring program to protect bowhead whales. Therefore, Stipulation No. 5 for site-specific monitoring was developed to protect bowhead whales. Stipulation No. 8 was developed to protect subsistence bowhead whaling. This clarification was discussed in the "Purpose" section for Stipulation No. 8. The development of these two stipulations provides the Secretary with a choice of either stipulation. The selection of Stipulation No. 8 would therefore preclude the need for Stipulation No. 5.

Also, see Response AOGA-11.

MMC-12:

The details of a specific monitoring plan recommended by the commenter would be incorporated when the lessee(s) submit their proposed plan to MMS. At this time, other agencies, including FWS and NMFS, would review and could provide detailed recommendations on the specifics of the monitoring plan. This allows the flexibility to adopt individual monitoring plans to site-specific situations and data needs. Also, see Response MMC-2.

MMC-13:

The text has been amended to address this concern.

MMC-14:

The FWS, NMFS, and other agencies have the opportunity to review both the IIL and the orientation program submitted by the oil companies. A statement to that effect in IIL No. 1 is not necessary.

MMC-15:

It is presumptuous to state that polar bears that occur on Wrangell Island do not contribute to the Alaskan polar bear population. Mark-and-recovery data on polar bears indicate that some Alaskan-captured bears in the Chukchi Sea move as far west as Wrangell Island, and that Alaska and the U.S.S.R. may share a polar bear population in the Chukchi Sea (Lentfer, 1983). The DEIS does not imply that denning areas along the Beaufort Sea coast are unimportant. The DEIS has made an effort to show all recent den sites that occurred within and adjacent to the proposed sale area in Graphic No. 2.

MMC-16:

The commenter misread the text in Section IV.A.2. The text states that 0.01 percent of the Exxon Valdez spill was recovered in 2 weeks with the recovery percentage increasing to 7 percent in 3 weeks. Thus, the oil recovery from this spill did fall within the referenced range of 5- to 15-percent recovery.

Further discussion has been added to Section IV.A.2 to address the concern regarding cleanup effectiveness in the Beaufort Sea. This issue also is addressed in the EIS in Section III.D of Appendix M.

MMC-17:

Without specific examples, we can only respond to the statements in the comment in a general manner.

This EIS is prepared in compliance with the CEO Regulations, 40 CFR 1502.21, Incorporation by Reference, which states:

Agencies shall incorporate material into the environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment.

In general, the material summarized and incorporated by reference comes from the Sale 97 FEIS or other FEIS's prepared for OCS oil and gas lease sales in the Beaufort Sea Planning Area. The MMS believes these documents are reasonably available to those persons wishing to comment on the Sale 124 DEIS. We realize that referring to other documents may be inconvenient. However, through incorporating by reference and summarizing material from previous EIS's, as well as other documents, we are striving to reduce the size of the EIS. For many potentially interested persons, the size of the EIS also is a concern.

MMC-18:

A discussion of incidental take of polar bears due to their attraction to the oil rigs during the winter has been added to the text in Section IV.B.5.a, Site-Specific Noise and Disturbance Effects.

**MMC-19:**

Respective biological opinions are appended to the FEIS, and the text has been amended to explain the opinions and respective mitigating measures. Also, see Responses MMC-1 and MMC-8.

**MMC-20:**

The issue of the effect on water quality of under-ice spills has been addressed in greater detail in Section IV.C.1. The effect of (cold) temperature on the rate of evaporation from crude and other oil is discussed in Section I.A of Appendix M. The variants of the slick-weathering models used in this EIS to estimate evaporation, dispersion, spreading, and persistence (Kirstein, Redding, and Payne, 1987; Kirstein and Redding, 1988; Ford, 1985) incorporate the process rates at in situ temperatures. The 3-day rule of thumb for vented volatile toxics is conservative even for arctic water temperatures. For example, half of the total volatile fraction (9 of 18 percent) of Prudhoe Bay crude would evaporate in 24 hours at the average summer water temperature of 1 °C in the sale area (Appendix M).

**MMC-21:**

The referenced sentence has been rewritten as suggested.

**MMC-22:**

The citation for this information (Barsdate et al., 1980) was provided in Section IV.J.5 of the Sale 100 FEIS (USDOI, MMS, Alaska OCS Region, 1985a). This latter section is incorporated by reference and summarized in Section IV.C.1 of this EIS. Because this procedure is used to shorten EIS's and to avoid repetition, citations provided in the prior document generally are not repeated.

**MMC-23:**

The text has been amended to address this concern.

**MMC-24:**

The analysis in question is based on several threads of information. First, amphipods are thought to be very sensitive to oil pollution. Other invertebrates may be (and some definitely are) less sensitive. Some of these invertebrates (that could figure importantly in the Beaufort) are mysids and the isopod *Saduria entomon*. Also, as stated in the analysis, fish are not apparently food-limited in the nearshore environment; so depletion of, or effects on, some of their prey may not affect the fish to any great degree. Other factors than food (e.g., the extent of overwintering habitat) may be limiting fish populations.

**MMC-25:**

The exposure experiments conducted by Geraci and St. Aubin (1982) on dolphins represent more than a realistic worst-case exposure of whales to oil contact that would occur if an oil spill were encountered. In the experiments, the oil was held in place on the dolphin's skin under airtight disks while in a real-spill encounter, the oil would be exposed to evaporation and washing by movement of the animal through the water. It is the analyst's professional opinion that this study does provide sufficient insight into the potential effect of oil on dolphins and belukha whales to assess the likely effects that oil would have on these closely related species. The reference to the absence of several killer whales from Prince William Sound (PWS) coincidental to the Exxon Valdez oil spill has not been verified. There is no scientific evidence to suggest that any of these whales were killed or injured by the oil spill. Interactions between these killer whales and the long-line commercial fishery in PWS is known

to have resulted in the injury of some killer whales. These interactions are more likely to be the cause or contributing factor to the absence of some of the whales from PWS.

**MMC-26:**

The concept this reviewer is referring to that states that displacement of animals from a local habitat to an adjacent habitat will lead to increased competition and damage to the food supply probably does not apply to highly mobile and migratory species such as marine mammals. This concept has not been adequately demonstrated with sedentary terrestrial populations let alone mobile, marine populations. The movement of marine mammals from an area of prey (food) scarcity to an area of prey abundance is a very common occurrence in the marine environment. Short-term changes in prey abundance that might be associated with an oil spill would be similar to natural changes in prey abundance that marine mammals are adapted to.

**MMC-27:**

Dissolved toxic hydrocarbons are likely to be rapidly diffused in the water column prior to encapsulation of the oil in the ice. Toxic hydrocarbons in the oil would be released again when the oil melts out of the ice and would be rapidly evaporated in the air and rapidly diffused in the water column. Primary prey of seals such as arctic cod as a population are not vulnerable to oil-spill effects because they are very abundant and widely distributed in the Arctic Ocean. The effect of oil spills on arctic cod and other primary prey of marine mammals is expected to be LOW—see Section IV.B.3.a(1)(c).

**MMC-28:**

Marine mammals prey on the adult stages of their food items (prey species). Although a portion of a year-class of arctic cod (eggs or larvae) might be affected by a large oil spill very near the spill or slick locations, the entire year-class for the entire Beaufort Sea would not be affected. Such a loss of part of a year-class of the arctic cod population is not likely to have a long-term effect on the availability of food of arctic marine mammals.

**MMC-29:**

The text has been changed in response to this comment.

**MMC-30:**

The larval stages of walrus' primary prey—clams—are extremely abundant and very widely distributed as components of the seasonal plankton concentrations occurring in the Beaufort Sea. The effect of oil spills on plankton, including clam larvae, are expected to be LOW—see Section IV.B.2.a(2).

**MMC-31:**

The one-time loss of 20 to 30 bears discussed in the analysis refers to an event where that many bears would be gathered at one location, such as at a whale carcass. However, a spill on, in, or under the ice also would be moving, and the chance encounter with the spill of another concentration of bears at another whale carcass is very unlikely. Any spill-cleanup efforts would include helicopter and boat traffic that is likely to frighten bears away from the areas where dispersants are being used. Thus, bears are not likely to be affected by these chemicals.

The one-time loss of 20 to 30 polar bears compared to an annual harvest of 35 bears per year by Natives in just one portion of the Beaufort sea would suggest that the expected effect of the oil spill should be considered LOW. The polar

bear-mortality rate associated with OCS activities is likely to be a small fraction of the total human-induced mortality of polar bears over the life of the oil field. For example, 35 bears harvested each year in each of three subsistence regions (Barrow, Kaktovik, and the Northwest Territories) equals 105 bears. If 105 bears were harvested each year for the next 20 years (the life of the oil field), the total harvest would equal 2,100 bears. In comparison, a total of 70 bears, or only 3 percent of this human-induced mortality, would be lost over this same 20-year period if 30 bears were lost to oil spills and another 40 bears were lost to interactions (an average of about 1-2 bears/year).

**MMC-32:**

The number of disturbance events is likely to be low because only one or two helicopter trips per day to the platforms are assumed to occur, and the flight line of the helicopters would transect a very small portion of the ice-front habitat of the walrus herd. The existing traffic is primarily coastal and is unlikely to transect walrus nursery herds that occur offshore. Air traffic associated with existing OCS leases also is low (a few/day), most of which occurs in the Prudhoe Bay area east of the primary walrus habitat located in the far western Beaufort Sea and in the Chukchi Sea. Spotted seals are not known to occur in large breeding concentrations in which young pups would be vulnerable to trampling by adults during disturbance events. Aggregations of spotted seals that occur along the coast of the Chukchi and Beaufort Sea coasts are primarily adults. During aerial surveys, such aggregations have been observed to react to aircraft by temporarily leaving haulout sites, but they quickly return to these sites after the aircraft leave (K. Frost, 1989, personal commun.). There is no evidence to substantiate the idea that repeated disturbance would cause permanent abandonment of haulout areas by spotted seals or other marine mammals.

**MMC-33:**

There is no evidence that seals, polar bears, or other marine life are attracted to drill-platform lights that would be located above the water surface. Although exploration and production platforms located offshore can change local ice conditions—which may attract seals and, in turn, attract polar bears—the number of animals attracted to these sites is expected to be low (probably less than 100 seals and a few bears) in comparison to the population. The number of seals exposed to pollutants and increased predation by polar bears also is expected to be low. Such predation is a natural event that occurs at natural locations of seal concentrations, such as at leads and polynyas. The number of polar bears unavoidably killed by industry in the process of protecting oil workers is expected to be low (perhaps one or two bears/year for cumulative oil development in the Alaskan Arctic), which is insignificant to the population.

**MMC-34:**

See Responses MMC-18 and -25 through -33.

**MMC-35:**

A full discussion with study citations is found in the Beaufort Sea Sale 97 FEIS, which is incorporated by reference in the Sale 124 EIS. See Response MMC-17.

**MMC-36:**

See Response MMC-35.

**MMC-37:**

A full discussion of the effects of oil spilled into the spring-lead system during the bowhead whale migration is discussed in the Chukchi Sea Sale 109 FEIS. This 5-page discussion was summarized and incorporated by reference in the Sale 124 DEIS.

**MMC-38:**

The text has been amended to delete "a few."

**MMC-39:**

The text has been amended to address this concern.

**MMC-40:**

The text has been amended to address this concern.

**MMC-41:**

The text has been amended to address this concern.

**MMC-42:**

The text has been amended to address this concern.

**MMC-43:**

See Response MMC-3.

**MMC-44:**

The text has been modified in response to this and other comments; see Section IV-1-5.

**MMC-45:**

Nearly 900 sea otter carcasses were recovered as a result of the Exxon Valdez spill (DeGange, 1990); however, this is probably an underestimate of the total number of otters lost considering the remoteness of much of the coastal habitats affected by the spill. Thus, several otters that died probably were not recovered. The 1,000 animals is the analyst's estimate; there is no real estimate available of the total number of otters killed. Few northern sea lion carcasses were recovered in association with the spill, and no scientific information on the effect on the sea lion population is available. Most scientific information from studies on the effects of the spill is not available due to the pending lawsuit.

**MMC-46:**

See Response MMC-32.

STEVE COWPER, GOVERNOR

OFFICE OF THE GOVERNOR

OFFICE OF MANAGEMENT AND BUDGET  
DIVISION OF GOVERNMENTAL COORDINATION

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ENCLOSURE 1  
STATE OF ALASKA COMMENTS ON  
DRAFT ENVIRONMENTAL IMPACT  
STATEMENT, CCS LEASE SALE 124

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May 8, 1996

Mr. Alan Powers  
Regional Director  
Minerals Management Service  
949 East 36th Avenue, Room 110  
Anchorage, AK 99506-4302

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

RECEIVED  
MAY 8 1996

Dear Mr. Powers.

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT  
CCS SALE 124 - BEAUFORT SEA

Thank you for the opportunity to review the Department of the Interior's (DOI) Draft Environmental Impact Statement (DEIS) for the Beaufort Sea Outer Continental Shelf (OCS) Sale 124 planning area. To assist Minerals Management Service (MMS) in its planning process for the proposed Sale 124, we have prepared the attached comments. Our comments focus on two aspects of the proposed Sale 124 DEIS: (1) the lease sale configuration, and (2) the mitigating measures.

If you have questions regarding these comments, please contact me at 451-2819.

Sincerely,

*Elizabeth A. Benson*  
Elizabeth A. Benson  
Project Review Coordinator

Enclosures

cc: Dick Shideler, AEPG, Fairbanks  
Kris O'Connor, ADPP/DC&G, Anchorage  
Gayle Berger, ALEK/DLWF, Fairbanks  
Mike Wheeler, APEC, Anchorage  
Warren Matuneck, NCE, Barrow  
Perdall Weiner, TFA, Anchorage

The state has consistently supported environmentally sound exploration and development of the Alaska OCS. The first step in achieving a proper balance between OCS development and environmental protection is to appropriately schedule and configure lease sales. The state resource agencies have reviewed the DEIS for proposed CCS Lease Sale 124 and have developed the following recommendations on the lease sale configuration and proposed mitigating measures to assist MMS and DOI in their planning efforts.

LEASE SALE CONFIGURATION

Barrow Deferral

During the state's review of Lease Sale 97, the state recommended the Barrow area be deferred until additional information regarding effects of industry-related noise and disturbance on subsistence whaling activity and marine mammals could be obtained and appropriate mitigating measures for protecting the wildlife resources in the Chukchi polynya could be developed. When coordinating with MMS on Lease Sale 109 at the EIS and Proposed Notice of Sale stage, the state also supported deferral of this acreage. We suggested this area could be reevaluated for possible inclusion in OCS Sale 124. However, during the state's review of the Five-Year Oil and Gas Leasing Program (1991-1996), we again recommended deferral of this area. Our comments at that point were based on the fact that MMS had failed to impose effective seasonal restrictions on oil and gas exploration activities in recent OCS sales in the Beaufort and Chukchi Seas.

Although the risk of impacts caused by exploratory drilling would be minimized by the adoption of stipulation no. 8, this protection does not extend to production where, in the "preferred alternative-high case" scenario, two production platforms would be located in or near the polynya and a landfill and staging area would be located at Point Belcher. These facilities increase the potential for chronic disturbance of northward-migrating bowhead and beluga whales, and increase the risk of oil spills from up to 80 production wells and two subsea pipelines anticipated in the "preferred alternative-high case" scenario. While we understand that MMS may conduct additional comprehensive environmental studies prior to production we are not confident that we can rely on actual implementation of a seasonal restriction by MMS. Despite the state's recommendations for a seasonal drilling restriction (SDR) for both Lease Sales 97 and 109, MMS failed to adopt the restriction, and has waived the SDR in the past for exploratory operations in the Beaufort Sea.

We have reviewed the possible inclusion of the Barrow area in

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Sale 124. However, in light of past MMS actions in implementing appropriate mitigating measures we continue to recommend the Barrow Deferral. The deferral area has high fish and wildlife resource values and is an important subsistence use area. The fish and wildlife values in the Barrow Deferral area are especially high because it: (1) encompasses the the Chukchi polynya, an important spring migration corridor for waterbirds and bowhead and beluga whales, and (2) it encompasses the area north and east of Point Barrow-Plover Islands, where during summer the more productive Chukchi Sea water mixes with the Beaufort Sea to create an area of greater trophic biomass and diversity. The Chukchi polynya is an open-water ice "lead system" that occurs along the eastern shore of the Chukchi Sea. The lead system is extremely important to marine mammals and sea ducks, particularly bowhead whales and king eiders, as a spring migration corridor. Oil spills in this lead system could directly and severely impact these species. Noise and other disturbance caused by industrial activities in this area also have the potential to disrupt the spring migration of bowhead whales, because whales are restricted to the lead system during spring migration.

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Barter Island Deferral

In its comments on the CCS Sale 97 DEIS, in 1987, the state withheld making any recommendations on the Kaktovik deferral until it had an opportunity to review and consider the results of various studies. In the state's comments on Sale 97 Proposed Notice of Sale we continued to recommend that special attention be given to the Kaktovik deferral area. The state has long regarded the waters between Barter Island and the Canadian Border as important bowhead whale feeding habitat as well as an area important for subsistence activities.

While it may not be necessary to defer leasing in the Kaktovik area, the DEIS does not describe mitigating measures equivalent to stipulation no. 6 or the state's SDR policy that address the cumulative impacts of exploration and production on other subsistence activities in the Kaktovik area. While adoption of either the MMS (stipulation no. 8) or state's current SDR will reduce the probability for exploration activity adversely affecting subsistence whaling, nevertheless, as the DEIS states in Table S-1, effects of the action on Kaktovik's subsistence-harvest patterns range from moderate to high. As stated in Table S-2, this is because subsistence activities other than whaling would be adversely affected. The DEIS is intended to be a comprehensive environmental document and is an ideal vehicle in which to lay out not only the full range of impacts but also the full range of appropriate mitigation. The DEIS falls short of adequately addressing the cumulative impacts to subsistence activities in the Kaktovik area. The DEIS should

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rigorously explore and objectively evaluate the potential cumulative impacts. Without this analysis, the state cannot make any further recommendations on the Kaktovik deferral at this time.

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3

The DOI has continued to publicly support a "focused" leasing policy and has proposed it as a method to reduce potential environmental concerns associated with OCS lease sales in the five-year leasing program. The DCI told the New York Times on April 24, 1990, that "The policies of the 1980's, as they relate to offshore leasing are not working in the 1990's." The DCI stated that instead of considering vast expanses of offshore areas for oil development, the department would "draw boxes" around areas that would be off-limits because of environmental concerns. According to the DOI, the initial step of any leasing process would be to determine whether oil drilling would harm marine life. Those areas would be withdrawn from consideration. The article also stated that only areas where there is strong geological evidence of a potential oil strike would be put up for leases.

The state supports the DOI's continued commitment to reduce the size of lease sale offerings and focus on areas of high hydrocarbon potential. We recommend that Lease Sale 124 offerings be limited to areas of hydrocarbon potential that receive nominations of medium to high priority from industry interests. According to the DEIS, the proposed sale blocks appear to be limited to the area of hydrocarbon potential (as depicted in Figure I-2). However, if the conditional resource estimates are considered, the Alternative I Base Case, Alternative IV, and Alternative V have identical oil reserve estimate figures (Table II-A-1). Alternative IV is the Barrow Deferral and Alternative V is the Barter Island Deferral. These data indicate that the oil resource estimates remain the same if both deferrals are adopted.

AK  
4

PROPOSED MITIGATING MEASURES

As we have stated regarding past OCS lease sales, the state prefers the use of mitigating measures in lieu of deferrals whenever scientific information and technological capabilities enables leasing to proceed in an environmentally sound manner. Not only should stringent protective measures should be in place before leasing occurs in this area but development in the planning area should not occur until comprehensive environmental studies are conducted.

In reviewing the Sale 124 proposed mitigation measures, the state compared them with those for Sale 97 (the most recent previous OCS Sale in the Beaufort Sea). Generally, the Sale 124 proposed stipulations include those adopted for Sale 97. In addition, some new stipulations have been added. The new stipulations deal

with site-specific bowhead whale monitoring (Stipulation 5), coordination with subsistence whaling (Stipulation 6, which was previously an Information to Lessee (ITL) measure in Sale 97), and oil spill response preparedness (Stipulation 7). In addition to these stipulations, eight ITL's are proposed for Sale 124. The state supports the adoption of all of those proposed mitigation measures. While we are pleased that Minerals Management Service (MMS) has made much progress toward addressing state concerns, we recommend the following additional provisions:

Stipulation 6: The state recommends that DOI expand this stipulation to include all subsistence activities in the sale area, not just whaling. Performance standards, such as evaluating whether seasonal harvest activities have been disrupted by oil and gas activities associated with this sale, should be adopted to measure the success of the stipulation. Specific measures such as establishing a process for subsistence harvesters to register complaints and for industry to respond to these complaints, should also be included. This process should involve the North Slope Borough Fish and Game Management Committee. The logical outcome of the process should be specific measures that the BSFC would apply to the lessees to correct the situation.

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Stipulation 7: The proposed new stipulation on oil spill response preparedness requires that drills must be conducted under realistic conditions (including solid-ice, open-water, and broken-ice), and must include deployment of onsite response equipment and additional cooperative equipment identified in the Oil Spill Contingency Plan (OSCP).

AK  
6A

While we support this new requirement, the state believes it can be strengthened with the following modifications: (1) prior to drilling in oil and/or gas bearing strata, the lessee must adequately demonstrate response preparedness for those conditions that may occur during the proposed drilling schedule (e.g., if drilling will occur during broken-ice conditions then the lessee must adequately demonstrate response preparedness in broken-ice conditions; if drilling will occur during open-water and broken-ice conditions then the lessee must demonstrate response preparedness in both open-water and broken-ice conditions); (2) if a lessee fails to adequately demonstrate response preparedness for a given condition (solid-ice, open-water, or broken-ice), then the drilling operation must not continue during that given condition until such time as inadequacies in the response preparedness are addressed and the lessee successfully passes a new spill drill; and (3) the decision on whether or not a lessee successfully passes a spill drill shall be made by a committee composed of representatives from federal and state agencies

currently required to review the OSCF.

Stipulation 8: This proposed seasonal drilling restriction for Sale 124 would prohibit cowhale exploratory activities on certain blocks during the spring and fall bowhead whale migration. If the seasonal drilling restriction proposed in the DEIS is not adopted, then the state recommends that, at a minimum, the provisions of the state's current seasonal drilling restriction policy (Enclosure 2) be adopted by DOI.

AK  
6B

Lastly, the state recommends an additional stipulation to mitigate potential impacts of bottom-founded exploratory drilling and production activities on polar bears. Polar bears may be attracted to these activities, become a threat to human safety, and may be killed in defense of life, similar to the case this past winter at the "Stinson" exploratory site. Because the Beaufort Sea polar bear stock is thought to number only 2,000 animals and is stable, loss of even a few females of reproductive age could have serious long-term consequences. Polar bears have been attracted to drillsites and production areas because (1) bears are very curious about novel stimuli in their environment and will investigate these stimuli especially if food or cooking odors are also present; and (2) at drill sites located in the transition ice zone, the ice deformation caused by the drilling structure can result in localized concentrations of ringed seals, the bear's chief prey. Therefore, the state recommends the following stipulation be added:

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"Lessees shall, as part of their environmental orientation program for employees, include a section discussing the potential impacts of their activities on polar bears, and mitigation methods adopted by the lessee. Topics shall include a summary of the life history of Beaufort Sea polar bears; provisions of the Marine Mammal Protection Act of 1972 relevant to "take" of bears; and precautions to minimize encounters between polar bears and project personnel. In addition, the lessee shall prepare and implement an approved Polar Bear Interaction Plan to minimize conflicts at the site between polar bears and humans. At a minimum, the plan should include measures to: (1) minimize the attraction of bears to the site; (2) organize the layout of building and work areas to minimize bear/human interactions; (3) warn site personnel of bears in the area and on the site, and proper precautions to take; (4) if authorized by the U.S. Fish and Wildlife Service, deter bears from the site; (5) properly store materials (e.g., ethylene glycol) that may be toxic to bears and other

## BEAUFORT SEA SEASONAL DRILLING RESTRICTION POLICY

- MARCH 1990 -

mammals; and (f) provide a systematic record of bears observed on site or in the immediate area."

AK  
7SPECIFIC COMMENTS ON THE DEIS

Table S-1 and Elsewhere: The National Marine Fisheries Service (NMFS) 1989 Arctic Ecological Opinion specifically emphasized that production activities in the spring lead system (e.g., Alternative 1- high case) are likely to jeopardize the population. Furthermore, NMFS notes that several drill-sites operating during the migration even in open-water years, could form an acoustic barrier to whale migration. Although stipulation no. 8 would restrict exploration drilling during the fall whale migration, production activities are not restricted. Given the MMS decision to waive the equivalent stipulation in Sale 97, there are no assurances that both exploration and production activities would not be occurring simultaneously across the Beaufort Sea on Sale 97 and Sale 124 leases. Therefore, the state recommends that the effects be upgraded to HIGH for Alternative 1-High Case, MODERATE for Alternative 1-Base Case, and LOW for Alternative 1-Low Case.

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8

Information to Lessee (ITL) No.2: Add Flaxman Island area to the list of Areas of Special Ecological and Cultural Sensitivity. The lagoon system around Flaxman Island is an important waterbird use area, and Flaxman Island has been used recurrently as a polar bear denning area. Furthermore, Leffingwell's Cabin is a National Historic Site.

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Pages II-C-13-30: MMS should consult with the North Slope Borough Planning Department and the Alaska Department of Fish and Game, Division of Subsistence for the most current land use and harvest data for Nuiqsut and Kaktovik. We also believe it is inappropriate to cite information from sources not available for public review -- i.e., Steven R. Braund and Associates 1989a and b.

AK  
10

## INTRODUCTION

The State of Alaska initiated a review of the state's May 1986 Seasonal Drilling Restriction Policy for oil and gas exploration activities in the Alaska Beaufort Sea in August 1988. The state worked closely with the oil and gas industry, federal government, North Slope Borough (NSB), and other interested parties in reviewing information made available since 1986 regarding impacts of exploration activities on bowhead whales and subsistence whaling. After an extensive review of available information and comments received during the public review process, the Resources Cabinet issued the attached policy decision in March 1990 for revisions to the 1986 policy. The rationale for revisions to the 1986 policy is described below.

## BACKGROUND

Exploratory drilling operations have been limited by a seasonal drilling restriction since the first Beaufort Sea OCS Lease Sale in 1979. The 1979 Joint Federal/State Beaufort Sea Lease Sale imposed a seven month drilling restriction on most leases to protect endangered bowhead whales.

The 1979 seasonal drilling restriction was modified in 1982 to generally restrict exploratory drilling during the fall bowhead whale migration period of September 1 through October 31 in the Western Beaufort Sea and August 1 through October 31 in the Eastern Beaufort Sea. A spring drilling restriction from April 15 through June 15 was also applied to the Western Beaufort Sea. This modified seasonal drilling was applied to certain leases in the OCS Sale 71 area and to all leases in the OCS Sale 87 area.

In 1985 two oil companies submitted requests for departures from the OCS Sale 87 seasonal drilling restriction during the 1986 bowhead whale fall migration. These companies also proposed using drillships which had not previously been used in the Alaska Beaufort Sea. In response to this request the state, in consultation with the oil industry, federal government, and NSB, undertook a review of all information relevant to exploratory drilling activities and their effects on the bowhead whale. As a result of this review the state established a seasonal drilling restriction policy in May 1986 which would apply to exploration activities on federal leases subject to the state's coastal consistency review as well as offshore state oil and gas leases.

In October 1988 a notice requesting comments and suggestions for amendments to the May 1986 Policy was distributed to the oil and gas industry, state and federal agencies, North Slope communities and environmental interest groups. The state formed a working

group comprised of the three resource agencies and the North Slope Borough to review comments received. The state's review focused on noise impact studies since 1986 that have been conducted to determine the impacts of industry activities on the bowhead whale migration and on the subsistence whaling activities. These studies include:

- (1) LGL Ecological Research Associates, Inc. 1987. Importance of Eastern Alaska Beaufort Sea to Feeding Bowhead Whales, 1985-1986. Volumes I and II. OCS Study MMS 87 (Draft).
- (2) LGL Limited and Greeneridge Sciences, Inc. 1987. Response of Bowhead Whales to an Offshore Drilling Operation in the Alaskan Beaufort Sea, Autumn 1986. Prepared for Shell Western Exploration and Production, Inc.
- (3) LGL Limited and Greeneridge Sciences, Inc. 1986. Bowhead Whales and Underwater Noise Near the Sandpiper Island Drillsite, Alaskan Beaufort Sea, Autumn 1985. Prepared for Shell Western Exploration and Production, Inc.
- (4) BBN Laboratories Incorporated 1987. Prediction of Drilling Site-Specific Interaction of Industrial Acoustic Stimuli and Endangered Whales in the Alaskan Beaufort Sea. Report No. 6509. OCS MMS 87-0084.
- (5) Ljungblad, D.K., and S.E. Moore, J.T. Clarke, and J.C. Bennett. 1987. Distribution, Abundance, Behavior, and Bioacoustics of Endangered Whales in the Alaskan Beaufort and Eastern Chukchi Seas, 1979-86. Naval Ocean Systems Management Service, Alaska Region.

A program review of oil spill prevention and response will be addressed in the on-going review of the "Tier II" Research and Development Program established by the Departments of Environmental Conservation and Natural Resources in 1984. In addition, the Department of Environmental Conservation is currently examining revisions to State Oil Discharge Contingency Plan regulations and the legislature is currently considering further amendments to state laws governing contingency plans. Until the "Tier II" review is completed and the state's oil discharge contingency plan regulations have been reevaluated, the oil spill prevention and response measures described in the May 1986 Policy remain in place.

#### POLICY RATIONALE

The results of several studies completed since the enactment of the May 1986 Policy have provided the state with information on the noise characteristics of drilling operations and related support craft activity, the unique characteristics of the acoustic environment of the Beaufort Sea, and the reactions of whales to various noise sources.

These studies suggest that bowhead whales react to noise generated by drilling operations and associated support activities. However, the information is limited and inconclusive with respect to the long term effects of noise on bowhead feeding and migratory behavior. More data is needed on the observed responses to known noise sources, especially the combination of drillships and ice breakers during ice management activities. Such data are especially lacking during heavy ice years. Furthermore, available noise studies have demonstrated that acoustic transmission properties in the Beaufort Sea are somewhat site-specific.

Studies of industrial noise characteristics also show that drilling from floating platforms, and the ice management activity required to protect floating platforms, transmit more noise in the water column than drilling from bottom-founded structures and natural and gravel islands. In addition, aircraft and vessel activities (e.g., tugs and barges) associated with both floating and bottom-founded structures can generate significant noise levels. Restrictions on essential and non-essential activities are intended to minimize the noise disturbance associated with ice management, supply operations, and mobilization/demobilization of the drilling structures, floating or bottom-founded.

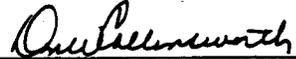
Although the results of available studies have not provided definitive answers regarding the long-term effects of drilling activity, the state has concluded that bowhead whales will react to noise associated with industrial activity and will avoid heavily ensounded areas. If such displacement occurred in the traditional whaling areas, whales could be deflected out of the range of whalers.

New timing and geographic restrictions on drilling and support activity have been adopted for operations located in three subsistence whaling zones (SWZs) during the whale migration period. The SWZ is defined as three specific regions in the Beaufort Sea, within 20 nautical miles of the coast where subsistence whaling occurs. The zones correspond to the Beaufort Sea communities of Kaktovik, Nuiqsut, and Barrow. These communities rely on the bowhead whale as part of their traditional subsistence culture. Historical whale harvest data was used to delineate the SWZ areas.

In addition to its importance for whaling, the Eastern SWZ also encompasses an important feeding area for bowhead whales. Feeding whales, often in groups of 30 or more, are seen every year during September and October in the area between Kaktovik and the U.S.- Canada border. On a single day in September 1982, 128 bowheads were counted north of Demarcation Bay. The behavior of whales usually consists of milling and diving for extended periods in a particular location. The stomachs of whales harvested at Kaktovik virtually always contain substantial amounts of food, confirming that this region is used extensively for feeding and is not just part of the corridor used by whales during the fall migration.

MARCH 1990 BEAUFORT SEA SEASONAL DRILLING POLICY

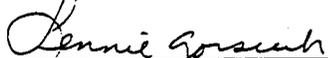
After reviewing new information and public comments received regarding impacts to bowhead whales and subsistence activities, the state has determined that the attached decision and measures contained therein are necessary to maximize conformance with the habitat and subsistence standards of the Alaska Coastal Management Program (6 AAC 80.120 and 130) and the North Slope Borough Coastal Management Program subsistence policies (2.4.3(b)). The state has determined that the safeguards contained in this decision will assure continued and uninterrupted opportunities for subsistence usage of coastal areas and resources. Offshore habitats, subsistence activities and water quality of the affected Beaufort Sea coastal zone will be maintained and adequately protected pursuant to the measures contained in the attached proposed policy decision. The state resource agencies will use this policy to interpret the ACMP standards and the NSBCMP policies when reviewing state and federally permitted exploration activities subject to review for consistency with the ACMP.



Don W. Collinsworth  
Commissioner  
Alaska Department of Fish and Game

3-25-90

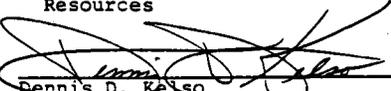
Date



Lennie Gorsuch  
Commissioner  
Alaska Department of Natural Resources

March 29, 1990

Date



Dennis D. Kelso  
Commissioner  
Alaska Department of Environmental Conservation

March 27, 1990

Date



Robert L. Grogan  
Director  
Division of Governmental Coordination

3/22/90

Date

1. Exploratory Drilling From Bottom-Founded Drilling Structures and Natural and Gravel Islands

Subject to conditions 3 and 4 below, exploratory drilling operations and other downhole operations from bottom-founded drilling structures and natural and gravel islands are allowed year-round in the Central and Western Subsistence Whaling Zones (SWZ)\*. In the Eastern SWZ, drilling is prohibited upon commencement of the fall bowhead whale migration until whaling quotas have been met.

2. Exploratory Drilling Operations from Floating Drilling Structures

Subject to conditions 3 and 4 below, exploratory drilling below a predetermined threshold depth and other downhole operations from floating drilling structures is prohibited throughout the Beaufort Sea upon commencement of the fall bowhead whale migration until the whale migration mid-point\*\*.

In addition to the above restriction, exploratory drilling above and below a predetermined threshold depth in the Eastern SWZ from floating drilling structures is prohibited upon commencement of the fall bowhead whale migration until the whaling quotas have been met.

\* Subsistence Whaling Zones:

Eastern SWZ is that area within 20 nautical miles of the shoreline between 141° and 144°W longitude.  
Central SWZ is that area within 20 nautical miles of the shoreline between 144° and 151°W longitude.  
Western SWZ is that area within 20 nautical miles of the shoreline between 154° and 157°W longitude.

\*\*Migration Dates:

Eastern SWZ - September 1 - October 10 with the midpoint of the migration on September 20.  
Central and Western SWZ - September 10 - October 20 with the midpoint of the migration on September 28.  
Outside SWZ - seaward of the Eastern SWZ - September 1 - October 10 with the midpoint of the migration on September 20; Seaward and west of the Central SWZ - September 10 - October 20 with the midpoint of migration on September 28.

The midpoint of the migration is when 50 percent of the whales have been deemed to have passed the drill site.

In the Central and Western SWZ, exploratory drilling above and below a predetermined threshold depth may be prohibited on a case-by-case basis until the whaling quotas have been met. The following criteria will be used to evaluate these operations: proximity of drilling operations to active or proposed whaling areas, drilling operation type and feasible drilling alternatives, number of drilling operations in the same area, number of whaling crews in the area, and the operator's plans to coordinate activities with whaling crews. If upon review of the proposed operation using the above-described criteria the state determines that a conflict with subsistence whaling activities may occur, additional seasonal drilling restrictions, similar to those imposed for the Eastern SWZ, may be imposed in the Central and Western SWZs.

3. Exploratory Drilling During the Fall Bowhead Whale Migration

When exploratory drilling activity is authorized and conducted at a location inside or outside the SWZ during the bowhead whale migration, the operator must conduct a bowhead whale research program to determine the effects of noise from the drilling activity and related support activities on bowhead whales and on the subsistence bowhead whale hunt.

The general objectives of the research program shall be to determine if the following occurs as a result of noise and disturbance generated from drilling and support activities:

- A. disruption of bowhead whales, or bowhead whale hunters, that makes subsistence hunting more difficult;
- B. short-term displacement of bowhead whales from their migratory path, from subsistence hunting areas, or from feeding areas. Information must be collected on the distribution, behavior, and movement of bowhead whales in the vicinity of the drillsite and of support operations. This information will later be used to determine whether long-term displacement is occurring; and

To ensure that the research program will adequately address these objectives, the operator shall observe the following schedule for submitting proposed research programs to the state:

- by April 1: Draft scope of work submitted for state review and comment;
- by May 15: Draft proposal submitted for state review and comment (after applicant selection of contractor);

- by June 15: State approval of proposal;
- by March 1 (of following year): Draft report submitted for state review and comment;
- by May 1: Final report release.

All non-essential activities associated with drilling is prohibited in the Eastern, Central, and Western SWZs during the whale migration until the whaling quotas have been met.

Essential support activity associated with drilling structures that occurs within active whaling areas shall be coordinated with local whaling groups.

"Essential activities" include those necessary to maintain well control, maintain physical integrity of the drilling structure, and scheduled crew changes. Support craft includes aircraft, boats, and barges. "Non-essential activity", by exclusion, are those activities that do not fit the definition of essential activities. Both types of activities must be described by the operator in their exploration plans submitted for state review. Mobilization and demobilization of the drilling structures should, to the extent feasible, not occur during the whale migration. If operators propose to mobilize/demobilize during the whale migration, they must describe the activity in their exploration plan and must demonstrate why the activity must occur during the migration period.

4. Exploratory Drilling in Broken Ice

Consistent with the May 15, 1984, "Tier 2" decision, lessees conducting drilling operations during periods of broken ice must: (1) participate in the Oil Spill Research and Development Program; (2) be trained and qualified in accordance with Minerals Management Service standards pertaining to well-control equipment and techniques; and (3) have an oil spill contingency plan approved by the state which meets the requirements of the "Tier 2" decision, including requirement for in situ igniters, fire resistant boom, relief well plans, and decision process for igniting an uncontrolled release of oil.

## Responses to Comments in the Letter from the State of Alaska

### AK-1:

The MMS did not adopt an SDR for Sales 97 and 109 because the NMFS biological opinions for the sales agreed with MMS that an SDR was not necessary to protect bowhead whales because the "probability of an oil spill during oil exploration is very small." A site-specific monitoring program to assure no major disturbance of the bowhead migration was recommended by NMFS, adopted as a stipulation in both sales, and proposed for Sale 124 (Stipulation No. 5). In addition, any development and production for all OCS sales, including Sales 97, 109, and 124, will require a reinitiation of formal Section 7 consultation with NMFS and FWS to assure protection of threatened and endangered species. The NMFS emphasizes this requirement and concern for development and production in the spring-lead system in their November 23, 1988, ARBO. In the ARBO, NMFS stated "that development and production activities in the spring lead systems used by bowhead whales for their migration would be likely to jeopardize the population." Consequently, for Sales 97 and 109, MMS prepared ITL's to advise lessees of the development- and production-phase consultation requirement and also of the possibility that production in the sensitive spring-lead system could be constrained or precluded if suitable alternatives or mitigating measures are not developed.

### AK-2:

The concern for production in the spring-lead system and its use by migrating bowhead whales was addressed in Response AK-1. In addition, the NMFS ARBO and Sale 124 opinions do not apply to any exploration activities proposed for the spring-lead system. The ITL No. 7 has been amended to advise lessees of the requirement to consult with NMFS for any proposed exploration activities and also of the possibility of the constraint or precluding of activities if suitable alternatives or mitigating measures are not developed.

The EIS also recognizes the importance of the Barrow Deferred Area to marine and coastal birds and to marine mammals—see Sections III.B.3 and III.B.4.

Other concerns about the offshore area northeast of Barrow were addressed in the Section IV.G.2.

### AK-3:

The text has been amended to address this concern.

### AK-4:

All of the blocks offered for leasing in Sale 124 received industry nominations, and most received medium- to high-priority industry nominations. About 90 blocks, in waters 400 to 1,000 m deep, received low-priority nomination but were included in the Proposal to give industry an opportunity to explore in deeper water.

As noted in Section II.A.2, the resource estimates for the Sale 124 area were revised after publication of the DEIS. The amount of oil estimated to be present in the sale area for the base case for Alternative I is 900 MMbbl; for each of the deferral alternatives, Alternatives IV and V, the amount is estimated to be 890 MMbbl. The differences between the resource estimates for Alternative I and for Alternatives IV and V result in some slight changes in the levels of activities for development and production; Table II-A-1.

The deferral alternatives are selected on the basis of information obtained during the scoping process, Section I.A.5, and not on potential petroleum resources. Estimates

of the petroleum resources for each of the deferral alternatives are obtained after the deferred areas have been determined; and, until exploration and delineation wells are drilled, these resource estimates remain very speculative.

### AK-5:

Stipulation No. 6 has been amended to include other subsistence activities.

In addition, Stipulation No. 6 requires the lessee to contact potentially affected subsistence communities and the AEWC to discuss potential conflicts with the proposed operations and make reasonable efforts to assure that their operations will not unduly interfere with subsistence harvests. A discussion of resolutions reached during this process and any unresolved conflicts shall be included in the exploration or development and production plans submitted to MMS for review and approval. The MMS considers the consultation procedures required by Stipulation No. 6 to be an appropriate forum to address concerns regarding the manner in which to resolve the complaints of subsistence harvesters.

### AK-6A:

In response to your comments on Stipulation 7, we would like to point out that this stipulation is not a new requirement. The stipulation is a summary of the detailed requirements for oil-spill preparedness and drills and training contained in Title 30 Code of Federal Regulations Part 250.42 and 250.43. These requirements, or similar requirements, have applied to all previous Alaska OCS sales and OCS lease activities. We would also like to stress that, to date, only exploratory drilling has occurred on the Alaskan OCS; therefore, current practices for OSRD's are based on the type, location, season, and duration for each exploration activity. If development and production from the Alaska OCS Region would be proposed, additional requirements and practices for conducting OSRD's would be developed commensurate with the type, location, and scope of proposed activities.

Item (1) of your comments suggests the MMS set a threshold depth before which the OSRD must be held. Although this specific point is not addressed in the stipulation, the Alaska OCS Region requires that drills be held before drilling below surface casing, to ensure that OSRD's are completed well above potential hydrocarbon accumulations. The following summarizes the requirements for timing and frequency of drills for exploration drilling:

1. When pollution-control equipment is initially put in place and, in the case of a new well, before drilling out of the surface casing;
2. At least every 12 months;
3. If environmental conditions change during exploratory operations (i.e., open water to solid ice); and
4. Upon request of the RS/FO.

In addition, we also require a Table Top/Communications Exercise for testing the lessee's communications, knowledge of the Oil-Spill-Contingency Plan (OSCP), and ability to initiate a response to a major oil spill.

Item (2) of your comments suggests that the MMS not allow drilling in a particular ice season until a satisfactory OSRD is conducted in that particular ice season. As indicated above, the Alaska OCS Region requires the lessee to demonstrate adequate response preparedness for each type of

environmental condition that occurs during drilling operations. This also is reflected in the proposed stipulation, which requires lessees "to conduct drills . . . for appropriate environmental conditions, e.g.: solid ice, open water, and broken ice conditions." If well drilling activities should continue year round in the Arctic, the operator would be required to conduct a drill in solid ice and open water/broken ice. If, upon evaluation of the results of the OSRD, the RS/FO finds the response inadequate, the RS/FO may require the lessee to conduct additional drills to correct any deficiencies found.

Item (3) of your comments requests that the MMS create a committee composed of representatives from State and Federal Agencies to provide an adequacy decision for the OSRD. The RS/FO is responsible for evaluating OCS OSCP's and related activities, and MMS cannot transfer this statutory responsibility. In the Alaska OCS Region, the principal State and Federal Agencies involved in oil-spill response (U.S. Coast Guard and Alaska Department of Environmental Conservation) are involved through review and comment on OSCP's and attending and observing the OSRD.

All advice and comments are incorporated into the RS/FO's decision to approve or disapprove the plan and drills. This method has proven satisfactory, and we see no need to modify this process.

#### AK-6B

The Secretary of the Interior has the option of selecting any or all of the mitigating measures analyzed in the FEIS after consultation with the Governor of Alaska, pursuant to Section 19 of the OCSLA, as amended.

The purpose of Stipulation No. 8, Seasonal Drilling Restriction, is to reduce the risk of noise and disturbance associated with exploratory-drilling activities from interfering with the subsistence hunting of bowhead whales and other species. The probability of an oil spill occurring and contacting a bowhead whale subsistence-harvest area is very low; and as noted in Section IV.C.10, effects from oil spills during exploratory drilling are not expected because of the very low probability of such a spill occurring. In addition, in the ARBO (November 23, 1988), NMFS found that exploratory-drilling activities will not jeopardize the continued existence of the bowhead whales. The MMS has agreed to reinstate consultation with NMFS in the event oil is discovered and development and production activities are proposed.

#### AK-7

The "Stinson" exploratory-site incident involved a Native worker who shot the bear on or near the drill platform. Although the incident is unfortunate, further incidents of this nature should be and are expected to be avoidable. A stipulation in regard to this one incident or in regard to any unavoidable killing of polar bears is not necessary to protect polar bears, which already are protected from excessive takes or human-induced mortality under the MMPA. Concerns about harassment and taking also are covered under Stipulation No. 3, the Orientation Program, and under ITL No. 3, Information on Bird and Marine Mammal Protection. All of the State-proposed measures under the State-proposed Polar Bear Interaction Plan are covered under existing OCS regulations or would be covered under FWS review of OCS exploration and development plans. For example, existing regulations prohibit the dumping of garbage that would attract bears; and the organization and layout of buildings and work areas are confined to the offshore drill platform or gravel island, thus minimizing the chances of bear/human interactions. The proper storage of toxic materials also is covered under existing OCS and EPA

regulations. A systematic record of polar bear observations from the drill platforms is a measure that could be recommended by the FWS—under the management authority of the MMPA—in their review of specific exploration and development plans.

#### AK-8

As described in Response AK-1, MMS will be required to reinstate Section 7 formal consultation under the ESA before any development and production activities occur as a result of Sale 124 or any Alaska OCS sale. In addition, under NEPA guidelines, an EIS would be prepared for any future development and production activities. Through the Section 7 consultation and the EIS process, proper mitigating measures to protect endangered whales from effects, including "acoustic barriers" due to numerous drill sites, would be developed.

#### AK-9

The text of the EIS has been changed in response to this comment.

#### AK-10

Impact Assessment, Inc. (1990a and b) has just issued two final special reports, "Subsistence Resource Harvest Patterns: Nuiqsut" and "Subsistence Resource Harvest Patterns: Kaktovik." The data used for these reports was collected from the North Slope Borough Traditional Land Use Inventories as well as from fieldwork conducted in both communities. Large harvest maps accompany these reports and are at MMS, Alaska OCS Region. The maps in the Sale 124 FEIS include this new information. Also, the technical reports by Stephen R. Braund and Associates (1989a and b) are now available for public review.

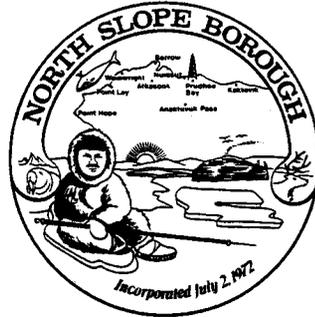
# NORTH SLOPE BOROUGH

OFFICE OF THE MAYOR

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George N. Ahmaogak, Sr., Mayor



May 8, 1990

Alan D. Powers  
Regional Director  
Minerals Management Service  
949 East 36th Avenue, Room 110  
Anchorage, AK 99508-4302

RE: PROPOSED BEAUFORT SEA LEASE SALE 124

Dear Mr. Powers:

As should have been very evident from the testimony of our residents at the well-attended public hearings in Barrow, Kaktovik, and Nuiqsut on April 17, 18, & 19 respectively, the North Slope Borough remains strongly opposed to this proposed offshore lease sale. The reasons given for opposition to the sale by Borough and local officials, our elders, whaling captains and crews, wives and mothers, social and health workers, tribal representatives, biologists, and many others were varied, but together left little doubt about the local sentiment against offshore activities in the Beaufort Sea. We continue to believe that oil and gas leasing, exploration, and development should be restricted to onshore or shallow-water tracts, where proven techniques and technologies can be employed to significantly limit impacts from both day to day operations and catastrophic events. No one can yet make the same claim with respect to offshore operations requiring the use of drillships. These comments will be in two major parts; Section I will discuss our general position that leases should not be sold in the arctic OCS in waters which would require drilling from floating structures, and Section II will deal with specific provisions of the Sale 124 Draft EIS.

## SECTION I. OCS LEASE SALES IN THE ARCTIC NOT SUPPORTABLE

We believe that the path from leasing to development is a downhill one; that a bias in the regulatory process increases the likelihood with each successive step that the following step will find approval. Recognizing this, we do not believe that the first

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REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

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step (leasing) should be undertaken unless and until firm assurances can be made, based on good scientific evidence, that the intermediate step (exploration) and final steps (development and transportation) can be undertaken safely and with minimal disturbance of wildlife and subsistence activities. Without that essential base scientific evidence, including a much broader understanding of arctic ecosystems, noise impacts, and the effectiveness of oil spill clean-up techniques in the region, the leasing and regulatory agencies are playing a high stakes guessing game with our shared biological heritage and the Inupiat culture.

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We are not alone in questioning the sufficiency and quality of the scientific information which has underlain federal and state decisions concerning offshore industrial activities. The Arctic Research Commission was created by the Arctic Research and Policy Act of 1984 (15 USCS § 4102) to "promote Arctic research and to recommend Arctic research policy", and is composed of five members appointed by the President. In December 1989 the Commission published a fourth in its series of FINDINGS AND RECOMMENDATIONS reports with the title IMPROVEMENTS TO THE SCIENTIFIC CONTENT OF THE ENVIRONMENTAL IMPACT STATEMENT PROCESS. The report states that the Commission undertook a review of the EIS process "[b]ecause accurate scientific and technical information and adequate data bases are such a fundamental requirement, and because the Arctic presents very unique environmental problems". (p. vii) The Commission identified an imperative need to improve the EIS process in several respects, but concluded that the "most critical deficiency is the absence of impartial external quality-control mechanisms for the data and information used in the stages of scoping, synthesis and EIS preparation, and the follow-up monitoring programs." (p. 1) While we urge you to carefully review and respond to the entire brief report before proceeding with this lease sale or permitting any other industrial activity on the Alaskan OCS, several of the document's findings and conclusions merit special mention here:

p.5. The effects of man-made environmental insult are aggravated by the relatively small number of species in arctic ecosystems and the slowness of environmental recovery (environmental fragility). The result is that there are few comparable precedents on which to base EIS predictions in Alaska, and that the environmental consequences of erroneous predictions can be far more serious and long-lasting than in temperate regions.

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In the Arctic, including the Alaskan Arctic, there is a serious lack of data and information concerning the

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physical and biological (ecological) environment covering long periods of time, on a decadal scale.

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p.6. The scoping process is sometimes perceived to be organized to support decisions already made.

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EIS's are often viewed as supporting agency opinions rather than being the basis for such opinions.

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Too many nonverifiable hypotheses and unstated assumptions are included in the EIS, and much of the documentation is based on the "gray literature."

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p.11. To improve the EIS process, impartial external scientific and engineering review mechanisms should be established for each of the following three stages: The scoping plan; Synthesis and preparation of the EIS; and Environmental monitoring programs.

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Some decisions stipulate that an environmental monitoring program is to become part of the project. Peer review of the design of the monitoring procedures will help assure accurate and usable results.

Also instructive is the February 1990 final report of the Alaska Oil Spill Commission, entitled "SPILL: The Wreck of the Exxon Valdez". While this report focuses primarily on the Prince William Sound tragedy, it also contains several important general observations, as well as specific recommendations concerning continued industrial activities in the arctic. We ask that you consider the entire report and respond to these points before you proceed with this lease sale:

p.100. The consequences of the Exxon Valdez oil spill have brought into question the usefulness of existing oil spill containment and pollution-abatement technologies, not only for a catastrophic spill the size of that from the Exxon Valdez (10.8 million gallons) but also for any major oil spill in an offshore, remote or sensitive area.

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In general, none of the currently available technologies are adequate for these incidents. In the United States, almost all existing technology has been developed for use in harbors and other protected waters, not in offshore, remote or environmentally sensitive waters.

p.125. Conclusions reached for Prudhoe Bay were that in summer the spill response would be effective for small spills, but that there was insufficient equipment to contain and recover a large spill. Contingency planning at Prudhoe Bay relies heavily on the ARCAT skimmer, but there have been no tests to see how well it recovers oil, specifically how well it would recover highly weathered Prudhoe Bay crude.

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During fall at Prudhoe Bay the spill response in a growing offshore ice field would be only marginally effective with present equipment. Spill response on shorefast ice would not be easy, but there would be more time to marshal heavy equipment and personnel out on the ice where scrapers and front-end loaders could recover the pooled oil. During breakup there could be a period of several weeks in which the only action response crews could undertake would be to watch the interaction of the ice and the spilled oil....

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The picture is bleak for remote areas. An effective response effort for a large spill from a drill ship or a tanker accident very far from Prudhoe Bay or Barrow would be extremely difficult...[u]sing airborne applications of chemicals, either dispersants or gelling agents, has received no testing whatsoever in these conditions, and none is known to work on heavy crude oils at typical arctic temperatures.

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p.144. The long-term need to develop environmental safety regimes of great stringency cannot be ignored. Development of arctic oil discoveries dependent on maritime transportation should await the preparation of approved systems of oil transportation using experience gained from the trans-Alaska pipeline system.

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p.201. The commission does not think that oil should be developed to production in any arctic area without a substantial planning effort on the transportation leg.

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We have long argued that drilling from floating structures, and therefore lease sale terms which would permit such drilling, are insupportable in arctic waters. You simply do not have enough good baseline scientific data to appropriately assess the environmental risks posed. You do not know how bowhead (and belukha) whales are impacted by industrial noise; just how vital their ability to communicate is to navigation in heavy ice

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conditions, whether heavy seismic activity has damaged the hearing of individual whales, whether whales have already been driven from traditional migratory and feeding areas, or if intense localized drilling, support, or seismic noise could act as a migratory barrier and subject a large aggregation of animals to increased risk from environmental hazards. You are not certain how whales and other organisms would be affected by exposure to spilled oil in the arctic environment; whether an entire migratory pulse of whales could be harmed by even a comparatively small spill which could not be avoided due to environmental conditions, how long oil and its toxic byproducts would persist and migrate in the cold and ice of the arctic, or how spilled oil would affect krill, mollusk, and fish populations, and the higher organisms which feed on them, including seals, walrus, whales, and man. You are unsure of industry spill response, clean-up, and containment technologies under ideal conditions and in accessible locations, much less in the harsh and remote environment of this proposed sale. All this and more is the information which must be known before the true risks of oil exploration, development, and transportation can be determined. Without really understanding these variables, rather than just paying lip service to them, you cannot know whether the risks outweigh, or are outweighed by, the supposed benefits which you also accept with little basis. We strongly recommend that the final EIS contain as a preferred alternative a sale which would only offer for lease those tracts in water depths which could be explored and drilled from islands or bottom-founded drilling structures.

SECTION II. PREFERRED ALTERNATIVE AND PROPOSED MITIGATING MEASURES OF DEIS DO NOT ADEQUATELY PROTECT SALE AREA ENVIRONMENT OR SUBSISTENCE ACTIVITIES

As explained above, we do not believe any Beaufort Sea tracts should be leased which would require exploratory drilling to be conducted from floating structures. Drilling from floating structures, whether anticipated under the low, base, or high case scenarios offered in the DEIS, would not comply with the provisions of the North Slope Borough Coastal Management Program prohibiting (1) significant interference with subsistence whaling, (2) jeopardy to the continued availability of whales for subsistence, (3) depletion of subsistence resources below the needs of local residents, (4) preclusion of reasonable access to subsistence resources, and (5) noise disturbance in areas of concentrated wildlife, and those provisions requiring effective oil spill control and clean-up plans. Our belief that drilling cannot now be conducted from floating structures with the required assurances of safety and non-interference with wildlife and subsistence

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activities is reflected in the Offshore Drilling Policy contained in the revised Land Management Regulations recently adopted by the Borough Assembly.

The debate over the need for, and scope of, any seasonal drilling restriction (SDR) to protect migrating bowhead whales has often dominated the discussions preceding previous Beaufort Sea lease sales, including Sale 97, held in March 1988. We have consistently argued that the burden falls on those desiring to lease and explore offshore tracts to prove that exploration, development, transportation and related activities will not have an adverse impact on these endangered animals or the subsistence harvest. To its credit, the State of Alaska has acknowledged the potential threats posed by industrial activities, and has recently adopted a revised Beaufort Sea SDR. This new policy, unfortunately, only addresses potential noise impacts, and has left to a later date further improvement of measures to minimize oil spill threats.

The SDR embodied in our Offshore Drilling Policy, though applicable directly only in State waters, addresses both noise and oil spill threats, and will be our guide in any consistency review of proposals in federal waters as well. The policy is as follows:

19.70.040 Offshore Development Policies. The following policies are intended to guide the approval of development and uses in the portion of the Beaufort Sea within the Borough boundary. Case by case extensions to the time periods below may be granted during approval or as a use permit if the activity will not significantly impact subsistence activities, will have minimal environmental risk, and all review agency comments have been addressed.

- A. Drilling shall be conducted from bottom founded structures.
- B. Drilling above threshold depth may occur year-round.
- C. Drilling below threshold depth shall be conducted during the winter (November 1 through April 15) and be completed as early in this period as practicable.
- D. Confirmation, extension or delineation drilling, well testing and other well completion activities shall be completed by June 15. Consistent with C above, any additional drilling or other activities shall not penetrate any new oil or gas bearing formations, or significantly increase the risk of an oil spill.

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- E. All nonessential boat, barge and air traffic associated with drilling activity shall occur prior to or after the period of whale migration through the area. Essential traffic (traffic that could not reasonably occur prior to or after the period of whale migration through the area) shall avoid disrupting the whale migration, subsistence activities, and be coordinated with the Alaska Eskimo Whaling Commission.
- F. Year-round drilling can occur following the unitization and approval of the Plan of Operation and Borough approval of a Master Plan and rezoning to the Resource Development district for the proposed development.

By comparison, the proposed Stipulation 8 of the DEIS falls short of providing adequate protection for whales, other wildlife resources, and the subsistence harvest. While if imposed, the stipulation is an incremental step in the right direction for MMS, its time frames are not restrictive enough, drilling from floating structures is permitted when adequate spill response capability does not exist, and it fails to address the potential cumulative impacts of development.

Alternative I is unacceptable in other respects as well. Both the Barrow and Kaktovik Deferral Areas should be removed from consideration for this proposed sale and future sales. You should refer to our October 27, 1988 comments during the scoping process for Sale 124, and again to our Sale 97 comments, for extended discussions of the need to defer these areas. The Spring lead system around Barrow remains a unique and sensitive area of concentrated biological diversity and subsistence activities. Though the DEIS states that the risk of oil contact with bowheads is low, we think it is clear that the consequences of an oil release into the Spring lead system could be catastrophic. The Bering Sea stock of bowheads typically migrates through a very confined area (Pt. Franklin, Pt. Hope, Pt. Barrow) in a relatively short period of time. In some years (e.g. 1980 and 1988) more than 90% of the population may move past Point Barrow in less than two weeks. This behavior, and the nature of the confining lead system itself, could make a dangerously high percentage of the population vulnerable to harm should oil be released or persist in this migratory corridor.

As we stated in our previous comments, you should accept as true the long-held Inupiat belief that the waters to the east of Barter Island are an important bowhead feeding area. So often in

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the past, outsiders were slow to accept Inupiat claims about their environment which were later proven correct only after much time-consuming and expensive research. In addition, information available only since our last comments has indicated the importance of the ANWR coastal plain and adjacent waters to denning polar bears. With the continued closure of ANWR to industrial activity, far greater consideration must also be given to the difficulties of oil transportation over extended distances offshore before tracts in the eastern Beaufort are leased.

In addition, the DEIS understates the potential negative cumulative impacts of oil exploration, development, and transportation. The document states that in the cumulative arctic case, there is a 99% chance of an oil spill in excess of 1000 barrels, with it most likely that there will be eight such spills. Looking at only the Beaufort Sea, the probability of one or more spills of at least 1000 barrels is stated to be 49% in the base case, and 91% in the high case. These are disturbing predictions to our coastal residents who subsist largely off the resources of the ocean.

The DEIS also states that since 1964, there have been twenty OCS spills of greater than 1000 barrels. While this is touted as an impressive statistic, it means to us that the eight spills predicted for the arctic represent a number of incidents equal to a full 40% of those occurring on the entire OCS over a period of 26 years. Unless arctic activity is expected to be at a level approaching 40% of all OCS activity over the past 26 years, it appears that MMS is anticipating greater difficulty in operating safely in the arctic than has been experienced elsewhere. Coupled with the far greater difficulty in responding to such significant spills in the arctic, we have little confidence that we should not expect significant cumulative impacts over the life of arctic OCS development.

There is also information available, but not discussed in the DEIS, which should raise serious concerns over the possibility that vastly increased vessel traffic associated with development could impact the bowhead population. The Borough has documented scarring on whales which is believed to be the result of collisions with ships. The incidence of bowhead/ship collisions appears to be low (ca. 2%), and is probably not a significant source of mortality for the Bering Sea stock. This low rate is most likely attributable to the low level of vessel traffic within their range. Socializing right whales, however, have been found particularly vulnerable to collisions when they become apparently oblivious to approaching

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vessels (Goodyear 1989).<sup>1</sup> That the same may be true of bowheads is evident in film recently shot by scientists having just completed a tagging effort in the eastern Beaufort Sea. Individual animals repeatedly collided with their vessel while the boat moved among a large aggregation of apparently socializing and feeding bowheads.

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Ship collisions are not infrequent for the North Atlantic Right Whale (NARW), a species closely related to the bowhead. Kraus (1990) has found evidence that perhaps 33% of NARW mortality is human induced, and that ship collisions are a significant problem.<sup>2</sup> He suggests that such human-induced mortality may be preventing recovery of the NARW stock despite a more than 70-year ban on commercial hunting. Our concern is that increased vessel traffic, including ice breakers operating in lead systems, will lead to a dangerous increase in the incidence of bowhead/ship collisions.

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### SECTION III. CONCLUSION

We have discussed the State of Alaska's position on the Sale 124 DEIS with agency officials, and agree with much of their analysis regarding the shortcomings of the document's proposed mitigating measures and the need for the Barrow and Kaktovik Deferrals. Because our position, however, is that lease tracts should not be sold in waters which cannot be explored and drilled from bottom-founded structures, we find it unnecessary to comment on much of the DEIS. We do ask that you carefully consider and where appropriate, specifically respond to, the comments of those who testified at the public hearings in our villages. The elders who spoke particularly deserve a response to their concerns that bowheads and other subsistence resources have already been significantly displaced by industrial activity, and that current technology can neither withstand worst-case ice and weather conditions, nor deal with significant oil spills in this environment. You should respect the fact that no one knows this environment better than its Inupiat residents, and no one will

<sup>1</sup> Goodyear, J. 1989. Feeding ecology, night behavior, and vessel collision risk of Bay of Fundy right whales. In: Abstracts of the Eight Biennial Conference on the Biology of Marine Mammals. Available from: The Marine Mammal Society.

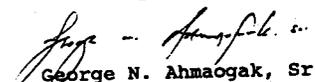
<sup>2</sup> Kraus, S. 1990. Rates and potential causes of mortality in North Atlantic right whales. Marine Mammal Science. (In press).

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suffer more if your best guesses as to the potential impacts of offshore oil development prove wrong.

Thank you for this opportunity to comment.

Sincerely,

  
George N. Ahmaogak, Sr.  
Mayor

cc: Steve Cowper, Governor  
Ron Morris, NMFS  
Mayor Don Long, Barrow  
Mayor Thomas Napageak, Nuiqsut  
Mayor Herman Aishanna, Kaktovik  
Dan Fauske, Acting CAO  
Warren Matumeak, Director, Planning  
Ben Nageak, Director, Wildlife Management  
Edward Hopson, Chairman, AEWG  
Jessica LeFevre, AEWG Attorney  
Elizabeth Benson, Division of Governmental Coordination  
Dennis Roper, Federal Affairs  
Anthony Kesler, State Affairs  
Eugene Brower, President, BWCA  
Tom Albert, Borough Senior Scientist  
Tom Lohman, Assistant Borough Attorney  
mayor/powers5.gna/k

## Response to Comments in the Letter from the Mayor of the North Slope Borough

### NSB-1:

Neither the regulatory procedures of the OCS oil and gas leasing program nor the petroleum-industry operations guarantee leasing, exploration, or development and production will occur in any area of the OCS. Proceeding from one step to the next in a leasing program for a sale area often depends on an evaluation of available information on operational success.

The OCS oil and gas leasing program was authorized by the OCSLA, as amended. In this act, Congress declared it was the policy of the United States that:

the outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

The OCSLA directs the Secretary of the Interior to establish policies and procedures for managing the oil and natural gas resources of the Outer Continental Shelf. The Act notes:

Management of the outer Continental Shelf shall be conducted in manner which considers economic, social, and environmental values of the renewable and nonrenewable resource contained in the outer Continental Shelf, and the potential impact of oil and gas exploration on the other resource values of the outer Continental Shelf and the marine, coastal, and human environments.

The Secretary has designated MMS as the agency within the USDO I responsible for the management of the OCS oil and gas leasing program.

In the leasing process, there are a number of steps that must be completed before there is a lease sale; these steps are noted in Section I.A of the EIS. The lease-sale process enables the Secretary to balance the concerns of the public, the private sector, Government agencies, and other interested parties with the national interest in deciding if, where, and when to conduct an oil and gas lease sale.

The Call for Information and Nominations, Section I.A.2, requests that companies and others identify areas of interest and their priorities for leasing. This information helps the Secretary decide whether the presale process should be continued, cancelled, or deferred. If the Secretary decides to continue the lease sale, the process includes additional steps for gathering and analyzing information about the sale area and the effects the sale might have on the environment; the steps include scoping, preparing a DEIS, conducting endangered species consultation, holding public hearings (on the DEIS), and preparing a FEIS.

After publication of the FEIS, a SID is prepared to enable the Secretary to consider the economic, social, and environmental values or renewable and nonrenewable resources that might be affected if oil and gas in the proposed sale area were developed. The SID assists the Secretary in (1) balancing the benefits of exploration and production with possible risks to the environment and (2) deciding on the location, size, timing, and terms of the proposed lease sale.

Before the proposed lease sale, a sale proposal is published

in the Federal Register. A copy of the proposal is furnished to the Governor so that the State and any affected local governments may comment on the size, time, and location of the sale. After consideration of the Governor's comments and all other pertinent new information, the Secretary makes a final decision on whether to conduct, cancel, or defer the sale.

After the sale, MMS regulates exploration and development and production on a lease to ensure operations are conducted in a safe and pollution-free manner. Before a company can explore or develop their lease, they must submit an exploration or development and production plan to MMS. These plans outline how the lease will be explored or developed; when, where, and how development will take place; and what safety measures will be taken to protect the crew and the environment. Also included in the plans are an environmental report and an oil-spill-contingency plan.

The plan is reviewed by MMS, by other Federal and State agencies, and by local government officials. After all of the reviews are completed and any changes that may be required are made, the plan is approved. After the exploration plan is approved, the company files an APD with MMS. An APD is required for each well drilled under an exploration plan and provides MMS engineers and other staff specialists with information to evaluate the drilling program with respect to operational safety and pollution-prevention measures. When approved, the APD becomes the drilling permit; and exploratory drilling may begin if the company has fulfilled all other Federal and State requirements.

Before a discovery can be exploited, a development and production plan must be submitted and reviewed to assure that it meets the requirements of the NEPA and the OCSLA.

The MMS inspects all OCS oil and gas operations for compliance with stringent safety and pollution-prevention regulations. (In the Alaska OCS Region, MMS inspectors are at exploration-drilling sites during all drilling operations.) Citations are issued for noncompliance with regulations and if corrective action is not taken within a reasonable length of time, civil penalties may be assessed and criminal proceedings initiated. In instances where a violation poses a threat of serious, irreparable, or immediate harm or damage to life (including fish and other aquatic life); property; any mineral deposit; or the marine, coastal, or human environment, suspension of a component or of the entire drilling or production operations may be ordered. Also, the Secretary may cancel a lease if, after a hearing, it has been determined that:

- (i) continued activity pursuant to such lease or permit would probably cause serious harm or damage to life (including fish and other aquatic life), to property, to any mineral deposit (in areas leased or not leased), to the national security or defense, or to the marine, coastal, or human environment;
- (ii) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and
- (iii) the advantages of cancellation outweigh the advantages of continuing such lease or permit force.

The opportunities the leasing program provides for reviewing information and plans help assure offshore operations are conducted safely, oil spill and other pollution prevention is emphasized, and local concerns are addressed.

The historical record of the OCS leasing program in Alaska has not shown that leasing leads to development as indicated in the comment. The MMS has held 15 oil and gas lease sales in the Alaska OCS Region since April 1976. For these sales, 17,822 blocks were offered. However, there are only 1,477 leases (plus an additional 20 leased blocks in boundary-disputed areas), and 504 of these leases have been relinquished or have expired. In the areas leased, 73 wells have been drilled, but MMS has determined that only 8 of these wells are producible. (This determination indicates that the well is capable of producing petroleum, it does not indicate a commercial discovery.)

Also, 13 lease sales have been cancelled, deleted (from the sale schedule), deferred, or delayed. The reasons include (1) cancelled because of lack of industry interest and concerns of local officials--1 sale; (2) cancelled because of lack of industry interest--4 sales, (3) deleted or deferred because of concerns of the Governor or the State--4 sales; (4) cancelled or deleted from the sale schedule by the Secretary--2 sales.

#### NSB-2:

The EIS recognizes that the number of species in the arctic ecosystem are generally fewer than in temperate systems (especially fish and invertebrate species) and that recovery from manmade perturbations might be slow depending on the type of perturbation (oil-spill contamination of sediments would be slow to biodegrade, while removal of manmade gravel islands by wave action after protection were removed would be quite rapid). However, the abundance and productivity of most of these species present in the Arctic (with the exception of endangered species) is great, and recovery of most populations is likely to be within one generation. Some oil-spill pollution has occurred in arctic areas such as in the Hudson Bay area (Repulse Bay), Canada, and the effects on the marine environment were not that traumatic or long lasting.

The ability to predict the types and extent of consequences of offshore oil and gas activities on the Alaskan Arctic has been improved by the funding of numerous studies specifically targeted at improving our understanding of the environment and possible effects. Also, studies done in the Canadian Arctic and other arctic areas are cited where appropriate. In addition, even though parameters such as the number of species may differ from temperate areas, ecological relationships may be similar, although the strengths of interactions may differ, and alterations in a simpler system may more readily affect other species.

#### NSB-3:

Although there is generally less scientific information on the arctic ecosystem than temperate systems, a considerable amount of oceanographic and biological information has been acquired over the past 10 to 20 years by MMS, NOAA, and other agencies and institutes.

The paucity of this type of information for many areas, not just the Arctic, has prompted the National Science Foundation to set up Long-Term Ecological Research sites. It would be a benefit to have at least one marine site in the Alaskan Arctic set up for such long-term research.

#### NSB-4:

The scoping process is organized to meet the requirements of the CEQ Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR 1501.7) and to determine, in an early and open manner, the scope and the significant issues to be analyzed in depth in the EIS. It is not, as noted in the comment, organized to support decisions already made. The scoping process for

Sale 124 is summarized in Section I.D, and the major issues analyzed in the Sale 124 DEIS are listed in Section I.D.1. Because the comments of the NSB on the Sale 124 DEIS do not contain any specific references to the scoping process or the major issues that were analyzed, it is difficult to understand how the comment relates to this EIS and to determine what information would be needed for a response that expresses more than the opening statement of this paragraph.

Sale 124 is the fifth OCS oil and gas lease sale proposed for the Beaufort Sea Planning Area. The scoping process used to determine the significant issues to be analyzed in the EIS's for these sales has included holding scoping meetings and public hearings in the communities of the NSB that might be affected by the sales. In addition, information from many other sources has been evaluated to determine the significant issues. These sources include personal contacts between residents of the NSB and members of the MMS staff, NSB staff, various departments of the State of Alaska, NOAA, EPA, FWS, MMC, environmental organizations, and private individuals. The information from these and other sources is evaluated before decisions affecting the lease sale are made.

#### NSB-5:

The EIS's are written to provide a full and fair analysis of the potential effects that a proposed oil and gas lease sale might have on the environment; they are not written, as suggested in the comment, to support agency opinions. Another purpose of the EIS is to inform the decision makers and the public of the reasonable alternatives that would avoid or minimize adverse effects. The EIS is used by Federal officials in conjunction with other relevant material to plan actions and make decisions.

#### NSB-6:

The EIS is an analysis of a proposed action, not a scientific report. In the case of the Sale 124 EIS, it is the analysis of the projected effects of activities that could occur in large area. The geographical and temporal scales involved, as well as the hypothetical nature of the development scenarios, predispose the analysis to a somewhat hypothetical nature. The amount of research that would allow hypotheses to be verified would take years, but the analysis must be done now. We would prefer to use peer-reviewed published literature in the analysis, but analysts use the best available information, whether it be published scientific reports or gray literature. The assumptions of the analysis should be stated.

#### NSB-7:

Many of the aspects governing the EIS process are mandated by the CEQ Regulations for Implementing the Procedural Provisions of the NEPA; NEPA is the basic national charter for the protection of the environment. After preparing a draft EIS and before preparing a final EIS, 40 CFR 1503.1 notes that the agency shall:

- (1) Obtain the comments of any Federal Agency which has jurisdiction by law or special expertise with respect to any environmental impact involved or which is authorized to develop and enforce environmental standards; and
- (2) Request the comments of:
  - (i) Appropriate State and local agencies which are authorized to develop and enforce environmental standards; and
  - (iii) Any agency which has requested that it

receive statements on actions of the kind proposed.

The agencies, institutions, groups, and individuals that were sent copies of the DEIS for review and comment are listed in Section VI.C. The distribution of the Sale 124 DEIS provides an opportunity for many individuals from many professions—including the natural and social sciences, legal, regulatory, health care, and engineering, as well as private citizens—to comment on the adequacy of the statement, merits of the alternatives, or both. Responses to comments received might include the following: (1) modifying alternatives, including the proposed action; (2) developing and evaluating alternatives not previously considered; (3) supplementing, improving, or modifying the analyses; or (4) making factual corrections. The MMS considers this review and comment process ensures a full and fair analysis of the potential effects that the proposed oil and gas lease sale might have on the environment. The scoping process is part of the EIS process and thus subject to review, comment, and responses as are other parts of the EIS.

Monitoring programs are developed in conjunction with other Federal agencies and with State and local agencies that either have jurisdiction with respect to the program by law or special expertise or are authorized to develop and enforce environmental standards. The MMS considers that the consultation process used to develop monitoring programs will result in the acquisition of information to address the environmental concerns the programs are established to monitor.

#### NSB-8:

The quoted conclusion from the Alaska Oil Spill Commission is consistent with the analysis of effectiveness of oil-spill response in Section IV.A.2. The analyses of effects in this EIS do not assume mitigation through response efforts. See also Response MMC-16.

#### NSB-9:

The "large spill" discussed by State of Alaska, AOSC (1990), was an instantaneous, unconfined spill of 50,000 bbl. By "effective," the AOSC meant recovery of at least the bulk of the spilled oil. It is unlikely that effective recovery would occur for such a spill anywhere offshore, much less than in Prudhoe Bay. Such effectiveness is not presumed in this EIS as discussed in Section IV.A.2. The AOSC conclusion is based more on circular reasoning than on an analysis (State of Alaska, AOSC, Appendix L, p. 4, regarding a Prudhoe Bay-spill response): "For large spills, there probably would not be enough equipment to contain and recover the oil so large quantities of spilled oil would escape into the environment. It is never possible to anticipate exactly how much recovery equipment will be necessary for spill response, but experience has shown that there is never enough."

The likely effectiveness of the ARCAT skimmer in recovery of highly viscous crude (such as weathered Prudhoe Bay crude) is discussed in Section III.D of Appendix M in this EIS. Rope-mop skimming devices, such as used by the ARCAT, are generally more effective with higher viscosity oils than with lower viscosity oils. Part of the concern of AOSC with the ARCAT is based on an assumption that Prudhoe Bay crude at 0 °C (32 °F) is near its pour point (temperature at which oil will no longer flow). The pour point of Prudhoe Bay crude is actually much lower, -23 °C (-10 °F) (Payne et al., 1984a).

#### NSB-10:

Potential response efforts during freezeup and breakup are discussed in Section IV.A.2 and Appendix M (Sec. III.E) of the EIS. Figure IV-A-2-4 summarizes the applicability of oil-

spill-response techniques in the proposed sale area. There are few response options for both breakup and freezeup, and these are undemonstrated in the Arctic. Complicating matters, spills frozen into winter multiyear ice—the dominant winter-ice form in the sale area—would gradually melt out during the following summer, with about 10 percent of the oil not melting out until a second summer. In a freezeup spill, the spilled oil would be scavenged by grease ice and would either have to be mechanically separated from the ice or removed with the ice for recovery. Once the grease ice solidified, the oil would be trapped within the ice matrix and would be recoverable only by cutting and removing the ice or by waiting until meltout the next summer. In addition, landfast ice beyond about a 10-m water depth does not dependably thicken sufficiently to allow mobilization of heavy equipment until January. Thus, heavy equipment may not be usable for up to a 3-month period during fall freezeup and early winter.

The most effective procedure for spills during both freezeup and breakup may be to wait and ignite pools of oil on the ice as they form during the following breakup and summer(s).

#### NSB-11:

Crude tankers are not anticipated to be used for oil shipment in the Beaufort Sea Planning Area for either the Proposal or the cumulative case. Response would be difficult. As a rule of thumb, logistical constraints (e.g., fuel versus dispersant loads, flight and loading times, number of daylight and weather hours, airfield locations) may restrict effective aerial application of dispersants to spills within 50 nmi of land. There have been unsuccessful dispersant field tests—only partly attributed to cold-water effects—in the Canadian Beaufort Sea, resulting in the recommendation that dispersants not be considered a primary response tool in the Arctic (Swiss and Vanderkooy, 1988).

#### NSB-12:

The system used to transport any commercial oil discoveries will depend on where the oil is discovered and the environmental features at and near the discovery site: the amount and characteristics of the oil; the relative costs of constructing, operating, and maintaining various systems that might be used; regulatory requirements; and the possible use of existing transportation systems. Existing transportation facilities that might be utilized to transport any oil from the Beaufort Sea Planning Area might include TAP, the Kuparuk or Endicott Pipelines, and tankers from the Marine Terminal in Valdez, Alaska; these are approved facilities.

Before production can begin on a lease, the lessee must submit a Development and Production Plan to MMS in accordance with the requirements of 30 CFR 250.34. The plan must include a description of the means proposed for transportation of oil and gas to shore, the routes to be followed by each mode of transportation, and the estimated quantities of oil or gas, or both, to be moved along each route. After the plan has been deemed submitted, copies are sent to the Governor or the Governor's designated representative and also to the CZM agency of each affected State as well as the executive of each affected local government that requests a copy. Copies of the plan must be made available to appropriate Federal agencies, interstate entities, and the public. Comments and recommendations are submitted to MMS and are processed in accordance with regulations in section 30 CFR 250.34 and regulations governing Federal CZM consistency procedures, 15 CFR Part 930. A development and production plan may be (1) approved; (2) modified if it determined the lessee has failed to make adequate provisions for safety, environmental protection, or conservation of resources; or (3) disapproved if:

(i) The lessee fails to demonstrate that compliance with the requirements of the (OCS Lands) Act, provisions of the regulations prescribed under the Act, or other applicable Federal laws is possible,

(ii) State concurrence with applicants coastal zone consistency certification has not been received, the State's concurrence has not been conclusively presumed, or the State objects to the consistency certification and the Secretary of Commerce does not make the determination authorized by section 307(c)(3)(b)(iii) of the CZMA.

(iii) Operations threaten national security or defense; or

(iv) Exceptional geological conditions in the lease area, exceptional resource value in the marine or coastal environment, or other exceptional circumstances exist, and all of the following:

(A) Implementation of the plan would probably cause serious harm or damage to life (including fish and other aquatic life), property, any mineral deposits (in areas leased or not leased), the national security or defense, or to the marine, coastal, or human environment.

(B) The threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time.

(C) The advantages of disapproving the plan outweigh the advantages of development and production.

The regulations contained in 30 CFR 250 cover all aspects of oil and gas operations on the OCS including pollution prevention and control (includes oil-spill-contingency plans for exploration and for development and production), drilling, well completion and workover, abandonment, production-safety systems, platforms and structures, pipelines and pipeline rights-of-way, and training of personnel.

The MMS considers that the procedures of the OCS oil and gas leasing program, some of which are summarized above, ensure safe operations and minimize the risk of pollution.

#### NSB-13:

See Response NSB-12.

#### NSB-14:

The ice-strengthened drillships and the CDU have shown that they can be used to safely and successfully drill exploration wells. Prior to operating in Alaskan waters, these units have been used since 1976 to drill exploration wells in the Canadian Beaufort Sea; also, they were inspected by MMS and the USCG to ensure compliance with applicable MMS and USCG regulations.

Before an exploration well can be drilled on an OCS lease, the lessee must submit an exploration plan in accordance with 30 CFR 250.33 for approval by MMS. Information in the plan includes (1) a description of the type of drilling unit to be used and important safety and pollution-prevention

features and (2) an oil-spill-contingency plan.

After it has been deemed submitted, the exploration plan is transmitted to the Governor and the CZM agency of each affected State. Comments from the Governor are considered in the evaluation of environmental impacts of the activities described in the plan. The exploration plan may be (1) approved; (2) modified if it is inconsistent with the provisions of the lease, OCSLA, or regulations prescribed under the OCSLA including air quality, environmental safety, and health requirement; or (3) disapproved if it is determined that a proposed activity probably would cause serious harm or damage to life, property, offshore natural resources, the national security or defense, or the marine, coastal, or human environment, and that the proposed activity cannot be modified to avoid the condition(s).

Prior to the initial drilling of a well under an approved exploration plan, the lessee shall submit to MMS an APD for approval (30 CFR 250.64). The APD's for wells to be drilled from mobile drilling units shall include (1) an identification of the maximum environmental and operational conditions the rig is designed to withstand; (2) documentation of operational limitations imposed by the American Bureau of Shipping classification or other appropriate classification society, and either a U.S. Coast Guard Certificate of Inspection or Letter of Compliance; and (3) for frontier areas, the design and operation limitations beyond which suspension, curtailment, or modification of drilling or rig operations are required (e.g., vessel motion, offset, riser angle, anchor tensions, wind speed, wave height, currents, icing or ice loading, settling, tilt, or later movement) and contingency plans that identify actions to be taken prior to exceeding the design or operating limitations of the rig.

The MMS considers that the operating experiences, the inspections, and information submitted in the exploration plans and the APD's ensure exploration wells can be drilled safely from floating units and in a manner that minimizes potential environmental effects and pollution risks.

#### NSB-15:

Exploration drilling from floating units is discussed in Section II.B.2 of the EIS. Also, see Response NSB-14.

Several MMS- and industry-funded studies on the effects of industrial noise on bowhead and belukha whales have been conducted in the Beaufort Sea. Noise levels from seismic operations are not likely to cause any damage to the hearing apparatus of the whales, nor are such operations likely to interfere with or block whale movements or migrations. Seismic operations are conducted either in open water away from ice-lead systems or landfast ice away from spring leads used by the whales. A considerable amount of scientific information on the effects of oil on marine life, including effects on whales, has been acquired (see Sections IV.B.5-6 and IV.C.5-6). This information strongly suggests that whales are not that sensitive to oil-spill contact, and studies on oil-ice interactions indicate that exposure of the whales is likely to be low due to the encapsulation of the oil in the ice (winter spills) and its release from the ice during melt-out after the whales have migrated through the lead system.

Although we are not certain how various organisms will be affected by spilled oil, the analysis in the EIS uses the best available information to discuss the fate and effect of spilled oil (e.g., where it is likely to go, how its toxicity changes with time, etc.; Secs. IV.A.1 and 2), the known effects of oil on pertinent organisms (various chapters in Sec. IV), and the possible effects of an oil spill on the food web (Sec. IV.C.2.a.[3]).

Concerns regarding oil spill issues are addressed in Responses MMC-16, NSB-8, NSB-9, NSB-10, and NSB-11.

The concerns expressed in this comment also are addressed in Responses AK-1 and 2 and N-7, 13, and 14.

#### NSB-16:

This comment relies, in part, on the NSB interpretation of its CMP policy 2.4.4(b), which requires that "offshore structures must be able to withstand geophysical hazards and forces which may occur while at the drill site." The MMS believes that floating structures that comply with USCG and MMS requirements for drilling in the Arctic are capable of meeting this requirement; see Response NSB-14. Regardless of the type of drilling unit, assuring no significant interference with subsistence whaling, the availability of whales, and access to subsistence resources would be fostered through several proposed mitigating measures, particularly Stipulations Nos. 5 (Industry Site-Specific Bowhead Whale-Monitoring Program), 6 (Subsistence Whaling and Other Subsistence Activities), and 8 (Seasonal Drilling Restriction). The remaining CMP policies identified by the NSB—depletion of subsistence resources below the needs of local residents, noise disturbance in areas of concentrated wildlife, and effective oil-spill control and cleanup plans—are assessed in this document and would be subject to further review at the time an exploration plan is filed. Additional protection for subsistence and subsistence resources is provided through several IIL's proposed for this sale, including: IIL's Nos. 1 (Information on Bird and Marine Mammal Protection), 2 (Information on Areas of Special Biological and Cultural Sensitivity), 6 (Information on Endangered Whales and MMS Monitoring Program), and 7 (Information on Development and Production Phase Consultation with NMFS to Avoid Jeopardy to Bowhead Whales) help the Proposal comply with the NSB CMP.

Also, see Responses AK-1 and 2 and N-7, 11, and 13.

#### NSB-17:

The MMS also acknowledges the potential threats posed by industrial activities on migrating bowhead whales, which is why Stipulation No. 8 has been included in this EIS.

See Responses AK-1 and 2.

#### NSB-18:

Other mitigating measures proposed would provide additional protection for bowhead whales (see Response NSB-16). In addition, further consultation with NMFS would be required prior to any activity (exploration or development/production) within the spring-lead system (see Responses AK-1 and AK-2). The "timeframes" for the Stipulations Nos. 5 and 8 have been formulated through aerial-survey data collected each year since 1982 and coordinated with NMFS.

MMS believes that the evidence supports that stipulation No. 8 would be protective of the subsistence whale harvest. The timeframes for the SDR are based on current information on when the largest percentage of the bowhead whale harvest and migration occurs.

Other mitigating measures help to provide adequate protection of whales and other wildlife. See also Response NSB-16.

#### NSB-19:

Both the Barrow and Barter Island Deferral Alternatives were suggested as deferral alternatives during the scoping process for Sale 124; the Proposal and the deferral

alternatives are analyzed in the FEIS. The Secretary of the Interior has the option of selecting any or all of the deferral alternatives analyzed in the FEIS or deferring areas proposed after consultation with the Governor of Alaska, pursuant to Section 19 of the OCSLA, as amended. The proposed area that would be eliminated from leasing in the Barrow Deferral Alternative was deferred from Sales 87 and 97.

An analysis of oil spills in the spring migration corridor for the bowhead whale was presented in the DEIS (see Sec. IV.C.6). Also, see Responses AK-1, AK-2, and N-6.

#### NSB-20:

See Response NOAA-18.

#### NSB-21:

The EIS recognizes the importance of the ANWR coastal plain and adjacent waters to denning polar bear (see Sec. III.B.4 and Graphic No. 2), and that transportation of oil by offshore pipeline would avoid conflicts with development and this polar bear-denning area. Also, the potential cumulative effects of noise and disturbance on polar bears and other marine mammals, including State oil leasing adjacent to ANWR, are addressed in the EIS (see Graphic No. 3 and Sec. IV.L5.c).

#### NSB-22:

Based on increased resource estimates, the likelihood and most likely number of major spills have been increased for both the proposed sale and the cumulative case in the FEIS (see Table IV-A-1-1). The FEIS analysts have reevaluated the effects of oil spills on environmental resources. The new most-likely number of spills of at least 1,000 bbl for the cumulative case is 10, with a reoccurrence interval (average time between spills) over the life of the proposal of 2.8 years for spills along the coastal Chukchi and Beaufort Seas. This cumulative frequency and this magnitude of spillage may already be occurring. There have been two spills (heating oil and diesel) of at least 1,000 bbl in the Beaufort Sea over the past 5 years (Sec. IV.A.2), for a reoccurrence interval of 2.5 years.

#### NSB-23:

The cited OCS spill statistics for pipelines and tankers were calculated from the 19 spills of at least 1,000 bbl that occurred from 1964 through 1987 during the production of 7.5 Bbbl (Anderson and LaBelle, 1990). The cumulative most likely number of 10 major spills in the coastal Arctic Ocean in the FEIS (an increase from the 8 in the DEIS) occurs during the projected production of 8.24 Bbbl, more than produced from the entire U.S. OCS (Table IV-A-1-1). Thus, arctic offshore oil production is projected at 110 percent of the entire OCS production from 1964 through 1987.

#### NSB-24 and 25:

Proposed mitigating measures, such as Industry Site-Specific Bowhead Whale-Monitoring Program, Stipulation No. 5, and IIL No. 1, Information on Bird and Marine Mammal Protection, would provide protection for bowheads from vessel collisions by documenting the presence of bowheads in the area (monitoring) and a 1-mile distance from whales by vessels (IIL No. 1). The text has been modified to address this concern.

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Al Powers  
April 20, 1990  
Page 2

April 20, 1990

Al Powers, Regional Director  
Leasing & Environment  
Minerals Management Services  
U. S. Department of Interior  
949 East 36th Avenue, Room 110  
Anchorage, AK. 99508

Re: RESPONSE TO EIS STATEMENT/OIL  
& GAS LEASE SALE 124

Dear Mr. Powers:

Does one way of life have to die so another can live?  
This question arose at a conference of the Yukon/Kuskokwim  
residents in 1974.

Hello, my name is Thomas Napageak Sr., Mayor of the City  
of Nuiqsut; thank you for giving me this opportunity to voice  
out our concerns in response to the EIS Draft Statements.

The City of Nuiqsut respectfully submits the following  
comments in response to the proposed oil and gas lease sale 124  
in the Beaufort Sea. At the outset, we must evaluate what can  
be gained by the lease sale and what can be lost. What can be  
gained is money and oil. What can be lost, however, is an en-  
dangered species; the Bowhead Whale and the Inupiat's way of life;  
subsistence hunting. The loss of the Bowhead Whales and the  
Inupiat's way of life would be immeasurable and could never be  
replaced. Thus, we must all carefully scrutinize the ramifications  
of the sale.

Congress has recognized that extraordinary measures are  
necessary to insure the protection of marine mammals. Marine  
mammals are "resources of great international significance", and  
"they should be protected and encouraged to develop to the greatest  
extent feasible ... and that the primary objective of their man-  
agement should be to maintain the health and stability of the

marine ecosystem. Efforts should be made to protect the  
rookeries, mating grounds, and areas of similar significance for  
each species of marine mammals from the adverse effect of man's  
actions." /

Lease sale 124 would be the fifth in the Beaufort Sea.  
There are already thirteen exploration wells in Sales 71 and 87 and  
9 in Block Sale BF. Lease sale 124 proposes to lease an additional  
22.1 million acres, about 5 to 260 kilometers off shore. Over the  
life of the field, it is estimated that there is a 49% chance that  
one or more spills of at least 1,000 barrels will occur in the  
Beaufort Sea planning area from production platforms or pipelines.  
There is an additional 29% chance of an oil spill within the Prince  
William Sound or the Gulf of Alaska from tankers. In the  
cumulative section, the estimated number of oil spills is eight for  
the production period in the Arctic Region with a greater than 99%  
probability of one or more spills greater than or equal to 1,000  
bbl. / The Environmental Impact Statement concedes that despite  
mitigating measures, some consequences are simply unavoidable.

The EIS seems to underscore the likelihood of an oil  
spill and the resulting damage. An oil spill in the Arctic Ocean  
would have a devastating impact on both marine mammals and the  
Alaska Native subsistence community. The EIS relies on oil spill  
data collected from 1971-1981. Over this period 13,000 OCS wells  
were drilled. However, only a fraction of the oil wells were  
drilled in the Arctic region; yet, the EIS relies on the fact that  
for the 13,000 wells drilled, no oil was spilled due to a drilling  
blowout. / Reliance on this data is misplaced because it does  
not account for the severe weather conditions found in the Arctic.  
Further research is required to determine the probabilities of oil  
spills occurring in Arctic conditions.

Recent data demonstrates that the oil industry is not  
capable of halting a blowout; is not capable of containing and  
cleaning up spilled oil; and that an oil spill would severely  
impact marine mammals and subsistence communities. The recent oil  
spill in the relatively placid waters of the Gulf of Mexico, at

16 USC § 1361(6) (1988).

16 USC § 1361(2).

EIS § IV(E)(15).

EIS § IV(c)(45).

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REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

V-63

N-1

N-2

Ixtoc I demonstrates that the oil industry has only limited capabilities to halt a blowout. This blowout resulted in the worst oil spill in history. The oil spill occurred in early June of 1979; however, the flow was not contained for 295 days, or until late March 1980. Meanwhile, Ixtoc I poured 140 million gallons of oil into the sea, almost 14 times more oil than was spilled from the EXXON Valdez. Unlike an oil spill from a tanker, which is limited by the size of the tanker's cargo, an uncontained blowout is limited only by the size of the reservoir tapped during drilling. The Ixtoc I blowout occurred in the relatively placid waters of the Gulf of Mexico where year-round operations are possible, yet it took nearly 10 months to control. In the Beaufort Sea there is only a very limited opportunity for well containment during the brief open water season; thus, it may take years to contain such a blowout. This of course assumes that a blowout in Arctic seas can be contained. In fact, it is unknown whether a blowout in the Arctic Sea can ever be contained.

N-2

The recent EXXON Valdez oil spill in Prince William Sound and the oil spill in Cook Inlet in July 1987 demonstrates that even under sub-Arctic conditions, the oil industry is unable to mitigate the effects of an oil spill and is unable to return the environment to the prior ecological balance. The IWC Scientific Committee recently found that:

N-3

[P]resent emergency plans for oil spill containment and cleanup have not proved to be effective. In general, experience shows that responses to oil spills are slow and inadequate. In remote areas with severe weather conditions (e.g., polar regions), even well-designed contingency plans are likely to be difficult to implement.

The oil industry has failed to formulate an "appropriate and realistic" plan for oil spill containment and for mitigating the effects of oil spills on the marine environment, and cetaceans in particular. Whether or not any of these things can effectively and actually be implemented in Arctic conditions is to

N-4

<sup>5</sup> Report of the IWC Scientific Committee ad hoc working group on the effect of oil spill on cetaceans at 1, IWC/41/4 Annex T (June 9, 1989) ("working group report").

<sup>6</sup> Working group report at 1; report of the IWC Scientific Committee at 83; IWC/41/4 (June 6, 1989) ("report of the scientific committee").

a large extent unknown. Until the oil companies can develop and put into effect an oil contingency plan that will be implementable in Arctic conditions, further oil and gas exploration and development in the Arctic OCS should be delayed.

N-4

The EIS underscores the damage and impact that an oil spill can have on marine mammals and subsistence communities. The oil spills in the Prince William Sound and Cook Inlet provide new scientific data that indicates that oil impacts on animals can be lethal to cetaceans and other marine mammals. The IWC has found that inhalation and ingestion of oil are likely to occur during an oil spill and that the impacts of oil spills on cetaceans "could be significant." Another scientific study by Oristland, et al. demonstrated that oil has a lethal impact when ingested by polar bears.

N-5

Further, the EIS fails to consider (1) that Bowhead whales not only feed near the surface of the water during migration but also socialize near the surface and (2) that cow-calf pairs of Bowhead whales generally remain close to the surface during migration, rendering them vulnerable to injury from spilled oil. Thus, the potential impact of an oil spill on the net recruitment rates of Bowhead whales could be high; however, the EIS states that the effect on Bowhead whales from an oil spill would be low. The EIS also notes that perhaps the cetaceans would avoid the oil spills.<sup>7</sup> However, recent scientific evidence demonstrates that the animals do not avoid oil spills. The IWC Committee found that 100% of the 173 cetaceans observed in the vicinity of Prince William Sound swam directly through and made no effort to avoid the oil slick.<sup>8</sup> In fact, Bowhead Whales may be less able to avoid the oil slick due to their lack of mobility.

N-6

The EIS also fails to evaluate the effect of oil spill cleanup on the animals. Cleanup attempts would involve substantial noise, increase in vessel traffic, a large number of people, and physical obstruction of some areas. This could result in reducing access of subsistence hunters to their resources. In fact, the oil slick itself may prevent subsistence hunters from being able to reach the whales, depending on the size, location, and duration of

N-7

<sup>7</sup> Oristland, N.A. et al., Affect of Crude Oil on Polar Bears (1981) (prepared by the Department of Indian & Northern Affairs, Ottawa, Canada).

<sup>8</sup> EIS § IV(c)(44).

<sup>9</sup> Working Group report at 1.

the discharges, ice conditions and the behavior of oil trapped in ice or may result in the total or substantial depletion of the resource itself.

N-7

In sum, the complete ramifications of an oil spill on the Arctic eco-system are unknown. In addition, the ability of the oil industry to prevent a blowout or to clean up an oil spill in Arctic conditions are also unknown. Until the time that further research is done and more advance scientific technology becomes available to aid the oil industry, the proposed lease sale should not take place.

N-8

Oil and gas lease sale 124 will result in substantial increases in noise disturbances and vessel traffic. Such increases will result from barge and other support and supply vessel traffic necessary to service drilling operations, ice-breakers required to maintain open water in the vicinity of drilling operations, and emergency-standby vessels for the potential evacuation of personnel in the event of a blowout or other emergency. In the base case, activities most likely to affect Bowhead whales would include aircraft traffic, ice-breaking or other vessel traffic, geophysical seismic surveys, drilling, pipeline laying and production operations. Helicopter trips during exploration-well drilling are estimated to average one trip per day per site, and two trips per week per platform are expected during production.

The draft EIS concludes that the overall effect from noise and disturbance on Bowhead Whales would be very low or low. However, there is substantial evidence to the contrary. Currently, there is substantial off-shore exploratory activity in the Chukchi and Beaufort Seas. The IWC has already recognized the adverse impact these activities are having on Bowhead Whales. In addition, Natives have observed whales responding to noise over forty miles away. This evidences the fact that Bowheads have strong adverse reactions to noise.

N-9

The EIS first fails to take into account the sound propagation that occurs in Arctic waters. Arctic waters possess

N-10

<sup>10</sup> 54 Fed. Reg. at 40, 704-05.

<sup>11</sup> EIS, § IV(c)(47).

<sup>12</sup> EIS Table II-H-1, Summary of Effects for Alternatives I, IV, and V.

<sup>13</sup> See Working Group Report at 1.

highly efficient sound propagation characteristics. To a large extent, these characteristics determine the distances at which marine mammals are affected by industrial noise. In 1987, a BBN Laboratories, Inc. study noted the unusually efficient sound propagation characteristics of the Beaufort Sea. This study concluded that site specific analysis of conditions were required in the Beaufort Sea to determine the effects of noise on mammals.

N-10

Thus, in order to fully evaluate the potential impacts of the proposed activities upon marine mammals, two factors must be taken into consideration. First, the fact that industrial sea sounds can travel great distances in the Beaufort Sea must be considered and analyzed. Second, measurements from specific locations must be conducted in order to clearly establish the zone within which a Bowhead will react to industrial noise. Without this crucial data, EIS can not conclude that the noise and disturbances resulting from the industrial activities will have a low or very low affect on Bowhead whales. At best, without these studies, the EIS can only guess at what the actual effects that industrial noises will have on Bowheads.

The EIS also fails to consider the most recent scientific studies on Bowhead whale navigation behavior by John C. George, et al., and the recent study released in August 1989 which analyzed the acoustic disturbance potential of petroleum industry activities on marine mammals.

N-11

<sup>14</sup> P.R. Miles, C.I. Malme, Prediction of Drilling Site-Specific Interaction of Industrial Acoustic Stimuli and Endangered Whales in the Alaska Beaufort Sea (1987) ("BBN Noise Study").

<sup>15</sup> EIS Table II-H-1.

<sup>16</sup> J. George, C. Clark, G. Carroll and W. Ellison, Observations on the Ice-Breaking and Ice Navigation Behavior of Migrating Bowhead Whales (Balaena mystecitus) Near Point Barrow, Alaska, Spring 1985, 42 Arctic 24 (March 1989). ("Navigation Studies").

<sup>17</sup> See C. Malme, et al., Analysis and Ranking of the Acoustic Disturbance Potential of Petroleum Industry Activities and Other Sources of Noise in the environment of Marine Mammals in Alaska, BBN No. 6945, OCS Study - MMS89-0006 (August 1989).

According to the George study, Bowhead whales "assess ice conditions acoustically by using their FM calls. . . a Bowhead could determine where there is thin (flat) or thick (generally rough) ice ahead by perceiving the relative level of its own call as it is reflected off of the ice."<sup>13</sup> The Navigation Study describes how all the whales in the 1985 spring migration avoided a large flow of multi-year pack ice that was obstructing the lead system, most of which had refrozen so there was no open water for the whales to migrate through.<sup>14</sup> Even though the lead system was frozen, the migration was able to continue because the Bowheads were able to detect where the ice was thin enough for them to break small breathing holes through.<sup>15</sup> The research concluded that Bowheads found areas of thin ice "through a combination of visual and acoustic cues. . . [w]e suspected the whales detected the [multiyear pack ice] flow by perceiving the strength of their reflected calls off its deep walls and swam around it."<sup>16</sup>

N-11

This research is extremely important to the proposed lease sale. In areas where the Bowheads call or sing to each other increased background noise levels would diminish the distances at which whales could perceive objects. Thus, the waves of sound produced by the Bowheads would become disordered, distorted, or deadened by hitting the waves produced by drill ships or other vessel traffic instead of hitting ice flows and other objects and bouncing back. If the Bowheads attempted to navigate dangerous ice under these conditions, many of them might run into heavy pack ice and either injure themselves or become trapped and drown.

The EIS also finds that the effect, in the base case, on Beluga whales from noise disturbance will be low.<sup>17</sup> However, in testimony delivered before NMFS during the November 10, 1989, public hearing, Geoff Carroll, Wildlife Biologist for the Alaska Department of Fish & Game, testified that the eastern stock of Beluga whales' migratory and feeding patterns have changed. He stated that the Belugas "moved into southeast Kotzebue Sound in

N-12

<sup>13</sup> Navigation Study at 25.

<sup>14</sup> Navigation Study at 27.

<sup>15</sup> Id.

<sup>16</sup> Id.

<sup>17</sup> EIS Table II-H-1.

large numbers."<sup>22</sup> Carroll also testified that Kotzebue whalers enjoyed a plentiful harvest during this time: in 1980, 1981, 1982 and 1983 the harvest was 101, 39, 129, and 48 Belugas.<sup>23</sup> However, since 1983 vessel traffic has increased greatly in the area, while the number of whales sighted and harvested has sharply decreased. In fact, in 1984, very few Belugas were seen in the area and none were harvested. In 1985, 1986, 1987, 1988, and 1989, 2, 0, 7, 4 and 12 Belugas were harvested. Additionally, the number of Belugas coming into the area was smaller than before 1984. However, the hunting success of nearby villages, Point Lay and Wainwright, have not been reduced in numbers from the pre-1984 figures. Thus, it appears that the Belugas have been displaced from Kotzebue Sound by the increase in activity there. Id. Likewise, there is no reason to believe that the Bowheads would not change their migratory patterns to avoid increased activity. If the migratory patterns of the Beluga and Bowhead change, this would significantly and adversely impact the Inupiat's subsistence hunting and way of life.

N-12

Additionally, between August 21st and September 18th of last year, EXXON's Arctic Rose conducted seismic activities. This activity was conducted during last year's fall hunt in the Beaufort Sea off Point Barrow. During the five week period in which the seismic activity took place, whalers from Barrow only sighted one Bowhead whale.<sup>24</sup> Immediately after the Arctic Rose left the area, the Bowhead whales migrated.<sup>25</sup> This evidences the fact that the Fall migration of an entire Bowhead population can be stopped by seismic activity. If the seismic activity continued long enough and the animals were trapped for too long of a period, they could be unable to get through the ice pack and drown.

N-13

This data is important. It evidences the fact that the migratory patterns of Belugas and other cetaceans may be permanently altered by industrial noises. This is contrary to the finding in the EIS where it states that "there has been no documented evidence that noise from OCS operations would serve as

<sup>22</sup> Testimony of Geoff Carroll at NMFS hearing in Barrow, Alaska (Nov. 10, 1989) ("Geoff Carroll testimony").

<sup>23</sup> Id.

<sup>24</sup> See Testimony of Eugene Brower, President of the Barrow Whaling Captain's Association at NMFS's hearing in Barrow, Alaska (Nov. 10, 1989) ("Barrow testimony").

<sup>25</sup> Id.

a barrier to migration" or change migratory patterns. <sup>27</sup> The evidence concerning the Belugas indicates that further research on the effects of noise should be undertaken before oil and gas lease sale 124 takes place. Likewise, further research needs to be done on the effect of drilling site noise impacts on the migration and reproductive behavior of the Bowhead whale.

N-13

The EIS also fails to fully evaluate the effect on Bowhead whales from seismic and geophysical activities. The EIS does not analyze (1) the potential of hearing damage to the Bowhead, (2) does not analyze the impacts upon communication and navigation, (3) does not analyze the effect upon migration and reproduction. As discussed earlier, the background noise disturbance from a seismic vessel operation may interfere with the Bowhead's ability to navigate. Further research and evaluation needs to be done to determine whether the industrial noise generated by geophysical operations could damage the whales' hearing and; thus, their ability to navigate through the ice pack. The cumulative effects that noise disturbances have on the Bowhead whales are significant. The Bowhead's migration path could be changed, altered, or stopped, resulting in the possible extinction of the Bowhead whale. Reproductive cycles may be substantially changed. This, in turn, would substantially decrease or eliminate the whale hunt. This is particularly important in the Inupiat community since the whale hunt has especially important social, cultural, and emotional ties.

N-14

The EIS also fails to account for the impacts on whales from propeller strikes and vehicle collisions. Collisions of Bowheads with vessels have been documented in the Beaufort Sea. It is estimated that approximately 95 whales have been struck by vessels. This estimate was found from data on the existing levels of vessel activity in the Beaufort and Chukchi Seas. Since Bowhead whales socialize and feed near the surface of the water during migration and females nurse their calves near the surface in the Spring and Fall, they will be very vulnerable to collision and propeller strikes from increased vessel traffic. Additionally, it appears that due to their lack of mobility they may be unable to avoid collisions. If oil and gas sale 124 takes place, the actual number of Bowheads being injured and killed will increase substantially due to the increase in vessel traffic.

N-15

The EIS record is completely deficient on the issue of propeller and vessel strikes resulting in injury or death to Bowheads. Further study in this area is necessary because

<sup>27</sup> EIS § IV(c)(46)

reduction in the Bowhead stock may result in reduction or elimination of Bowhead quotas for subsistence hunters in the Inupiat community.

N-15

Throughout the EIS, the draft concludes that the effect on Bowhead whales from noise disturbances will be very low, or low. <sup>28</sup> However, the effect on subsistence harvest patterns are expected to be very high in the Nuiqsut area as a result of effects on Bowhead whales and caribou harvest due to construction activities at Point Thompson, while moderate effects are expected in Barrow, Atkasuk, Wainwright, and Kaktovik. <sup>29</sup> On one hand, the draft states that the effect on Bowhead whales from noise disturbances will be low. On the other hand, the same draft states that the effect on subsistence harvest from the reaction of Bowhead whales to noise disturbances will be high. These findings are internally inconsistent.

N-16

The Bowhead whale hunt plays an important role in the Inupiat community. Whaling is a primary subsistence activity for Nuiqsut. However, whaling is more than a subsistence issue; it is a proud tradition involving ceremonies, singing, dancing, visiting, cooperation between communities and sharing of food. In fact, the Bowhead whale is the most important animal to the North Slope socio-cultural system. <sup>30</sup> It is certain that the reduction or elimination of whaling could have severe ramifications on the socio-cultural and family network system of the Inupiat community. Therefore, it is absolutely imperative that the Inupiat community and the oil industry work together to mitigate the adverse impacts on subsistence hunting. A way of life that has existed for centuries should not be eliminated in the 30 years over which the leases in the Beaufort Sea will run.

N-17

In conclusion, oil and gas lease sale 124 should be postponed for several years while further research is conducted concerning cetaceans, and in particular the Bowhead whale. The sale should also be postponed until more scientific knowledge and more advanced equipment is available concerning the Arctic Ocean and its related temperatures and weather conditions. Delaying the sale may be the best possible solution to safeguard the fragile ecosystem of the Arctic Ocean and the Native subsistence hunting.

<sup>28</sup> EIS Table II-H-1.

<sup>29</sup> Id.

<sup>30</sup> See EIS § III(c)(7).

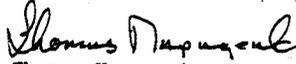
Al Powers  
April 20, 1990  
Page 11

Additionally, if the sale was delayed long enough, fewer leases would be operating on the ecosystem at the same time.

If the sale is finalized, the individual Inupiat communities should be given more control in the process from the beginning until the end. Mitigating measures such as limiting drilling offshore to 80 feet, only allowing bottom founded drilling, and reducing industrial activities during the whale hunt season should be agreed upon. The mitigating measures should be clearly detailed and the oil companies should be required to abide by the plan and severely sanctioned if they do not comply. However, until the effects on the subsistence hunting can be reduced, lease sale 124 should not take place. The overall ramifications for the Inupiat community are clearly too high.

N-18

Respectfully submitted,

  
Thomas Napageak, Mayor

cc: Jermain, Dunnagan & Owens, P.C.  
Mr. Tom Albert, NSB Wildlife Management  
Eddie Hopson, Chairman, A.E.W.C.  
Mr. Warren Matumeak, Director, Planning, NSB  
Mr. Eugene Brower, Barrow Whaling Captains Assoc.  
Mr. Lynn Sutcliffe, Van Ness, Feldman, Sutcliffe & Curtis

## Responses to Comments in the Letter from the Mayor of Nuiqsut

### N-1:

This concern is addressed partially in Response NSB-23. The rationale for using historical OCS statistics to project spillage for the proposed sale is described in Section III of Appendix G. Historically, severe weather has been a principal causal agent in only 10 percent of the major OCS spills. In addition, no major oil blowouts have occurred in either Canadian or U.S. arctic waters in over a decade of exploration and discovery of 2.76 Bbbl of oil (Table IV.A-1-1), although one major fuel spill of at least 1,000 bbl has occurred during Canadian explorations. Spill risk is much greater during production than during exploration, and this EIS assumes that all major spills occur in production rather than exploration. Research into arctic-specific spill rates could be accomplished only through either tabulating spills as they occur or through a fault-tree analysis. Fault-tree analyses are too situation-specific to be a reliable spill predictor at the time of a sale EIS (Anderson and LaBelle, 1990).

### N-2:

The Ixtoc I spill was the world's largest spill, 42-fold greater than the largest OCS platform spill, the 1969 Santa Barbara spill. A blowout that size in the Beaufort Sea, although perhaps not impossible, would be extremely improbable. Most blowouts naturally bridge—about 60 percent of blowouts cease within a day, while only 10 percent have lasted more than 7 days (see Section IV.C.12).

Platform spills are considered a less-serious spill risk than tanker spills. The average tanker spill is fivefold greater than the average OCS platform or pipeline spill (Sec. IV.A.1). In addition, tanker spills are almost instantaneous. The Exxon Valdez spill poured out of the tanker within a few hours. The largest blowouts are those that persist for several months, allowing mobilization of response equipment and expertise early in the spill. Surface blowouts or subsea blowouts, depending on ice cover, can be ignited to lessen pollution. Independent estimates of how much of the Ixtoc spill was burned at the sea surface range from 30 to 50 percent, with some additional, but less than 10 percent, of the crude recovered (NRC, 1985).

For most of the sale area, floating drilling platforms will be necessary. A relief well, if necessary, in these cases would have to be drilled in the short open-water season. Such a relief well would be drilled to intersect the wellbore of the blowout and would not be drilled to the bottom hole depth of the blowout well. Thus, it might be possible to drill a relief well in as little as 30 to 60 days. There is no reason to expect that a relief well could not be completed in the Arctic Ocean. If the relief well could not be completed by freezeup, completion would have to wait until the next summer.

### N-3:

The MMS is aware of no persisting effects of the 1987 Glacier Bay spill in Cook Inlet nor of any scientific evidence that the ecological balance of Cook Inlet was in any way affected by this spill. The quotation provided regarding effectiveness of oil-spill response is consistent with analysis of response provided in Section IV.A.2 of this EIS. See also Responses MMC-16 and NSB-8 through -10.

### N-4:

Partially as result of the increased concern regarding spill response since the Exxon Valdez spill, the oil industry has upgraded its spill cooperative, ACS (Sec. IV.A.2), and the USDO, MMS, OCS Oil Spill Task Force, has made

recommendations to the Secretary of the Interior on improving evaluation of industry oil-spill-contingency plans (Sec. III.D, Appendix M). Industry is unlikely to make improvements in oil-spill-response capabilities if the privilege to explore for hydrocarbons is withdrawn. First production from the Beaufort Sea Planning Area would be preceded by a developmental EIS in which future, site-specific response capabilities could be evaluated. See also Responses MMC-16, NSB-9, NSB-10, and NSB-11.

### N-5:

The EIS recognizes that oil ingestion and inhalation can have lethal effects on polar bears and other marine mammals (see Sec. IV.C.5.a[2]). Inhalation and ingestion of oil by bowhead whales are discussed in the EIS; see Section IV.C.6.a.

### N-6:

The comment concerning potential lethal effects to bowhead whales due to an oil spill has been addressed in the EIS (see Sec. IV.C.6.a). The effect level on the bowhead whale from an oil spill (LOW) and the combined effects (LOW) have been changed to MODERATE to reflect the potential lethal effects.

### N-7:

In the subsistence sections, the text has been amended to include some discussion about the effects on subsistence from cleanup efforts. The commenter also is urged to read Section IV to see the evaluations of the potential oil spills on biological resources and subsistence harvests.

### N-8:

This concern is addressed in Responses N-2, N-3, and N-4.

### N-9:

The primary discussion of noise and disturbance effects on bowhead whales is found in the low case (Sec. IV.B.b). Also, note that the Beaufort Sea Sale 97 FEIS, which is summarized and incorporated by reference for Sale 124, contains an extensive discussion and analysis of noise and disturbance effects on bowhead whales, as well as oil effects. As cited and discussed in the low case section, Malme et al., 1987, estimated that bowhead whales would respond to various drilling activities at various distances. This could result in distributional changes (no lethal effects) affecting a low number of bowhead whales but not a population decline (lethal effects). Therefore, the noise and disturbance effects are considered VERY LOW, or LOW. As noted in Response N-6, the combined or overall effects on the bowhead whale have been changed to MODERATE.

### N-10:

The EIS does consider the propagation of sound in arctic waters (see discussions in Sec. IV.B.6); Miles, Malme, and Richardson 1987; a BBN Laboratories report; and discussion under Section IV.C.B(2). The sound measurements from the studies cited were conducted in the Beaufort Sea. Although sound propagation will vary from one local geographic site to another, so will the ambient sounds of ice movements and wave actions vary geographically and seasonally. The specific locations of drilling activities cannot be determined until after leases are awarded (after the lease sale) and exploration plans are submitted, at which time reviewers such as NMFS can request that such information on drilling-noise propagation be required for the specific drill site. However, information gained from several different locations in the

Alaskan and Canadian parts of the Beaufort Sea has indicated that bowhead whales reacted little to the sounds of industrial activities in these locations.

Also, see Response N-9.

N-11:

The text has been amended to include the studies suggested. With the high ambient-noise levels associated with the heavy-ice conditions of the spring-lead system, it is probable that industry noise would be masked and not interfere with bowheads locating migration paths. Also, ambient light is a factor in under-ice bowhead navigation. George et al. (1989) concluded that "bowheads appear to use ambient light cues and, perhaps, the echoes of their calls off the keels of thick ice" for "under-ice navigation and avoidance of large multi-year floes." Considering the extreme ice-induced noise level associated with the spring-lead system and the adaptability of the bowhead whale to migrate through the ice leads, it is difficult to conclude that bowheads "might run into heavy pack ice and either injure themselves or become trapped and drown" due to encountering noise from drilling operations. Also, the drilling operation is stationary, whereas the spring-lead system moves and allows paths where the drilling operation would not potentially interfere with bowhead movement. Additionally, (1) any drilling activity proposed for the spring-lead system will require review by NMFS (see Responses AK-1 and AK-2) and (2) Stipulation No. 5, if adopted, requires a site-specific monitoring program to protect bowhead whales from drilling activities.

N-12:

There is no scientific information to support the contention that changes in the distribution and/or abundance of belukha whales in Kotzebue Sound have any relationship with increases in vessel traffic in that area. Scientific studies on the same eastern stock of belukha whales in relation to industrial (oil and gas exploration) in the Canadian Beaufort indicated that the distribution and general feeding activities of these whales and the Native harvest of these whales were not affected by increases in vessel traffic (Fraker, Sergeant, and Hoek, 1978).

N-13:

Several mitigating measures (Stipulations and Information to Lessees) have been proposed to protect migrating bowhead whales from noise disturbance (see Responses AK-1 and AK-2). Also, in their biological opinions, NMFS has expressed their concern for limiting the number of industrial sites "to ensure that the potential for adverse effects is low." IFL No. 6, Information on Endangered Whales and MMS Monitoring Program, provides notice that activities will be modified when necessary to protect endangered whales.

Also, see Response NSB-15.

N-14:

As noted in Response N-9, the Sale 97 FEIS is summarized and incorporated by reference for Sale 124. Because Sale 124 is likely to have few or no associated high-energy, low resolution seismic surveys, and because of the small amount of the relatively quiet, high-resolution seismic surveys likely to result from the sale, these seismic activities are not likely to adversely affect endangered whales. Behavioral responses (brief flight response, changes in surfacing and dive times, and temporary changes in migration routes) are likely. These short-term responses are not likely to preclude a successful migration or to significantly disrupt feeding or mating activities. See pages IV-B-58 and 59 of the Sale 97 FEIS for a full discussion of the effects of seismic activity on bowhead whales. The text of the Sale 124 EIS has been amended to

include hearing and navigation effects. The text has been amended to address the George et al. (1989) study and the potential navigational impairment (see Sec. IV.B.6.). George et al. (1989) concluded that "bowheads appear to use ambient light cues and, perhaps, the echoes of their calls off the keels of thick ice" for "under-ice navigation and avoidance of large multi-year floes."

N-15:

The text has been amended to address this concern.

N-16:

The EIS text and Table II-H-1 do not say that VERY HIGH effects are expected on Nuiqsut subsistence-harvest patterns. In addition, the effects on a biological resource—e.g., bowhead whales—and the effects of a harvest are very different and the definitions for each of these are very different. For example, while noise and disturbance may not affect the whale population as a whole (thus the LOW effect level in the section on effects on bowhead whales), noise and disturbance could cause a harvest to be decreased from 2 or 1 to 0, which would be a HIGH effect. This is generally only the case with bowhead whaling because there are so few bowheads harvested each year in most communities.

Also, see Response N-7.

N-17:

The MMS recognizes the extreme importance bowhead whaling plays for the Inupiat whaling communities. In Nuiqsut, the HIGH effects on the subsistence-harvest patterns are from effects on bowhead whaling. It is also for this reason that MMS has proposed Stipulations Nos. 3, 5, 6, and 8 in the EIS.

N-18:

The OCS leasing program does provide opportunities for interested parties to express their opinions and concerns throughout the leasing process, but management of the program is the responsibility of the MMS. The MMS's management responsibilities include fully evaluating the public's opinions and concerns and balancing all the various interests in the decision-making process.

Prior to a lease sale, there are several opportunities for various sectors of the public to state their opinions or concerns about the general aspects of a lease sale in a particular OCS oil and gas planning area. These opportunities, which are noted in Section IA of the EIS, include scoping meetings, public hearings (on the DEIS), and Proposed Notice of Sale.

After the lease sale—and before exploration drilling or petroleum production can occur—the lessee must submit to MMS for approval an exploration plan and, if economically recoverable resources are discovered, a development and production plan. Regulations contained in 30 CFR 250.33 require the exploration plan to be sent to the governor and the CZM agency of each affected State; MMS also sends a copy of the exploration plan to the NSB. Regulations 30 CFR 250.34 also require that the development and production plan be sent to the governor and the CZM agency of each affected State and to the executive of each affected local government that requests a copy. This part of the leasing program provides the State and local governments an opportunity to review and comment on specific operations.

The MMS does not consider it necessary to have mitigating measures that limit exploratory drilling to waters shallower than 80 feet or to a specific type of drilling unit. The consideration is based on the previous operating experiences

in which floating drilling units have safely and successfully drilled exploratory wells in the Beaufort and Chukchi Seas; during these operations, weather and ice conditions are monitored and icebreaking vessels stand by to protect the drilling unit from moving sea ice. If the weather or ice conditions pose a risk to the drilling operation, the floating unit can safely shut-in the well and move away from the drilling site until it is safe to return and commence operations. Also, as noted in Response NSB-14, the floating units are inspected to ensure compliance with MMS and USCG requirements.

The MMS has presented a mitigating measure to prohibit exploratory drilling during the bowhead whale migration. The effect of this measure on subsistence whaling is analyzed in Section II.G.2.a of the EIS. Also, MMS has presented Stipulation No. 6, Subsistence Whaling and Other Subsistence Activities, requiring lessees to contact communities that might potentially be affected by exploration and development and production activities and discuss potential conflicts with the siting, timing, and methods of the proposed operations. The MMS feels that this consultation process should assure that exploration and development and production activities are compatible with whaling activities and do not result in undue interference with the subsistence whale hunt. The effects of this measure also are analyzed in Section II.G.2.a.

Stipulations that are approved by the Secretary of the Interior become part of the lease agreement between MMS and the lessee. The requirements of these stipulations are enforced by MMS, and any violations are administered in accordance with the regulations contained in 30 CFR 250.200.



W. R. Francis  
Division Land Manager

May 7, 1990

**Amoco Production Company**

Northern Division  
1670 Broadway  
P.O. Box 800  
Denver, Colorado 80201  
303-830-4040

**Minerals Management Service**

Alaska OCS Region

May 7, 1990

Page Two

**TELECOPY AND REGULAR MAIL**

Regional Director  
Minerals Management Service  
Alaska OCS Region  
949 East 36th Avenue, Room 110  
Anchorage, Alaska 99508-4302

Subject: Comments on the Draft Environmental Impact Statement  
Beaufort Sea Planning Area  
Oil and Gas Lease Sale 124  
Alaska OCS

Gentlemen:

Reference is made to the subject Draft Environmental Impact Statement ("DEIS") for Proposed OCS Sale 124, Beaufort Sea, Offshore Alaska and to that certain Federal Register, Vol. 55, No. 50, dated March 14, 1990, wherein the Minerals Management Service ("MMS") requested comments and suggestions relating to the DEIS from interested individuals, representatives of organizations and public officials.

Amoco Production Company ("Amoco") supports the positions of the Alaska Oil and Gas Association ("AOGA") as stated in their comments filed in regard to the Sale 124 DEIS and, rather than comment on all the points addressed by AOGA, hereby submits our viewpoint on the following two (2) extremely crucial issues:

1. Amoco sees the adoption by the MMS of Alternative I to have a significant impact on not only oil and gas exploration in the Beaufort Sea, but OCS leasing in general. Alternative I, which is the proposed action by the MMS, is based upon offering for lease in April 1991 the entire proposed sale area covering 4,095 blocks (approximately 8.95 million hectares or 22.1 million acres) in the Beaufort and Chukchi Seas.

It is absolutely critical for the oil and gas industry to be able to confidently rely upon a consistent MMS leasing schedule. The point about the OCS needing to be explored and developed to help reduce our nation's dependence on foreign energy and for national security purposes has been stressed before, and no doubt needs to be reiterated. However, another key consideration is industry's manpower and budget allocations.

**RECEIVED**

MAY 11 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

If the MMS can not provide a reliable OCS leasing schedule, then the fact remains that the manpower and exploratory dollars that would have been allocated to OCS areas will be redirected to arenas where funds can be spent to find oil and gas. Once company dollars, manpower and long-term strategy have been focused in one direction (i.e., international), it is time-consuming and expensive to reverse the trend.

Perhaps even more critical than the timing of Sale 124 is the area to be offered for leasing. As set out in Alternative I, industry needs to be allowed to explore for hydrocarbons in the most prospective areas. Any restriction on the number of blocks would place an undue hardship on industry's Alaska efforts and ultimately our national security.

2. Amoco strongly opposes Stipulation No. 8 - Seasonal Drilling Restriction (pages II - 50 through 54). This stipulation may have a negative effect on industry's interest in Sale 124 as the most advantageous time to drill during the fall drilling season has been virtually eliminated. The actual drilling days for a floating drill system would be reduced to a point that a prospect may take 3 to 4 years to drill, which, when taking into account mob/demob costs, could cause the project to be deferred or even cancelled. The cost of doing business in Alaska as a result of environmental difficulties prohibits many energy companies from spending dollars there and causes other companies to downsize their operations. Stipulation No. 8 further exacerbates the problem.

AMO  
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Amoco greatly appreciates the opportunity to comment on the DEIS for Beaufort Sale 124. Should you wish to discuss this matter further, please contact the undersigned at (303) 830-5497.

Sincerely,

AMOCO PRODUCTION COMPANY

*Robert S. Fabris*

Robert S. Fabris  
Alaska Land Coordinator

RSF25/s1

AMO-1:

Your position has been noted.

# Alaska Oil and Gas Association

121 W. Fireweed Lane, Suite 207  
Anchorage, Alaska 99503-2035  
(907) 272-1481

May 8, 1990

Regional Director  
Minerals Management Service  
Alaska Region  
949 E. 36th Avenue  
Anchorage, Alaska 99506-4302

Draft EIS - Proposed Beaufort  
Sea Lease Sale 124

Gentlemen:

The Alaska Oil and Gas Association (AOGA) is a trade association whose member companies account for the majority of oil and gas exploration, production and transportation activities in Alaska. Members of our organization have reviewed the Draft Environmental Impact Statement (DEIS) for proposed Beaufort Sea Sale 124 (April, 1991) and AOGA is pleased to have this opportunity to comment.

As we stated in our testimony at the April 20, 1990 hearing, we strongly recommend the adoption by MMS of Alternative I - offering the entire proposed sale area on schedule. Given the continued decline in domestic production, and increase in foreign imports, it is imperative the resource potential of this area be made available for careful exploration and production.

The DEIS addresses eight potential stipulations to be considered for Sale 124, including a seasonal drilling restriction. As discussed in our testimony and in the attached detailed comments, AOGA's members believe such a restriction is unnecessary, and we recommend the stipulation not be applied in Sale 124.

Overall, the DEIS and accompanying appendices are thorough, well-written and adequately address the proposed sale, the related potential effects of the sale and resulting exploration and development activities. Our comments on specific sections of the DEIS are attached for your consideration.

Sincerely,



WILLIAM W. HOPKINS  
Executive Director

WWH:ts5:552  
Attachment

RECEIVED

MAY 8 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

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COMMENTS OF THE  
ALASKA OIL AND GAS ASSOCIATION  
ON  
DRAFT ENVIRONMENTAL IMPACT STATEMENT  
ON OCS SALE 124  
BEAUFORT SEA PLANNING AREA

Page xxiii

Footnote 2, References Table III-A-1: This is incorrect; it should be Table III-A-3 (Air Standards). The listed Table III-A-1 is Water Types.

Page I-5, Last Paragraph under "Drilling"

The number of wells drilled on federal leases in the Beaufort Sea as stated in this paragraph should be changed from 21 to 22 to agree with discussion on page II-2 and in Appendix H.

Table II-A-1

The table indicates four exploratory wells will be drilled with bottom-founded units. It is likely that the four wells envisioned would include some floating operations. Further, the timing for exploration and production may be somewhat optimistic.

Page II-8, First Paragraph under "Timing of Activities"

Having the first "delineation" well drilled in the second year of exploration doesn't seem to be consistent with a "discovery" occurring between the second and third years as stated.

Page II-14, Second Complete Paragraph

The possibility of any new pipeline from Point Thomson tapping into the Endicott line should be mentioned, as it will shorten the length of new line required.

Page II-14, Sixth Complete Paragraph

The possibility of any new pipeline from Pitt Point tapping into either the Milne Point or the Kuparuk lines should be mentioned as it will shorten the length of new line required.

Page II-16, Fourth Paragraph; Last Sentence

The word "increasing" should be added between "with water". If it is not added, no relationship of burial depth with water depth is expressed.

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<u>Page II-24. Second Paragraph under "Support and Logistics"</u>	AOGA 8
The range of open water seasonal drilling rigs, i.e., 2 to 10, is too high. The upper end of this range cannot be reached without new construction of both rigs and icebreaking vessels. A more reasonable upper end may be 5 or 6.	
<u>Page II-32 and II-35; (1) Resource Estimates</u>	AOGA 9
In stating the Barrow deferred area, Barter Island deferred area and the Base Case, the assumption is made that no resource is lost by the deferrals. This may not be an appropriate assumption until the areas are explored.	
<u>Page II-44. Stipulation No. 4</u>	AOGA 10
This stipulation expresses a preference for pipelines for transportation of crude oil. The selection of the means of transporting crude should be left flexible enough that all means can be considered equally at the time a transportation system is needed. Economics should be the primary criteria, as long as the option is environmentally acceptable.	
<u>Page II-49. Stipulation No. 7</u>	
The new oil spill response preparedness is apparently an attempt to address the recent tanker spills in Alaska, California and on the East coast. The section is a reasonable attempt to address oil spill preparation and contingency planning. In addition, the paragraph found on page 49-50 does an admirable job in describing the volume consequence and difference between a transportation and an exploratory/production well spill.	
<u>Pages II-50-II-54. Stipulation No. 8</u>	AOGA 11
As to seasonal drilling limitations identified in Stipulation No. 8, AOGA submits that such limitations on exploratory drilling are unnecessary. Industry's 10 year record of drilling in the Beaufort Sea, coupled with the history of cooperation with the whalers, clearly demonstrates our ability to operate currently with subsistence whaling without conflict. The limitations on drilling required by Stipulation No. 8 are unnecessary, particularly in light of stipulations No. 5 & 6 which require whale monitoring and consultation with native whalers.	
There is an inherent conflict between stipulations 5 and 6 and stipulation 8. In order to impose stipulation 8 on the oil and gas industry, a pre-determination is made that oil and gas exploration activities are detrimental to the bowhead whales or to subsistence whaling. Further, if stipulation 8 is imposed, the opportunity to employ stipulation 5 most effectively is denied. This eliminates the	

opportunity to determine if stipulation 8 is truly necessary to protect resources. AOGA recommends stipulation 5 and 6 as the proper method of dealing with the conflicts discussed above.	AOGA 11
The seasonal restrictions on drilling have been an issue since the first Beaufort Sea Sale in 1979. Over the years since 1979, the stipulations limiting the periods when drilling can take place have been relaxed. The gradual relaxation was based on the substantial body of evidence that had been accumulated over the past several years. Seasonal drilling restrictions were removed for the March 1988 OCS Sale 97 and subsequently waivers were issued for Sales 87 & 71 operations. The addition of seasonal drilling restriction would not only have an adverse effect on the viability of prudent exploration for Sale 124 leases, but would also generate an inconsistency with the stipulations for the 2.7 million acres currently under lease from previous Beaufort Sea sales.	
<u>Figures III-C-2 and III-C-3</u>	AOGA 12
Both figures need a specification of units for their ordinates.	
<u>Page III-C-16. Second Line in Paragraph under "Wainwright"</u>	AOGA 13
"Beaufort" should be replaced with "Chukchi".	
<u>Page III-C-27. Line Eight in Paragraph under "Bowhead Whales"</u>	AOGA 14
The word "migration" should be replaced with "proportion".	
<u>Page IV-A-6. Second Complete Paragraph</u>	AOGA 15
Given that these spill statistics are based on the historical record, it should be noted that future spills might be fewer because of the improved tanker practices to and from Valdez (eg, expanded radar coverage, use of ocean going tugs as escort vessels, more extensive piloting, etc.).	
<u>Page IV-A-7. Second Line of Second Paragraph under "Fate and Behavior..."</u>	AOGA 16
The reference to "the multiyear ice that covers most of the sale area in winter" is not consistent with the more appropriate description of the ice on page IV-C-46, second-to-last line of paragraph three, which states "First year arctic ice--the most prevalent type in the area..." Also, the word "arctic" should be replaced with "sea" in the latter reference.	
<u>Figures IV-A-2-2 and IV-A-2-3</u>	AOGA 17
The legends on these figures should indicate that the probabilities are expressed as a percentage.	

Page IV-A-10, Last Paragraph

It should be noted that Alaska Clean Seas has expanded its area of interest to include onshore and the mission has been expanded to include response as well as resources.

AOGA  
18

Page IV-N-4, First Paragraph under "Effects on Marine and Coastal Birds"

It does not appear reasonable to have this many birds affected by a spill that occurs in late fall. Birds will not return until late spring - early summer by which time the oil will have undergone clean-up and natural processes.

AOGA  
19

## Responses to Comments in the Letter from the Alaska Oil and Gas Association

### AOGA-1:

The table footnote has been revised.

### AOGA-2:

The text has been revised.

### AOGA-3:

The estimate of the types of drilling units that might be used to drill exploration wells for the low case for Alternative I, Table II-A-1, has been revised.

### AOGA-4:

The sentence has been deleted from the text.

### AOGA-5:

The suggested information has been added to Section II.B.2.a(4).

### AOGA-6:

The suggested information has been added to Section II.B.2.a(4).

### AOGA-7:

The text has been revised.

### AOGA-8:

The text has been revised.

### AOGA-9:

As noted in Section II.A.2, the resource estimates for the Sale 124 area were revised after publication of the DEIS. The amount of oil estimated to be present in the sale area for the base case for Alternative I is 900 MMbbl; for each of the deferral alternatives, Alternatives IV and V, the amount is also estimated to be 900 MMbbl.

The deferred areas are selected on the basis of information obtained during the scoping process, Section I.A.5, and not on potential petroleum resources. Estimates of the petroleum resources for each of the deferral alternatives are obtained after the deferred areas have been determined; and, until exploration and delineation wells are drilled, these resource estimates remain very speculative.

MMS recognizes the deferred area in each of the deferral alternatives might contain petroleum resources and has analyzed for each deferral alternative the potential effects of the development on each of the resource categories. The assumptions and hypothetical scenarios used in the deferred-area analyses are described in Sections IV.G and IV.H.

### AOGA-10:

The MMS considers pipelines to be the preferred method of transporting to shore any oil that might be produced in the Sale 124 area. This preference is based, in part, on historical trends that indicate oil spills from pipelines are less frequent than spills from tankers; Appendix G, Table G-14. However, Stipulation No. 4 provides for alternate methods of transportation if they can be shown to be environmentally, socially, and economically preferable to pipelines.

### AOGA-11:

Your position has been noted. It also should be noted that these stipulations have not been included in the lease sale and are being presented to the Secretary of the Interior for a decision (see Sec. II.G.2 for the discussion stating that these stipulations are only proposed). It is possible that the Secretary could select one but not the other stipulation.

### AOGA-12:

The figure has been revised.

### AOGA-13:

The text has been amended to address this concern.

### AOGA-14:

The text has been amended to address this concern.

### AOGA-15:

The recent changes in tanker practices out of Valdez are not likely to significantly decrease the frequency of major spills ( $\geq 1,000$  bbl) on the TAP tanker route. The rate of major oil spillage by the TAP tanker fleet has increased greatly in the last few years, from about one-sixth of the rate assumed in the EIS to about twice the EIS rate. Through November 1985, TAP tankers experienced one major spill while transporting 4.5 Bbbl. Since that time, TAP tankers have had seven major spills while transporting 3.0 Bbbl (through May 1990). The recent excess spillage over the EIS rate—three of these last seven major spills—were caused by structural cracking. The USCG is very concerned about the rate of structural failures in the larger ( $\geq 700$  ft) TAP tankers (USDOT, USCG, 1989). The TAP tankers have a fourfold higher incidence of serious structural failure than does the rest of the U.S. tanker fleet.

The changes in tanker practices to date address only some of the contributing factors to the Exxon Valdez spill and do not even return levels of protection to those originally proposed by industry and government or initiated when TAP tankering started (U.S. Government Accounting Office, 1989; U.S. House of Representatives, Committee on Merchant Marine and Fisheries, Subcommittee on Coast Guard and Navigation, 1989; Townsend and Heneman, 1989; USDOT, USCG, 1989). When TAP was being approved, USDO and USCG assumed that TAP tankers would be double-hulled (Townsend and Heneman, 1989). When the TAP tanker traffic started, State-licensed pilots were required out to Hinchinbrook Entrance; post-Exxon Valdez requirements for pilotage are only to past Bligh Reef. Tanker manning has decreased through the years in TAP tankering (and in the international trade), and crew fatigue and multiple duties have been identified as contributing factors to the Exxon Valdez spill by the National Transportation Safety Board. Manning levels of TAP tankers have not been increased since the spill. The Coast Guard is reconsidering its 1984 decision to decrease radar coverage in Prince William Sound but has not committed to expanding coverage.

If the voluntary improved tanker practices remain in effect and produce a decrease in tanker spillage, that decrease will be reflected in future estimates of spill rates. However, past experience in TAP port and tanker operations has shown that if spills do not occur, there is a tendency to relax the restrictions (Townsend and Heneman, 1989).

**AOGA-16:**

More than 90 percent of the proposed sale area lies within the pack-ice zone (Appendix M). In the Beaufort Sea and Northern Chukchi Sea, most of this pack ice is multiyear ice (Shapiro and Barry, 1978). The statement cited in Section IV.A.2 of the EIS is correct; the contradictory description in Section IV.C.6 has been revised to reflect the presence of multiyear sea ice.

**AOGA-17:**

The two figures have been revised as suggested.

**AOGA-18:**

The text of Section IV.A.2 has been revised as suggested.

**AOGA-19:**

Although the 160,000 bbl spill started in the late fall—November—it continued to spill through July of the following year; the oil was released from the ice during the spring-summer open-water season when the birds were concentrated in the lagoons and open-water areas. Thus, spill contact with large numbers of birds is not only reasonable but likely.



Page 2  
May 7, 1990  
Mr. Alan Powers  
Re: Proposed Beaufort Lease Sale 124 - DEIS

May 7, 1990

Mr. Alan Powers, Regional Director  
Minerals Management Service  
Alaska Region  
949 East 36th Avenue  
Anchorage, Alaska 99508-4302

Re: Proposed Beaufort Lease Sale 124 - Draft Environmental Impact Statement

Dear Mr. Powers,

ARCO Alaska, Inc. has reviewed the Beaufort Sea Planning Area Oil and Gas Lease Sale 124 - Draft Environmental Impact Statement (DEIS). We have the following commentary that we urge the Minerals Management Service (MMS) to carefully consider. In addition to our comments, ARCO supports the comments that have been submitted by the Alaska Oil and Gas Association (AOGA) on the Beaufort Sea Lease Sale 124 - DEIS.

In general the DEIS reflects a very reasoned approach to the various aspects of the lease sale. The MMS is commended for this approach as it reflects the use of recent information, recognition of advancing technology, and the balance required for prudent, environmentally sound oil and gas development. As stated many times in the past, the need for continued oil and gas exploration is of paramount importance, if the United States is to maintain some degree of import/export balance. Without this ongoing exploration effort the probability of further dependence on foreign sources, to meet our energy needs is assured, and will be of greater significance in the future, than it is in 1990. We therefore both urge and support the MMS to continue the process for this OCS Lease Sale 124 in the timely and deliberate manner outlined for the Alternative 1 - Proposed Action.

As stated in the document, due to the insufficiency of data (I-15) and based on available information (II-50), the seasonal drilling restriction will be stipulated as part of this Sale 124 (Stipulation 8).

We believe that a temporary suspension of Stipulation 8, for this lease sale area, would be productive - for a study to gather actual data with regard to marine mammals (whales) and their interaction with exploration equipment. As a catch 22 exists in this regard - data is needed, yet the ability to get the data under operating conditions is disallowed - by suspending this stipulation, this study and the acquiring of this actual operational data would be accomplished and could serve several purposes:

- 1) The industry could proceed with exploration in a timely and cost effective manner,
- 2) The MMS would have available the data derived from this action, adding to its limited data base regarding marine mammal interaction with exploratory equipment,
- 3) If bowheads avoid exploratory drilling operations by migrating closer to shore, the native community could be a potential recipient of greater numbers of, and closer to shore whale availability. However, there also exists the possibility that no whales would be taken in the area of exploration activity.

The study would be funded by the industry, with the cooperation of the Alaska Eskimo Whaling Commission (AEWC), Village Whaling Captains' Associations, the Department of Interior (Mineral Management Service - MMS), North Slope Borough, the State of Alaska, and scientists of the NOAA - National Marine Fisheries Service (NMFS). This study could be patterned similar to the one discussed on page II-52. During the course of this study, if it is found, and compelling evidence is demonstrated, that whale avoidance has an affect on the subsistence whaling effort - the stipulation would be re-instated during the next migratory period.

Further, if it is found that, through this actual experience of this long term (5 year) study - during which exploration activity will be occurring, the subsistence whaling effort is impeded, ARCO would accept the stipulated "no exploratory activity during migration" without further future contention. However, if there are no harmful affects, this stipulation and those requiring other aspects of whale study would be dropped as a stipulation(s) from all future lease sales.

The discussions found in sections III and IV, with regard to migratory bird species, are missing an important aspect relative to total cumulative impact, that being - the "take" during the hunting season, as not all of the impact on the migratory species are oil industry related, but also result from the yearly egg gathering activity of the subsistence users and hunters. By gathering these eggs, the probability that the number of hatchlings reaching reproductive maturity are diminished significantly. We recognize this as a reality. If the realization that all "taking" contributes to the total cumulative impact, the effect that the oil industry activity would have would be less dramatic than the picture offered in this EIS prior to a proposed industry exploration and / or development effort.

Page IV - N - 7 (8) Effects on Sociocultural Systems - "While no studies have been completed as of the publication of this EIS, early indications are the Prince William Sound oil spill caused a tremendous amount of social upheaval - particularly seen in increases in depression, violence, and substance abuse (Anchorage Daily News, September 26, 1989; New York Times, September 18, 1989)".

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MAY 8 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Page 3  
May 7, 1990  
Mr. Alan Powers  
Re: Proposed Beaufort Lease Sale 124 -DEIS



BP EXPLORATION

BP Exploration (Alaska) Inc.  
900 East Benson Boulevard  
P.O. Box 196612  
Anchorage, Alaska 99519-6612  
(907) 561-5111

May 8, 1990

This is not a true representation of the articles cited. The Anchorage Daily News article "THE SUMMERTIME BLUES" states the primary cause of the "problems" are related to the influx of money to the economies of the villages - not as it is implied in the DEIS - the oil spill - on their simpler subsistence way of life. The New York Times article "OIL CLEANUP BRINGS SAD PROSPERITY TO VILLAGE" stated basically the same thing, the increase in wealth was the apparent cause for the problems cited.

ARCO  
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If you have any questions with regard to the above comments, please feel free to call me at 265-6101.

Yours truly,

*Nelson Kumar*  
*for J. L. Dees*

J. L. Dees, Vice President  
Exploration and Land

**ARCO-1:**

Your position and the suggestion for further studies have been noted.

**ARCO-2:**

The taking of eggs for subsistence use by Natives near the villages probably represents a small percentage of the eggs of tundra-nesting birds lost to other sources such as predation by arctic foxes throughout the tundra habitat of the North Slope, and these sources of egg loss are not industrial effect agents of concern in the EIS. The main type of perturbation that is likely to have long-term or significant adverse effects on birds is the loss of habitat that is associated with onshore development under the Proposal. The loss of eggs to subsistence uses is likely to be insignificant compared to the egg loss due to predation. The abundance of predators such as arctic fox tends to increase near industrial facilities such as those near the Prudhoe Bay area and, in turn, the predation losses of bird eggs and young increases in association with oil development on the North Slope.

**ARCO-3:**

The text has been amended to address this concern. However, ARCO should note that the increase in wealth contributing to the problems was from money received from oil-spill cleanup. Other problems also were a result of crews not being able to harvest subsistence resources.

Mr. Alan Powers  
Regional Director  
Minerals Management Service  
Alaska OCS Region  
949 East 36th Ave., Room 110  
Anchorage, AK 99508-4302

Draft Environmental Impact Statement  
OCS Lease Sale 124, Beaufort Sea, Alaska

Dear Mr. Powers:

BP Exploration (Alaska) Inc. (BP), appreciates the opportunity to comment on the Draft Environmental Impact Statement (DEIS), for Oil and Gas Lease Sale 124. As an important component of the lease sale planning process, it affords all concerned parties the occasion to express their views and concerns. To that end, we note herein our general positions regarding the DEIS and we enclose herewith specific comments on various topics contained in the DEIS.

BP strongly supports Alternative 1 of the DEIS which provides for an offering of the entire proposed sale area on schedule. We believe it is in the best interests of industry, the public, the State of Alaska and the nation to proceed with the evaluation of the hydrocarbon potential of the Beaufort Sea in a prompt manner. Further delay of the sale would contribute to the steadily growing dependence on foreign sources for energy.

BP urges that Stipulation 8, the seasonal drilling restrictions (SDR), be deleted. Its stated purpose is to ensure that subsistence whaling is not adversely affected by offshore petroleum operations. BP believes that Stipulations 5 and 6, which respectively require monitoring of whale movements and consultation with whaling communities, and the cooperative agreement between whalers and industry make Stipulation 8 redundant. Recently prepared biological opinions by the National Marine Fisheries Service strengthen this view point.

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MAY 9 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Mr. Alan D. Powers  
May 8, 1990  
Page 2

As written the SDR deletes the open water "window" during which is required for exploratory drilling in these areas. While waivers have been issued in the past and presumably will be in the future the retention of the SDR will provide industry with an additional variable to factor into its assessment unless the conditions under which waivers will be issued are clearly defined. In an operationally difficult and expensive area this can only serve to inhibit timely exploration.

BP  
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Apart from these general concerns we detail our comments on specific sections of the DEIS on the attachment. We request that these comments receive full and careful consideration.

Sincerely,



Steven D. Taylor, Manager  
Environmental & Regulatory Affairs, Alaska

SDT/III

#### GENERAL COMMENTS ON THE LEASE SALE 124 DEIS

SEASONAL DRILLING RESTRICTION: Stipulation 8 specifies a seasonal drilling restriction (SDR) which appears to duplicate provisions in other stipulations and is therefore unnecessary. The primary purpose of the SDR is stated to be to ensure that subsistence whaling is not adversely affected by offshore petroleum operations. However, Stipulation 6 requires that operators planning any activities consult with the potentially affected communities to ensure that subsistence whaling is not hampered. Furthermore, since 1986, the industry has voluntarily entered into a cooperative agreement with the whalers to avoid interference with their hunt. In addition, the industry has provided life-saving emergency assistance.

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In view of the recent biological opinions prepared by the National Marine Fisheries Service, it is not necessary to impose an SDR to protect bowhead whales. The outstanding questions about the effects of disturbance on bowheads can be met by the monitoring studies that are mandated by Stipulation 5.

Therefore, Stipulation 8, which imposes a seasonal drilling restriction, is redundant and unnecessary. The protection of subsistence whaling is provided for by Stipulation 6, and the need to learn more about the responses of bowhead whales to offshore operations is met by the requirement for approved monitoring programs under Stipulation 5.

HABITUATION: The analysis of cumulative effects of disturbance on animals does not generally take into account the fact that habituation occurs in animals. Habituation results in a diminished response, and therefore reduced impact, to human activities that do not harm the animals in question.

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BP believes that MMS should take habituation into account in its analysis of cumulative impact.

#### DETAILED COMMENTS ON THE LEASE SALE 124 DEIS

p.xxi, Table S-2 The definition of VERY LOW and LOW effects under Biological Resources and Endangered and Threatened Species seem inconsistent.

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p. II-5, para.3 It is not clear why mortality is predicted for disturbance to both walrus calves and seal pups. Walrus are very large animals that congregate in nursery herds, so that a stampede could result in some calves being injured or killed. In contrast, seals are much smaller and do not congregate, so that the possibility of mortality from disturbance would appear to be very remote.

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p. II-5, para.4 The term 'sublethal' in line 10 seems inappropriate. Webster's New World Dictionary defines 'sublethal' as "not quite lethal". Thus the implication is that the effect could be very serious, but not quite enough to cause death. The example that is given is short-term avoidance, which is a small effect, well-below that implied by sublethal.

p. II-19, para.4 The suggestion that there could be mortality to seal pups seems overstated; see comment on p. II-5, para.3.

p. II-19, para.5 The assessment here of LOW effect seems overstated; VERY LOW would appear to be more reasonable. (See comment on p. xxi.)

p. II-23, para.1 Flaxman Island has been used by Nuiqsut whalers in some, but not all years. In fact, Cross Island could more accurately be identified as the center of Nuiqsut whaling operations.

p. II-29, para.2 It should be considered that whales will, like most other species, habituate to activities that are not harmful. With habituation, disturbance would not increase with increasing activity levels, and consequently, the level of overall effects would decrease.

p. II-50, para.5 Stipulation 8 is not necessary and should be dropped, as it was in Lease Sales 97 and 109. The numerous studies over the past decade, funded by MMS and by industry, provide sufficient information to ensure that whales are not placed at risk from disturbance by offshore operations. We acknowledge that our understanding is imperfect, but the only way that knowledge can be improved is by means of research/monitoring projects conducted during full-scale offshore drilling operations, as is provided in Stipulation 5.

p. II-53, para.3 The estimated effects levels appear to be overestimated here, if one applies the criteria in Table S-1. There is no evidence of significant effects on whaling by offshore operations, particularly since the Oil/Whalers Cooperative Agreements have been operative since 1986.

Following p. III-B-10 (Graphic 1) The bird colonies shown in Canadian territory do not appear to be correct. The Kendall Island Snow Goose colony does not appear to be represented. 'Gary' Island in the Mackenzie estuary should be 'Garry'.

Following p. III-B-12 (Graphic 2) The belukha whale concentration area in the Mackenzie estuary is depicted much larger than it is actually, by a factor of at least 10. See Fraker et al (1978) for a more accurate portrayal. Polar bear den 'sights' should be 'sites'.

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p. III-B-14, para.3 The polar bear population information here and in Graphic 2 should be more up-to-date.

p. III-B-15, para.6 The indications are that the bowhead population is at least stable and possibly increasing; there is no indication of decline. Zeh et al. (1990) have presented an analysis that suggests a rate of increase of 3.1% over the years 1978-1988. [Zeh, J.E., A.E. Raftery, J.C. George, and G.M. Carroll. 1990. Rate of increase, 1978-1988, in bowhead whale population size estimated from ice-based visual census data. Paper presented at the Fifth Conference on the Biology of the Bowhead Whale, *Balaena mysticetus*. Held 1-3 April 1990 at Anchorage, Alaska.]

The stock of whales that summer in the eastern Beaufort Sea was only a part of the bowhead population in the Western Arctic, and thus, the current status of this group is much better than that of the population as a whole. (see M.A. Fraker. 1989. Aspects of the ecology of the bowhead whale (*Balaena mysticetus*) in the Western Arctic. pp. 254-279 In: Proceedings of the Sixth Conference of the Comite Arctique International. L. Rey and V. Alexander, eds. E.J. Brill, Leiden, Netherlands.)

p. IV-B-6, para.3 The most extensive work on the effects of disturbance on belukha whales has been done in the Mackenzie River estuary and adjacent Beaufort Sea. This work applies directly to the Mackenzie stock of whales, which is the main one under consideration. That work showed responses at distances of about 4 km. The majority of research on belukhas would indicate only a VERY LOW effect. There has been considerable work on belukha whales and their response to human activities, and the work by Finley and Davis (1984) is unique in showing such a long range response, and judgement should be reserved on that study until more information is available. It may be that the heavy ice conditions that prevailed during their spring studies and the lack of previous exposure of belukhas in the Canadian Eastern Arctic, resulted in the apparently higher sensitivity. The following studies contain useful information:

The effect level should be VERY LOW for temporary, local displacement.

p. IV-B-6, para.4 In considering the potential for disturbance from helicopters, it should be realized that twin-engine helicopters used in offshore operations are normally IFR equipped, and consequently do not need to operate below the cloud ceiling.

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p.IV-C-38, para.3	With respect to the Finley and Davis (1984) study, heavy spring ice conditions, that may have confined the animals and limited their options to move, may have made them more sensitive.	BP 19
p.IV-C-41, para.1	If there are frequent overflights, the seals, like most other pinnipeds, are likely to habituate.	BP 20
p.IV-C-47, para.1	Some clarification of what is meant by 'thin ice' should be given. George et al. (1989) observed bowheads breaking ice that was 20cm thick, while Eskimo hunters (quoted by George et al.) have observed bowheads breaking ice that was about 60cm thick. Most readers would consider even 20cm ice, which is capable of supporting adult humans and light vehicles, to be moderately thick. The 60cm ice is quite thick. This information, combined with observations of bowheads moving through closed ice cover, leads to the conclusion that bowhead whales really are quite competent in rather heavy ice.	BP 21
p.IV-D-9, para.4	The hypothetical mortality discussed here would be replaced in much less than a generation. The average life-span is probably 15-20 years, pregnancy rates are typically high (>80%) (K.J. Frost and L.F. Lowry, 1981. Ringed, Baikal, and Caspian Seals - <i>Phoca hispida</i> , <i>Phoca sibirica</i> , and <i>Phoca caspica</i> . pp. 29-53. In: S.H. Ridgway and R.J. Harrison, eds. Handbook of Marine Mammals, vol. 2. Academic Press, New York). Thus, any impact would only a LOW effect.	BP 22
	The large-scale movements of ringed seals that appear to have occurred during the winter of 1974-1975 suggest that any local depletion would be quickly made up by immigration (I. Stirling, R. Archibald, and D. DeMaster. 1975. The distribution and abundance of seals in the eastern Beaufort Sea. Beaufort Sea Project Report No.1. Environment Canada, Victoria, B.C., Canada. 58pp.) This further suggests that any impact would be LOW.	BP 23
p.IV-G-6	The analysis would lead to the conclusion of LOW effects.	BP 24
p.IV-H-6	The analysis would lead to the conclusion of LOW effects.	BP 25

p.IV-I-13, para.2	The 5000 figure for sea otters in Prince William Sound is an underestimate. Irons et al. (1988) made this estimate based on a boat survey which is known to miss a large proportion of sea otters, particularly those that are away from the immediate coastal area. Monnett (pers. comm.) using aerial survey places the minimum number at 10,000. For perspective, it should be noted that the fisheries in Prince William Sound are believed to kill more than 300 sea otters each year (C.O. Matkin and F.H. Fay. 1980. Marine mammal - fishery interactions on the Copper River and Prince William Sound, Alaska, 1978. Marine Mammal Commission, Washington, DC. 71pp).	BP 26
p.IV-I-13, para.4	Much of this paragraph is excessively speculative. The suggestion that all coastal polar bear denning would be abandoned is an example.	BP 27
p.IV-I-24, para.6	The basis is unclear for the claim that belukha whales are sensitive to noise and disturbance and that they "avoid areas of heavy industrial activities ... in the Canadian Arctic." Belukhas do move away from the immediate vicinity of moving vessels (Fraker et al. 1978), but they are common in the Port of Churchill, Manitoba, where there is considerable vessel activity. Belukha whales are also seen commonly around oil production platforms in Cook Inlet (Gales 1982).	BP 28
p.IV-I-25, para.1	The basis for the conclusion that there could be VERY HIGH effects on belukha whale harvest is not at all clear. There has been no effect on the harvest of belukha whales in the Mackenzie estuary from petroleum-related activities there (Fraker et al 1978; Fraker 1983). Local changes in distribution would result in only a LOW effect, according to Table S-2.	BP 29
p.IV-I-25, para.2-4	This analysis appears to greatly overestimate the level of impact on subsistence, particularly in view of Stipulation 6 and other similar stipulations that would be incorporated into any development plan. A MODERATE effect would appear to be the most extreme level of effect that is likely.	BP 30
p.IV-N-5, para.1-3	The analysis appears to overestimate the level of effect that can be expected. It is more reasonable to expect a LOW effect, according to the criteria outlined in Table S-2.	BP 31

## Responses to Comments in the Letter from BP Exploration

### BP-1:

Your position has been noted.

### BP-2:

Your position has been noted. It also should be noted that the voluntary cooperative agreement program created by the Oil/Whalers Working Group formed in 1986 has been discontinued. Companies operating in the Beaufort Sea have been agreeing to cooperate with the Natives to coordinate their efforts with subsistence activities, but it has been on a case-by-case basis and not in the more formalized manner that had existed with the Oil/Whalers Working Group.

### BP-3:

Most of the biological populations to which noise and disturbance are a concern—namely, birds and marine mammals—are migratory species that are seasonally exposed to the disturbance sources on the North Slope and along the Beaufort Sea coast. Thus, they are not likely to habituate to disturbances to which they are seasonally exposed. Most examples in which biological populations have shown habituation are those that are continuously exposed to the disturbance sources, which is not the case for most species occurring in the Arctic.

The possibility of habituation to noise by bowheads is noted in Section IV.B.b. It is difficult to document a true habituation of a species to a disturbance stimuli because there would be a variability of reactions between individuals. Also, see Response TFA-2.

### BP-4:

The effects definitions for biological resources and endangered and threatened species are inconsistent because endangered and threatened species are separated from the biological resources category with their separate effects definitions.

### BP-5:

The EIS recognizes that injury from a stampede is likely to be more of a problem to walrus calves than to seals—see Section IV.B.5.a.

### BP-6:

"Sublethal" as used in this context refers to the endangered and threatened species effects definitions, where "sublethal" is distinctive from "lethal."

### BP-7:

See Response BP-5.

### BP-8:

Local changes in the distribution or abundance that last for a short period of time are considered to be a LOW effect (see biological effect definitions, Table S-1).

### BP-9:

It is true that Flaxman Island is not the only location of bowhead whaling for Nuiqsut residents, but according to Nuiqsut whalers it is the primary location.

### BP-10:

See Response BP-3.

### BP-11:

Your position has been noted.

### BP-12:

Since the Oil/Whalers Cooperative Agreement is voluntary, it cannot be used to mitigate future effects that might or might not occur. It also should be noted that this agreement is no longer in effect.

### BP-13:

Graphic No. 1 has been changed in response to this comment.

### BP-14:

Other concentrations of belukha whales can occur within the area depicted on Graphic No. 2, as reported in Norton and Harwood (1985). The spelling of polar bear den "sites" has been corrected on Graphic No. 2.

### BP-15:

The text has been changed in response to this comment.

### BP-16:

The text has been amended to address this concern.

### BP-17:

See Response BP-8.

### BP-18:

Helicopters flying IFR (instrument flying-low visibility due to fog) probably would not be able to see concentrations of walruses and seals so as to avoid disturbing them.

### BP-19:

Similar heavy spring ice conditions could occur in the Beaufort Sea Planning Area.

### BP-20:

Frequent overflights of ice habitats along flight paths to and from the drill platform are not likely to disturb the same individuals or the same segments of the walrus and seal populations in order for habituation to occur, due to the constant changes in the graphic location of the ice and to changes in the locations of the hauled-out seals and walruses. Different groups of walruses and seals are likely to be exposed to air traffic along the flight paths to and from the drill platforms.

### BP-21:

The text has been amended to address this concern.

### BP-22-23:

Although the average lifespan of ringed seals is about 15 to 20 years, the generation time (time between birth of a seal and birth of its offspring) is about 4 to 5 years. The losses due to assumed spills could take up to 4 to 5 years for total recovery to occur. Immigration movements of seals in the

Canadian Beaufort Sea in 1974 to 1975 may not be applicable to the Alaskan Beaufort Sea.

**BP-24:**

See Response BP-22-23.

**BP-25:**

See Response BP-22-23.

**BP-26:**

Although 5,000 sea otters may be an underestimate of the Prince William Sound population, it is the only reported estimate available. The vast majority of the otters lost due to the spill were reproductive females (Lensink and DeGange, 1989), which is likely to have greater significance than the random losses to fishery interactions mentioned by the reviewer.

**BP-27:**

The uncertainties about future development, particularly on ANWR, require the EIS analyst to speculate on what the potential effects of loss of polar bear-denning areas along the Beaufort Sea coast would be. The EIS states that a MODERATE effect is possible, not necessarily probable.

**BP-28:**

The text has been amended to address this concern.

**BP-29:**

The text has been amended to address this concern.

**BP-30:**

The evaluation of the effects of the proposed lease sale on the alternatives does not consider the stipulations to be in place. We agree that with Stipulation No. 6 in place, the effect level would be lowered from HIGH to MODERATE (see Sec. II.G.2.a, Effectiveness of Stipulation No. 6), but the Proposal is not analyzed in this manner.

**BP-31:**

Given the uncertainties about the sensitivities of walrus calves and young seal pups to oil-spill contact and the known sensitivity of polar bears to a large spill that might contaminate large numbers (several thousand animals) of seals and walrus and possibly several hundred polar bears, an estimated HIGH effect is not unreasonable.



**Chevron U.S.A. Inc.**  
 P.O. Box 167839, Anchorage, AK 99516 • Phone (907) 563 2560

May 4, 1990

Comments - Draft Environmental  
 Impact Statement (DEIS)  
 Proposed Beaufort Sea  
 Lease Sale 124

Mr. Alan D. Powers  
 Regional Director  
 Minerals Management Service  
 Alaska Region  
 949 East 36th Avenue  
 Anchorage, AK 99508-4302

Dear Mr. Powers:

These comments are submitted in response to the Federal Register Notice (at Page 9513) dated March 14, 1990, regarding the DEIS for proposed Beaufort Sea Sale 124 tentatively scheduled for April 1991.

Chevron strongly urges the adoption by MMS of Alternative I - offering the entire unleased part of the planning area that has been identified for further study. We believe that only by offering the largest area available for leasing will industry have the widest selection of tracts possible to implement various exploration concepts and increase the possibility of discovery.

Proposed Sale 124 is the 5th in the series of sales in the Beaufort Sea dating back to 1979. The large number of existing lease blocks throughout the Beaufort Sea area and the fact that 21 exploratory wells have been drilled to date, demonstrate a high degree of industry interest in the sale area. Chevron has participated in the development of AOGA's oral testimony of April 20, 1990 and written comments which will be filed before the comment deadline. We fully endorse and support AOGA's comments.

With respect to the seasonal drilling restriction, we agree that it is unnecessary for the reasons clearly stated in AOGA's comments. Chevron is committed to consultation and cooperation with whalers and their communities and we believe that the process will reduce (mitigate) conflicts with subsistence activities.

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We appreciate the opportunity to comment on the subject DEIS.

Very truly yours,

*Thomas Cook*

Thomas Cook  
 Exploration Representative-Alaska

RECEIVED BY: *Paul Star*  
 DATE: 5/4/90 11:00 AM

CHE-1:

Your position has been noted.

**EXXON COMPANY, U.S.A.**

POST OFFICE BOX 4297 • HOUSTON, TEXAS 77210-4297

EXPLORATION DEPARTMENT  
 OFFSHORE/ALASKA DIVISION  
 JOHN A. WILLOTT  
 MANAGER

May 4, 1990

Draft EIS - Proposed Beaufort  
 Sea Lease Sale 124

Regional Director  
 Minerals Management Service  
 Alaska Region  
 949 E. 36th Avenue  
 Anchorage, Alaska 99506-4302

Gentlemen:

As a corporation active in exploration, production and transportation in Alaska, Exxon Company, U.S.A., a division of Exxon Corporation, is pleased to have the opportunity to comment on the captioned Draft Environmental Impact Statement (DEIS) for the proposed Beaufort Sea Sale 124 (April 1991).

Exxon as a member of the Alaska Oil and Gas Association generally supports the comments of AOGA, both in their testimony at the April 20, 1990 hearing and in their written comments. Exxon strongly recommends the adoption by MMS of Alternative I - offering the entire proposed sale area on schedule.

In addition to the above, Exxon recommends that Stipulation No. 8 - Seasonal Drilling Restriction not be applied in Sale 124. There is no evidence that exploration drilling activity has more than a negligible effect on the migration of the bowhead whales or that drilling activity would adversely effect the subsistence harvest of bowhead whales. Exxon believes that current practices of cooperation with subsistence whalers, Stipulation No. 5 - Industry Site-Specific Whale-Monitoring Program(s) and Stipulation No. 6 - Subsistence Whaling and Other Subsistence Activities provide assurances that drilling operations will be conducted with no more than a negligible impact on the subsistence hunt and allow the gathering of further data on whale movement. By reference, Exxon wishes to incorporate herein the comments made by the Petitioners concerning Notice of Proposed Rulemaking: Incidental Take of Marine Mammals, 54 Fed. Reg. 40703, (October 3, 1989) by letter to the Director, Office of Protected Resources and Habitat Programs, Dept. of Commerce, dated January 31, 1990, including all exhibits. As demonstrated by past experience, through cooperation, both industry and subsistence users can have successful seasons.

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We hope that you will find these comments constructive and that they may be useful to you in preparing the Final Environmental Impact Statement for Sale 124.

Very truly yours,

*John A. Willott*

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JAW:ET:bk  
 a:ET#1.55

REGIONAL DIRECTOR, ALASKA OCS  
 Minerals Management Service  
 ANCHORAGE, ALASKA

EXX-1:

Your position has been noted.

ADELAIDE • AMSTERDAM • ANCHORAGE • AUCKLAND • BOSTON • BRUSSELS • BUENOS AIRES • CHICAGO • COPENHAGEN • DUBLIN  
FORT LAUDERDALE • GOTHENBERG • HAMBURG • LEWES - U.K. • LONDON • LUXEMBOURG • MADRID • MONTREAL • OSLO • PALMA DE MALLORCA  
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WASHINGTON • WORLD PARK BASE - ANTARCTICA • ZURICH

# GREENPEACE

Greenpeace USA • 1436 U Street NW • Washington DC 20009 • Tel (202) 462-1177  
Tlx 89-2359 • Fax (202) 462-4507

May 10, 1990

Mr. Alan Powers  
Alaska Regional Director  
Minerals Management Service  
549 E. 36 Ave., Rm 110  
Anchorage, AK 99508

Re: Comments on the Draft Environmental Impact Statement for  
Lease Sale 124 in the Beaufort Sea.

Dear Mr. Powers:

Greenpeace has reviewed the Draft EIS for Lease Sale 124 and submits grave concerns regarding effective oil spill clean up capability. In view of the Exxon Valdez incident and two oil spill cleanup demonstrations conducted in the Beaufort and Chukchi Seas last summer, it is clear that neither oil spill contingency plans nor the available technologies are at all reliable in Alaskan waters. Moreover, routine industrial operations pose threats to marine species and coastal habitat.

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We share the environmental concerns expressed by Trustees for Alaska and the Northern Alaska Environmental Center in their comments on this document and concur that Lease Sale 124 should be deferred. In light of MMS restructuring for the proposed 5 Year Plan 1992-1997, we request that MMS adopt a conservative approach to the current 5 Year Plan by deferring this sale.

Thank you for your consideration of these comments.

Sincerely,  
*Dorothy Smith*  
Dorothy Smith  
OCS Campaign Coordinator

GRE-1:

This concern is addressed in Responses MMC-16, NSB-9, NSB-10, NSB-11, N-3, and N-4.

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MAY 10 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

\*\* TOTAL PAGE.002 \*\*



## Northern Alaska Environmental Center

218 DRIVEWAY  
FAIRBANKS, ALASKA 99701  
(907) 452 5021

Mr. Alan Powers  
Regional Director  
Minerals Management Service  
949 E. 36th Ave., Room 110  
Anchorage AK 99508

Dear Mr. Powers:

We offer our comments on the Draft EIS for Beaufort Lease Sale 124. The bulk of our comments relate to oil spills and the capability of present technology to adequately respond to them. The Exxon Valdez disaster taught Alaska the harsh lesson that industry is not equipped to handle a large spill; other examples before and after have shown similar inability to deal with even small to moderate ones. The EIS notes on page IV-A-16 that production and transportation technologies for Arctic offshore waters are not well developed. We fear that is an understatement, and that safe development of exploration and production facilities in the Beaufort is beyond the limits of present technology. In either case, the likelihood of significant spills in the Beaufort is amplified by the limits of technology and the severe conditions extant in the Beaufort. The report to the Presidents OCS Task Force, "The Adequacy of Environmental Information for Outer Continental Shelf Oil and Gas Decision: Florida and California", affirmed the widespread perception that MMS habitually fails to separate leasing and exploration from development and production; i.e, that once MMS has leased an area, production is a foregone conclusion if economic discoveries are made, without adequate new studies. Given this habit and the fact that technology is not equal to the situation, we feel that MMS should defer the Lease Sale 124 and initiate an aggressive campaign to dramatically improve exploration, production, and cleanup technologies in its stead. Of course we are aware that MMS will not leap to adopt this suggestion. At a minimum, we feel that MMS should adopt the Barter Island and Barrow deferrals, and add additional 50 mile buffers around other biologically special areas such as those listed in ITL No. 2. This is in keeping with DOI's newly announced policy of avoiding oil development in areas of environmental concern.

We find the discussion of the Exxon Valdez and its implications for the Lease Sale to be woefully inadequate. Why not call a spade a spade? The spill was a watershed event, both in terms of the widespread realization that present cleanup technology is not effective and the public's relationship to petroleum operations in marine environments. As such, it merits a thorough analysis in the EIS, not the cursory, simply inadequate presentation that it is given in Appendix C. Likewise, the discussion on the fate and behavior of spilled oil is far too simplistic. Shortly after the Exxon Valdez wreck, the "experts" explained to the public what the oil would do and how that would limit the ecological impacts of the oil. They were wrong time and

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MAY 14 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

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time again. The fate of oil in the environment is complex and uncertain, especially in a place with such varying conditions as the Beaufort Sea, and thus worthy of far more detailed explanation. For example, we are skeptical that oil would simply freeze to the bottom of winter ice and slowly be released. Additionally, how would such oil be recovered? Similarly, we are dubious of the extremely small probability that oil would hit land as presented on p. IV-A-8. The Exxon spill demonstrated that reality intrudes upon neat analyses of the kind presented on these pages. A cogent point stressed at the Barrow public meeting on this EIS is that the most likely time for a spill to occur is during the most difficult time to clean it up, most particularly when ice is moving. We urge MMS to acknowledge these facts and engage in a more detailed and intellectually honest appraisal of oil's fate in the environment.

Stipulation #7 on p. II-49 is another example of the need for a more meaningful and honest evaluation. Oil spill cleanup demonstrations in the past have suffered greatly from being unrealistic representations of what would happen in an actual situation. Two excellent examples are the drills held last year for Chukchi and Beaufort exploratory wells. In the former, the tests were held in the far more protected waters of Kotzebue Sound. As if to underscore the point, the day before the drill the waves were 16 feet at the drill site and 3 feet at the test site. In the latter, despite MMS' confident assertions to Alaska's conservation community that spills could be handled in icy conditions, an ice breaker led the test equipment five miles away from the drill site so the tests could be conducted in an area where there was no ice. Meaningful standards and testing methodologies should be developed to make sure that these tests are truthful appraisals of industry's ability to clean up Arctic oil spills.

The most forthright statement on the topic of oil spill cleanup is found on p. IV-A-13: "cleanup at sea is generally only marginally effective". A faithful interpretation of ITL #8, which should certainly be adopted, could shut down all operations in broken ice, because the lessee will not be able to actually demonstrate cleanup capability. This is a major crux of our point about leasing in a hazardous and ecologically fragile place like the Beaufort Sea. MMS should be overseeing exploration and development operations in the Beaufort in an environmentally sound fashion, so that it could shut down activities if functional cleanup capabilities cannot be proven in broken ice. However, given that technology is at or beyond its limits and the ineffectiveness of cleanup techniques, MMS cannot do so at this time. MMS should not be pushing forward at present, but instead reevaluating cleanup technologies and instituting a major program to improve them. The \$6 million program mentioned in Appendix C is a minor beginning. First, more funding is needed, and second, it will take denial of desired areas to convince the industry that concerted actions are needed to improve their oil spill response programs.

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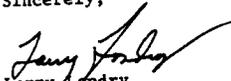
The discussion on mobilization time on p. IV-A-11&12 is another instance when the best laid plans could easily go awry due to logistical snafus or foul weather. For this reason, we feel it is imperative that each exploratory and production site have available, proven equipment on hand to ensure immediate spill response capabilities. The spill response barge used in the Chukchi is a good example, though more barges are necessary to ensure quick response time.

The Committee which prepared the above mentioned report to the President's OCS Task Force concluded that "available scientific and technical information bearing on potential environmental impacts is currently inadequate for development and production", and generally marginal or inadequate for leasing in three lease sale areas in Florida and California. This Committee was a blue ribbon panel composed of many highly qualified individuals; its conclusion is worthy of considerable credence by MMS. In its report, the Committee noted that there is significantly greater information available about the areas it examined than other offshore lease areas. The Beaufort is probably one of the least understood offshore areas in the nation. Therefore, the same conclusion must be reached. There is simply not enough research and information available for this Lease Sale to go forward at this time.

Lastly, we think it is essential that MMS adopt the stipulations listed as potential mitigating measures, incorporating the recommendations made by the State.

Thank you for considering these comments.

Sincerely,

  
Larry Landry  
Northern Alaska Environmental Center

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## Responses to Comments in the Letter from the Northern Alaska Environmental Center

### NAEC-1:

The development of production facilities and transportation systems for the arctic offshore areas has been delayed because of the relatively recent interest in exploring this area for petroleum resources and the lack of a significant number of discoveries of economically recoverable resources that could stimulate such progress. However, if future discoveries warrant, information obtained from (1) experiences associated with petroleum production and transportation in other areas and (2) studying the arctic marine environment could be used to design, fabricate, operate, and maintain production facilities and transportation systems in the Beaufort Sea Planning Area. Experiences acquired from (1) operating production facilities for the Prudhoe Bay and Kuparuk River Units and the Trans-Alaska and Kuparuk Pipelines and (2) exploration drilling from natural and manmade islands in the Beaufort Sea helped to develop the production facility and pipeline used for the Duck Island Unit (Endicott)—the first production facility in the Beaufort Sea.

To ensure oil is produced safely and pollution is prevented, lessees are required to comply with many regulations including those in 30 CFR 250. The regulations cover many aspects including exploration and development and production plans, pollution prevention and control (including oil-spill-contingency plans), drilling operations, well-completion and workover operations, production-safety systems, platforms and structures, pipelines and pipeline rights-of-way, and training of personnel.

For a summary of the requirements for production and transportation technologies, see NOAA-6, second paragraph.

### NAEC-2:

See Response NSB-1.

### NAEC-3:

Through the process of reviewing exploration, development and production, and oil-spill-contingency plans as required by regulations in 30 CFR 250, MMS considers measures can be taken to adequately protect known areas of biological sensitivity and that a 50-mile buffer around each is not necessary.

### NAEC-4:

The MMS considers that a thorough analysis of the effects of the Exxon Valdez oil spill could not be done at this time because many research efforts on the effects of the spill are still being conducted, and the results of these and other investigations are not available to the public. However, the potential effects of a very large oil spill, 160,000 bbl, are analyzed in Section IV.N of the EIS.

### NAEC-5A:

The MMS models used to make predictions about the Exxon Valdez spill appear to have been more successful than those reported to have been made by the "experts." For example, MMS has an oil-weathering model developed from studies of Alaskan crude oil under Alaskan marine conditions (Payne et al., 1984a, Kirstein and Redding, 1988). A model run that was conducted for Prudhoe Bay crude on March 27, 1989, estimated that less than 15 percent of the spill would evaporate through 10 days and only 18 percent through 30 days. The NOAA initially mistakenly estimated 30 to 40 percent evaporation through the first week of the spill. Whereas the media cited some "experts" as saying the spill would disperse and disappear once it reached the rough

waters of the Gulf of Alaska, the MMS-sponsored studies and model indicated that mousse would persist. The MMS model estimated that only 39 percent of the slick would have dispersed in the water column or evaporated through 30 days, leaving 61 percent on the water surface (or shoreline).

Once the slick reached the Gulf of Alaska and did not disappear, NOAA was unable to initially model whether and when the spill would contact Kodiak and other locations. At that time, MMS supplied trajectory maps for spills leaving Montague Strait to the Alaska Regional Response Team, based on the prespill OSRA conducted for proposed Sale 114. Locations of shoreline contact and speed of the spill were correctly predicted.

Some of the erroneous predictions made by the "experts" in the initial weeks of the Exxon Valdez spill may have been the result of application of generic models and information to the spill, and some of the other erroneous predictions had basis in public relations rather than scientific practice.

Recommended public-relations practice in spill events is to provide only facts, not speculation (Texas Engineering Extension Service, Oil and Hazardous Material Control Training Division, 1978). Thus, Exxon and USCG spokesmen in a public meeting in Valdez dismissed questions regarding bird deaths as unsupported speculation until a scientist walked in and interrupted the meeting with a bag of dead birds. Similarly, spokesmen were unwilling to admit that sea otters were likely to be killed by the spill until the otter body count started. The MMS, on the other hand, estimated in 1984 that a major spill in Prince William Sound or other concentration area could have a MAJOR effect on the regional sea otter population (Sale 88 FEIS, USDO, MMS, 1984).

### NAEC-5B:

The discussion of the fate and behavior of spilled oil in Section IV.A.2 is only the summary of a detailed discussion contained in Appendix M of the EIS. The evidence that oil would freeze to the bottom of winter ice and be slowly released is a combination of theoretical and laboratory studies such as those by Rosenneger (1975) and Cox and Schultz (1981), which have been confirmed by field tests with crude oil under winter first-year ice (NORCOR Engineering and Research, 1975; Buist, Pistruzak, and Dickins, 1981) and multiyear ice (Comfort and Purves, 1982). Conclusions of these studies are briefly summarized in Section IV.A.2 and are discussed further in Appendix M. The concern regarding recovery of under-ice oil is addressed in Responses MMC-16 and NSB-10.

### NAEC-5C:

The low probability of land contact evident in Table IV-A-2-1 is the product of the assumed location of the oil resource for the sale (relatively far offshore and in the western portion of the sale area in the FEIS), the high likelihood that spill trajectories would be toward the northwest (as evident in Figs. IV-A-2-3 and -4), and the 68-percent chance (base case) that at least one major spill would occur in the Beaufort Sea Planning Area.

For very large spills such as the Exxon Valdez spill, the interpretation of probabilities of contact becomes complex. This issue is addressed in Sections IV.A.2.b(3) and IV.N. Note that as discussed in Section IV.A.2.b(3) and in Response NAEC-5a, the Sale 114 OSRA of MMS was used to accurately predict the timing and location of land contact for the Exxon Valdez spill in the Gulf of Alaska.

**NAEC-5D:**

This concern is addressed in Responses MMC-16 and N-1.

**NAEC-6:**

This concern is addressed in Response AK-6.

**NAEC-7:**

This IIL is in effect on Sale 87 leases in the Beaufort Sea Planning Area. In the case of drilling to date on these leases, the RS/FO has made the determination that industry oil-spill-response capabilities are adequate in broken ice. The MMS does not anticipate that this IIL would shut down all operations in broken ice for Sale 124 leases.

The concern regarding reevaluating cleanup technology is addressed in Response N-4.

**NAEC-8:**

The MMS has no plans to increase the amount of onsite-response equipment for exploration wells. In addition, starting in 1992, the Chukchi spill-response barge will be considered an equipment warehouse—equivalent to the ABSORB warehouse in Deadhorse—supplying equipment and spill expertise for multiple, simultaneous drilling activities in the Chukchi Sea Planning Area and western Beaufort Sea Planning Area. The barge will no longer be considered part of the onsite-equipment package and will not be required to be onsite at each drilling site.

**NAEC-9:**

The MMS considers the information currently available to be adequate for a basic understanding of the potential environmental effects of Sale 124 in and adjacent to the sale area. In addition, MMS has successfully evaluated the potential environmental effects of four other lease sales in the Beaufort Sea Planning Area. The first sale was held in December 1979, but the task of analyzing the effects of the sale had to begin before the sale date. Since work began on the first sale, the amount of information available to analyze the effects of petroleum exploitation in the Beaufort Sea has been increasing.

The MMS environmental studies program has helped to increase this information base. As a measure of this contribution, MMS has expended over \$120 million on environmental studies in the Beaufort and Chukchi Seas during the period 1975 to March 1988. The studies conducted have investigated major disciplines including geology, oceanography, sea ice, pollutant transport, living resources, endangered species, ecosystems, oil-spill effects, noise effects, sociocultural systems, socioeconomics, and transportation; and a considerable effort has been made to integrate and synthesize available information. Also, monitoring programs have been developed to study specific effects on resources of concern.

Beaufort Sea Planning Area Oil and Gas Lease Sale 124--

Comments to Draft Environmental Impact Statement ("DEIS") re Impacts to Marine Mammals

Trustees for Alaska ("Trustees") is a non-profit, public interest environmental law firm dedicated to the wise management of Alaska's natural resources, consistent with the protection of Alaska's environment. Trustees appreciates this opportunity to comment on the draft Environmental Impact Statement ("DEIS") for the proposed Outer Continental Shelf ("OCS") Lease Sale 124 in the Beaufort Sea. Trustees opposes Lease Sale 124 due to the irreversible adverse impacts of oil and gas development on irreplaceable significant marine mammals, fish, coastal birds and other wildlife. This opposition is also based on Trustees' objection to "side effects" of the proposed oil exploration and development activities which will likely result in the degradation of delicate habitat and wilderness values.

Trustees also believes that the DEIS is wholly inadequate. Repeatedly, the DEIS attempts to apply a very simple analysis to an immeasurably complex problem. Wildlife in this area of the Beaufort Sea are extremely sensitive to oil and gas activities because their migration, breeding and feeding habitats are overlapped by the area included within Lease Sale 124. Large concentrations of many species gather in or migrate through traditional habitat areas that are subject to Lease Sale 124. In the DEIS' analysis of impacts to marine mammals, the DEIS

optimistically assumes that animals will habituate to proposed exploration and development activities. Trustees is very disturbed by the fact that the DEIS dedicates little, if any time pondering the validity of this assumption. If this assumption is wrong, the proposed activities could predictably result in a reduction in population, shift in distribution away from a traditional habitat, and deterioration of the health of a large number of the population. Operating alone, any one of the foregoing factors will have a devastating effect on the ability of a species to survive in the harsh and often cruel arctic habitat.

Trustees' opposition to Lease Sale 124 is reached after a thorough review of past industry practices, the relevant scientific literature and the DEIS. Based upon this review, Trustees is forced to conclude that the DEIS' conclusions were based on a desired outcome rather than available data. This was especially notable in the DEIS' analyses of the environmental impacts of the proposed activities on marine mammals. Although many other areas of the DEIS are warrant comment, Trustees has chosen to focus these comments on the DEIS' inadequate analyses of environmental impacts of Lease Sale 124's propose activities on marine mammals. Trustees reserves the right to comment on other aspects of Lease Sale 124 in the future.

#### I. INDUSTRIAL NOISE AND DISTURBANCES

##### A. General Comments

The impacts of industrial noise on marine mammals must be evaluated in light of many factors, two of which are of utmost

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importance in any evaluation of industrial noise on marine mammal residing in the Beaufort Sea. First, the transmission loss ("TL") or sound propagation characteristics of the medium through which the sound travels must be taken into consideration. Second, a thorough understanding of the noise source, or detailed "site-specific" information is necessary. The DEIS fails to address either of these crucial concepts.

1. Sound propagation characteristics - Beaufort Sea

The DEIS fails to even mention the highly efficient sound propagation characteristics of the Beaufort Sea. Specifically, it is well-documented that the Beaufort Sea has extremely efficient noise propagation characteristics and that these characteristic are very important factors which must be taken into account in any consideration of the effect of acoustical activities on marine mammals:

There is strong evidence that the presence of sub-sea permafrost and overconsolidated clay sediments contribute in an important way to unusually efficient sound transmission over the continental shelf of the Beaufort Sea. In fact, comparison of the [noise transmission loss] characteristics in the Beaufort with those measured in similar water depths in more temperate ocean areas demonstrates that the Beaufort [transmission loss] characteristics are unusually efficient.<sup>1</sup>

<sup>1</sup> P.R. Miles, C.I. Malme, Prediction of Drilling Site-Specific Interaction of Industrial Acoustic Stimuli and Endangered Whales in the Alaskan Beaufort Sea (1987) at ix.

Regretably, the DEIS fails to note the efficient noise propagation characteristics of the Beaufort Sea in its discussion of environmental impacts of exploratory and development activities on marine mammals.

2. Site specific characteristics

The DEIS fails to analyze the actual physical characteristics of exploratory and development sites. The need for site specific information revealing the actual conditions and methods by which the noise is emitted from a site cannot be overstressed. As has been noted:

Acoustic transmission loss [TL] in shallow continental shelf waters where oil industry activities occur is very site-specific. Hence, there is a need to measure the TL characteristics of each site . . . . Variations in ocean bottom and surface conditions at each site, e.g. bottom composition, ice cover, and wave conditions, cause site-specific differences . . . .<sup>2</sup>

Although the DEIS purports to evaluate "site-specific Noise and disturbance effects," without particular site specific information or assumptions, including sub-sea conditions, this label is inaccurate and the distances at which marine mammals are affected by industrial noise are impossible to determine. Assumptions regarding site conditions can be made in order to predict the TL characteristics for a typical exploratory or production site. Despite the fact that this information can be reasonably assumed for purposes of evaluating environmental impacts, the DEIS fails to do so. Without this crucial

<sup>2</sup> Id.

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information, the impact of industrial noise on marine mammals cannot be evaluated and any meaningful impact finding is precluded.

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B. The Effects of Industrial Noise on Specific Marine Mammals

The following discusses individual marine mammals by biological order, and if applicable, by family.

1. Cetaceans

In its 1989 Arctic Biological Opinion, the National Marine Fisheries Service ("NMFS") stated that oil and gas production activities in the spring lead system would likely jeopardize the population of bowhead whales. The DEIS fails to discuss this fact in its section discussing environmental impacts on bowhead whales due to industrial activities associated with the "Alternative I - high case." In light of NMFS' opinion, it is inconceivable that the DEIS can conclude that the effects on bowhead whales of activities associated with the "high case" would be low. Moreover, Stipulation number 8 merely restricts exploratory activities in migration areas, not production activities. NMFS' opinion letter indicates that any oil and gas production activities will jeopardize the population by forming an acoustical barrier to migration. The scientific basis for this is discussed in more detail below.

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a. Underwater noise

Even limited solely to exploratory activities, dramatic increases in vessel traffic will occur as a result of the proposed lease sale. This increase will result from supply boat traffic,

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icebreakers, and tugs. Moreover, most of the unleased blocks in proposed Sale 124 are in waters deeper than twenty meters, and as such require

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bottom-founded mobile-drilling units, such as the Concrete Island Drilling System ("CIDS") or the Single Steel Drilling Caisson ("SSDC"), and floating vessels, such as ice-strengthening drillships or the Conical Drilling Unit ("CDU"), [to] be used to drill the exploration wells. Presentday bottom-founded mobile units are designed to operate year-rounds in waters as deep as about 25 m. Movement of these units would require the assistance of 3 to 6 tugs. With icebreaker assistance [one or more]<sup>3</sup>, the floating units are capable of operating in limited sea-ice conditions."<sup>4</sup>

Despite the stated facts concerning increased industrial noise, the DEIS cavalierly ignores scientific evidence that records the adverse effects of these disturbances on marine mammals. The following highlight some of the more dramatic documented adverse effects to whales that the DEIS fails to consider.

Many of the noises produced by exploratory and production activities occur at low sound frequencies under 1000 Hertz. This is also the range of whale vocalization. The DEIS fails to analyze, or even mention, the potential for hearing or navigational impairment to whales from drilling or icebreaking activities. Specifically, there is no treatment of the potential impact on the

<sup>3</sup> "Exploration drilling units; depending on ice conditions, depending on ice conditions, the floating units would be supported by one or more vessels with icebreaking capabilities." DEIS at IV-B-6

<sup>4</sup> DEIS at II-3.

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ability of whales to assess ice conditions acoustically. Yet, there is evidence which indicates that Bowhead Whales determine areas of thin or thick ice by perceiving the relative level of their own call as it is reflected of the ice.<sup>5</sup>

One study<sup>6</sup> documented whale behavior during the 1985 spring migration during which whales avoided a dense floe of multi-year pack ice that obstructed the lead system. A huge portion of this floe had refrozen resulting in little to no open water or ambient light for the whales to follow during their migration. Nonetheless, the whales continued their migration by detecting ice thin enough for them to break out small breathing holes to continue the migration. The observers concluded that the whales detected areas of thin ice by "a combination of visual and acoustic cues . . . [W]e suspect that the whales detected the [dense ice] floe by perceiving the strength of their reflected calls off its deep walls and keels and swam around it."<sup>7</sup>

Despite the fact that the foregoing data are directly applicable to the proposed activities in Lease Sale 124, the DEIS failed to analyze the effects of industrial noises on whale

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<sup>5</sup> J. George, C. Clark, G. Carroll & W. Ellicon, Observations on the Ice-Braking and Ice Navigation Behavior of Migrating Bowhead Whales (Balaena Mysticetus) near Point Barrow, Alaska, Spring 1985, 42 Arctic 24 (March 1989); W. Ellicon, et al., Potential Use of Surface Reverberation by Bowhead Whales, Balaena Mysticetus, in Under-Ice Navigation: Preliminary Considerations, 37 Rep. Int. Whal. Comm. 329 (1987).

<sup>6</sup> George, supra note 5.

<sup>7</sup> Id. at 27.

navigation in any meaningful fashion.

Data indicate that bowhead whales exhibit strong avoidance reactions to vessel traffic from great distances and that whales begin to swim rapidly away as boats approach within one to four kilometers.<sup>8</sup> Despite these facts, the DEIS' oblique treatment of this issue appears in such statements as "the energetic cost to bowheads of travelling a few extra miles to avoid a noise source is very small in comparison with the energetic cost of migrating from the central Bering Sea to the eastern Beaufort Sea and back."<sup>9</sup> This attitude is representative of the DEIS' result-oriented "analysis" of the industrial noise on marine mammals.<sup>10</sup>

The foregoing discussion provides only a few examples of how the DEIS fails to realistically discuss effects of industrial noise on whale navigation. Another glaring example is the DEIS' failure to analyze whether a heavy ice year would aggravate the adverse

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<sup>8</sup> Behavior, Disturbance Responses and Distribution of Bowhead Whales (Balaena Mysticetus) In The Eastern Beaufort Sea, 1980-84: A Summary, prepared by W. John Richardson, C.R. Greene and B. Wursig for the U.S. Marine Minerals Management Service (August 1985).

<sup>9</sup> DEIS at IV-B-12.

<sup>10</sup> It goes without saying that this type of rationale is superficial in that migrating mammals will virtually be forced to swim through huge portions of the Chukcki and Beaufort Seas which will be "booby-trapped" with acoustical interferences from seismic activities, vessel traffic and other industrial activities. Predictably, although any one sound source may force the animal off the migration path by a "few extra miles," the overall effect of these disturbances will be tremendous and will further tax the migrating mammals. Moreover, this simplistic conclusion fails to mention the stress and additional energy cost to those animals who become separated from other members of a migrating group.

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effects to whale migration. Specifically, in a heavy ice year, drillships, icebreakers and attendant vessels may distort the sounds produced or received by whales. This distortion would necessarily impair the ability for whales to detect ice thin enough to be pierced for a breathing hole. Without this ability, large numbers of whales may become trapped in heavy ice, drown, or both.<sup>11</sup>

b. Increased air traffic

A huge increase in air traffic will occur in the Beaufort Sea in the event that proposed lease sale is allowed. In part, this increase will be due to fixed wing planes, but most of the increase will be due to helicopter traffic to and from the production platforms. The DEIS predicts the number of helicopter excursions to be anywhere from 360 to 1,600 roundtrips per platform per year. Despite these huge numbers of overflights, the DEIS states that, upon being overflown by helicopters, bowheads will "probably . . . dive quickly."<sup>12</sup> This bare analysis is wholly inadequate. It fails to discuss the effect of these overflights on whale activities occurring at the surface, such as mating and nursing. Yet, it seems only logical that the need to continually "dive quickly" in response to repeated overflights will impair these two

<sup>11</sup> This prediction has been borne out by history -- in 1988, three gray whales were trapped off Point Barrow. This incident revealed the government's and oil industry's inability to rescue only three whales trapped in heavy ice.

<sup>12</sup> DEIS at IV-B-9.

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critical functions.<sup>13</sup>

c. Seismic activities

In the Beaufort Sea OCS Lease Sale 124 area, 1,500 trackline miles will be surveyed. As the DEIS notes "[s]hallow-hazards seismic surveys for exploration-delineation-well sites would be conducted during the ice-free season."<sup>14</sup> Yet, there is no discussion in the DEIS of the potential damage to bowheads due to seismic studies, rather the DEIS simply states in its summary of the environmental effects of industrial activities that "[t]here is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely affect bowhead use of that area . . . , but there has been no documented evidence that noise from OCS operation would serve as a barrier to migration. As a result, the effect . . . is expected to be LOW."<sup>15</sup> This conclusion does not follow from the lack of evidence, since there is no documented evidence that noise from OCS operations would NOT serve as a barrier to migration. If anything, the evidence to date suggests that noise from OCS operations will serve as a barrier.

Observations of whale reactions to seismic activities indicate that whales exhibit "strong noise avoidance response, . . . unusual respiration, [and] surfacing and dive behaviors similar to those

<sup>13</sup> There is also no mention of the large sound transfer that occurs at the air-water interface.

<sup>14</sup> DEIS at IV-C-47.

<sup>15</sup> DEIS at IV-C-48.

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of disturbed bowheads."<sup>16</sup> These observations have been noted to occur at long distances from the seismic source -- these observations can reasonably be expected to apply with equal, if not more force, in the Beaufort Sea, due to its highly efficient sound propagation characteristics, as discussed above. Despite these data, the DEIS inappropriately concluded the effects of seismic activities on whale navigation would be low.

## 2. Pinnipeds and Ursus maritimus

Most pinnipeds congregate during breeding and pupping season at historical areas along the ice edge. These are areas of high animal concentration and as such, expose large numbers of a population to adverse effects of exploratory and developmental activities which may affect these areas. As noted in the DEIS, air-borne noise will cause hauled-out seals and walruses to panic. In turn, the panicked adult animals may trample or abandon walrus calves. In light of the decreasing walrus population, this impact cannot be taken lightly. Seismic operations present a huge threat to ringed seal and their pups during whelping. Ringed seal pups are born in late March through April in lairs excavated in snowdrifts and pressure ridges primarily in the landfast ice zone. Pups remain in the lair during the nursing period of six weeks. Seismic activity could result in displacement from preferred pupping habitat, or worse, pup abandonment.

The foregoing observations are equally applicable to the

<sup>16</sup> Ljunblad, et al., Behaviorial Responses of Bowhead Shales (Balaena mysticetus).

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Beaufort Sea polar bear population. Pregnant females and females with cubs are particularly vulnerable in nearshore areas of the eastern Alaska Beaufort Sea because they are likely to encounter industrial activities when entering or leaving fast ice or onshore denning areas. Moreover, like the ringed seal, female polar bears and their cubs are at risk from disturbances during the four to five month period they spend in dens. The Alaska Department of Fish and Game has recently noted that loss of even a small number of reproductive females can have a large impact on the population because of the population's stable status.<sup>17</sup>

## II. OIL SPILLS

Although a comprehensive summary of the effects of the probable effects of an oil spill is beyond the scope of these comments, there is one overriding omission that Trustees is compelled to comment upon. By definition, the DEIS makes certain assumptions concerning the environmental impact of an oil spill on various animals. As Table S-2 illustrates, implicit in the definitions used in the effects assessment is the assumption that reproductive capabilities of surviving animals will not be adversely affected by hydrocarbon contamination. Although there is little on the subject, Trustees believes this underlying assumption to be invalid.

If Lease Sale 124 goes forward, Trustees believes Stipulation number 7 should include a mandatory suspension of all exploratory

<sup>17</sup> "Stable" means that the number of animals entering the population is equal to the number of animals leaving.

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or drilling activities in the event that the lessee fails to adequately demonstrate response capability in any one of the listed environmental conditions (i.e., solid-ice, open-water, or broken ice). This suspension should remain in full force and effect until the lessee successfully completes a new spill drill under the particular condition.

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III. SUBSISTENCE

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As Trustees has made clear, Trustees opposes Lease Sale in its entirety. By way of these comments, however, if Lease Sale 124 proceeds, Trustees strongly urges the extension of Stipulation number 6 to all subsistence activities, not just the bowhead whale harvest.

IV. CONCLUSIONS

For the foregoing reasons, Trustees opposes Lease Sale 124.

## Responses to Comments in the Letter from the Trustees for Alaska

### TFA-1:

The MMS recognizes the complex nature of evaluating the potential effects of oil and gas exploitation on the environment but considers these effects are adequately analyzed in the EIS for Sale 124. This analysis includes the effects of oil spills, habitat alteration and destruction, and noise and disturbance on the wildlife that inhabit or migrate through the sale or adjacent areas. In addition, MMS has successfully evaluated the potential environmental effects of four other lease sales in the Beaufort Sea Planning Area.

### TFA-2:

The EIS does not assume that marine mammals will habituate to every disturbance source. The analysis recognizes that seals and walrus are not likely to habituate to disturbance from aircraft overflights. However, the EIS also has to recognize habituation where it has occurred, as in the case of belukha whales to boat traffic with the possible exception of icebreaker noise (see discussion under Sec. IV.B.5.a and IV.C.5.b[3]). There is no information in the scientific literature to suggest that a shift in belukha whale distribution or decrease in abundance is likely to occur as a result of boat traffic; even in the case of icebreaker noise in Canada, the effect lasted for only for a few days (see Sec. IV.B.5.a).

There is no "assumption" made that bowhead or gray whales habituate to the proposed exploration and development activities. The DEIS discusses several studies that suggest that bowhead whales habituate from ongoing distant activities. The discussion of noise and the expected effect levels are not derived by assuming a habituation to noise activities. Also, see Response BP-3.

### TFA-3:

The DEIS's conclusions in the marine-mammal sections are based on the available data rather than a desired outcome. For example, in Section IV.N.5 (Low-Probability, High-Effects, Very Large Oil-Spill Event), the conclusion for pinnipeds, polar bears, and belukha whales of a HIGH effect on pinnipeds and polar bears is surely not a desired MMS or industry outcome. The conclusion is based on known and potential sensitivity of these species to oil spills.

### TFA-4:

Sound transmission and sound propagation are factored into the analysis of effects of noise and disturbance on marine mammals (see Sec. IV.C.5.b[2]). The measurements reported by Greene (1981) and discussed in the analysis were made in the Beaufort Sea. Although subsea permafrost and overconsolidated clay make sound transmission unusually efficient, the consequence of this factor to the effects of noise on marine mammals is not apparent. Ambient noise (non-manmade sounds) also are efficiently transmitted and include the sounds of ice against ice, which is very loud and can mask the noise transmitted from drilling platforms. Just because marine mammals might hear noise transmitted from industrial activities does not mean that they are adversely affected by it. Studies of the reactions of marine mammals to industrial noises have indicated that effects are VERY LOW to LOW (see Secs. IV.C.5 & 6).

### TFA-5:

Although sound-transmission loss and sound propagation do vary depending on the location of the drill platform, the ambient-sound transmission varies with location and with the season (such as the sounds of ice movement). Site-specific-

transmission loss of sounds from the drill platforms is not relevant to the analysis; only the known responses of marine mammals to the sounds are relevant to determining the effects of noise on marine mammals. The distances to which marine mammals could hear the sounds determined by the sound propagation (related to transmission loss) will vary greatly, depending not only on specific location of the sound source but also on the level of ambient noise in the background (during ice movement in the spring, ambient noise is very loud).

### TFA-6:

The effect levels for the high case as well as the base, the alternatives, and the cumulative have been amended. The NMFS biological opinions for this sale do not cover exploration activities in the spring-lead system and, as pointed out by the commenter, have concerns for potential jeopardy for the bowhead whale due to development and production activities within the spring-lead system. Therefore, before any activity is conducted in the spring-lead system, consultation with NMFS would be required. A mitigating measure (ITL No. 7) is provided to inform lessees of this requirement. Also, see Responses AK-1, AK-2, and N-13.

### TFA-7:

See Responses N-9, N-11, and N-14.

### TFA-8:

See Response N-11.

### TFA-9:

There is no scientific information to suggest that seismic activities or the underwater sounds of such activities would "booby-trap" or result in the creation of a zone of acoustic interference that would block or divert the migration of individual whales or the population. Scientific studies of the reaction of whales to seismic operations indicated brief displacement of some whales near the operations but no widespread displacement of the whales. It would take perhaps several hundred seismic vessels operating in the Beaufort and Chukchi Seas at the same time to create a potential zone of acoustical interference as contended. The oil companies typically employ one or two seismic vessels per year in the Beaufort Sea. Such a level of operations is very unlikely to cause areawide interference with the whales' ability to communicate or navigate.

Also, see Responses N-13 and N-14.

### TFA-10:

The primary discussion of noise and disturbance on bowhead whales is found in the low case (Sec. IV.B.b). Also, note that the Beaufort Sea Sale 97 FEIS is summarized and incorporated by reference for Sale 124 and contains an extensive discussion and analysis of noise and disturbance effects (including aircraft disturbance), on bowhead whales (see Response N-9). The concern that "mating and nursing" bowheads would be continually diving due to aircraft disturbance is very unlikely. Helicopter support is estimated at one trip per drilling rig per day, which would not result in a continual disturbance of an individual or group of bowhead whales, especially considering the mobility of the whales in relation to flight patterns to and from the rigs. A mitigating measure (ITL No. 1), if adopted, would mitigate disturbance by aircraft overflights.

**TFA-11:**

See Response N-14 concerning seismic activity. The expected conclusion of LOW is based on the available information to date. Mitigating measures such as Stipulation No. 5 and IIL's Nos. 1 and 6, if adopted, would provide protection for bowheads from noise and disturbance. In addition, the NMFS concerns for increased density of industrial noise could be controlled through the site-specific review of individual exploration plans by MMS and other agencies, including NMFS.

Shallow-hazards seismic surveys for exploration-well sites would be conducted during the ice-free season, thus negating the possibility of delaying the whale migration and trapping whales in ice leads. In those cases where bowhead disturbance by nearby seismic surveys has been observed, the whales' surface-respiration-dive characteristics appeared to recover 30 to 60 minutes following the cessation of the seismic disturbance.

**TFA-12:**

See Response N-14 concerning seismic activity.

**TFA-13:**

Arctic pinnipeds do not congregate in large groups during the breeding and pupping season, with the exception of walrus. The geographic locations of walrus congregations vary greatly in time and in space as the ice front moves north and south in the Chukchi Sea. Arctic ringed seal pupping occurs widely throughout the fast-ice zone along the Beaufort Sea coast. Only small segments of the walrus and seal populations are likely to interact with and be affected by industrial activities. The walrus population is not reported to be on the decline.

**TFA-14:**

Seismic operations do not represent a huge threat to ringed seals during the pupping season. Studies indicate that seismic operations might cause some very local displacement of ringed seals within 150 m of the seismic lines. See the discussion under Section IV.C.5.c.

**TFA-15:**

The EIS discusses the potential disturbance of denning polar bears, see Section IV.I.5.c. The disturbance of denning female bears is not likely to result in the loss of the adult bears but might result in the loss of the cubs if disturbance occurred early in the denning period when the cubs were very young.

**TFA-16:**

There is no scientific evidence to suggest that sublethal exposure of seals, walrus, polar bears, or belukha whales to oil contamination would result in a reduction in reproductive capacity of the populations. Both seals and whales are capable of excreting and metabolizing sublethal amounts of oil with no apparent effects on their reproduction (see Sec. IV.C.5.a(2)).

**TFA-17:**

This concern is addressed in Responses NAEC-7 and AK-6.

**TFA-18:**

Your position has been noted. See also Response AK-5.

United States Department of Interior  
 Minerals Management Service  
 Alaska OCS Region  
 949 East 36th Avenue, Room 110  
 Anchorage, AK 99508-4302  
 att'n: Response Officer  
 DEIS AOCS  
 Beaufort Sea Planning Area  
 Oil and Gas Lease Sale 124



Comments on DEIS 124 (OCS EIS/EA MMS 90-0006)  
 of John Luther Mohr  
 3819 Chanson Drive  
 Los Angeles, CA 90043-1601  
 [background appended]

*John L. Mohr*  
*16 May 1990*

**POSITION : ALTERNATIVE II NO SALE** should be elected.

Among the reasons for this are:

a) information is lacking, insufficient or dubious in many critical areas; b) from what is known, it is clear that very serious harm could be caused by expansion of operation areas now. The data deficiencies are much too large to be filled within two years, thus Alternative III is not appropriate.

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Consideration of environmental impact begins properly with the nation's commitment and responsibility to posterity in National Environmental Policy Act with the clear imperative to protect the environmental interests of future generations. That commitment must have precedence over profits now as well as over convenience now. One aspect of this is that stimulation of continued expansion and/or appetite of North Slope Borough in the near future will with the sharp fall-off of oil and gas a little later be followed by economic collapse countered by no alternative economic support of comparable size.

Here, as in at least many issues raised, lack of appropriate concern by legislators (and lack of appropriate action) is a root problem as are cop-outs of higher-level members of the executive and to some extent of the judiciary, but there remain despite much evidence of hard and good work many deficiencies that rest with the Preparers (and Revisers) of the Draft Environmental Impact Statement of Proposed Sale 124 (DEIS 124).

It is desirable that there be awareness of ethical context. Particularly on the legal side some awareness is provided by Stone, Christopher D.

1974 *Should Trees Have Standing?* Los Altos: William Kaufmann revised edition, 1973 New York: Avon Books.

1987 *Earth and Other Ethics: The Case for Moral Pluralism.* New York: Harper & Row.

The latter has references to problems of the North Slope Borough including Beaufort Sea whaling issues.

Concerning oil spills it is useful to begin with Moel Grove's 20th anniversary luncheon address at the 1989 Biennial Oil Spill Conference at San Antonio, Texas. Grove noted that

1) in listening to papers at this conference he had learned of no responses that he had not heard about at the spill conference a decade earlier; 2) in the (at that time) very recent spill beside the Antarctic Peninsula, responsible entities did not field a clean-up team for more than a week. He pointed out that in another sort of response the U. S. can field a military force half way around the globe within a day. Mr. Grove's address is not included in the printed Proceedings of the conference which were distributed at registration. [Likewise post-paper discussion are not provided, contrary to the situation with the Lake Buena Vista Drilling Discharges Symposium of January 1980 - referred to in references of DEIS 124 as *Proceedings of a Symposium on Research on Environmental Fates and Effects of Drilling Fluids and Cuttings. Washington, DC; Courtesy Associates.* Because it is in the discussions that particularly vital facts tend to come out, proceedings without them - that on the 1988 Calgary drilling discharges conference is another - such coverages without the discussions tend to be disinformation publications.] Grove's cautioning needs to be kept in mind.

It is useful also, from the start, to consider impact problems in light of industry confidence as expressed by Albert Spaulding, then manager of Western Oil & Gas Association, at a House of Representatives subcommittee hearing at Santa Monica College, 12 Oct. 1984, chaired by Representative Mel Levine; Spaulding could imagine no situation of offshore oil so difficult that "industry ingenuity" could not handle it. [I will provide some responses, probably in a separate mailing.] Spaulding's position, it should be noted, raises a broad problem of revolving door with steward agency employees. He was earlier a Los Angeles city employee presumably a "watchdog" in petroleum matters and has been referred to in the hotly contested case of the Occidental Petroleum Pacific Palisades Petroleum Project.

With the widespread and greatly needed reassessment of assurances that everything can be adequately controlled by industry and some agencies that follows Exxon Valdez' grounding and spill, it is necessary to examine closely what can be learned from less spectacular events at lower latitudes presumed to involve less difficult circumstances and particularly much more relatively-adequate and close-by clean-up provisions than existed for Prince William Sound and for the Beaufort Sea. [Preparers should keep in mind in this connection that within about a week of the Exxon Valdez spill Exxon had another spill in the Mississippi River and a spill in Hawaiian waters.]

Just on the Pacific Coast there have been a number of spills more recent than the collision of two Standard of California tankers going in opposite directions (therefore at least one in a wrong lane) almost under the Golden Gate bridge. It is convenient to consider the spills from south to north rather than by date.

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American Trader which stabbed itself with its anchor, off Huntington Beach, California, near the platform at which an Exxon group performed the drilling discharge model field test considered below.

PacBaroness sunk in a collision off Santa Barbara (Santa Barbara Channel, not far from site of the 1969 Santa Barbara Channel oil spill.)

Puerto Rican one half sunk at the Farallon Islands Marine Sanctuary after an explosion; not far from the Golden Gate where the Standard of California tankers collided.

Nestucca off Gray's Harbor, Washington.

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For appreciating the implication of these a number of sources not included in your references would be useful to Preparers/Revisers of DEIS 124. For tanker Puerto-Rican the Romberg Center special volume, the records of the California Coastal Commission, and accounts of Clean Seas assembled by Mr. William H. Mason, 1861 9th Street #A, Los Osos, CA 93402 in relation to William H. Mason, plaintiff vs. Offshore Tanker Marine, et al., Superior Court State of California, County of San Luis Obispo and L. Avery Cook, plaintiff vs. Helmerich & Payne International Drilling Co., U. S. District Court, Central District of California and reports of Clean Seas, Inc., 1180 Eugenia Place, Suite 204, Carpinteria, CA 93013 provide depth and perspective. For PacBaroness the report, CLEAN SEAS' RESPONSE TO THE "PACBARONESS" OIL SPILL, JANUARY 1988, combined with the account of Mr. Mason, who was first mate on Mr. Clean II, provides understanding of the practicalities of such efforts.

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Planning of spill responses requires knowledge of local water movements. For Californian waters CalCOFI (California Cooperative Oceanic Fisheries Investigation) with more than 40 years of measurements and MMS contractors integrating same provided impressively extensive water mass data. Oregon and Washington university oceanographers have accumulated water movement measurements far more than are likely to be made for Beaufort Sea any time soon. However, in all of these spills although response headquarters were relatively nearby and there was this abundance of water-movement data, clean-up teams were quite unable to predict correctly what they must do on the many messy tomorrows. Part of the difficulty is that most of the data is mesoscale, distance units not less than about 30 miles; part is the continuing fact that each day's weather shapes the microscale events - the events with which clean-ups deal.

With this go the pitifully small scoops-up or pumpups actually achieved by operators as opposed to what is advertised. Mr. Mason has followed this in central Californian waters (Santa Barbara to San Francisco). His calculations have to be followed

to be fully comprehended. For the American Trader-Huntington Beach spill twenty clean-up boats were reported to have participated, yet considerable amounts tarred the beaches and a rocky shore area and some oil reached protected wetlands.

It would be useful for DEIS Preparer/Revisers to sample one available form of public reaction to spill events as represented in a Phil Donahue program. For this Donahue Transcript #2890, National Feed Date: February 26, 1990 is available.

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There are at least two other aspects of importance for DEIS 124 considerations in the William H. Mason case. One is Mr. Mason's noting that use of alcohol and drugs was a real problem with a clean-up crew and contributor to clean-up failures. This needs to be examined in connection with the ONR:ESN report of alcoholism among platform workers of the United Kingdom sector of the North Sea and closer to Beaufort Sea, with the alcohol problem of the skipper of the Exxon Valdez and in the North Slope Borough. For me it recalls jarringly the murder on Ice Island T3 of the station leader following argument, not involving the victim, over illegal home brew sharing. Alcohol may be a disaster factor in any of the Arctic operations unless there are much more extensive and continuous provisions (perhaps protocols is the correct word) than I have noted in DEIS 124. Dr. Elliott Norse, formerly of EPA and of Council on Environmental Quality, while at EPA interviewing Gulf of Mexico platform workers during on-shore breaks, found drinking obvious and frequent. All this is to say alcoholism is almost certainly a pervasive problem with the offshore oil industry; to date it has been too much glossed over.

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Pervasiveness of drug use is less clear, but it may be important and it should be looked for. There is Mr. Mason's pointing to it as a problem with Clean Seas operations. This reminded that when Dr. Max Britton and I moved in to a laboratory at Arctic Research Laboratory in summer of 1952 there was a considerable stock of narcotics on a lower shelf. Dr. Wiggins, the director, promptly removed all. On the Antarctic Research ship, Eltanin, again there were rumors that the ship's doctor was a "user". This may be totally "anecdotal", but the danger potential is genuine and high, so there needs to be frank appraisal of possibilities and provisions for continuous alertness.

The second matter is that September 22, 1987, while responding to the PACBARONESS spill, Mr. Mason was doused with dispersant sprayed from a DC4 Air Response, Inc. dispersant aircraft. The dispersant was Exxon Corexit 9527 which Mr. Mason learned belatedly contained 2-butoxy ethanol as covered in Exxon Chemical Material Safety Data Sheet 79527000, Exxon Chemical Americas, P.O. Box 3272, Houston, TX 77001, and from painful symptoms (he has still not

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returned to work.) and *HESIS Fact Sheet #8*, Department of Health Services, CAL/OSHA 2151 Berkeley Way, Berkeley, CA 94704, that it is poisonous.

A related matter, proprietary secrecy, is raised in Section II of the Exxon sheet on Corexit 9527 - in small type:

"the precise composition of this mixture is proprietary information. A more complete disclosure will be provided to a physician or nurse in the event of a medical emergency. The following components are defined hazardous in accordance with 29 CFR 1910.1200:

OSHA HAZARD	COMPONENT
Combustible	2-Butoxy ethanol
Eye & Skin Irritant	2-Butoxy ethanol
PEL/TLV	2-Butoxy ethanol"

It should be noted by Preparers that there are components of Corexit 9527 that are not revealed and that 1) they may still be designated hazardous by OSHA, that OSHA since the start of the Reagan presidency has been a pushover, and that we really should have at least as much and preferably more information for all dispersants that may be used in the area. DEIS 124 does not cover the matter at all adequately. For the human environment it is not enough that Exxon Chemical Americas will tell a doctor or nurse what might be done after a human being or human beings are in "a medical emergency". Knowledge of effects of any dispersants on marine organisms is scandalously inadequate. DEIR 124 is part of the problem.

Proprietary secrecy complicates other matters of concern about DEIS 124. EPA has not required adequate revelation on bacteriocides used to limit bacterial corrosion during drilling. These are often included in drilling slurries. *NAS/NRC Assessment Panel 1983 Drilling Discharges in the Marine Environment* has done a particularly bad job on the bacteriocides, providing not even general notions of what they might do in environments and in no way piercing the proprietary hood.

Thomas Royer *Alaskan Oil Spill Letters*, *SCIENCE*, 29 June 1989, p. 243 properly warns that some in government and industry are trying to have information on the Exxon Valdez spill made proprietary. If essential information in any of these matters is to be withheld, under NEPA and Clean Water Act further developments should be stopped. All of the federal agencies involved in these matters, it appears to me, have been lacking in diligence and resolve (= have been patsies).

A further problem with the Corexit 9527, any similarly patented dispersants, proprietary bacteriocides and some other materials that are put into the sea is that authorities make no check on variation in composition from batch to batch or the possibility of reformulation. This certainly negates proper environmental control.

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In view of the sickness of Mr. Mason after exposure to Corexit 9527 and to the accounts of OSHA effects (poisonousness in ordinary parlance) in Exxon Chemical Company and *HESIS* papers, it is upsetting to find that Exxon's advertisement for Corexit 9527 on the cover of a handout of advertizers in San Antonio during the 1989 Oil Spill Conference is not coverage, not a mention of hazards.

Similarly in the developing drafts of the *ASTM Dispersants Use Guidelines* and in the four sections (including Arctic) that I purchased of the published version, there is no caution about poisonousness or other hazard.

The steward agencies appear to provide no check on suppliers or users of these materials.

DEIS does not provide adequate answers on how any dispersant as now constituted affects environmental components of the Beaufort Sea area: What would each one considered for use in the area do to the environmental webs of the sea at a number of representative plots, under what seasonal and weather conditions at what concentrations? What hazards such as combustibility and attacks on tissues do they -all of them- under current or expanded operations -pose for people? You do not tell us.

Occasional references and the fact that the California Department of Fish & Game authorizes use of a relatively small number of dispersants, all of which it has tested in its own laboratories, suggest that the Department has substantially better knowledge at least of some of them than is available in the open literature. MMS would do well to obtain this for the FEIS and it would do a notable service in urging publication. It is doubtlessly significant that California Department of Fish & Game officers with science background and assigned to marine and Sacramento Delta waters have consistently opposed use of dispersants although they have been overruled from time to time.

Mathematical models, along with numerical predictions of spills to come, have been cherished by MMS and EPA. We have seen that they did not make responses adequately effective in the Exxon Valdez, or even in the lesser American Trader, PacBaroness, Puerto Rican and Nestucca spills. Drilling discharge models are treated by agencies as if they were reliable. In fact they have never been field-tested scientifically. I pointed out the weakness of the summer 1978 field test, actually its total unrepeatability, of the Offshore Operators Committee (OOC) Model in the Chukchi Sea DEIS comments [included in FEIS]. J. E. O'Reilly and others pretend that they have verified the model in a study off Huntington Beach, California (p. 647-665 in Engelhardt, F. R., Ray, J. P. and Gillam, A. H. *Drilling Wastes* London & New York, Elsevier). The reality is that the presenter, at the 1988 Calgary drilling wastes conference, conceded orally that the equipment could work

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only when the surrounding water mass was moving in one particular direction and the tests had to wait several days until the ocean obliged. This is not mentioned in the paper as published, another critical example of Proceedings that do not honestly reflect the process. In this one the publication came a year after the meetings, so, unlike those distributed at the actual meetings, had the editors chosen, it could have been accurately published. The test runs used mud that was not analyzed physically or chemically, they were made at four depths but only one site (bottom depth 18 meters), with one size of discharge pipe, one receiving current rate, and one particular bottom slope. Obviously such a test does not cover all discharges even just in one direction from that one platform. Industry representatives generalize to all discharges at all platforms or rigs at all seasons at all levels and conditions of Coriolis' force, and so on.

At times I have had the impression that participants in this work (the earlier field studies were reported at the Lake Buena Vista Symposium in January, 1980) are so incompetent as to be unaware how bad the studies were (and are). E. W. Behrens in *Middleditch, Brian S., 1981 Environmental Effects of Offshore Oil Production: The Buccaneer Gas and Oil Field Study. Marine Science 14, p. 130*, states accurately

".....the contaminated material does not diminish with distance from the source but bypasses a considerable distance before it is deposited in the sediment. However, in detail, the distribution of the possibly contaminated mode is quite irregular and does not correspond to any obvious two- or three-dimensional model of distribution from a production platform source."

Two measurements of discharge movements that seem to be forgotten: 1) Dames and Moore, 1978, Lower Cook Inlet - a rhodamine WT "tag" followed 13 km from discharge pipe beyond which it still could be seen; 2) J. H. Thompson, Jr. [1980 *Responses of Selected Scleractinian Corals to Drilling Fluids Used in the Marine Environment. Ph. D. Dissertation, Texas A. & M. University, also covered in University Microfilms Dissertation Abstracts*] detected physiologically stimulating material for sensitive corals in a discharge plume 12 km from the source. These very likely (for reasons I shall not pursue) do not indicate limits; the matter has not been studied by anyone else at these or at greater distances from discharge points.

Along with many other chunks of evidence the Dames and Moore and the Thompson distance determinations point to the low credibility of the large component of the DEIS 124 references produced by or for oil companies or associations. For example, there are several references of which J. M. Neff is an author.

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He was a member of Thompson's dissertation guidance committee and his signature is just a few pages from the statement in the Abstract about physiological effect 12 km from origin of plume. In the dozens of Neff papers I have worked over (during one three year period he had new titles at the rate of one every calendar, not work-, days) I find no evidence that he remembered that plume influence could go so far. (By then he was doing consultant work for the industry.) As to the Dames and Moore study's finding rhodamine WT tag 13 km from the Lower Cook Inlet drilling rig (the late, lamented *Ocean Ranger*) that disappears in the two years to the version of the study that was presented in 1980 at the Lake Buena Vista Symposium and from the similar one forming part of the 1981 Dames and Moore report on work at Lower Cook Inlet and at Georges Bank. The industry position, which steward agencies have generally accepted, is that discharge influence is much less far-reaching. The evidence be damned.

IN CALIFORNIA THE PROPOSAL HAS BEEN MADE THAT IN INFORMATION-GATHERING WHERE OIL COMPANIES ARE REQUIRED TO FUND THE WORK, THE STEWARD AGENCIES, OR BETTER, A FARTHER REMOVED BODY REPRESENTING THE PUBLIC INTEREST, SHOULD CHOOSE THE INVESTIGATORS AND OTHERWISE OVERSEE THE PROCESS. Until some such separation is provided, it is correct and necessary to anticipate accommodative technology rather than science in these studies. Absence of such conflict of interest immunization detracts from the reliability of the DEIS.

There is some reference to bacterial degradation of spilled oil as effective response. This heightened as strains were isolated degrading more quickly. Prof. Jacques Berger, who has worked on microbes and degradation (*pers. comm.*) explained the meaning of all this to me. At our latitudes the ordinary microbes break down the oil in something like a half year. The "quick bugs" do it a couple of weeks faster. They may be expected to act more slowly at Beaufort Sea temperatures. Of course the inner parts of thick flows and strandings and masses covered over by sand will be protected to various degrees from bacterial action.

For spill oils, drilling discharges and formation "waters" alike there are rather few analyses of contents and physical characteristics for any offshore oil area. So far as published accounts go, there appear to be none or nearly none for Beaufort Sea fields. This means that the why's of any environmental studies' results remain obscure, that most conclusions (if one follows scientific rules) must be provisional, and that many are very likely to be wrong.

It is true that in the management of procedures in offshore oil agencies other than MMS make many of the crucial decisions under existing rules and MMS may not be able even to influence them; however Preparers/Revisers of DEIS 124 have a clear duty to make plain the limitations, contradictions and the like of work referred to; they have been, as I read it, not as critical as they should be of performance of other agencies. This may seem court-

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eous and very likely is normal biobiosis, but it is not quite harmonious with NEPA and other documents.

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I have not the resources to give extensive coverage but point out that DEIS 124 assumes that drilling slurries of only low toxicity/poisonousness are used in the Beaufort Sea fields. This probably means that the drillers say, among other things, that they do not use diesel oil drilling fluids (only generic fluids that are water-based). Against this cries the strong (= loud) arguments API representatives have made at EPA workshops (at Denver and at Santa Barbara in my presence) for being permitted to use diesel oil "pills" to treat various drill-chain abrasions suggest that whenever drilling is not continuously monitored, diesel oil will be used more than just as fuel in engines.

MOHR 12

The DEIS 124 mention of barite as not significantly poisonous ignores important facts: 1) of the two general sorts of barite, vein-mined ores run high in metals and are conceded to have two or more trouble-makers such as arsenic and mercury, the kinds varying with origin while bed barites, such as Nevada barite, having been laid down from seas, have barium halides. Barium halides, as the *Registry of Toxic Effects of Chemical Substances* (RTECS) indicates, release barium ions, that is, are exceedingly poisonous; 2) Although industry people and sometimes agency officials talk as though barites were barium sulfate of pharmaceutical grade, no more threatening than a barium meal or a barium enema for x-ray purposes, the fact is that barites are ores with components other than barium sulfate and they are often totally unanalyzed except by API standards relating to their performance in drilling slurries. As I have noted before, studies published in respectable journals have noted increased solubility in sea water when there is pressure from depth and where there is organic decay. The objection to easy generalizations about drilling barites raised by a Shell chemist at the Lake Buena Vista Symposium is germane: "A barite is not a barite is not a barite." They are, according to the experts, immensely variable. To assume that barites are harmless, especially in sea water, is on the part of a Preparer a failure to act responsibly.

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Use of bacteriocides to control corrosion bacteria also needs more informed and responsible control. Preparers of DEIS 124 appear to have done no better than the Assessment Panel that produced the *NAS/NRC 1983 Drilling Discharges in the Marine Environment*. The panel was heavy with oil company employees and people who did or might hope for work for oil companies or associations. Nearly all of it accords with industry releases. Very little is said about the bacteriocides used in drilling slurries, there is no account of how often, how long or at what concentrations they are used. Kinds, among them acrolein, mentioned in *Middleditch 1981 Buccaneer Field Study, Marine Science 14* and in releases of EPA: Region 9

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are ignored. *Drilling Discharges* states that bacteriocides include carbonates (which appears preposterous), but there is indication elsewhere that carbamates are used. It is interesting that although I called attention of this and other mistakes in *Drilling Discharges* (especially citation of levels of poisonous metals lower than they appear in the studies from which they were supposedly taken; cf. table on p. 106) to Dr. Jenkins, a member of the Assessment Panel, a copy I purchased two years later still had no correction sheet.

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In any case, bacteriocides are killers and Preparers should make clear that here as elsewhere the limited available data do not support generalizations of low drilling slurry poisonousness.

Uncertainties about "produced water", the solutions and mixtures of stuffs from the drilled strata to be discarded, are even greater. The *Middleditch Buccaneer Field Study* is the only substantial study I have found. About this one, it is somewhat disquieting that Middleditch has also done work for the American Petroleum Institute which appears to pose something of a conflict of interest problem. Many, perhaps most, of the *Buccaneer* papers give an impression of being a first try at their problem; pioneering, in a sense, and accordingly lacking in refinement and experience. There is substantially less replication than desirable, but what is there gives thought for serious problems: very poisonous biocides have been used for corrosion control, particulate sulfur is calculated to be discharged in tonnes per year, more than 60 kinds of cyclical hydrocarbons were identified, *Jassa falcata* "suffe<sup>d</sup> 100% mortality when placed in a 10% produced water/sea water mixture for 48 hr" and so on. Some of the work, for example that of Rose and Ward (see especially p. 312) on effects of "produced water", puts in a single confusing table at least four different sorts of experiments (aerated and non-aerated, 2- and 4-day exposures, different species groups and exposures at different seasons). The hodge-podge strikes me as not just inadequate, but bad; the authors reach generally comforting conclusions that are not justified by the evidence. However, *Buccaneer Field Studies* does make a start (a number of the studies are respectable), but there are not follow-ups for other areas, specifically not for the Beaufort Sea. A serious gap in *Buccaneer Field Study* is the lack of information on the effects of particulate sulfur on the sea bottom (one paper does deal with sulfur bacteria in the water column); as in all such programs there is far too little on the plant communities.

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The Preparers may be inclined to dismiss "produced water" effects as without importance for DEIS 124 as they have indicated that these are generally reinjected. Unless there is rigorous and continuous (that is both at one time) monitoring of operations, the industry history indicates that discharges will be made if that is more "convenient". At least in Region 9, EPA's rules permit exceptions for many difficulties. These, with loose monitoring,

\* is grotesque

mean that there is little assurance of good behavior. Under Beaufort Sea conditions of ice barriers, discharges are less likely to disperse and dilute, so local effects must be more intense than they would be off Galveston. There is urge t need for re-casting the DEIS section on discharges during the development and production phases.

The matter of particular sulfur with probable alteration of sea bottoms to a domination of communities by the various sulfur microbes and the relatively few multicellular organisms that thrive in their presence (a condition likely to be present wherever formation "waters" from sour crudes are released), points to the dearth of information on marine microorganism of the sea bottom. The pioneering study of Johanna M. Resig 1960 *Foraminiferal Ecology Around Ocean Outfalls Off Southern California*, pp. 104-121 in Pearson, E. A. (ed.) *Proceedings of the First International Conference on Waste Disposal in the Marine Environment, University of California, Berkeley, July 22-25, 1959*. New York: Pergamon Press, which unfortunately has not been followed by enough kindred studies, demonstrated that altered distributions of foraminiferans give excellent indications of sewage pollution patterns. Obviously they would, if properly studied, be similarly useful as markers of alterations from offshore oil activities. Also, because skeletons persist, in at least some situations, changes in deposition would tell something of changes in pollution distribution over time.

However, there is not only no accumulation of knowledge of forams as influenced by Beaufort Sea offshore oil activities, but there is no examination of the microscopical biotic component. Certainly microbes are important: the change of a basic population for example to predominately a slime form like *Beggiatoa* after settling of a lot of sulfur as described by Middleditch for the Buccaneer area or whatever happens when every bottom sample contains benzo-alpha-pyrene, as a Middleditch doctoral student, Branda Pitts Basile found. Arsenic, barium, copper, mercury and so on from drilling slurry discharges must change the ranks of the very small. Lack of knowledge of the microbes is important and possibly crippling deficiency of DEIS 124 and other O.C.S. documents. There is an obligation to make plain the lack of such information.

DEIS 124 Preparers/Revisers need to take into account the findings of researchers at University of California, Santa Barbara Institute of Marine Science that there are rather greater differences in sensitivities than agencies have recognized and that the patterns make generalizations extremely difficult and doubtful. Different stages may be orders of magnitude different in vulnerability; in a *Haliotus*, swimmers are very sensitive, as expected, but settlers are still more sensitive. Among crustaceans studied (ones of commercial interest) ammonia (neglected in oil field studies) is numbing at very low levels for some forms; not so for others. The MSI work emphasizes the fact that studies on concentrations of chemicals that interfere with escape from predators, with finding food, with finding a mate, with finding a proper substrate and so on must be added to the essential-

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ly primitive protocols covered in environmental documents to date. Quite simply, from the investigations available Preparers can make only crude guesses as to what proposed expansion of offshore oil activities could or would do; it seems likely that they are almost totally ignorant of much that has happened already.

Damage to local populations in the Beaufort Sea is probably longer lasting than for comparable damage (in amount) at lower latitudes because of seasonal extremes and because adjacent populations that might provide replenishment are not very large. A blow can be particularly bad if it comes at a low part of a regular population cycle.

Use of hydrofluoric acid (hydrogen fluoride) has recently raised concerns about oil industry hazards in southern California. Mobil Oil, in Torrance, uses large quantities of the compound at its refinery and several other refineries here use it. Louise Carty, a retired public health chemist, pointed out during a hearing at Santa Barbara several years ago, that there are large hydrochloric acid and hydrofluoric acid tanks in a drilling area near that city. Later I found in a University of Texas oil field primer that when accumulation of particles blocks flow of crude oil through the bearing formations to well shafts, "acidization" opens the way. Single applications may require small amounts to thousands of gallons. Hydrochloric acid removes limestone particles; hydrofluoric acid clears siliceous particles. Accounts of the Mobil Oil, Torrance situation state that in the event of a major leak, many people would be killed and that some could be seriously hurt as far as four miles from the tanks. Such uses appear to be regarded by industry as a proprietary matter. It is vital that the Impact document determine and reveal whether hydrofluoric acid or any other highly toxic substance is used, or like benzo-alpha-pyrene, is released, what the amounts are, what potential damage is, and what measures, including emergency responses, are prepared for.

A 1984 volume White, Harris H. (ed.) *Concepts in Marine Pollution Measurements*. College Park, University of Maryland, has a number of papers that could be useful in revision of DEIS 124. M. E. Q. Pilson's essay, *Should We Know the Fate of Pollutants?*, [p. 576 f., beginning "The title of this paper is rhetorical. The answer is YES] notes how little has been investigated of marine situations as compared with fresh waters. Cairns and Buikema on *Verifying Predictions of Environmental Safety and Harm*, White on "mussel madness", Azam and others on the role of bacteria in polluted marine ecosystems, the Grassles on single species population studies, Smayda on variations and long-term changes and others provide information and thinking putting the brakes on unfounded optimism.

In DEIS 124 as in worst case scenarios prepared for the Pacific Coast by MMS: Los Angeles there appears to be no recognition that a number of things may go wrong in the same period. A spill and a break in a hydrogen fluoride tank can happen synchronously. A wind may nudge a tanker against a platform and squash a personnel helicopter against another platform starting

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a spill from the one and a blaze and a blast, also with release of crude oil, at the other. And the weather may make doing something about it all impossible for a considerable time. For the Beaufort Sea possibilities for complications are not negligible. With the response to the Puerto Rican blast and spill accounts indicate that Clean Seas crews were not in best shape, the seas were rough and the lead boat was smashed, two crew members being crippled, officials in charge had somewhat different agendas and decisions were retarded, charts of local water currents for the wrong season were consulted und so weiter. It seems appropriate that DEIS 124 Preparers make more clear the fact that Beaufort Sea happenings may be exceedingly complicated and unsettling.

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## Responses to Comments in the Letter from John L. Mohr

### MOHR-1:

See Response NAEC-9.

### MOHR-2:

Improvements in oil-spill response over the last decade have been marginal: refinements of older techniques rather than development of new techniques. Thus, the effectiveness of response—in terms of percentage recovery—has not increased from the time of the 1979 Ixtoc I spill to time of the 1989 Exxon Valdez spill. Response planning providing for short response times (6-12 hours and 48 hours for additional equipment) is required for drilling operations on the Alaska OCS; similar requirements are not in place for general ship traffic in Antarctic waters.

### MOHR-3:

The spills cited by the commenter provide additional examples of the problems encountered in spill cleanup off the west coast of the lower 48 but would provide little insight into the problems of remote, cold-water response that are already provided in discussions of Alaskan spills in Sections IV.A and IV.C.1 and Appendix M.

### MOHR-4:

Spill-trajectory considerations in the EIS (see Sec. IV.A.2.b[3]) are on the mesoscale that the commenter suggests is most appropriate and accurate.

### MOHR-5:

The authors of the Sale 124 DEIS and many of those who review the document live in Alaska and are well aware of the public reaction to the Exxon Valdez oil spill from articles in newspapers, magazines, and journals and from radio and television broadcasts. In addition, the transcripts of the public hearings on the DEIS contain some testimonies that include reactions to the Exxon Valdez oil spill; these transcripts are available to the authors and reviewers. Thus, MMS does not believe that it is necessary to obtain a transcript of the suggested program.

### MOHR-6:

It is incorrect to single out the oil industry as having higher than average abuse of alcohol or drugs. Substance abuse is a prevalent problem in many sectors of the work force. In many ways, it is easier for the oil industry to control substance abuse in Alaska than it is for other employers' work places because the oil-industry employees live in confined quarters and have strict rules regarding importation of alcohol. It might be expected that oil-spill-cleanup crews would be more difficult to control, particularly since they are "short-timers" and have less of a need to keep their jobs. We agree that the oil industry needs to look closely at substance abuse in the camps as well as in cleanup efforts.

### MOHR-7:

Similar reports of observers rather than the slick being dosed with dispersant were made on the Exxon Valdez spill; however, no significant dispersant injuries were reported. Obviously, getting the dispersant onto the slick can be a problem.

In terms of human safety, dispersant application is probably safer than mechanical recovery in many situations. One death did occur during nondispersant response to the Exxon Valdez spill. Dispersant application rather than mechanical

response is considered the safer option from mid-September through April in Prince William Sound and other areas affected by the Exxon Valdez spill.

Effects on biota of dispersant application are considered prior to USCG granting permission for their use. Most, but not all, EPA-listed dispersants have been shown to only slightly or negligibly increase toxicity of dispersed oil to standard-test organisms. A few listed dispersants do significantly increase toxicity. The EPA requires toxicity and effectiveness testing to list a dispersant but does not actually require that the tests show either low toxicity or high effectiveness.

Whether reformulation of dispersants to improve their characteristics should require new toxicity and effectiveness tests and a new EPA listing has been an issue among the Alaska Regional Response Team and industry during the response to the Exxon Valdez spill. The issue has not been fully resolved.

The EIS does not recommend dispersant application as a primary-response tool as suggested by the commenter. Dispersants in field tests in Beaufort waters (Swiss and Vanderkoo, 1988) and in open-ocean waters in general (USDOI, MMS, OCS Oil Spill Task Force, 1989) have been routinely ineffective and are not recommended for primary response.

### MOHR-8:

This concern regarding spill models is addressed in Response NAEC-5a. The drilling-discharge model used by MMS and EPA has been field tested many more times than the once in 1978 and once in circa 1988 suggested by the commenter. Some of these tests, including several in Alaskan waters, are discussed in Appendix L.

The concern regarding discharge-model plumes apparently derives from the commenter misunderstanding both what plume models are supposed to do and the economics of experimental design. The primary purpose of plume models is to quantify the peak concentrations, that is, concentrations along the centerline of the plume. Thus, it makes both economic and scientific sense to concentrate current and turbidity-sensor moorings in the downcurrent direction of the plume—the area of interest. If currents reverse after moorings are in place but before the experiment, one must either move the moorings or wait for the current to again be in the direction of the moorings. This is common sense, not dishonesty or weakness. Apparently, the commenter is concerned that the plume may move upcurrent. In addition, the Coriolis force is not significant on the scale of concern with plume models—a 100-m radius about the discharge—and the models include no parameters that are a function of compass direction.

### MOHR-9:

Science should be evaluated on the merit of that science and not, as proposed by the commenter, on the basis of who funded the research or who was on his/her dissertation committee. The purpose of plume models is to estimate dilution and concentrations at the edge of the 100-m mixing zone and not to evaluate some undefined, far-field "plume influence" kilometers from the discharge. If Federal water-quality criteria are met at 100 m from the discharge, the steward agencies do presume that the same criteria are also met by the discharge at a distance of several kilometers.

### MOHR-10:

## IV.C. Public Hearing Comments and Responses

Public hearings on the Sale 124 DEIS were held in the following Alaskan communities in April 1990: Barrow on the 17th, Kaktovik on the 18th, Nuiqsut on the 19th, and Anchorage on the 20th. At the hearings in the NSB communities of Barrow, Kaktovik, and Nuiqsut, MMS arranged for the services of a professional translator from the Inupiat History and Language Commission of the NSB to translate testimony spoken in Inupiaq to English for the hearing record; 12 testimonies were presented in Inupiaq and translated into English.

Because of the volume, transcripts of the oral testimonies are not reproduced in the EIS; instead, significant issues discussed by the speakers have been excerpted and presented in this section. A copy of the complete transcript for each of the hearings is available at the Alaska OCS Region, Public Information Library, in Anchorage. Also, a copy of the hearing transcript was mailed to the mayor in each of the NSB communities in which the hearings were held.

During these hearings, many residents of the NSB expressed concerns about how their culture, lifestyle, and subsistence resources might be affected by oil and gas development in the Beaufort Sea. The MMS is making a very strong effort to ensure that the government and industry are aware of the importance of the subsistence lifestyle to the Inupiat.

Information-gathering (scoping) meetings and public hearings were held in all communities of the NSB potentially affected by the MMS OCS oil and gas leasing program. The MMS presently is sponsoring and previously has sponsored social and environmental studies that directly relate to the Beaufort and Chukchi Seas and adjacent coastal communities.

The testimony given at the Sale 124 public hearings will help in the understanding of the importance of culture, lifestyle, and subsistence resources to the peoples living along the coasts of the Beaufort and Chukchi Seas.

Speakers at the public hearings are listed below in the order of their appearance. Speakers whose presentation has been excerpted are identified by a \*; presentations spoken in Inupiaq are identified by an \*.

### 1. Barrow Public Hearing

- Don Long
- Arnold Brower, Jr.
- Warren Matumeak
- Eugene Brower
- Tom Lohman
- Robert Aiken
- Daniel Leavitt\*
- Joash Tukle
- Marie Adams
- Walter Akpik, Sr.\*
- Author Neakok\*
- Delbert Rexford
- Burton Rexford
- Henry Huntington
- Nate Oleman\*
- Charlotte Brower
- George Edwardson
- Raymond Neakok, Sr.\*
- Marth Aiken
- Beverly Hugo
- Charles Okakok
- John George
- Benfer Simmonds
- Douglas Edwardson

### 2. Kaktovik Public Hearing

- George Tagerook
- Fenton Rexford
- Issac Ahkootchik\*
- Jonas Ningeok\*
- Alfred Lynn
- Jane Thompson
- Nolan Soloman
- Joe Sopl
- Herman Aishana
- Robert Thompson
- Eddie Rexford

3. Nulqsut Public Hearing

- Nelson Ahvakana
- Isaac Nukapigak
- Thomas Napageak  
Sarah Kunaknana  
Joesph Ericklook

- Joe Kasak  
Margaret Gegoseak
- Berniece Pasula
- Maynie Ahnupknak\*

4. Anchorage Public Hearing

- Richard Ogar
- Don Hartman
- Sharon Sturges

- Jane Degnan  
Tom Cook

## BARROW PUBLIC HEARING

### Excerpts from the Public Testimony of Donald Long:

#### Comment BAR-1:

My point is that most of the people who live and die in Barrow were and are here because of the bounty of the sea. Any attempt of offshore drilling against the objection of the people without proven oil spill contingency plans could be construed as a first step of genocide against the Inupiat people of the North. The only basic — the only and basic reason why we live here is because of the ocean. Remember, these whales and other animals will migrate; it's their instinct, and Point Barrow is their only route.

### Excerpts from the Public Testimony of Arnold Brower, Jr.:

#### Comment BAR-2:

Continued operations of offshore operations by the oil and gas industry harasses the Inupiat whalers from their subsistence catch limits.

#### Comment BAR-3:

Any accidents of oil spill would have a devastating impact to the bowhead population if encountered by a large migrating school that happens to want to pass through their natural migratory pattern and time it needs to move itself from the Beaufort Sea.

#### Comment BAR-4:

Since we have not seen any form of assurance of cleanup capability by the industry, no leases should be activate — no leases should be resolved — wait a minute — activated for exploration until this has been resolved. If it is not resolved, the industry and the federal government will finally initiate a plan that will not work under harsh arctic environmental conditions because you would finally, perhaps, like they did in Valdez area that initiates some kind of program that has not been tested here.

#### Comment BAR-5:

There needs to be training of the Arctic residents for oil spill containment programs in each village, from Kaktovik to Point Hope. You spoke of training oil and gas industry employees. I think that should not be limited because they have their own limitations of knowledge to this Arctic harsh — to these harsh environments that we are so used to. This program has to belong to the communities and remain there for the benefit of the local residents that depend on the sea for livelihood.

#### Comment BAR-6:

Again, I want to go on record to oppose the offshore drilling without a safe oil spill contingency program and a provisional schedule of the migratory bowheads' pass either at Point Barrow or Point Franklin on the Chukchi Sea in the fall migration each year, also a communication program that will activate the oil spill contingency program. With declining revenues, the dependence of our subsistence resources, it is even more critical now and in time to come. These are in our best interests as local residents of the Arctic coastal communities.

For instance, in the migration of the bowhead whales, that if there is no limit and these things are not adhered to for allowing the natural migration of the bowhead whale, it can cause it to alter or stop by certain activities, influx, especially

influx of activity offshore. And the — if they are stopped like that for a course of a week for instance, and the Arctic flows and it freezes fast, and those are some of the things that I am concerned about so that these animals, these endangered species be allowed to go down to their westward migration down south before they are trapped in the Arctic. I'm count — especially like the ones that were trapped there, the gray whales there. Unfortunately, those — that issue has been demonstrated once.

#### Comment BAR-7:

I'd like to make some concluding remarks in hearing and reviewing some of your pamphlets. In the event that oil spills occur and cleanup is done on our beaches, using dispersants on the beach to clean up the — will have a detrimental impact to other living marine resources. So there needs to be an exploration of — and research to clean up these type of beaches with non-toxic dispersants so that these little fish eggs that are trying to grow — I'm especially going to name one that has been depleting since the encroachment of offshore activity, one, the — namely, the Arctic cisco (ph), which is still caught, barely caught, in Barrow since that — since the beginning of oil industry, offshore industry.

I'm very adamant about this because I feel that there has been a lack of care in making stipulations because of wanting to receive the dollars for the benefit of the departments of the United States, and I think that the United States must view all of its environmental impact statements so that these dispersants do not kill off the resources that we depend upon on our coastlines off Alaska and the rest of the United States. Using toxic dispersants to clean up our beaches will further endanger all of the other marine resources.

A decline of catch limits of Arctic cisco has been very predominant. It's been so evident that I keep bringing it up at these hearings, that they are doing investigations, research related to this west stock (sic) for instance, those type of things. And that's why I'm speaking and, namely, on that one critical issue.

#### Comment BAR-8:

I have not discussed that too much. I think this is one of my first statements here because I have learned that they are trying to put these training programs in there. But I would like to see that the permanent people, permanent residents people be here, that they learn and become a part of the cleanup activities in the event. But this is very important because people, Arctic residents, from here are more knowledgeable of the adverse impacts and the adverse weather conditions, sea ice conditions, here more than they do from Texas.

### Excerpts from the Public Testimony of Warren Matumcak:

#### Comment BAR-9:

The MMS, in my view, should not lease anything beyond the land-fast ice area because the floating structures that are used out there poses a lot of risk, and if there is a blow-out from one of those floating structures, let's say if the blow-out occurs in October, at freezing time, the relief well would not take place at the time because it is freezing. And so anything blowing out would continue all through the winter until the next drilling season. Now, that poses a very grave risk, and it would damage a lot of our subsistence animals.

#### Comment BAR-10:

So I also want to state that the MMS should not allow any drilling with floating structures when there is a plan to use a conical-shaped bottom founded structure which can be used in deeper waters. Global Marine has that plan, and most of the industry knew about it, and I guess you people know about it. The two safest rigs, drilling platforms, that are being used up here are the CIDS, what we call CIDS, and the SSDC. These are bottom founded structures, and that is into gravel islands and ice islands. The blow-out preventor is on top, and if there is a blow-out after freeze-up, the oil would be contained on top without oil going away and -- with the current and stuff like that. And it can be saved; it can be used. But if there's a blow-out in the ice-infested waters, the industry nor MMS, or anybody, have the capability of cleaning spilled oil, as demonstrated in the Valdez spill.

Comment BAR-11:

But I would like to state that anything outside of the land-fast area be deleted until the MMS and the industry come up with a drilling structure that can safely drill beyond the land-fast area.

Comment BAR-12:

And you made an excuse; you're saying that you did everything possible to make the risk less by putting people on the rig or having a lot of people review the oil spill contingency plan. These things cannot stop a blow-out; a blow-out will come in accidentally or the equipment failure. These reviews will not do it. The person on the ship will not prevent it. It's the accident by a person or the failure of the equipment, and with the ice conditions up here, a 200-barrel-a-day -- 200,000-barrel-a-day blow-out will -- if it continues over the winter, will be a devastating -- will have devastating effect to our food, food chain.

Comment BAR-13:

And also frown at using dispersants because it only turns transfer of that dispersant into the water, which would then go into the ecosystem that the larger animals eat and then it could pass on to us. You know, these things are going to be done without having a full knowledge of what effect it will have on human consumption, or at least these are -- these fears are real to me.

Excerpts from the Public Testimony of Eugene Brower:

Comment BAR-14:

Why are you having lease sales while the incidental take permit issue, it has not been resolved yet? Are they not still pending? It has been resolved on an incidental take permit request by the district? While that is pending, I think there should be no lease sales on your federal lands out there.

Comment BAR-15:

And also, what guarantees do we have on the impacts from the drilling platforms or the ships or the contaminants that are going to be coming from these drilling vessels or these platforms, i.e., the drilling width, oil? Those are going to happen, and there's -- if anybody says that they -- it doesn't happen, I don't know who they're trying to pull the wool over. But my biggest question is, What happens if the drilling mud and the other contaminants that are -- and where are they stored if they are removed from these sites? Are they drilling a hole down in the ground and blowing them into the ground? If so, is that area safe, or are they seeping through? Those questions have never been answered, and nobody has brought these up before you, if I'm not mistaken, up here.

Comment BAR-16:

What about the multi-year ice? We haven't seen the -- any of the multi-year ice up here for quite a few years. About three or four years ago, United States super-icebreaker, the Polar Star, couldn't break its way through the Point out there. We were watching it ramming that ice day in, day out, and it couldn't even make a headway. What's going to happen when that ice comes around in this sale area you're proposing to sell? What kind of guarantees are we going to have? That multi-year ice is heavy, and they don't break easy, much to the embarrassment of our federal government, our supertanker couldn't even penetrate even how many feet into that ice? That's one of the things that should be looked at.

Comment BAR-17:

Also, what is your proposed drilling window once you have your lease sale? Is it going to be year-around or what? And also, you talk about the oil industry saying that they have the know-how and the technology to clean an oil spill. I've never seen it work up here. Have they found a way to do it underneath the ice, underneath the pressure ridges, where it's going to go? This ice is constantly moving, either northeast or southwest depending on the current up here. To this day, I don't think the industry has, or the federal government has, the technology to clean oil underneath our polar cap up here.

Excerpts from the Public Testimony of Tom Lohman:

Comment BAR-18:

Very flatly, the North Slope Borough does not believe that the industry has the capability to clean up oil in good environmental conditions and, much less, in the difficult environmental conditions which are the norm up here. I've got right here a copy of the report that was prepared by the Alaska Oil Spill Commission focusing on the Exxon Valdez spill. It obviously does not talk too extensively about spills in Arctic regions, but I'd like to read just a couple of things into the record that it does say, referring to Arctic regions.

Comment BAR-19:

Talking about regional oil spill risks -- and this is something that Arnold brought up -- you need to talk about oil spill risks in our area, not oil spill risks or oil spill scenarios, or models, that have been formulated in other environments. The report says, and I quote:

"The picture is bleak for remote areas. An effective response effort for a large spill from a drill ship or a tanker accident very far from Prudhoe Bay or Barrow would be extremely difficult. If the drill ship or tanker were saved, the oil spill would probably be uncontainable by that time. Sacrificing the vessel by burning is the only option offered by most who have experience in the Arctic."

Comment BAR-20:

In your preferred scenario, and in the scenarios developed in the EIS, there are amazing lengths of subsea pipelines discussed, several hundreds of miles of subsea pipelines which are supposed to be laid. We have very little confidence that this can be done either in the construction phase so as not to disturb the subsistence activities or the resources, but once those things are in, we don't have the confidence that they can be operated safely. And if you have a spill or leak or a break in the pipe during the winter, as Warren said, you are not going to be able to address it until the following open-water season. You're going to have water -- you're going to have oil under the ice, which is going to spread a very long

way; you are going to have springtime activities which are critical to this community and the communities in the Beaufort Sea affected very severely.

Comment BAR-21:

You've got safer alternatives onshore; we understand that you cannot lease areas which have not been opened by Congress. As Eugene said, we don't think you should be leasing if you can't deal with that final step in a safe manner. And we understand that oil development has provided benefits to the North Slope, and we hope it will continue to do so, but in the areas that are most sensitive to the livelihood, and the welfare, the continued cultural viability of these people, who, as Arnold said, live and die here, we don't think you should be operating out there in an environment that is difficult at best and in which you cannot assure these people that you can do it safely.

Excerpts from the Public Testimony of Robert Aiken:

Comment BAR-22:

I am very opposed to this. My grandpa, if he was alive, he'd back me up, and he'd tell you one thing or two. I'm sure I'm talking about our ancestors' wisdom when I say I've seen this happen. I've seen boats wrecked; I've seen ships stopped. And I've seen a lot of things, what he was talking about, and it's very true. We are dealing with very hard-packed ice that we never seen for how many years now. It's bound to come in sooner or later, and I hope it don't come in when you start drilling 'cause it's going to take that floating thing right up -- way up, way past the Point, and it's going to take it down, probably take it out there, the North Pole. 'Cause a lot of people, when they get lost out on the ice, when that ice floe comes through here, it don't stay here, it goes way out past the Point. And it's been know to happen when the ice comes together from the Beaufort Sea to the Chukchi Sea, when that -- when they come crashing together, and nothing going to stop them. All you'll see is just big piles of ice.

Excerpts from the Public Testimony of Daniel Leavitt:

(Mr. Leavitt's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-23:

I am very concerned on how much -- how -- what should be done on how to stop should there be a -- to stop the blow-out if it should happen. And should there be a blow-out in one of the oil rigs, it is very possible that much of the oil will spread out in the water before it goes out in the open air.

Comment BAR-24:

But me, as I have lived in my Inupiat way of livelihood, that's the only -- that's the only thing that drives me on is to get something for my family to fill up their stomachs from what -- from what I catch.

And if I should go out hunting, leaving my family with nothing to eat, and if I should catch something from the sea, like a sea mammal that has been taken in the oil spill and it has been contaminated from this oil spill, this thing that I caught to feed my family, when all the while when I left them, there was nothing in the house for them to eat, and that's very bad. It really hurts me even to think about it.

Comment BAR-25:

And not too long ago, from the caribou family, my -- my sons have been killing off some caribou that has been sick.

Because of these radios that have been attached right around the neck of the caribou, that has bothered them so much that they're -- they haven't been able to eat like they should, and therefore, they die.

And when we confront the officials about these, maybe we have -- maybe they just laugh behind our backs about these conditions that these animals are in.

Comment BAR-26:

And prior to this meeting, I have -- I have listened to what the oil companies -- companies have to say ....

That it is not our problem. We're not -- we have nothing to do with this oil that has spread around the water and in the ice.

If I understood them correctly, I -- I understood them to say that the cleanup job is for the federal government.

In these meetings, you have always said that all precautions have been taken to take care of any blow-out, but I have not seen a demonstration on how it can be done.

Excerpts from the Public Testimony of Marie Adams:

Comment BAR-27:

There's ongoing discussions of incidental take; that issue has not been resolved.

Comment BAR-28:

I'm very concerned that you are planning -- especially in the Chukchi Sea area where the ice dynamics are more extreme, and you don't have the experience there; no one has that experience. I'm very concerned that considering the amount of activity we've seen in the past and the chances are we'll probably see an oil spill if that -- if they start drilling and going into any activity on the Chukchi Sea area.

Excerpts from the Public Testimony of Walter Akpik, Sr.:

(Mr. Akpik's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-29:

So if you plan to drill from a ship....

We don't know what the ice conditions will be and how the ice conditions will handle that rig.

Because when the currents and the ice, there's no force to hold it once it starts moving, and no matter how big a ship there is that is used to drill in our waters, we are very concerned of what will happen to it should the ice conditions and the current start carrying that ice where it -- where it will.

Comment BAR-30:

And so from experience, I have watched how these pressure ridges pile up. They don't stop on the land -- land-locked ice, but they do come up on -- on top the ground and then they continue to pile up.

Comment BAR-31:

So as I have watched this, seen it from experience, there's no

telling. No matter how big a ship there is that's -- that has -- that has this break drilling for oil down there, there's no telling what will happen to it once you've struck oil and what will happen to it should these ice conditions pile up on it.

Excerpts from the Public Testimony of Arthur Neakok:

(Mr. Neakok's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-32:

So if you plan -- if there are plans to -- to put up an oil rig on a boat, a ship, whatever, I want you to know that even if there is no sign of ice anywhere, there can -- it can come up on you without notice and without any -- without any warning. And when that happens, all this water is covered by ice, and there is nowhere that a boat or a ship can travel when ice conditions come in like that.

If this rig is on a ship, whatever, these ice conditions, when they come in that fast, can take it anywhere with its current, can take -- the ice can take this oil rig, the ship, whatever. It can take it with it because there is no stopping when the ice conditions and the currents start going in one direction.

Excerpts from the Public Testimony of Burton Rexford:

Comment BAR-33:

The three active currents that we deal with here in Barrow, one is mentioned. I hear it on the radio -- or two of them -- from the west and east. The other one goes directly north; that's right at the Point. Now, these currents are very active, and they can change any direction, the two currents, any way from the east and west, without a moment's notice. The one coming from the east, generally, this time of the year, we'll make a test of the land shore-fast ice, and we'll test it for its strength and power. It has taken it out many a times in my years right through the sandbar, the land shore-fast ice. That's how much force that carries when it comes this time of the year.

Comment BAR-34:

So in the event there's a spill, we have these currents to be concerned with. The people before me that testified, there is no clean-up under the ice. This is very true. There was also a mention of the year-around ice. The year-around ice that was not mentioned, and the next current from here, it takes about six hours on full speed with a 70-horse and about an 18-foot Lund full speed, I would say about 60 miles at 270 degrees, six hours without slowing down. That is where you will find what we call the glacier ice. I don't know how many years old that ice is, but it's out there. With a strong west wind, high winds, it can come in to the beach here while I'm sleeping during the night. It doesn't give any warning; it comes in through, between here and Franklin Point. This glacier ice doesn't come in from the north; it comes in between here and Franklin Point.

Those are the currents. If there was a spill, I don't see how you can clean it up. The Eskimo has a right to be concerned about any offshore activity. They know their sea, land, ice; they have been conditioned for years and years. They learned from their forefathers. Their forefathers went through the same thing, the harsh times out in the ocean; they slept out there. So do we; we sleep out there on ice floes. We don't make an attempt to go home on some of those ice floes when we get caught out there merely because of safety of a younger generation. You don't dare try to go home in a big hurry, just -- we just take your -- just take our time. We know where we're going to hit land. If we get

caught on that north current that's going north, that's very easy to figure out for an Eskimo; we know where we're going to hit land.

Excerpts from the Public Testimony of Henry Huntington:

Comment BAR-35:

Section 4(n) also says that 20 spills or greater than 1,000 barrels have occurred since 1964 in Outer Continental Shelf activities. That means that since you expect eight spills in the Arctic, the Arctic spills would be equal to 40 percent of the spills that have already happen in the past 26 years. That seems like a lot of spills. The largest of these 20 spills was 160,000 barrels. The chances of a spill of that magnitude may not be great, but let's look again at the Exxon Valdez.

Comment BAR-36:

According to the Alaska Oil Spill Commission report quoted by Tom Lohman earlier, there have been more than 8,700 transits of Prince William Sound by oil tankers; only one spilled. One out of 8,700 is .01 percent. That sounds minimal, but with enough transits by tankers, the chances of a spill become great. If you said that .01 percent was the chance that a given well here would produce a major spill, you would probably go on to say that it wasn't worth worrying about. I don't think anyone would agree with that from Prince William Sound, and considering the devastating consequences of a spill to the Arctic environment, I don't see why it should be tolerated here.

Comment BAR-37:

In the oil spill report, it also states that the procedures developed in 1977 for tankers in the Sound were not being followed by them mid-1980s. Things got sloppy. You have mentioned procedures to minimize the risks of oil spills, but who is to say that they will be followed? Who is to say that things won't get sloppy here? Who is to say that a disaster won't materialize here? The oil spill clean-up techniques discussed in Section 4(a) of the Environmental Impact Statement include such measures as portable rope mops and manual removal. This brings to mind people in Prince William Sound wiping rocks with paper towels. That's not very reassuring. The only thing the Environmental Impact Statement promises is the 99-percent chance of a greater -- of an oil spill greater than 1,000 barrels.

Excerpts from the Public Testimony of Nate Oleman:

(Mr. Oleman's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-38:

I'm going to use as an example of what's in our background right now, in our back yard, of what the federal government has done. At Shooting Station, they have buried their debris into the spit going to the Point and sank some of the metal and other debris into our lagoon out there. We use that lagoon to go inland and to go hunting. We use the Shooting Station all summer for hunting in our ocean, in the lagoon, and on the land.

Not by cleaning up the debris, we the community have to suffer, and we see it every summer.

Back in '77, through a request from the community, I wrote a letter to the Navy since USE was run by the Navy -- not USE, USE now was run by the Navy, and we knew it as a Navy camp. The Navy respond and pass it down to U.S. Air Force at the DEW Line site saying it was their responsibility

to clean up the debris in the lagoon and along the spit since they were running the DEW Line site. The Air Force in turn respond and said that the debris was cleaned up around the DEW Line site and their responsibility wasn't the bay or the spit, it was the Coast Guard's responsibility.

And the Coast Guard looked into the matter because they mentioned the lagoon quite a bit, but when they investigated, some of the debris was along the coastline, both in the ocean and the lagoon and buried along the spit. So they determined that the responsibility lay on the U.S. Army Corps of Engineers to be cleaned up. The Corps did the same thing; they investigated and reported back that since the property was designated to the Navy and was under the jurisdiction of the Navy, and it was the Navy's responsibility to clean up the debris.

To this day, the debris is still out there, and that's just a example of how the government's version of coming in and saying they have the technology to clean up before they leave. The only technology they have is they know how to pass the buck. They know it's the government's responsibility, but they don't know who is to blame it on. The oil spill, if it occurs out in the ocean, is going to be routed the same way.

#### Excerpts from the Public Testimony of Charlotte Brower:

##### Comment BAR-39:

We're allocated so many strikes that we have to negotiate with the National Oceanic Atmospheric Administration, and within the last recent few years, due to Steven Brown Associates, we were able to convince the federal government and the IWC that there is a need to increase the quota so that the people throughout the nine villages could have, based on their nutritional needs, the number of strikes. The villages that are affected with lower number of strikes still feel that the Steven Brown Associates study is still inadequate because it has not met their nutritional needs.

##### Comment BAR-40:

We have the same problems that United States have, and that is in alcoholism, drug abuse, and then you have number of people that are going to be out there, whatever they're going to be doing, out in the ice, they're going to come with those problems, and then those problems will be our problems.

##### Comment BAR-41:

And right now, I think Sale 124 is a real important issue that the Barrow Whaling Captains are going to be faced with, and it is going to impact them, not only during their spring but in fall whaling in the next coming few years, and that's a reality that we have to face. Kaktovik Village and Nuiqsut Village had to endure all what they've done because of the Prudhoe Bay. The Prudhoe Bay area that is there has impacted their way of whaling that they have done throughout the number of years in the past. They have to go out of their way to go other places to go whaling, and they have to tow that whale from that place to their butchering site, and sometimes it takes them at least a good day if -- if not, to butcher that whale.

#### Excerpts from the Public Testimony of George Edwardson:

##### Comment BAR-42:

And if you want to talk about law, laws, this MMS has to follow the same federal laws and international treaties we have, don't we? You have the Endangered Species Act you're violating, and right there, right on the map behind

you, you're showing us where the bowheads and the other whales rest. You have 29 endangered specie animals living within the lease sale area where you're trying to say you want to sell. You're violating this Endangered Species Act you marine mammals protect -- your marine mammals -- Minerals Management Service, excuse me. And also the Marine Mammal Protection Act, you're violating that too. MMS is violating these acts also: the International Migratory Bird Treaty you're also violating to try to conduct your Lease Sale 124.

##### Comment BAR-43:

And to make it worse, I didn't even know about this hearing here, and I hadn't received your draft resolution or been, you know, notified except through the newspapers, and my villages, the only way they can find out is through the newspapers. Why weren't we properly notified you were going to go out and sell our ocean?

##### Comment BAR-44:

Now, you want to talk about, you know, how good you're going to clean up. You can't even start about that 'cause you, as America, claimed the last time those two icebreakers came up here they were the strongest in the world -- you couldn't even make it to Christmas. And here one of them was just following the other one back and both of them stuck in the ice. This is the most powerful ships you're going to use to take care of your clean-up crews?

##### Comment BAR-45:

Technology. You say you have technology -- you're still drilling with a piece of iron pipe. And we -- we all understand what happens when you heat one end of a piece of iron, the heat transfers to the other end. The permafrost is less than 12 degrees below freezing, and it's just -- just to give you an example how much permafrost, when a pipe sits in the ground and don't even move, ever since the Navy drilled at Onakpah (ph), the permafrost was at 1,900 feet. Just -- just this past year they tested it and found out it's up to 1,300 feet now. You just melted a spot in the permafrost just by leaving a pipe in the ground.

##### Comment BAR-46:

When the industry and the government decides to go look for oil, there is oil. You have satellites with infrared capabilities that can look below the surface. You have airplanes that can smell the air that comes -- that oil comes out of the ground with, even over the ocean. You worked on some of them there, John, while you were up here at Narl (ph).

##### Comment BAR-47:

And on your clean-up boats, your skimmer boats, back in the beginning of the 1970s, I spent better than seven and a half years in the oil industry. I was the person in charge of the first skimmer boat that ever came to Alaska in the beginning of the 1970s, and the skimmer boat they gave me to clean oil with in the Cook Inlet was a house pontoon boat without the house, and in order to make it stay afloat in the Cook Inlet, we had to fill the pontoons with styrofoam. That was the first clean-up boat that ever came to Alaska. And when you look at your clean-up equipment, it has not improved -- and you're talking about better than 20 years of experience that's supposed to refine your technology.

##### Comment BAR-48:

And if you want some facts on this matter, where you're going to go drill, that is the ice that feeds one-third of the world's fish, between Greenland and Canada, the currents flowing that way. You make a mess, you lose -- you lose

some oil, the toxicity of the oil does not deteriorate because it's cold. We don't have the warm weather like down in Valdez or down in Mexico where you lost it before. The — the toxic gases will not disappear; they will stay there. And every time the ice rotates, we're going to get hit with it again. You're talking about threatening two-thirds of the world's fisheries, you know, identified by the International Beaufort Sea synthesis that was conducted in Seward a few years ago.

Comment BAR-49:

And for — for the Inupiat as a people, we have never received any royalties in any extrac- — any mineral extraction or even renewable extractions from our region, and we have a legal, legitimate jurisdiction recognized by Congress countless times. Yet when industry decides to go out, or the federal government, either from the federal government level or from the State level, there is no talk about how much royalties we're going to get 'cause we've never received any. Right now we just entered into the Department of Justice through a U.S. attorney, appealing the United States' actions and asking, Where's our royalties for Prudhoe Bay? Which the Department of Commerce has notified us, and so far, it's up to 44 billion and we haven't even been able to touch it; now you're talking about going out in our whole ocean, and you haven't even come to talk to us about that.

Comment BAR-50:

Alcohol problems. When you look at the people, right now I'm — have to deal with — without any federal monies, without no help, not from churches, not from the state governments or from the federal governments — we have to deal with over 250 child cases every six months without no help, and a major portion of them is alcohol related because the parents are worried about, 'Where am I going to feed my kids from? I can't find a job.' And here we're sitting in the richest oil field in North America. And major portions of our population are unemployed and can't get work, with the biggest oil field sitting right to the east of us here. And the PRA, we've never received any royalties. Pet for (sic) when the Navy held it and kept us off our land, we never received any, neither from Prudhoe Bay.

Excerpts from the Public Testimony of Raymond Neakok, Sr.:

(Mr. Neakok's testimony was presented in Inupiat and translated into English by the translator.)

Comment BAR-51:

Before I go too far, what I am saying is we have been telling you all of these years that you have extract- — started extracting oil from our lands. You have very small disregard (sic) for the people in the North. America law only works for the Americans. We have hollered, we have cried when we see the industry literally destroying your homes right in front of your eyes. We have seen them dig up your brothers, your sisters, your grandfathers out of the ground and literally just walk over them with tractors.

We as Inupiat are treated by the Americans as an obstacle to steal our oil, our lands, our own burial grounds. Justice for Inupiat is not evident by a white man's law because white man is illiterate in the Inupiat law. You've been with us since the early 1700s, and yet not even 2 percent of you has even took the opportunity to learn our language, which is our way of life. Our culture, since time immemorial, has always looked at the ecosystem as one, not divided on (indiscernible) of a different environment.

Comment BAR-52:

Last, I want to say, if the federal agencies are going to be required to make an Environmental Impact Statement, you must include the Inupiat's recommendations, the stipulations, and recognize the Inupiat Tribal Government as government not just an instrument that you use to get your own recognition. We're a tribal government, and we are recognized in the Lower 48 as government. Traditional governments have been born before the United States, tribal governments in 1936, only to contract with the United States for our protection, and it has never been used.

Excerpts from the Public Testimony of Beverly Hugo:

Comment BAR-53:

And these are values that are real important to us; to me, this is what makes me who I am. And the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others; we respect other people; and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility for our tribe, humility.

These are some of the values that are — that we have — that make us who we are, and these values have co-existed for thousands of years, and they are good values, and maybe it's about time that some of the oil industry or the United States government start to recognize these things. You know, these have kept us in balance with other people, with our land, and with the animals that we hunt. And these are good values, and if you are going to be in our homeland, or in the circumpolar region, we are of a same group, the Inuits — Inuit people of the circumpolar region, we have these same values. And if anybody is going to be drilling out in our Beaufort Sea or Chukchi Sea, they have no business out there 'cause it's our business.

Excerpts from the Public Testimony of John George:

Comment BAR-54:

There's something that we've more recently — I hate to use the word 'discovered' but — become aware of is that, through examination of landed whales, we have evidence that — of two whales that have been — had collisions with large ships, and that data is not published. I presented a paper on that at the — on the Fifth Conference of the Bowhead Whale, and these two animals showed, in one case, a large area of evulsed tissue off the flukes, and in another case, there was screw marks down the one side of an animal. The incidence is low, but if we can use North Atlantic right whales as a model of what the effects of increased industrial activity or shipping activity, let's say associated with a lease sale might be, the researchers working with North Atlantic rights think that perhaps that ship collisions may be the most significant source of man-induced mortality on the particular group and even think that it may be preventing the population from recovering despite protection from hunting for over 70 years, I believe.

So that's something that should be treated in the EIS that — the connection is — the scenario might be that with increased activity offshore, there'd be increased ship traffic and a greater potential of collisions with whales, particularly if ships were using lead systems, which I assume they would if — because, obviously, they would be more navigable than moving through pack ice for instance.

Comment BAR-55:

In terms of the assessment of the effect of an oil spill on the

stock, the risk was considered to be low; however, it seems to me -- I'm generally not an alarmist, but it seems to me that you have as all -- all the -- you have a perfect situation to really affect this -- the entire herd in a dramatic way should somehow oil get into the spring lead system near here. In 1988 when we did a census, 95 percent of the whales, what we think is the entire population, went through was -- in roughly a two- to three-week period, it was a -- what we consider a pretty accelerated migration. Generally, we start seeing whales about now and end of June, and it's roughly bell-shaped through that and peaking in mid-May. However, in '88 and in '87, for some reason, the animal -- well, there's a nice open lead system, and they all chugged through in a pretty rapid matter.

So in other words, if you had oil in the lead in a situation like that for even a week or two, you could significantly affect potentially the entire herd. So that should be pointed out. And that'll be published in an IWC paper that is in press at the moment. We did an analysis where we showed the percent counted by 15 May for -- from 1976 to '88.

Comment BAR-56:

I really think that's something worth considering. And Scott Crouse (ph) did a very nice summary of the work on the North Atlantic right whales and examined strandings, and he shows pretty conclusively that ship collisions and -- are a serious problem for these types of whales, right whales in general. They tend to be -- when they're in these social aggregations on the surface, they, for some reason, become unaware of approaching vessels, and there was some dramatic footage shown at the last conference where they nosed a vessel right up to one of these groups of socializing, breeding animals, and they were -- it was as if they were completely unaware of the presence of the ship. And what they think is, during these periods, that collisions are -- would be strictly, you know, a random event, and it'd just be a matter of the probability of the ship and the whale being in the same place at the same time.

## Responses to Comments from the Barrow Public Hearing

### BAR-1:

This concern is addressed in Responses AK-6 and N-4.

### BAR-2:

The MMS recognizes and is sensitive to the fact that there will be some degree of interference with bowhead whaling activities from oil and gas exploration, development, and production (see Sec. IV.C.10); consequently, MMS has proposed stipulations to mitigate these effects.

### BAR-3:

The effects of an oil spill on migrating bowhead whales (particularly in the spring-lead system) was analyzed in Sec. IV.C.6.a. Also, see Responses AK-1, AK-2, and N-13.

### BAR-4:

This concern is addressed in Responses AK-6, N-4, and NAEC-7.

### BAR-5:

The MMS encourages petroleum companies to include in their oil-spill-contingency plans provisions to use the local knowledge and resources of communities that might be affected by an oil spill from operations associated with OCS oil and gas lease sales. In this regard, MMS has approved an oil-spill-contingency plan for ARCO's Fireweed Prospect in the Beaufort Sea that included trained village oil-spill-response teams.

### BAR-6:

These concerns are addressed in Responses AK-1, AK-2, AK-6, N-4, and NAEC-7.

### BAR-7:

Use of dispersants on beaches allows oil to penetrate farther into the beach profile, and in most spills—the Exxon Valdez spill being a major exception—dispersants are not used or recommended for beach cleanup. The site-specific oil-spill-contingency plans for OCS drilling in the proposed sale area will undergo a 30-day public review. This will allow for additional input by the commenter if, in fact, any of these plans propose use of dispersants on the shoreline.

Usually, dispersants are not used or recommended for use in beach cleanup. If they were used on beaches in the Beaufort Sea when capelin eggs or larvae were found on beaches or in the nearshore environment, then presumably the eggs or larvae could be negatively affected. The Arctic cisco found in Alaskan waters are believed to spawn only in the MacKenzie River; therefore, their eggs should not be exposed to any dispersants that might be used to clean up an oil spill originating from offshore activities. Historical catch data from the commercial fishery in the Colville River do not indicate any obvious decline in Arctic cisco numbers.

### BAR-8:

See Response BAR-5.

### BAR-9:

Blowouts result in the sudden, uncontrolled escape of gas, oil, or other well fluids at high pressure from a well. The MMS records for a 17-year period from 1971 through 1988 indicate that blowouts during drilling operations occur infrequently

and release only a relatively minor amount of oil (Harris and Thurston, 1989). During this period, 18,593 wells were started, and there were 37 blowouts from exploration wells and 30 blowouts from development wells. Blowouts during the drilling of two development wells resulted in 70 bbl of oil being spilled. In addition, there have been 42 nondrilling blowouts during production, workover, or completion operations; the amount of oil spilled as a result of these blowouts is estimated to be about 830 bbl.

Blowouts may last from less than an hour to several months. However, most of the OCS blowouts have been controlled within 7 days; most of these blowouts lasted less than 1 day (Tracey, 1988). In only a few instances has it been necessary to drill relief wells to stop a blowout. Many blowouts cease flowing when material from the wall caves into the borehole and provides an obstruction to the flow of fluids. If a natural obstruction does not occur in a borehole, other methods can be used to stop a blowout; these include the use of blowout preventers, drilling muds, and other techniques, or a combination of these.

The MMS feels that the regulations and inspections provide assurance that OCS oil and gas operations are conducted in a manner that emphasizes safety and minimizes the risk of pollution. Regulations in 30 CFR 250 apply to drilling and well-completion and -workover operations and require the use of best available and safest technologies; they also include requirements for well-control and safety-device training of personnel. In Alaska, MMS inspectors are at exploration drill sites during all drilling operations.

### BAR-10:

See Responses NSB-14 and BAR-9.

### BAR-11:

See Response NSB-14.

### BAR-12:

This concern is addressed by the analysis of a very large oil-spill event in Section IV.N of the EIS. Such a spill is unlikely; but, if it occurred, the effects would propagate through the food chain resulting in a VERY HIGH effect on subsistence-harvest patterns.

### BAR-13:

This concern is addressed in Responses MOHR-7, BAR-7, and NSB-11. The issue of dispersant use in sale-area spill response is also addressed in Section III.D of Appendix M.

### BAR-14:

The "incidental-take permit" application was made by industry in compliance with the MMPA as advised in ITL No. 1 (see Sec. II.G.2.). This is a process after the lessee(s) obtains a lease. Therefore, the lack of an incidental-take permit is not a criteria for delaying a sale.

### BAR-15:

Before exploration drilling can occur on a lease, the lessee must submit to MMS for approval an exploration plan in accordance with regulations in 30 CFR 250.33. The exploration plan must include a list of the proposed drilling fluids, including components and their chemical compositions, information on the projected amounts and rates of drilling fluid and cuttings discharges, and method of disposal. The disposal of these materials will be primarily at the drilling

site under conditions prescribed by the EPA's pollutant-discharge permit. Exploration plans are sent to the Governor and the NSB for review and comment.

#### BAR-16:

Sea ice is a major factor influencing operations in the Beaufort Sea Planning Area, and there are several strategies that can be used to contend with this constraint. One strategy is to limit operations to a time and areas in which sea ice is absent or covers only a small amount of the sea surface. Vessels operating under these conditions may need to be only ice-strengthened or capable of breaking relatively thin ice.

If, on the other hand, operations are going to be conducted year-round, permanent facilities will have to be designed and constructed to withstand the ice force; and vessels operating in such an environment must be capable of traveling steadily through level ice that is at least 8 feet thick and breaking through thicker ridges.

The USCGC Polar Sea completed the first winter passage to Point Barrow in February 1981. During operations west of Point Barrow, the ship's rudder system was damaged while backing and ramming in multiyear ice. This transit to Point Barrow was only one feature of the cruise. Another feature was the collection of data on icebreaker-design criteria and performance and on the hull structural response during icebreaking. The lesson of the Polar Sea is just one of many experiences involved in the design and construction of icebreakers that can successfully operate in the sea-ice environment.

#### BAR-17:

This concern is addressed in Responses MMC-16, NSB-9, NSB-10, NSB-11, and N-2.

#### BAR-18:

This concern is addressed in Responses MMC-16 and NSB-9.

#### BAR-19:

This concern is addressed in Responses MMC-16, NSB-9, NSB-11, and N-1.

#### BAR-20:

This concern is addressed in Responses NSB 12 and BAR-12.

#### BAR-21:

See Responses NSB-12 and 14.

#### BAR-22:

The characteristics of sea ice are described in Section III.A.4 of the EIS, and the strategies for operating in the Beaufort Sea Planning Area are discussed in Section II.B.

#### BAR-23:

This concern is addressed in Response N-2.

#### BAR-24:

The MMS recognizes that oil and gas exploration, development, and production activities could have an effect on subsistence harvests—as well as on Inupiat culture. In the base case (see Sec. IV.C.10), the analysis for effects on subsistence harvests has determined that HIGH and MODERATE levels of effect are likely to occur. The MMS

also has proposed a number of stipulations to mitigate the intensity of some of these effects.

#### BAR-25:

The matter of radio collars affecting caribou should be taken up with the local State fish and game biologist. If a radio-collared caribou dies, be sure to notify the ADF&G of the specific location of the caribou. Also, keep a record of what you have observed and a record of the names of other people who have seen the caribou.

#### BAR-26:

The concern regarding responsibility for responding to spills is addressed in Section IV.A.2.c of the EIS. Blowouts were addressed in Response N-2.

#### BAR-27:

See Response BAR-14.

#### BAR-28:

Although operating experience is more limited in the Chukchi Sea than in the Beaufort Sea, three wells have been drilled, using an ice-strengthened drillship, on three different tracts in the Chukchi Sea that were leased as a result of Sale 109 in the Chukchi Sea Planning Area. The ability to operate in the Chukchi Sea is based, in part, on investigations of the oceanographic, meteorological, and sea-ice regimes and also on operating experiences in the Beaufort Sea.

#### BAR-29:

The ability of drillships to operate in the sea ice environment of the Beaufort Sea Planning Area is based on past operating experiences in the Canadian and Alaskan Beaufort Sea. The drillships can use ice forecasting techniques, based on knowledge of global and local meteorological and oceanographic conditions, to warn of potential risks from moving sea ice. If future or approaching sea ice threatens a drilling operation, the drilling unit can safely shut in the well and move away the site. When conditions are safe, the drillship can return to the site and continue drilling. Also, the drillships utilize icebreaking vessels to break up ice floes that could threaten the drillship.

#### BAR-30:

The characteristics of the sea ice, including pressure ridges and pileups, are described in Section III.A.4 of this EIS.

#### BAR-31:

Drillships are not designed to operate year-round in the Beaufort Sea. If a discovery is made and the drillship is forced to relocate because of a threat from ice, the well can be shut in, preventing the oil from flowing out, until the ship can safely return to the site and complete work on the well. Some drilling units operate year-round in the Beaufort Sea. These units sit on the seafloor and are designed to withstand the forces, to a certain magnitude, of moving ice. In the event the ice forces become greater than those the unit was designed to withstand, the well also can be shut in until the threat passes.

#### BAR-32:

Drilling units operating in the Beaufort Sea use forecasts that predict the weather and ice movement. Also, radar units on board the units are used to determine ice movement, and aircraft might be used to determine the location of ice beyond the range of the radar units. The drilling units have contingency plans for the orderly shutting in of a well in the

event ice threatens the drilling operations. See also Response BAR-31.

**BAR-33:**

The currents and circulation patterns in and adjacent to the Beaufort Sea Planning Area are described in Section III.A.3 of the EIS.

**BAR-34:**

These concerns are addressed in Responses MMC-16, NSB-10, NAEC-5b, and NAEC-7.

**BAR-35:**

This concern is addressed in Response NSB-23.

**BAR-36:**

The Exxon Valdez spill was the second major tanker spill in Prince William Sound in 1989, not the only spill (see also Response AOGA-15). Tankers do pose greater risk than do either oil platforms or pipelines; however, no crude tankering is projected for the Proposal.

**BAR-37:**

This concern is addressed in Responses N-4 and AOGA-15.

**BAR-38:**

The MMS requires the lessee to remove all structures in a manner that assures the location has been cleared of all obstructions to other activities in the area.

**BAR-39:**

The MMS does not have the authority to increase or decrease the bowhead whale quota. The quota is set by the IWC in conjunction with NOAA and a Federal interagency commission, of which MMS is not a participant. Once the overall quota is set, the AEWG decides how many strikes each village receives.

**BAR-40:**

The MMS recognizes that there are social problems among the Alaskan Natives and that these problems can be exacerbated by oil and gas development (see Sec. IV.C.9).

**BAR-41:**

See Responses BAR-2 and N-17.

**BAR-42:**

The MMS is in compliance with the ESA by consulting with NMFS and FWS to determine any recommendations to protect the species (see Appendix K). Also, several of the mitigating measures presented in the DEIS and FEIS were formulated due to recommendations made by these agencies (see Responses AK-1 and AK-2). The lessees are advised in the mitigating measures (ITL No. 1) to comply with the provisions of the MMPA.

**BAR-43:**

The MMS considers newspapers, radio, and television advertisements an appropriate way to inform the public of hearings on proposed oil and gas lease sales.

The MMS is not selling the ocean but proposing to lease the subsurface for oil and gas exploration and possible development and production. The OCS oil and gas leasing

program was authorized by the OCSLA, as amended. In this act, Congress declared it was the policy of the United States that:

The outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

The OCSLA directs the Secretary of the Interior to establish policies and procedures for managing the oil and natural gas resources of the Outer Continental Shelf. The Act notes:

Management of the outer Continental Shelf shall be conducted in a manner which considers economic, social, and environmental values of the renewable and nonrenewable resource contained in the outer Continental Shelf, and the potential impact of oil and gas exploration on the other resource values of the outer Continental Shelf and the marine, coastal, and human environments.

The Secretary has designated MMS as the agency within the Department of the Interior responsible for the management of the OCS oil and gas leasing program.

**BAR-44:**

Icebreakers with greater icebreaking ability than currently available in the U.S. fleet can be constructed, as evidenced by the success of the U.S.S.R. icebreakers in freeing the whales. See also Response N-4.

**BAR-45:**

See Responses NSB 12 and 14.

**BAR-46:**

At present, the only way of determining if a subsurface geological feature contains petroleum is to drill a hole and test the rocks and produced fluids. Satellite images and geophysical records may help locate potential sites for exploration drilling.

**BAR-47:**

This concern is addressed in Responses N-4 and MOHR-2.

**BAR-48:**

See Response MMC-20.

**BAR-49:**

A large portion of revenues received by the United States Government through oil and gas leasing on the OCS is passed on to the State of Alaska, a portion of which is then returned to local communities, including the NSB, through various State assistance and spending programs.

The OCS Lands Act requires that 27 percent of all OCS revenues received by the Federal Government be paid to the State for all leases that are between 3 and 6 mi from the coast. As of December 1989, over \$389 million has been paid to the State as a result of bonuses, rentals, and royalties collected by the Federal Government from this zone. Likewise, when production occurs in this zone, 27 percent of the royalties derived from this area will also be paid to the State.

There are two other Federal programs funded in whole and

in part by OCS revenues from which the State of Alaska receives money. The Land and Water Conservation Fund must have at least \$900 million in it each year. About 85 percent of this money comes from OCS revenues. So far, this fund has received more than \$13 billion; about \$11 billion has come from money received directly from OCS activities. The State of Alaska has been paid over \$26 million from this fund. The other fund is the Historic Preservation Fund. This fund receives all of its money from OCS revenues. The State of Alaska has received about \$5 million from this account. The State must award at least 10 percent of its annual fund allocation to certified governments as subgrants.

The State distributes these monies through various procedures administered by the State of Alaska, Department of Natural Resources, Division of Parks and Outdoor Recreation.

**BAR-50:**

See Response BAR-40.

**BAR-51:**

See Response BAR-24.

**BAR-52:**

The MMS solicits participation in outlining the scope of the EIS very early in the process. All concerned individuals, organizations, and governments (including tribal governments) have the opportunity to assist in the planning process. A Notice of Intent to prepare an EIS for Sale 124 was published on September 14, 1988, with written comments due by October 31, 1988. This notice announced the beginning of the scoping process, which serves to assist in defining the scope of the EIS and in identifying significant issues related to the proposed action. Scoping comments for Sale 124 were solicited through newspaper, radio, and television advertisements in the NSB area. In addition, a scoping meeting was held in Barrow on December 7, 1988, which provided additional opportunity for anyone concerned to voice their concerns. As a result of the scoping process, MMS analyzed a number of mitigating measures for this and past sales in the Beaufort and Chukchi Sea areas to help eliminate or reduce the threat that petroleum exploration may pose. All comments received during the scoping process and in response to the draft EIS, written or spoken, are used to identify major issues, to evaluate potential stipulations and potential deferral areas, and to revise the EIS when necessary. The scoping process is discussed in Section I.A.4 of this EIS.

It is our goal to incorporate any new and additional information in our EIS's and make every effort to assure that this is accomplished. A mailing list has been established to assist us in our efforts. The designated representative for the Inupiat Tribal Government will be added to that list when we receive the name and address of that individual.

**BAR-53:**

The MMS recognizes the strong Inupiat values that continue to be important in Inupiat culture today (see Sec. IV.C.9) and also how very difficult it must be for the Inupiat to see their culture changing at such a rapid pace. It would, however, be incorrect to assume that all of this change is created by oil and gas exploration activities. These changes have occurred all over Alaska and can be attributed to other factors such as television, education, in- and outmigration, etc., besides "oil money." The MMS has proposed a number of stipulations that would mitigate some of the effects on subsistence and the Inupiat culture.

**BAR-54:**

See Responses N-15 and NSB-24 and 25.

**BAR-55:**

See Responses N-6, TFA-6, and MMC-7.

**BAR-56:**

See Response BAR-55.

## KAKTOVIK PUBLIC HEARING

### Excerpts from the Public Testimony of George Tagerook:

#### Comment KAK-1:

And what -- whatever the outcomes of the oil spill will be, bound to be all disastrous, and there's no way -- how you going to clean up a oil spill during ice floes, currents, and that stuff is pretty impossible. I don't know if you guys ever done that before, but, you know, I haven't witnessed it.

### Excerpts from the Public Testimony of Fenton Rexford:

#### Comment KAK-2:

I oppose Lease Sale 124. After briefly reading the draft EIS, I noted, or I noticed, that there is not enough information on subsistence and/or cultural -- our culture protection if there was to be oil spilled or any -- any adverse impact on -- on there. I noticed on all the alternatives that there is only a paragraph or less than a page addressing the socio-economic and also cultural effects on -- on any of the alternatives, whether it's no lease sale or deferred -- deferrals like around Barter Island.

I just noticed that there is not much information on the subsistence, resource, archeological protection, and just, that's all I have on that. I just oppose Lease Sale 124 (sic) on account that it does not address in detail the protection of our subsistence, cultural, and -- and also the animals if there were to be an oil spill. That's all I have. Thank you.

### Excerpts from the Public Testimony of Isaac Ahkootchik:

(Mr. Ahkootchik's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment KAK-3:

There is no demonstration or the proper clean-up of an oil spill where there's ice, where ice is involved. And so I have a lot of questions about that, and I would really like to know how that could -- how the clean-up could be taken care of to pick up all this oil that's under the ice or in the water should it occur.

#### Comment KAK-4:

As we were growing up, there was a lot of game plentiful, namely the caribou. But when development started in the years that he mentioned, they have been declining. Since this development of the oil companies started, there has been a very noticeable decline on the caribou. You have to travel way up, go up all the way to the mountains to catch any caribou nowadays.

### Excerpts from the Public Testimony of Jonns Ningeok:

(Mr. Ningeok's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment KAK-5:

And from experience, I can say that when pressure ridge is forming, even when there's no wind to help it along, the ocean currents can be such that they can pile up this ice that no matter how quick or how -- if you -- in your words, if you can say that evacuation must be done in a moment's time, even if you're that swift, there can be nothing you can do because, from experience, I can say something can happen

once the oil rig has reached all this oil down on the ocean floor, and then this pressure ridge starts forming. There can -- there there have been times when you can do nothing no matter how swift you think you are.

### Excerpts from the Public Testimony of Alfred Lynn:

#### Comment KAK-6:

I'm opposed to this lease sale because I feel that the oil companies, you know, they don't have -- they don't have enough technology to handle any blow-outs during exploration of oil in the Beaufort Sea. Would like to say that -- you know, let me put this theoretical scenario before you is, say some drilling rig is drilling for oil in the Beaufort Sea and at the very point where this exploration discovers oil there is a -- an earthquake, and, you know, they have oil blow-out. And it's just starting winter and they're drilling on the bottom of the ocean. Now, how is the oil company going to be able to handle the blow-out? You know, suppose that oil that they've just -- just discovered just now is all going out under the sea, and just the impact of this thing is that it will impact the very culture that I live in because I have -- because the very food that -- that I hunt for each spring would be hurt.

Now, the scene would be that it's summertime, and when all this oil that's coming out, now, how is the oil companies going to clean this out? You know, and this is why I'm very opposed to these lease sales. That's all I have....

### Excerpts from the Public Testimony of Nolan Solomon:

#### Comment KAK-7:

And if you have a floating structure, which I've seen in the -- over at Beaufort Sea, at Canada area, I have -- I have been to few of them just for -- just for the -- just to look at them, and I know how the -- how they put their anchors to this ship so it will never move. And it -- it's a -- they put great big anchors, probably more than six, I don't know. Probably if there's big current, they'll put more anchors. And ice is pretty strong. I don't think any anchor of anything that contains a great big cable would -- would stand any -- any ice pressure with a current anywhere, and that's what I'm afear'd (sic) of. I've seen this inside the Beaufort Sea right by a demarcation, where the oil company put their ships out and drilled with these -- with the big anchors, and I don't think it would stand out there.

### Excerpts from the Public Testimony of Herman Aishana:

#### Comment KAK-8:

Okay. Knowing that you'll be using the floating drill ships, I'm pretty leery about the safety of this program. You're going out in some deep waters. But I would like to see in place before the lease sale is held an oil spill contingency plan in place and also oil spill clean-up equipment in place in each drilling -- drilling ship if that's at all possible.

#### Comment KAK-9:

But for safety matters in case of an oil spill, a massive one or a little one, I think the oil industry should have a plan in place in Arctic drilling, especially out -- quite a ways out where it's quite deep, not using gravel islands or these -- the ships that are -- the ships they use in the fairly shallow -- shallow areas. The people are reluctant to have drill ships,

floating drill ships, drilling out there and especially in the wintertime.

So my main concern, for me, is the drill -- I mean the oil spill contingency plan should be in place and also a clean-up equipment and crew in place. That's about all I ask for. I can't -- I know my subsistence is jeopardized by your proposal, which is -- would be devastating if something happens, like a major oil spill they had down in Prince William Sound. There's all kinds of animals out there which we live on, and I presume that the federal government will do their best not to harm the resources, animal resources, out there.

Excerpts from the Public Testimony of Robert Thompson:

Comment KAK-10:

Also, I've read part of the Beaufort Sea Planning Area Oil Lease Sale 124, and I don't believe a lot of this is based upon factual data. Theories about oil movement under the ice, I don't know if it's based upon any actual situations. There seems to be a lot of theory; the theory seems to accommodate the purpose the oil companies have of trying to make it sound like they can do it without any problems. I don't believe that some of the data in this has been researched, such as the -- the level at which the oil will flow through the water. For some species, the documentation says that they won't be affected because the oil won't -- the spilled oil won't travel at those depths that those particular animals have for a habitat. But I believe the oil will travel at all different depths, and until such time that there's more research on -- on the oil behavior, I don't believe that this exploration should continue.

Comment KAK-11:

Also, it doesn't cover -- you know, it's not really into this oil sale, but the -- the method that industry will use to get the oil from where it's found to the shore, and you know, that -- that wasn't covered. And also this -- this is, I believe, a federal sale, and it will have to be crossing state -- state waters, and that hasn't been addressed. The State's held that it's -- some of the previous sales that they had, that data had to be provided, and I haven't seen that. Of course, I haven't got -- had much chance to look at this.

Comment KAK-12:

The other objection that I have about this -- this hearing is the time wasn't published, and I just got off work, so I missed most of the hearing. I question the legality of a hearing as such a time when many, many people will miss it because of work. If the time had been posted, maybe people could make their plans accordingly, but it -- I don't -- it wasn't to my knowledge.

Comment KAK-13:

I -- I haven't had a chance to really study this thoroughly 'cause I just got a copy of it yesterday, but the things that I did study, it seemed to not be based upon any actual factual data -- more theory than knowledge. Also, I don't believe that there's been many studies on the effects that oil -- the effects of oil pollution in colder waters, the long-term effects, the -- the effects that they have on whales. It was mentioned that in theory, the oil -- the whales would be able to avoid oil contaminated area. I don't know how the whales will know where -- what areas are contaminated and what areas are not, but somehow, the study presumed that the whales would be able to know and wouldn't be affected.

The -- the theory about the effects of the oil on the baleen, it -- the study admitted, weren't conclusive, but there is a

theory that the oiled baleen could separate from the whale's mouth and -- and be ingested and -- and could cause fatalities in whale. This -- this, if it is a theory that it could happen, I don't know how it could be studied, but that alone should be considered as a reason not to have the sale.

Comment KAK-14:

The -- the ocean currents, I believe, are parallel to the -- to the coast and along the same -- the same routes that the whales travel. So they -- the whales would have to be in the oil-contaminated area for a -- for four or five hundred -- or the whole length of the Arctic coast. And the studies -- apparently presume that it would be just a very casual confrontation with the oil. I -- I also am not sure just how accurately the ocean currents have been studied. I believe they should be thoroughly studied and so that all people will be able to know just how they -- they will be affected.

## Responses to Comments from the Kaktovik Public Hearing

### KAK-1:

This concern is addressed in Responses MMC-16, NSB-8, and NAEC-7.

### KAK-2:

The EIS describes the subsistence and sociocultural systems at length in Sections III.C.2 and 3. Sections IV.C.9 and 10 analyze the potential effects of the base case of the proposed lease sale on these important issues. These sections are the largest and most detailed—the low and high cases, cumulative, and alternatives build on the analyses in the base case.

### KAK-3:

This concern is addressed in Responses MMC-16, NSB-10, and NAEC-7.

### KAK-4:

Caribou herds on the North Slope have increased coincidentally with oil development (including the Porcupine Caribou Herd from about 100,000 in the 1970's to a recent estimate of about 180,000). Some local changes in the distribution of caribou have occurred. See Section IV.C.7.a(1) for a discussion of general effects of disturbance on caribou.

### KAK-5:

The sea-ice regime of the Beaufort Sea is discussed in Section III.A.4 of the EIS. This discussion notes the formation of ridges and of ice riding up and piling up along the coast.

### KAK-6:

This concern is addressed in Responses NSB-10 and N-2.

### KAK-7:

This concern is addressed in Response BAR-29.

### KAK-8:

Such plans and onsite-response equipment are required of a lessee by MMS after the lease sale but prior to drilling. Where wells will be drilled, who will drill them, and which drilling platform will be used are questions that cannot be answered until after a lease sale but must be known before a contingency plan can be written. See also Response BAR-7.

### KAK-9:

This concern is addressed in Responses NAEC-8 and KAK-8.

### KAK-10:

This concern is addressed in Response NAEC-5b.

### KAK-11:

The technologies that might be used to exploit the petroleum resources of the Sale 124 area are discussed in Section II.B of the EIS. State of Alaska oil and gas lease sales are noted in Table IV-A-4-1 and described briefly in Appendix E; the locations of these sales are shown on Graphic 3. The effects of the State oil and gas lease sales are considered in the cumulative-effects section of the EIS—Section IV.I.

### KAK-12:

Arrangements for the public hearing were made through the Mayors office in May. Also, publicity for the meeting appeared in the Barrow Sun and was broadcast over the Barrow radio and TV stations.

### KAK-13:

See Responses MMC-20, NOAA-24, and N-5.

### KAK-14:

The oceanographic conditions in and adjacent to the Beaufort Sea Planning Area are discussed in Section III.A.3 of the EIS.

## NUIQSUT PUBLIC HEARING

### Excerpts from the Public Testimony of Nelson Ahvakana:

#### Comment NUI-1:

It's very hard for our people to address, time after time after time, the concerns that they have. And when a meeting like this, which calibrates the concerns of our people, they never receive or hear what -- what really happened to those -- those statements that they had made. A lot of the people here don't speak English, and they don't write either. So it's very hard for them to -- to understand whether or not their concerns are -- are considered wholeheartedly by MMS.

#### Comment NUI-2:

Another concern that -- that draft EIS may not address -- I don't know whether it did or not -- is the fishing of the coastal villages, especially this village. They fish for whitefish, and they fish for -- for Arctic cisco, and these are practically a daily consumption requirements for -- you know, for these people here.

#### Comment NUI-3:

What adverse effects is this going to have on the whaling? It's so stated on the Alaska Offshore Oil and Gas Leasing Program, and I kind of laughed about it, on the question about, What about oil spills? It stated here that MMS also is responsible for ensuring that OCS oil and gas operations here do not pollute the environment. I hope this is -- this is true, but it made me wonder of what happened down at -- at Valdez area and the problem that -- that they incur on an oil spill there through the tanker. I know that we're not talking about tankers here, but it would have probably about the same adverse effect in this area and maybe more.

#### Comment NUI-4:

I don't believe that -- that MMS (sic) -- MMS should be security in their minds of the industry, and indication that they do have these -- these people available, that they are well trained, that these things will never happen. It's so stated here that -- that there have never been -- been an oil spill in Alaska from the -- from the drilling, the offshore. That may be true, but it only takes one to show whether or not people that is well educated, well able to put everything on paper, let's say, and the actuality of what they say when it comes to the reality of this thing. I think this could be a concern for the draft EIS.

#### Comment NUI-5:

And another concern should be the addressing of the Inupiat people. We're part of the habitats of this area. I don't believe that whoever is writing the EIS should be concerned just -- just of the animals and the species that are here in the North Slope; they should be concerned about the Inupiat people as well 'cause presently, we're surrounded here in this village, and before too long, once the total sale is completed and drilling takes place, there's going to be some restrictions that will be handed out to us again.

Like a good example is Prudhoe Bay. They say that that area is open for subsistence, and it's not. It's written on paper that it is, but the actuality, you go and take a rifle over there, the first things -- first thing that you're going to find out is -- is that the security's going to take care of you. They're not going to let you go anywhere, even though that you may say that I'm out here on subsistence hunt. They don't have no concern whatsoever about that; their concern primarily is the protection of that field, and this is exactly what's going to happen down there.

### Excerpts from the Public Testimony of Isaac Nukapigak:

(Mr. Nukapigak's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment NUI-6:

Well, the only concern I really have right now on the Beaufort Sea Lease Sale 124 is the -- I know that for the fact is the federal government nor the Minerals Management Service don't have the technology of an oil spill clean-up. If an oil spill happened to occur out in the Beaufort Sea during the winter months, I know it's going to -- I know it's going to be hard cleaning up -- cleaning that oil.

Oil companies, the U.S. federal come and don't have the technologies; I know for a fact. They don't have the technology still. They may have the manpower and the equipment to clean up the oil spill, but the technology, is still -- hasn't there (sic).

#### Comment NUI-7:

That Exxon Valdez had killed a lot of migrating birds; beavers were killed. They were in thousands. If an oil spill happened to occur in the Beaufort Sea, we're looking at our subsistence resource. We have lot of migrating birds along the Peril (ph) Islands. If an oil spill happened to occur, that's what going to happen too.

#### Comment NUI-8:

Actually also the -- also the commander of Nuiqsut Oil Spill Response Team. I definitely have went through training on the oil spill, and from the -- the experience what I learned from this training, technology, it still needs to be there (indiscernible). Oil companies say that you may have -- they may say that they have the capability to cleaning a spill, but -- but if the oil spill occurred in the winter, in the winter months, underneath the ice, we're talking, 'cause of the different -- 'cause I know that the current moves any direction out in the Beaufort Sea, and the ice is so thick and rough, it's going to be hard trying to clean up the spill. The oil companies say they have the equipment and the manpower to do it. Federal government, I know that for a fact, they still needs to do more research on the technology of oil spill clean-up.

### Excerpts from the Public Testimony of Thomas Napageak:

(Mayor Napageak's testimony was presented in Inupiaq and in English.)

#### Comment NUI-9:

Further study in this area is necessary because reduction in the bowhead stock may result in reduction or elimination of bowhead quotas for subsistence hunters in the Inupiat community. Throughout the EIS, the draft concludes that effect on bowhead whales from noise disturbance will be very low or low; however, the effect on subsistence harvest patterns are expected to be very high in Nuiqsut area as a result of effect on bowhead whale harvest due to construction activities at Point Thompson, while moderate effects are expected at Barrow, Atkasuk, Wainwright, and Kaktovik.

On one hand, the draft states that the effect on bowhead whales from noise disturbance will be low; on the other hand, the same draft states that the effect on the subsistence harvest from the reaction of bowhead whales to noise

disturbance will be high. These findings are eternally inconsistent.

In Nuiqsut, the effect of subsistence harvest patterns will be very high because not only will the bowhead whale always be reduced or eliminated by construction activities.

Comment NUI-10:

The caribou hunt will be reduced as well by construction activities and the pipelines.

Comment NUI-11:

There's a -- there is a high likelihood that the reduction or elimination of whaling could have severe ramifications of the socio-cultural and family network system of the Inupiat community. Therefore, it is absolutely imperative that the Inupiat community and the oil industry work together to mitigate and -- mitigate the adverse impact on subsistence hunting. A way of life that has existed for centuries could not be eliminated in 30 years -- 30 years over which the leases on the Beaufort Sea will run.

Comment NUI-12:

In conclusion, Oil and Gas Lease Sale 124 should be postponed for several years while further research is conducted and, in particular, the bowhead whale. The sale should also be postponed until more scientific knowledge and more advanced equipment is available concerning the Arctic Ocean and its related temperatures and weather conditions. Delaying the sale may be the best possible solution to save but a fragile ecosystem of the Arctic Ocean and the Native subsistence hunting.

Comment NUI-13:

Additionally, if the sale was delayed long enough, fewer leases could be operating on the ecosystem at the same time. If the sale is finalized, individual Inupiat communities should be given more control in the process -- in the process from the beginning until the end. Mitigating measures, such as limiting drilling offshore to 80 feet, allowing -- only allowing bottom-founded drilling, and reducing industrial activities during the whale hunt seasons, should be agreed upon. The mitigating measures should be clearly detailed, and oil companies should be required to abide by the plan and sanctioned if they don't comply.

Comment NUI-14:

Recent emergency plans for oil spill containment and clean-up have not proved to be effective. In general, experience shows that response to oil spills are slow and inadequate in remote areas with severe conditions. Even well designed contingency plans are likely to be difficult to implement.

Excerpts from the Public Testimony of Joe Kasak:

Comment NUI-15:

Yes, I'd just like to point out what -- had a question. What was causing all these caribous to die off last summer and this summer -- and, I mean, this winter too? And how much relationship you got with the Fish and Game personnel? And what developments they give you from all the findings they have been finding from these dead caribou? Like last summer, there was a herd of caribous coming out from the east and they were crossing the Nerluk (ph) Channel, and some people were killing some caribous. And they find that the -- the skinny ones they found were discolored on their meat. And what would cause that discoloration of the meat they found?

And what I guess would be caused by that laying around over there by Prudhoe Bay where all that burning that gas with their chemical mixed with it may have caused that or something. And some of these -- when the people go out to Prudhoe Bay for a clean-up job, you know, volunteer type, you know, with small pay, they always have something to say about these birds being dead out there.

Excerpts from the Public Testimony of Bernice Pasula:

Comment NUI-16:

And right now, what we are talking about is the ocean. Nobody owns the ocean except what you guys say you guys do, the federal government, just like what they're doing in Prudhoe Bay. So therefore then, you guys are battling us, the whole community, and I'm just concerned about what we have to fight with. We have no -- no -- we have no deeds to that ocean but to tell you that it's being used year after year for whaling for so long. It goes way back to 1800s, and it's still being used. And as far as I'm concerned, the impact of sale to open up -- open it up for drilling would hurt us.

Comment NUI-17:

You guys have no promises in writing that you'll guarantee us jobs, security, because as far as I know, you guys look for qualification in paper. Are you a qualified operator? Do you have proof? Have you gone to school, or can you speak English? And as far as I know, in Prudhoe you have to be so much qualified to be working over there. And the people around here, how can you get experience without going on the job and training? How do we know what kind of opportunities we will have? What -- what do we gain from this? Just like you say you have everything in writing, what do we gain from it in writing? Can we have it in writing? 'Cause if we have it in writing and you go back on your word, then we could go to court and tell you you've said it.

Comment NUI-18:

What kind of studies is there in the Arctic Slope that has done drilling in the Arctic Slope? What -- what's the success rate? Has there been any drilling in the Arctic Slope in the ocean? How do we know it'll work?

Excerpts from the Public Testimony of Majorie Ahnupknak:

(Ms. Ahnupknak's testimony was presented in Inupiaq and translated into English by the translator.)

Comment NUI-19:

True, there are times you are taking every precaution, but there are also times when the inevitable happens -- happens. And so should the blow-out occur, what -- what technology or what equipment can go under the ice and clean up this spill?

## Responses to Comments from the Nuiqsut Public Hearing

### NUI-1:

The MMS considers the comments of the residents of the NSB communities important to our understanding of concerns they have regarding the OCS leasing program; by having an interpreter available at the hearings, we hope to reinforce this conviction. Comments and concerns that are expressed at the public hearings are reviewed by the authors who prepare the analyses and respond to comments. These comments are evaluated to determine if changes need to be made to the alternatives or mitigating measures, descriptions of the affected environment, or environmental consequences and what, if any, these revisions should be.

### NUI-2:

The EIS describes Nuiqsut fishing activities in Section III.C.3.b(4)(g) and analyzes the effects of the proposed lease sale on fishing in Sections IV.B.10., IV.C.10.b(4) and c(3), IV.D.10, IV.E.10; IV.F.10, IV.G.10, IV.H.10, and IV.I.10. See also Response ANC-10.

### NUI-3:

The MMS activities on the OCS are aimed at assuring operational safety and preventing pollution, with major emphasis on preventing oil spills. An MMS inspector is at the site during all exploratory-drilling operations. For development and production, MMS inspects all OCS oil and gas operations at least once each year, and more often if necessary, for compliance with stringent safety and pollution-prevention regulations.

This concern also is addressed in Responses NSB-8 and NSB-23.

### NUI-4:

This concern is addressed in Responses NSB-23, N-1, and N-4.

### NUI-5:

See Responses ANC-10 and N-17.

### NUI-6:

This concern is addressed in Responses MMC-16, NSB-8, NSB-10, N-2, NAEC-7, and MOHR-2.

### NUI-7:

The MMS recognizes that if an oil spill were to occur in the Beaufort Sea such as occurred in Prince William Sound, large quantities of subsistence resources would be harmed and that the oil would be difficult to clean up. This has been analyzed in Section IV of the EIS.

### NUI-8:

This concern is addressed in Responses NUI-6 and N-4.

### NUI-9:

See Response N-16.

### NUI-10:

The caribou population (Central Arctic Herd) has greatly increased (from about 3,000 in the early 1970's to about 18,000 at present) since oil development in the Prudhoe Bay

area has begun. Restrictions on subsistence hunting have occurred in this area and are expected to occur near development facilities assumed under the Proposal (see Sec. IV.C.10.b(3)), last paragraph). See Section IV.C.7 for effects of the Proposal on caribou.

### NUI-11:

See Response N-17.

### NUI-12:

While more information may be useful, MMS believes it has an adequate database with which to analyze the potential effects on the environment of the proposed sale. The MMS prepared EIS's for four previous oil and gas lease sales in the Beaufort Sea Planning Area.

### NUI-13:

See Response N-18.

### NUI-14:

This concern is addressed in Responses MMC-16 and NSB-8.

### NUI-15:

The die off of caribou is often caused by natural diseases; however, any die off such as that described should be reported as soon as possible to the nearest State ADF&G biologist (in Fairbanks, telephone 452-1531, or in Barrow the biologist named John Trent). Hopefully, the State biologist will investigate to determine the cause of death. The MMS does not have any direct connections with State fish and game authorities. Anyone observing such die offs of caribou or other animals should record their observations and also the names of the persons who saw the die off. This information should be given to the State fish and game biologist. It is very important to convey as much information as possible to ADF&G so that they will investigate and determine if the die off was caused by natural disease or could be related to pollution.

### NUI-16:

Through the OCSLA, as amended, Congress authorized jurisdiction of the Federal Government over the submerged lands of the OCS. The Congressional declaration of policy, 43 U.S.C 1332, states:

It is hereby declared to be the policy of the United States that--

(1) the subsoil and seabed of the outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this subchapter; and

(3) the outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

In addition to petroleum exploitation, other activities that involve the submerged lands of the OCS and the overlying waters are subject to applicable laws, regulations, and international treaties of the United States.

For Alaskan Natives who reside in Alaska and dwell along the coast of the North Pacific Ocean or the Arctic Ocean, Federal law (Marine Mammal Protection Act of 1972) recognizes the taking of marine mammals for purposes of subsistence or creating and selling authentic Native articles of handicrafts and clothing.

In deciding if a lease sale should be held, the Secretary of the Interior must consider the economic, social, and environmental values of the renewable and nonrenewable resources and balance the benefits of oil and gas exploration and possible development and production with potential risks to the environment.

**NUI-17:**

The MMS recognizes the frustration North Slope residents must feel when they are unable to attain employment in the oil industry. The issue of local hire is a problem throughout Alaska, not just in Prudhoe Bay. Companies may decide they will hire a certain percentage of local residents, but this is not a requirement MMS can attach to the lease.

**NUI-18:**

As noted in Section I.B.2 of the EIS, 22 wells have been drilled on Federal leases in the Beaufort Sea; MMS has determined that 8 of these wells are producible (this determination indicates that the well is capable of producing petroleum but does not indicate a commercial discovery). Also, as of December 1, 1989, 62 wells have been drilled on State of Alaska coastal lands and in State waters.

**NUI-19:**

This concern is addressed in Responses MMC-16, NSB-10, and NAEC-7.

## ANCHORAGE PUBLIC HEARING

### Excerpts from the Public Testimony of Richard Ozar:

#### Comment ANC-1:

Tract Deferral Alternatives IV and V are not justified by the MMS analysis in the DEIS, which conclude there -- that there is no significant change in potential adverse impact by deferrals. Although resource estimates have been made in the DEIS, deferral areas could contain significantly greater resources. Only the drilling of exploratory wells will determine if oil is indeed present.

#### Comment ANC-2:

As to a seasonal drilling limitation during times when bowhead whales may be present, AOGA submits that limitations on exploratory drilling such as required by Stipulation No. 8 are not necessary, particularly in light of Stipulation 5 and 6, which require whale monitoring and consultation with Native whalers. Moreover, industry has established a precedent of establishing formal, cooperative agreements with whalers to avoid conflict with subsistence whaling.

### Excerpts from the Public Testimony of Don Hartman:

#### Comment ANC-3:

We believe that Alternatives IV and V, which would delete large areas from the vicinities of Barrow and Barter Island, are not supported by the discussion in the DEIS. The conclusion of the MMS analysis is that there is little effect on potential impacts of the sale by these deletions, and there is the possibility that these areas may contain significant oil reserves.

### Excerpts from the Public Testimony of Sharon Sturges:

#### Comment ANC-4:

Trustees' opposition to Lease Sale 124 is based, in part, on the lack of scientific data supporting the DEIS impact conclusions. This failure is especially glaring in the DEIS analyses of the potential environmental impacts of oil exploration and development activities on marine mammals. Regrettably, the DEIS treatment of impacts to marine mammals was highly selective in that it failed to evaluate or, in many cases, even mention the present scientific data examining the effects of exploratory and development activities on marine mammals.

#### Comment ANC-5:

Point No. 1: The DEIS failed to consider the extremely efficient sound propagation characteristics of the Beaufort Sea in its consideration of potential effects of marine seismic and industrial noise on marine mammals. This failure is especially disturbing in light of the huge surface areas that will be surveyed. Moreover, the best available scientific evidence demonstrates that bowhead whales, a listed endangered species, exhibit strong avoidance behavior when encountering operating seismic vessels in Arctic waters, even at substantial distances. Nonetheless, the DEIS optimistically concludes that the effect of acoustical disturbances on bowhead whales would be very low.

#### Comment ANC-6:

Point No. 2: The DEIS failed to consider the full impact of

helicopter traffic on seal and walrus pup survivability. Flight responses of hauled-out adult seals and walrus pups will certainly decrease pup survival -- excuse me -- survivability due to pup trampling during adult flight responses from helicopter traffic. Seal and walrus rookeries are areas of high animal concentration, and thus, large numbers of pup deaths can be expected.

#### Comment ANC-7:

Point No. 3: Many of the noises produced by exploratory and production activities occur at low sound frequencies, under 100 hertz. This is also the range of whale vocalization. The DEIS fails to analyze, or even mention, the potential for hearing and navigational impairment to whales from industrial noise.

#### Comment ANC-8:

Point No. 4: The DEIS fails to adequately address the impacts of increased vessel traffic on whale navigation. Specifically, there is no treatment of the potential impact on the ability of whales to assess ice conditions acoustically. There is evidence which indicates that bowhead whales determine areas of thin or thick ice by perceiving the relative level of their own call as it is reflected off the ice. Drill ships and attendant vessels may distort the sounds produced by whales, thus, impairing their ability to detect ice thin enough to be pierced for a breathing hole; without this ability, whales may drown.

#### Comment ANC-9:

Point No. 5: The DEIS fails to consider the effects of oil spills on the reproductive capacity and health of marine mammals. This is an extremely important consideration in light of the DEIS's conclusions that the effects of an oil spill on marine mammals would be merely a moderate effect because any fatal -- excuse me -- fatalities would be replaced in one generation.

### Excerpts from the Public Testimony of Jane Degnan:

#### Comment ANC-10:

I'm not saying we're against development, but I think what the voices want to reiterate is that we need a safe and sane approach to what we do on land and sea. I listened to the testimony of the two gentlemen ahead of me saying it wasn't necessary to consult with the whale hunters or necessary to protect subsistence. I disagree with that because we all know that the subsistence issue is a hot, politically debated issue at this point.

## Responses to Comments from the Anchorage Public Hearing

### ANC-1:

As noted in Section II.A.2, the resource estimates for the Sale 124 area were revised after publication of the DEIS. The amount of oil estimated to be present in the sale area for the base case for Alternative I is 900 MMbbl; for each of the deferral alternatives, Alternatives IV and V, the amount also is estimated to be 900 MMbbl.

Estimates of the petroleum resources for each of the deferral alternatives are obtained after the deferred areas have been determined; and, until exploration and delineation wells are drilled, these resource estimates remain very speculative. Even though they might contain only negligible or small amounts of petroleum resources, exploration drilling could occur in the deferred areas if they were offered for lease; and if a discovery were made, development and production might follow. The analyses of the potential environmental effects of the lease sale take into consideration the possibility of some level of petroleum-industry activity in the deferred areas. Because the deferred areas may be important for a variety of biological and sociocultural reasons, the elimination of possible exploration and development and production activities from these areas by deleting them from the lease sale could be significant.

### ANC-2:

See Responses BP-2, AOGA-11, and MMC-11.

### ANC-3:

See Response ANC-1.

### ANC-4:

The EIS analysis on the effects of oil and gas exploration and development on marine mammals is based on relevant scientific information and a synthesis of this information—see Sections IV.C.5.a and IV.B.5(1) and 2(2), General Effects of Oil and General Effects of Noise and Disturbance, respectively.

### ANC-5:

See Responses TFA-4, TFA-5, and N-14.

### ANC-6:

See Response TFA-13.

### ANC-7:

See Responses N-9, N-11, and N-14.

### ANC-8:

See Response N-11.

### ANC-9:

See Response TFA-16.

### ANC-10:

The MMS agrees that the effect of the proposed lease sale on subsistence harvests is an important issue. Effects on subsistence harvests are estimated to be HIGH. Stipulations Nos. 3, 5, 6, and 8 have been proposed to mitigate some of these effects.

## **SECTION VI**

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# **CONSULTATION AND COORDINATION**

## VI. CONSULTATION AND COORDINATION

### A. Development of the Proposal

The proposed Beaufort Sea Planning Area oil and gas lease Sale 124 is one of 38 proposed Outer Continental Shelf (OCS) sales included in the current 5-Year OCS Oil and Gas Leasing Schedule. Official coordination with other government agencies, industry, and the public regarding this proposed action began on September 14, 1988, with a Call for Information and Nominations and Notice of Intent to Prepare an Environmental Impact Statement (EIS), which requested expressions of industry interest in blocks within the Call area and requested comments on environmental issues related to possible oil and gas leasing in the area. Responses were received from nine companies, the State of Alaska, the North Slope Borough (NSB), U.S. Fish and Wildlife Service (FWS), National Park Service, U.S. Navy, and the National Oceanic and Atmospheric Administration (NOAA).

Following evaluation of the area nominations and environmental information received in the process described above, together with other relevant information, the Minerals Management Service submitted a recommendation for area selection to the Secretary of the Interior. On December 23, 1988, the Department of the Interior announced the area selected for further environmental study. (See Sec. I.A for more details.)

### B. Development of the EIS

During preparation of this and past EIS's for the Beaufort Sea Planning Area, Federal, State, and local agencies; industry; and the public were consulted to obtain descriptive information, to identify significant effects and issues, and to identify effective mitigation measures and reasonable alternatives to the proposed action. The comments received during the scoping process for Sale 124 also noted that issues raised and mitigating measures and alternatives suggested for past Beaufort Sea Planning Area lease sales were relevant to Sale 124. All of the information received has been considered in preparing the Sale 124 EIS. In addition, a scoping meeting was held in Barrow, Alaska, with local agencies and the public to identify more clearly and specifically issues and alternatives to be studied in the EIS. Scoping information can be found in Section I.D. Departmental agencies with interest and expertise in the OCS were consulted during the development of the potential mitigating measures for this proposed action (see Sec. II.G.1). Public hearings on the Sale 124 draft EIS (DEIS) were held in the NSB communities of Barrow, Kaktovik, and Nuiqsut and in Anchorage during April 17 to 20, 1990.

### C. List of Contacts for Review of the EIS

Federal, State, and local government agencies, academic institutions, industry, special-interest groups; other organizations; and private citizens were consulted prior to and during the preparation of this EIS. These agencies, institutions, groups, and individuals are listed below and were sent copies of the DEIS for review and comment.

#### Federal

##### Executive Branch - Departments

Department of Commerce  
National Oceanic and Atmospheric  
Administration  
Department of Defense  
Deputy Assistant Secretary for Environment  
and Safety  
U.S. Army  
Corps of Engineers  
Waterways Experiment Station  
Cold Regions Research and  
Engineering Laboratory  
Alaska District  
Department of Energy  
Technical Information Center

Department of Health and Human Services  
Centers for Disease Control  
Department of the Interior  
Bureau of Indian Affairs  
Bureau of Land Management  
Bureau of Mines  
Fish & Wildlife Service  
Geological Survey  
National Park Service  
Office of Environmental Assessment  
Department of State  
Office of Environment and Natural Resources  
Department of Transportation  
Commandant, U.S. Coast Guard  
Office of Pipeline Safety

Legislative Branch

U.S. House of Representatives  
Committee on Interior & Insular Affairs  
Committee on Merchant Marine & Fisheries  
Subcommittees on Panama Canal &  
OCS

U.S. Senate  
Committee on Energy and Natural Resources  
Congressional Budget Office  
Library of Congress  
Congressional Research Services

Administrative Agencies and Other Agencies

Environmental Protection Agency  
Marine Mammal Commission  
National Science Foundation  
Division of Polar Programs  
Nuclear Regulatory Commission  
Division of Site, Safety, and Environmental  
Analysis

Other Organizations

Smithsonian Institution

State of Alaska

Alaska State Legislature  
Senate Resources Committee  
Alaska Oil & Gas Conservation Commission  
Department of Community & Regional Affairs  
Department of Commerce & Economic Development  
Department of Environmental Conservation  
Department of Fish & Game  
Department of Labor  
Department of Natural Resources  
Department of Health and Social Services  
Office of the Governor  
Division of Governmental Coordination  
University of Alaska  
Arctic Environmental Information and Data Center  
Elmer E. Rasmuson Library  
Fossil Energy Research Council  
Geophysical Institute  
Institute of Social and Economic Research  
Institute of Arctic Biology  
Institute of Marine Science  
Marine Advisory Program  
Petroleum Development Lab  
Water Research Center  
Department of Civil Engineering

Local Governments, Native Organizations, and Libraries

Alakanuk Public Library  
Alaska Eskimo Whaling Commission  
Aleut Corp.  
Arctic Slope Regional Corp.  
Bristol Bay Coastal Resource Service Area  
City of Barrow  
City of Kaktovik  
Kaveolook School Library  
City of Kotzebue  
George Francis Memorial Library  
City of Nuiqsut  
City of Point Hope  
Cenaliurrit Coastal Management District  
Davis Menadelook Memorial Library, Diomede  
Eskimo Walrus Commission  
Eyak Corporation  
Inalik Native Corporation, Little Diomede Island  
Kegoyah Kozga Public Library, Nome  
Kenai Community Library  
Kingikme Public Library, Wales  
Koyuk City Library  
Kuukpik Corporation, Nuiqsut  
Maniilaq Association, Kotzebue

Matanuska-Susitna Borough  
Municipality of Anchorage  
Z.J. Loussac Public Library  
NANA Regional Corporation, Inc.  
Native Village of Barrow (Inupiat Traditional  
Government)  
Nellie Weyiouanna Iiisaavik Library, Shishmaref  
North Slope Borough  
Northwest Arctic Borough  
Savoonga Public Library  
Shishmaref Native Corporation  
Sitnasuak Native Corp  
Soldotna Public Library  
Stebbins Community Library  
Ticasuk Library, Unalakleet  
Tikigaq Library, Point Hope

Canada

Canadian Wildlife Service, National Wildlife Research  
Centre  
Circumpolar Affairs, Government of the NWT  
Department of Fisheries & Oceans  
Department of Indian & Northern Affairs  
Geological Survey of Canada  
Institute of Ocean Sciences, Dept. of Fisheries &  
Oceans, Sidney, BC  
Joint Secretariat, Fisheries Joint Mgt. Com., Inuvik, NWT  
Regional District of Mount Waddington, Port McNeill,  
BC

Special-Interest Groups

Friends of The Earth  
Greenpeace  
National Audubon Society  
Natural Resources Defense Council  
Northern Alaska Environmental Center  
Sierra Club  
Trustees for Alaska

Petroleum Industry

Alaska Clean Seas  
Alaska Oil and Gas Association  
Alaska Support Industry Alliance  
Amerada Hess Corporation  
American Petroleum Institute  
AMOCO Canada Petroleum Co., Ltd.  
AMOCO Production Company  
ARCO Alaska, Inc.  
Baroid Drilling Fluids  
BP Exploration  
Chevron USA Inc.  
Columbia Gas Devel. Corp.  
Conoco Inc.  
ELF Aquitaine Petroleum  
Enserch Exploration Inc.  
Exxon Company, USA  
Fina Oil and Gas Company  
Global Marine  
Halliburton Geophysical Services, Inc.  
Home Oil Company, Ltd.  
Hunt Oil Company  
Kerr-McGee Corporation  
M-I Drilling Fluids  
Marathon Oil Company  
Murphy Oil USA, Inc.  
Mobil Oil Corporation  
ODECO Oil & Gas Company  
Pennwell Publishing Co.  
Pennzoil Exploration & Production Co.  
Petro-Canada Inc.  
Petroleum Information  
Oil & Gas Journal  
Shell Western E&P Inc.  
Tennessee Gas Pipeline

Texaco Inc.  
Tide Petroleum Company  
Union Texas Petroleum Corporation  
UNOCAL

Regional Technical Working Group

Paul Gronholdt, Sand Point  
Perry Adkison, Dillingham  
Alaska Dragers Assoc., Executive Director, Kodiak  
Bering Sea Fishermen's Assoc., Extension Specialist,  
Anchorage  
Chevron USA, Inc., Exploration Representative,  
Anchorage  
Department of Natural Resources, Petroleum Mgr., Div.  
Oil & Gas, Anchorage  
Environmental Protection Agency, Anchorage  
Exxon Company, USA, Alaska Coordinator, Houston,  
TX  
FWS, Chief, Div. Tech. Support, Anchorage  
Halliburton Geophysical Services, Inc., Mgr., Alaska  
Division, Anchorage  
National Wildlife Federation, Alaska Resource Center,  
Director, Anchorage  
NOAA, National Marine Fisheries Service, Anchorage  
NSB, Planning Director, Barrow  
Shell Western E&P Inc., Mgr., Development  
Engineering, Alaska Division, Houston, TX  
U.S. Army Corps of Engineers, Chief, Regulatory  
Branch, Alaska District  
U.S. Coast Guard, Juneau

Individuals, Associations, Companies, and Other Groups

Adriaan Volker Worldwide Dredging BV  
Alaska Geographic Society  
Alaska Journal of Commerce  
Alaska Oil and Industry News  
Alaska Pacific University, Center for Polar Research and  
Education  
Alaska Public Radio Network  
Amax Mineral Resources Co.  
Anchorage Chamber of Commerce  
Anchorage Daily News  
Andrews University  
Applied Science Associates  
Arctic Biological Station  
Arctic News-Record & Polar Bulletin  
Arctic Slope Consulting Group  
Ms. Cass Arley  
Atwater Consultants

Battelle Ocean Sciences  
Belmar Engineering  
Earl H. Beistline  
Bering Straits Coastal Mgt. Prog.  
Richard Berley  
Biosphere  
Bolt, Bernak, and Newman  
Mr. William Britt  
Brown & Root USA, Inc.  
Dr. Ernest S. Burch, Jr.

C & S Mining Company  
Cascadia Research  
Tim Casteel, Jr.  
CGG American Services, Inc.  
Coastal Ecosystems Mgt., Inc.  
Continental Shelf Associates

Dames & Moore  
Dartmouth College, Institute of Arctic Study  
Digicon  
Doyle & Savit  
Mrs. Sue Duthweiler

EBA Engineering, Inc.

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## **APPENDICES**

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- A      Resource Estimates**
- B      Exploration and Development Report**
- C      Synopsis of the Exxon Valdez Spill**
- D      Alternative-Energy Sources**
- E      Major Projects Considered in Cumulative-Effects Assessment**
- F      MMS Alaska OCS Region Studies Program**
- G      Oil-Spill-Risk Analysis**
- H      Exploration, Development and Production, and Transportation Estimates and Assumptions**
- I      Archaeological Analysis Prepared by MMS**
- J      Supporting Tables for Section III.C.1, Economy of the North Slope Borough, and Section IV.C.8, Effects on the Economy of the North Slope Borough**
- K      Endangered Species Act Section 7 Consultation and Documentation**
- L      Fate and Effects of Exploratory Phase Oil and Gas Drilling Discharges in the Beaufort Sea Planning Area, Lease Sale 124**
- M      Aspects of Spilled Oil**

Table IV-B-1 and Appendix L present chemical concentrations in discharged drilling muds in the Beaufort Sea. The EPA generally requires a chemical analysis of drilling mud for each exploration well as a permit condition. Concentrations of pollutant concentrations in drilling muds are limited by toxicity criteria and direct limitations of pollutant concentrations noted in NPDES permits. Formation waters are not being discharged from the single producing field in the Beaufort Sea. Formation waters are highly variable in pollutant content, and maximum pollutant concentrations in discharged formation waters are limited by EPA as described in Section IV.B.1. These limitations allow maximum allowable discharges of some constituents to be estimated in the EIS. A much more accurate estimate of discharges--if discharges are even proposed--can be made at the time of a developmental EIS for a field, based on measured concentrations in muds, cuttings, and formation waters for that field.

#### MOHR-11:

The MMS assumes that all laws and regulations that apply to OCS oil and gas operations are properly administered by those Government agencies that have enforcement responsibilities. The purpose of the EIS is to analyze the potential environmental effects of petroleum development on the OCS and not provide a forum for criticism of the action of other agencies; there are other means of informing the public about the actions of those agencies that might be negligent in performing their statutory or regulatory responsibilities.

#### MOHR-12:

This concern is addressed in Appendix L. The EPA NPDES permits for Alaskan waters allow discharge of only low-toxicity drilling muds and prohibit the discharge of muds contaminated with diesel. The EPA studied the diesel-spill issue and made the determination not to allow discharge of muds that have had a diesel pill added and then removed, because studies had demonstrated significant diesel contamination of the residual mud.

#### MOHR-13:

The EPA NPDES permits now prohibit the use of metal-contaminated barite. Barium ions are detoxified in seawater by the immediate precipitation of highly insoluble barium sulfate. If barium halides were exceedingly poisonous, as claimed by the commenter, they would not be used internally as a cardiac stimulant or bone-scanning agent in humans or for treatment of constipation in horses (Windholz et al., 1976).

#### MOHR-14:

Low toxicity of drilling muds is assured by limiting the ingredients that are allowed in discharged drilling muds. The permitted ingredients in discharged drilling muds are listed in Table 6 of Appendix L. Acrolein is not listed. Any substance that is an intentional component of a mud formulation and is not on the list would require authorization of the Regional Director, EPA.

Potential discharges of formation waters containing hydrocarbons were evaluated in Sections IV.C.1 and IV.D.1. See also Responses MOHR-9 and MOHR-10.

#### MOHR-15:

Produced waters are being reinjected primarily to enhance production rather than as a pollution-control measure in Alaskan oil fields. Once capital expenditure is made in reinjection equipment, a company is unlikely to discard that investment and not reinject produced waters. In addition,

although the analysis of water quality suggests that discharge of produced waters may not occur in the proposed sale area, such discharge of produced waters is conservatively assumed to occur for a MODERATE LOCAL and VERY LOW REGIONAL effect in the base case.

#### MOHR-16:

We have thus far been unable to determine if foraminiferans have been successfully used as indicators of oil pollution or other activities associated with oil exploration, production, or development. The effects of oil on bacterial assemblages in the Beaufort Sea have been examined by Atlas, and this work and the general issue are covered in Section IV.B.1 of the Sale 97 FEIS (USDOL, MMS, 1987).

#### MOHR-17:

The potential for disruption of chemically-mediated behaviors has been discussed in Section IV.C.2.a.2. Also, some findings of Dr. Dan Morse of the University of California at Santa Barbara have been added to the discussion of effects of drilling discharges (Sec. IV.C.2.c). You are correct in your conclusion that at the present we can make only crude guesses about the possible extent and importance of these types of effects.

#### MOHR-18:

Hydrofluoric and hydrochloric acids are used only for specific reservoir acidification requirements, and large quantities are not stored on a production platform. Furthermore, it may not be economical to produce petroleum from a reservoir requiring large quantities of either acid.

#### MOHR-19:

The potential environmental effects of Sale 124 are analyzed mainly on the basis of events that are likely to happen given the major scoping issues, Section I.D.1, and the scenarios, Sections II.B through F. Also, an event that has a low probability of happening but with potentially high effect levels is analyzed in Section IV.N.

Regulations for implementing the procedural provisions of the NEPA note the following (40 CFR 1502.1):

The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts. . . .

Furthermore, Sale 124 is a broad action that involves leasing a geographical area for possible petroleum exploitation; it is not a site-specific action, with designated technologies and operations, where the effects of specific actions, or series of actions, could be appropriately analyzed.

Thus, MMS considers the analyses in the Sale 124 EIS fulfill the purpose of the EIS and are appropriate for the type of action proposed.

The MMS recognizes a single accident might cause a series of other mishaps and is aware of the environmental factors and constraining activities in and adjacent to the sale area.

Harry E Wilson  
2120 N Callow Ave  
Bremerton, WA 98312-2908  
May 4, 1990

Richard W Roberts  
EIS Coordinator  
Minerals Management Service  
949 E 36th Ave  
Room 110  
Anchorage, AK 99503-4302

Dear Sir

Thank you for the opportunity to comment on the Draft Environmental Impact Statement for Beaufort Sea Planning Area Oil and Gas Lease Sale 124 (OCS EIS/EA MMS 90-0006).

I would like Alternative II - No Sale to be the preferred alternative but realize that it probably will not happen. In that case Alternative III - Delay the Sale should be the preferred alternative. The sale should be delayed until the United States has an energy policy.

I believe that the transportation times listed in table M-6 for storage locations, Seattle, Concord, Santa Barbara, Long Beach and Stockton are low and should be increased.

WIL  
1

The section on oil spills needs to be expanded.

WIL  
2

Thank you for your time and consideration.

Sincerely

*Harry E Wilson*

Harry E Wilson  
2120 N Callow Ave  
Bremerton, WA 98312-2908

WIL-1:

The listed transportation times are those provided to MMS in the cited oil-spill-contingency plans. The MMS accepted but did not independently verify these industry estimates, and such verification is not required of industry by MMS contingency-plan guidelines (see Allen, Hale, and Prentki, 1984).

WIL-2:

This concern is addressed in Responses MMC-16, MMC-20, MMC-22, and NAEC-5b.

## **APPENDIX A**

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### **RESOURCE ESTIMATES**

## Estimates of Quantities of Undiscovered Resources

### I. Resource Assessment Methodology

Estimates of potential quantities of undiscovered oil and gas are vital to essential long-range national planning. The Federal Government's offshore oil and gas leasing program depends in part on projections of the potential amounts of undiscovered hydrocarbon resources on the Outer Continental Shelf (OCS) and estimates of those resources which may be technologically and economically recoverable. The pace of discovery and development of these resources affects national security, the economic health of a large sector of the economy, the balance of trade, and many other important national issues.

The Minerals Management Service (MMS) develops estimates of the undiscovered oil and gas resource base and economically recoverable undiscovered hydrocarbons in support of the OCS leasing program. These estimates are used in a number of public and internal documents related to leasing, such as sale-specific Environmental Impact Statements (EIS), Secretarial Issue Documents (SID), the Biennial Report to Congress (Section 606, OCS Lands Act), formulation of the 5-Year Leasing Program, and technical publications.

The EIS's for specific lease sales and events such as the development of a 5-Year Leasing Program use the estimates as a basis for analyzing potential environmental impacts of a proposed activity, e.g., oil spill risk analysis, sale alternatives and deferral options, or any other requirement for which the potential resources in specific areas may serve as the basis for evaluating potential actions. In the SID, estimates of the amounts and locations of potential resources are used to assist the Secretary of the Interior in balancing the economic benefits of development against the environmental consequences resulting from the leasing of offshore areas for petroleum exploration and development. Estimates provided in the Biennial Report to Congress may be used by the legislative branch and others for national strategic and economic planning purposes.

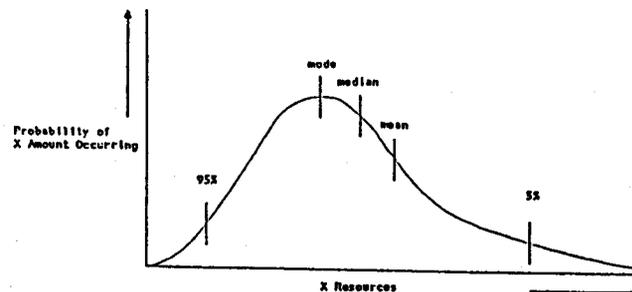
Estimating the undiscovered resource base and economically recoverable amounts of oil and gas remaining to be discovered on the OCS is a difficult task because of the uncertainties inherent in the process. The actual existence of hydrocarbon accumulations is not known with certainty prior to exploratory drilling. The only information concerning the existence of a potential producing field is derived from inferences, extrapolations, and subjective judgments. Geophysical data provide clues as to the existence and location of possible traps (prospects) and their general dimensions, but geologic data on the quality of any potential reservoir rocks or source materials are usually absent. Generally, until drilling operations commence, no data will be available on the nature and distribution of included hydrocarbons, or indeed whether hydrocarbons are present at all. Obviously, an exact prediction of resource quantities under such circumstances is impossible because the uncertainties in the input data set translate directly to uncertainties in the estimates.

Two main types of undiscovered resource estimates are commonly used, conditional and risked, each responding to different needs. Conditional,

undiscovered resource estimates represent the amount of resources anticipated if a certain condition exists, the condition being that recoverable quantities of oil and/or gas are present in the area of study. In other words, if oil and/or gas are found to exist in an area, the conditional estimates represent the amount of hydrocarbons determined to be ultimately recoverable. These estimates are used, for instance, to assess the full range of potential environmental impacts in an area if leasing, exploration, development, and production were to occur; the condition that hydrocarbons exist must be assumed, otherwise impacts would not be a concern.

However, if the economic value of a resource is being considered, conditional estimates are not the appropriate measure. In these cases, such as the economic analyses prepared for sale-specific SID's, the resource estimates must incorporate the probability (or risk, which is often extremely high in frontier areas) that recoverable hydrocarbons may not be present in the entire area. The conditional estimates are modified by consideration of this probability that recoverable resources do not exist (that is, factoring in the risk) and are then said to be risked resource estimates.

Considering the uncertainty of geologic and engineering variables associated with hydrocarbon traps, resource estimates are usually presented as a range or distribution of values; reporting just one value lends a false sense of precision to the estimate. If a single estimate is required, the mean value of the distribution of possible values is the single best indicator of central tendency, since it reflects both the probability and magnitude of the estimates. The mean, also known as the expected value, is the arithmetic average of all values in the distribution. It is not the "most likely" estimate. The most likely estimate is a probability-weighted average called the mode. Another indicator is the median, which is the value that divides a probability distribution into two equal parts; it corresponds to the 50th percentile on a cumulative frequency distribution. The figure below is a diagram depicting these three measures on a sample probability density curve, which displays the amount of resources versus the relative probability of occurrence. The 95 percent estimate shown on the graph indicates a low estimate having a 19-in-20 chance that the actual amount will be greater. The 5 percent value is a high estimate with a 1-in-20 likelihood that the actual amount will be greater.



The resource estimation process used by the MMS to generate estimates under conditions of uncertainty, incorporates a computer program called PRESTO (Probabilistic Resource ESTimates Offshore). This program provides MMS with a range of estimates, both conditional and risked.

The program is objective and utilizes a large geological and geophysical data base, not only from the offshore areas but also from onshore and offshore State lands. The results produced from the model are reproducible and updatable. This allows new data or new interpretations to have a quantifiable effect on the resource estimates. Results are presented as ranges of values rather than as single-point estimates, so that useful limits can be provided for planning purposes. The program is also functional under a wide range of uncertainty since our knowledge of potential offshore petroleum provinces varies from considerable to general regional knowledge.

The current PRESTO model is in its third generation and incorporates many new, state-of-the-art enhancements. The program uses the types of geologic and geophysical data normally used by the oil industry to locate and define potential hydrocarbon-bearing geologic features. These data are analyzed, interpreted, and eventually refined to a set of input values which numerically model all known potential prospects in the study area.

Since these input values are rarely exactly known, uncertainty is accounted for by range-of-values estimation, i.e., the inputs for variables can be entered as distributions over an appropriate range of possible values with associated probabilities of occurrence. The variables used to define prospects and their resource potential are:

1. areal extent (acres),
2. zone pay thickness (feet),
3. oil recovery factor (stock tank barrels/acre-feet),
4. gas recovery factor (thousand cubic feet/acre-feet),
5. proportion (PROP) of the zone pay thickness consisting of gas,
6. solution gas-to-oil ratio (standard cubic feet/stock tank barrel), and
7. condensate yield (stock tank barrels/million cubic feet of gas).

Dependencies among these input variables can be specified where appropriate. Two other zone properties that may be specified are (1) probability of all oil (OPROB) and (2) probability of all gas (GPROB) for each zone.

Before calculating resources, the model first uses the input geologic risks to determine if hydrocarbons are present in each specific prospect. Next it determines whether a reservoir contains all oil, all gas, or both (by using OPROB, GPROB, PROP). PRESTO then calculates volumes of oil, associated and

nonassociated gas, condensate and solution gas, as appropriate, for all hydrocarbon-bearing prospects on each trial by the following equations:

1. volume of oil, barrels = (acres)(thickness)(1-PROP)(oil recovery factor),
2. volume of nonassociated and associated gas, million cubic feet = (acres)(thickness)(PROP)(gas recovery factor)(.001),
3. volume of condensate, barrels = (condensate yield)(nonassociated and associated gas), and
4. volume of solution gas, thousand cubic feet = (gas-to-oil ratio)(oil, barrels)(.001).

Using the above set of inputs as the basis for estimates of resource volumes, the program uses sophisticated statistical sampling techniques to calculate resources. Since each input can be represented by a distribution of values, one point on the distribution for each variable is randomly sampled and the selected values are entered into the volumetric equations to solve for resource amounts. This process is called a "drilling simulation trial" or "pass" and can be repeated as many as 10,000 times. On each of these trials, the model simulates a state of nature by "discovering" which prospects will be hydrocarbon-bearing by using input risks to simulate drilling of each prospect.

To determine the number of trials in which a prospect or zone contributes to the total, the model uses a risk assessment considered at four levels: zone, prospect, basin (or play), and area (or basin). The evaluator must enter risk values which measure the probability that the prospect or zones within a prospect will be dry and the overall probability that the basin (and area) may be dry. Additional estimates of minimum economic field size for each prospect, and minimum economic basin and area reserves (in barrels of oil equivalent (BOE)) are required to determine the portion of the undiscovered resource base that is economically recoverable. Minimum economic field sizes are calculated exogenously through use of a discounted cash flow (DCF) model. They represent the smallest resource amount which would balance development and operating costs (including transportation costs for the gathering system) for a prospect and yield a minimum rate of return. The minimum economic field size is tailored to the prospect, considering factors such as water depth, distance from shore, depth to the potential pay horizon, and current and projected economic conditions.

PRESTO develops estimates of economically recoverable resources on a trial by comparing the calculated resource volumes of each successful prospect to the minimum economic field size. The gas volumes calculated for a prospect are converted to a volume of oil equivalent on the basis of energy or economic equivalency and then added to the oil volume to yield a total BOE for the prospect (BOE conversion is described further in Appendix A, Section II, categories of Resource Estimates). If the calculated prospect resource volume in BOE exceeds the minimum economic field size, the prospect is considered to be economically viable and its resources contribute to the

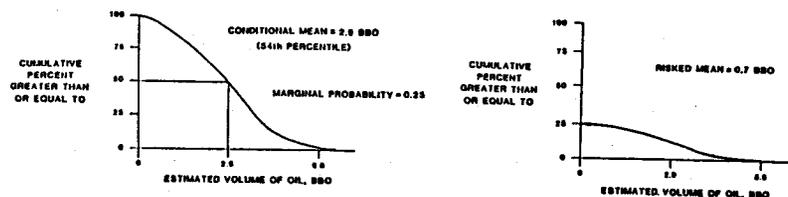
total. If the calculated prospect resources are less than the minimum economic field size, then the prospect is considered noncommercial and its resources are set equal to zero for that trial. Resource amounts greater than the minimum economic field size for prospects within a basin are aggregated on each trial and compared to a minimum economic basin reserve. The minimum economic basin reserve, also calculated exogenously, is the minimum amount of resources necessary to justify a regional production infrastructure in a basin. Finally, resource amounts for all basins in an area on a given trial are compared to a minimum economic area reserve to determine whether enough resources are present to justify production facilities for the area. This feature is more appropriate for frontier areas than for mature areas with an existing infrastructure.

When the specified number of trials is completed for either the undiscovered resource base or economically recoverable estimates, the solutions of each trial are sorted and ranked and the results are defined by distributions of solutions. Thus, the full range of possible volumetric solutions are represented by a single curve with each point on the distribution having an equal probability of occurrence. PRESTO outputs include both conditional and risked distributions. Since the output of PRESTO is a distribution of resource estimates, for convenience, the results are usually reported using only the mean value and the 5th and 95th percentiles. The 5th percentile can be considered a high estimate where there is a 5 percent chance of that amount or more occurring, the 95th as a low estimate where there is a 95 percent chance of that amount or more occurring, and the mean is the average value of all trials.

An important number associated with conditional estimates is the marginal probability. The condition is quantified by assigning it a numerical value (the marginal probability (MP)). The MP is a measure of the probability that hydrocarbons exist in an area and is represented as a decimal fraction. (For economically recoverable resources, the MP is a measure of the probability that commercial hydrocarbons exist in the area.) An MP of 1.00 indicates certainty of hydrocarbon occurrence in the area; an MP of zero indicates no chance whatsoever. The MP applies to the entire conditional distribution. As an example, consider an area having an MP equal to 0.25. This means that the area has a 25 percent chance of containing a hydrocarbon accumulation. If hydrocarbons do exist, then the conditional distribution represents the range of possible values. By removing the condition and incorporating the risk that the entire area may be barren of hydrocarbons, the estimates are said to be risked.

The following graphs illustrate conditional and risked resource distributions. Cumulative percentages are given on the vertical axis and oil volumes on the horizontal axis. The conditional curve has a corresponding MP of 0.25 and if hydrocarbons do exist, the conditional curve displays the calculated range of values. It can be seen on the conditional curve that the 50th percentile corresponds to 2.9 billion barrels of oil, i.e., there is a 50 percent probability that at least 2.9 BBO will be found if there are accumulations of oil present in the area (the mean or average value is 2.8 BBO which corresponds to the 54th percentile in this case). The graph on the right shows the risked distribution of estimates. Note

that the risked mean estimate is only .7 BBO (.25 X 2.8), reflecting the low probability of success in this hypothetical area. The risked curve also shows the chance of resource amounts being greater than or equal to zero is 25 percent (corresponding to the MP); there is a 75 percent chance the area is dry.



Conditional resource estimates are constrained by a number of statistical caveats which are not intuitive. PRESTO calculates planning area resource estimates (or any subset such as an alternative sale configuration) by statistically aggregating the estimates of resources in each individual prospect. It does not follow, however, that the total planning area estimate is the arithmetic sum of the prospect estimates. This is because each prospect has a different condition (i.e., the chance that hydrocarbons occur in the prospect). Prospect resources can be aggregated to planning area totals only by rerunning the program using all prospect data and making any required risk adjustments.

The conditional mean multiplied by the MP yields the risked mean, i.e., the average value factoring in the potential risk of no hydrocarbons existing in the area. However, this is statistically valid only for the mean value; the 5th and 95th percentiles cannot be multiplied by the MP for risked 5th and 95th percentiles. (The 5th and 95th percentiles on the conditional distribution, when multiplied by the marginal probability, will correspond to different percentiles on the risked distribution.)

The risked mean values can be added or subtracted. However, conditional means are not additive; conditional or risked percentile estimates (such as the 5th and 95th percentile estimates) cannot be added or subtracted, but must be aggregated statistically. Risked mean resource values are most useful in comparing different areas for ranking purposes. However, as mentioned earlier, it is the conditional and not the risked mean that is the amount anticipated if recoverable (or commercial) quantities of oil and gas occur in nature. The following example illustrates the essential difference between the two types of estimates and the need to consider both in making informed judgments and decisions. Two areas have been assessed, resulting in very different conditional mean resource levels and marginal probabilities.

	Conditional Mean (Million BBLs)	MP	Risked Mean (Million BBLs)
Area A	1,000	.10	100
Area B	125	.80	100

The risked mean values calculated for both areas are the same. However, Area A has a larger potential (eight times larger than Area B), with only a small chance (10 percent) of hydrocarbons existing in the area. If Area B contains hydrocarbons, the average amount anticipated is much smaller, but the chance of hydrocarbons existing in the area is greater (80 percent).

The distinction between conditional and risked results is further illustrated by the following example. The undiscovered resource base for a fictitious OCS basin is estimated to be between 1 and 7 billion barrels of oil with an average of 3 billion barrels if oil is present in the basin. However, it is estimated that there is only a 25 percent chance that this condition will be met (oil present in the basin). In other words, if there were 100 basins in the world similar to this fictitious basin, 75 would be dry and 25 would contain oil. The 25 basins containing oil would each have between 1 and 7 billion barrels with the average size being 3 billion barrels. The average amount found in the 100 basins would be reported as 750 million barrels. This is the "risked mean" estimate. Therefore, based on current geologic, engineering, and economic knowledge, if this one fictitious basin is fully explored and oil is found, the amount found will be between 1 and 7 billion barrels with an average value of 3 billion barrels. There is, however, only a 25 percent chance of oil being present, so the risked mean estimate is reported at 750 million barrels. In actuality, the amount found would be either zero or between 1 and 7 billion barrels and not the risked mean estimate of 750 million barrels.

## II. Categories of Resource Estimates

Various categories of undiscovered resource estimates, each responding to a different question or need, can be developed using the models and methodologies described above. These estimates can be derived from a baseline data set comprised of all prospects in the area. These resource estimates form a nested hierarchy, where each estimate is a subset of previous estimates.

Planning Area Estimate  
(Undiscovered Resource Base)

Planning Area Estimate  
(Economically Recoverable)

Sale Area Estimate  
(Economically Recoverable)

A-8

Economically Recoverable  
Resources Estimated to be  
Leased Due to Sale

Resources Estimated to be  
Leased Due to Alternative  
Sale Configurations  
(or Deferral/Deletion Options)

Planning Area Estimates are the top tier of undiscovered resource estimates. These estimates are for policy guidance and as such, they are broad and all encompassing in nature. They are used, for example, to develop the 5-Year Leasing Program and the Biennial Report to Congress (Section 605, OCS Lands Act). These estimates include both prospects identified through interpretation of geologic and geophysical data and prospects postulated by the extrapolation of geologic trends into areas having scant data. They also include adjustments for the fact that current exploration tools and analyses are not perfect in identifying all potential accumulations.

The undiscovered resource base includes estimated quantities of oil and gas resources which can physically be produced at the surface by conventional technological means, without regard to any economic constraints. Planning area estimates that are described as economically recoverable include resources only from those prospects that are of sufficient size to be economically producible and marketable, based on current and projected economic conditions and foreseeable technological trends.

Gas production is presently uneconomic in all cases, assuming it must be marketed on the U.S. West Coast. The cost of platforms, wells, pipeline, liquefaction plant, tankers, and regasification is much higher than any projected return based on current price forecasts for the gas. The market price is not forecast to rise sufficiently during the sale scenario to change this conclusion. Produced gas, not flared or used as fuel, will be reinjected for pressure maintenance. For more information on the economics of gas, see pages B-3 and B-4 in Appendix B.

For the Beaufort Planning Area, the undiscovered economically recoverable estimates follow:

### Undiscovered, Economically Recoverable Resource Estimates \* Beaufort Planning Area (leased and unleased)

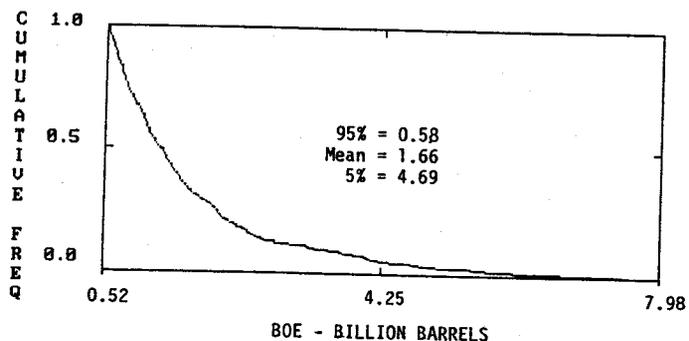
	Oil (Billion Barrels)	Gas (Trillion Cubic Feet)
Conditional		
95th Percentile	0.58	0.00
Mean	1.66	0.00
5th Percentile	4.69	0.00
Marginal Probability =	0.23	

A-9

Risked		
95th Percentile	0.00	0.00
Mean	0.38	0.00
5th Percentile	2.63	0.00

\* The above estimates are an update of the resource estimates developed for the National Resource Assessment (NRA) published in 1989. The updated estimates are a little higher than those published for the NRA. The modest increase in the updated estimates is attributed to the identification of several new prospects found in the mapping effort conducted in preparation for OCS Sale 97 (March 1988). Some additional seismic data were available for the Sale 97 mapping effort.

(Although estimates are shown at the 95th percentile, 5th percentile, and mean cases, these are only three possible numbers from a full and continuous distribution of possible values. The figure below shows a conditional distribution for the economically recoverable resources, in barrels of oil equivalent. Gas volumes are converted to barrels of oil on an energy equivalent basis and then added to the oil volume. One barrel of oil equivalent equals 5.62 Mcf of gas based on 5,800,000 Btu/barrel and 1,032 Btu/cubic feet of gas. Every point on these curves is equally likely to occur. However, the low and high estimates indicate the range of possible values and the conditional mean represents the average amount anticipated, given that recoverable hydrocarbons exist in at least one of the prospects modeled.)



BOE - BILLION BARRELS  
Conditional Results - Beaufort Planning Area

Sale Area Estimates are prepared to comply with sale-specific analytical requirements related to environmental analyses and cost/benefit studies. Oftentimes the area offered for lease is smaller than the entire planning area. Therefore, prospects lying outside of the proposed sale area must be deleted from the assessment. These estimates are undiscovered, economically recoverable resources which are based on current economic and technological conditions and projections. Since these estimates are more area-specific

and of nearer term use than planning area estimates, postulated (unmapped) prospects generally are not included, except where justified on a case-by-case basis. Economically recoverable resource estimates for the entire area offered for lease (excludes acreage already leased) in the proposed Beaufort Sale 124 are shown below: \*

Undiscovered Economically Recoverable Resource Estimates  
Beaufort Sale Area (unleased)

	Oil (Billion Barrels)	Gas (Trillion Cubic Feet)
Conditional		
95th Percentile	0.43	0.00
Mean	1.45	0.00
5th Percentile	4.19	0.00
Marginal Probability =	0.16	
Risked		
95th Percentile	0.00	0.00
Mean	0.24	0.00
5th Percentile	2.00	0.00

\* The above estimates differ modestly from the National Resource Assessment (NRA) estimates published in 1989. The NRA was conducted over a period of more than 2 years and reflects data and information available as of January 1, 1987. The updated estimates were developed using additional geophysical data not available for the NRA and also they incorporate the results of the Beaufort Sale 97, held in March 1988.

The sale area estimates represent the amount of undiscovered economically recoverable resources offered for lease. The Resources Estimated to be Leased represent an assessment by MMS of the amount of resources which would be leased, discovered, and produced as a result of the sale and, therefore, the amount upon which the impact analysis is to be based. For proposed Sale 124, MMS considered previous leasing rates, industry interest, prospect distribution, economic and technological considerations, and infrastructure distribution to determine the resources estimated to be leased.

Low, base, and high case estimates are developed to analyze the range of possible outcomes which could result from holding the proposed sale, as explained further in Section III, Rationale for Multiple Scenarios.

To arrive at the base case estimate, a judgment is made as to what percentage of the unleased conditional mean oil resources is expected to be leased and developed. Some of the major considerations in the judgment process include (but are not limited to) the quality and size of the prospects, their locations, reservoir and water depths, and historic patterns from previous sales. For the prospects that are expected to be developed (those that appear to offer the greatest potential for a sizeable discovery), an estimate is made as to what percentage of resources these

prospects contribute to the unleased mean resource. However, the resources for each developable prospect are conditional resources with varying marginal probabilities, and therefore cannot be used directly in the process. For this purpose, risked resources can be used because the probabilities that resources do not exist have been factored into each prospect. Therefore, the risked resources are normalized and have the same condition. It follows that by using the risked resources for the prospects, an estimate can be made as to what percentage the developable prospects contribute to the risked mean. This percentage is then applied to the unleased conditional mean to arrive at the base case volume. An estimate was made that the prospects that are expected to be leased and developed represent approximately 62 percent of the risked mean.

This factor was then applied to the unleased conditional mean to arrive at the base case estimate (1.45 billion barrels of oil X 0.62 = 0.90 billion barrels of oil).

This factor was also applied to other levels of the resource distribution. For the high case estimate, this factor was applied to the unleased conditional 5 percent volume to arrive at the high case estimate (4.19 billion barrels of oil X 0.62 = 2.60 billion barrels of oil).

This factor was also applied to the unleased conditional 95 percent volume to arrive at the low case estimate (0.43 billion barrels of oil X 0.62 = 0.27 billion barrels of oil). For the low case, leased acreage will be drilled, but no development will occur. The low case estimate is uneconomic because it is below the estimated minimum economic area resource of 0.52 billion barrels of oil needed for development.

Undiscovered, Economically Recoverable  
Resources Estimated to be Leased  
Due to Sale 124

	Oil (Billion Barrels)	Gas (Trillion Cubic feet)
Base Case	0.90	0.00
High Case	2.60	0.00
Marginal Probability =	0.16	

Resource estimates are also developed for Alternative Sale Configurations (or Deferral/Deletion Options). These estimates allow comparison of the Proposal and the various sale alternatives, using procedures developed to estimate the relative resource contribution of each alternative. To make this comparison, the analysis of the sale area alternatives is based on the same condition as the Proposal, that is, that economically recoverable resources exist in the sale area. Therefore, each alternative has the same marginal probability as the sale area. The alternative estimates are based on the prospect data set used for the resources estimated to be leased at the base case. Risked resource estimates are developed for each prospect and used to compute the relative contribution of the prospects for each alternative. Risked resources for prospects located in deferred areas,

outside of the alternative, are deleted from the base case estimate. The resultant total risked estimate for the alternative is then divided by the marginal probability to obtain the conditional amount shown below. This amount can then be compared to the amount estimated to be leased for the Proposal to determine the relative effects of the Alternative.

The following resource estimates have been prepared for Sale 124 Alternatives:

Undiscovered, Economically Recoverable Resources  
Estimated to be Leased as a Result of  
Alternative Sale Configurations

Alternative	Oil (Billion Barrels)	Gas (Trillion Cubic Feet)
Barrow Subarea Base Case	0.90	0.00
Barter Island Subarea (Kaktovik) Base Case	0.90	0.00
Marginal probability for all alternatives =	0.16	

Our current interpretation of available data suggests a negligible difference in resources expected to be developed and produced for Sale 124 between the two alternatives and the base case. However, this does not indicate a total lack of potential in the deferrals. In fact, we would expect some blocks in the deferrals to be leased and possibly drilled, and perhaps sub-economic volumes of hydrocarbons discovered. This would significantly contribute to area delineation of geology. Also, if an infrastructure is created for a major discovery in the alternatives, any sub-economic discoveries in the deferrals could become economic in the future by linking into the infrastructure. Furthermore, although our current interpretation of data does not provide any evidence to support a major discovery in the deferrals, it is certainly possible. Therefore, the blocks within the deferrals are important for the upcoming sale.

The procedures used to determine these different categories of resource estimates are similar in all cases. While subjectivity exists in determining inputs and which prospects are likely to be leased, judgments are consistently applied by specialists in each discipline. For example, inputs such as acreage and net pay are provided by geologists, reservoir engineering parameters are estimated by petroleum engineers, and so forth. The advantages of the model are that subjective judgments of subject matter experts are handled in an objective manner and written documentation of the various judgments is provided so that the estimates can be readily updated in the future as new information and interpretations become available.

### III. Rationale for Multiple Scenarios in Environmental Impact Statements (EIS's)

Estimates of remaining undiscovered, economically recoverable oil and gas in a proposed sale area are reported in EIS's to provide the basis for an assessment of the environmental, social, and economic impacts which might realistically be assumed to result from a specific sale. Resource estimates serve as the focus of the assumed exploration and development activities that are fundamental to a rigorous assessment of the potential effects of a proposed sale.

Formerly, the impact analyses for sales were conducted on the conditional mean sale area resource (except in the Gulf of Mexico) with a much abridged high (5th percentile) and low (95th percentile) case analysis separated from the primary analysis. The assumption that the total resources estimated to be present in the sale area would be leased, developed, and produced as a result of the sale overstated the level of activity that would result. Since the bulk of the analysis involved the mean resource, a perception developed among some readers that this amount of resource would, in fact, be discovered and produced. This and the resulting estimates of subsequent exploration and development activities acquired a validity among some readers that generally could not be supported by the available leasing data. The uncertainty inherent in the estimates and by inference in the complex series of environmental, economic, and social effects predicated on them needed to be emphasized.

Recognizing the inherent uncertainty associated with resource estimates, the EIS includes an analysis of a range of potential outcomes as represented by three distinct scenarios. This procedure acknowledges the uncertainties associated with estimating the amounts of resources which will be leased and emphasizes that the resource estimates reflect a range of possibilities. The limits of the range of resources are constrained by a low case and a high case, both of which represent realistic levels of exploration and development activity. Within the range is a base case estimate of resources which are believed likely to be leased, developed, and produced as a result of the sale. The low, base, and high cases and their attendant impacts are presented in the EIS for the proposed action.

The low case presented in EIS's is used in frontier planning areas where there is a high probability that commercially exploitable resources do not exist and development activities may not occur as a consequence of leasing. Therefore, for most frontier planning areas, the low case analysis considers impacts associated with industry efforts related only to exploratory activities because the resource estimated is usually below that which would be economic to produce. However, in the event that resource estimates for the low case justify commercial development, then development and production will be included in the low case scenario and analyzed. The low case is used in all areas except the Gulf of Mexico and Southern California which have established production or significant discoveries which may lead to production.

The base case includes undiscovered resources estimated to be leased, developed, and produced, assuming that hydrocarbons exist in the area (i.e., a conditional estimate), and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources. The base case estimate is presumed to be the likely result if hydrocarbons are present in the sale area in commercial quantities and if the sale occurs as proposed. Most of the analytical effort is focused on the base case because it represents the resource quantity that is expected to be found and developed as a result of the sale if hydrocarbons are present in economic volumes in the sale area. Post-exploration National Environmental Policy Act analysis is obviously pointless if commercial oil and/or gas does not exist; therefore, the base and high case resources are reported as conditional estimates because these estimates assume that economically recoverable hydrocarbons exist and will be discovered, developed, produced, and transported to the market. The base case estimate reflects the following: successes or failures since the previous sales in a planning area; previous leasing rates; perceived industry interest; costs associated with exploration and development; existing infrastructure to transport oil or gas to market; and so forth.

The high case is an estimate of a significantly higher level of resource recovery and attendant exploration and development activity which could result from leasing more acreage than may occur in the base case, or which could result from the discoveries of larger oil and gas accumulations than estimated under the base case assumptions. The high case estimate is a larger but still reasonable quantity of resources which very likely produce distinctly different impacts. Ordinarily, the effects of this scenario would be higher than those of the base case because they are predicated on more and larger discoveries. It represents a more optimistic scenario and assumes higher than expected leasing rates, favorable geologic conditions, or improved economics.

An examination of these three levels of resources and subsequent development will cover the range of probable outcomes and impacts which could be anticipated to occur as a result of a sale.

The object of the three-case analysis (base and high cases only in mature, producing planning areas) is to scrutinize a spectrum of activity levels, rather than to assess a single scenario which can change because specific estimates change during the 2- to 3-year prelease process. Representing resource estimates as a range recognizes the uncertainties associated with the estimation methodologies and allows some flexibility if the estimates should change.

Regional offices develop base case resource estimates consistent with the data available to them. The Gulf of Mexico Region uses a historical approach which derives the base case from a rigorous analysis of past leasing rates. The result is a time-dependent decline in resource volume for a succession of sales, wherein each sale is assumed to contribute a percentage of the total planning area resource. Other Regions use (with variations) a methodology which extracts and aggregates the resource volumes of those prospects considered most attractive from the PRESTO data base.

These prospects usually have high industry interest and are the most likely to yield the highest rate of financial return by reason of size, distance from shore, proximity to transportation infrastructure, water depth, etc., and are thus the most likely to be leased as a result of the sale.

#### IV. Exploration and Development Scenarios

Infrastructure for each Environmental Impact Statement (EIS) scenario (low, base, and high cases) is estimated for the Exploration and Development (E&D) Report based on the amounts of conditional resources estimated to be leased and subsequently discovered and developed. An exploration-only scenario results when there is an insufficient quantity of resources in the low case to justify development but only an exploration effort is carried out. The E&D Report is composed of timetables with the yearly numbers of successful and unsuccessful exploration, delineation, and production wells for oil and gas, the number of platforms, oil and gas pipeline miles and production schedules. The E&D infrastructure is estimated using methodologies which are specific to each Minerals Management Service Region and which are based on the amount of historical information available, evaluator's professional judgment, and the geologic, engineering, and economic uncertainties associated with each sale area. An EIS impact analysis based on these three distinct scenarios that are derived from a range of resource estimates, provides decisionmakers with a realistic assessment of the consequences of leasing.

#### V. Resource Estimates for Cumulative Analysis \*

In August 1989, the U.S. Geological Survey and the Minerals Management Service published the National Oil and Gas Resource Assessment (NOGRA) of the undiscovered conventionally recoverable oil and natural gas resources of the United States (Mast, et al., 1989). It considered new geological, technological, and economic information and uses more definitive methods of resource appraisal than previous assessments. The assessment was conducted over a period of more than 2 years and reflects data and information available as of January 1, 1987. The resource estimates for Chukchi, Beaufort, and Hope Planning Areas included in the NOGRA were updated as of January 1, 1990, to include use of geological and geophysical data in these planning areas purchased and available through January 1, 1989.

The updated NOGRA is the basis for the generation of both the sale area resource estimates and the cumulative case resource estimate. The cumulative case number will be arrived at by use of a probabilistic method (known as the USGS Crovelli model) which will yield a range of values. The methodology aggregates distributions (not single point estimates) while honoring the marginal probabilities for each of those distributions.

Conditional resource estimates are not directly comparable between planning areas since they are generally based on different marginal probabilities.

\* This discussion is limited to the methodology used to determine the resource estimates for the OCS in the Arctic Subregion.

A regional or subregional resource estimate derived from the NOGRA will be provided for the cumulative case analysis for individual lease sale EIS's. This resource estimate takes into consideration the different marginal probabilities of each planning area. It provides a resource estimate that gives a better indication of the likelihood of oil and gas activities occurring within the region or subregion over the life of the proposal, and provides consistency in the cumulative analysis from one EIS to the next in the region or subregion. Therefore, the life of the proposal considers past and future sales as well as the current sale, and includes both leased and unleased resources.

For the purposes of EIS analysis, conditional mean resource estimates derived for any subregion assume that the sales on the 5-Year Schedule in that subregion will result in exploration, development, and production. Although a precise schedule will not be developed for when that activity will occur, it is logical to assume that some exploration and/or development could occur from more than one sale in the subregion at the same time, and this could continue throughout the life of those sales.

The cumulative number will remain the same until the NOGRA is changed. Consequently, the analysis of the cumulative case for a sale in a given region or subregion will be similar for all other sales in that region or subregion, provided the NOGRA does not change. There will likely be some differences in the discussion of the contribution of the proposal to cumulative impacts from EIS-to-EIS. This will provide a consistent analysis of the cumulative case for all sales on the 5-Year Schedule in a given region or subregion. This avoids the problem of using a different basis for the cumulative analysis in a given area from one EIS to the next, which would result in inconsistent, conflicting analyses in the EIS's.

For Sale 124 the updated NOGRA resource estimates for the Chukchi, Beaufort, and Hope basins were aggregated using the USGS Crovelli model to develop a cumulative Arctic Subregion resource estimate. For the cumulative estimate the marginal probability increases as we would expect to 0.32 with an associated conditional mean estimate of 5.48 billion barrels of oil. The cumulative resources for the Arctic Subregion are as follows:

Undiscovered, Economically Recoverable  
Resources for the Arctic Sea Subregion  
(leased and unleased)

	Oil (Billion Barrels)	Gas (Trillion Cubic Feet)
Conditional		
95th Percentile	4.29	0.00
Mean	5.48	0.00
5th Percentile	6.87	0.00
Marginal Probability =	0.32	

Risked		
95th Percentile	0.00	0.00
Mean	1.74	0.00
5th Percentile	6.27	0.00

For a full analysis of the cumulative case impact, please see the section of the EIS addressing the analysis of the cumulative case. That discussion contains analyses of cumulative considerations that go beyond just the cumulative resources described above.

**APPENDIX B**

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**EXPLORATION AND DEVELOPMENT  
REPORT**

SALE 124 BEAUFORT SEA

Exploration and Development

1. Scenarios

Three scenario schedules for the Sale Area Proposal of figure 1 are attached. The first schedule shows a low case, the second a base case, and the third a high case. The base case is designed for oil discoveries totaling 900 million barrels (0.90 BBO), the high case for 2,600 million barrels (2.60 BBO).

The mean cumulative case will combine exploration and development efforts from each of three planning areas, including the Hope Basin, Chukchi Sea, and the Beaufort Sea. The table below outlines the selected locations for shorebase facilities as well as the selected transportation mechanisms. All assume a Valdez exit by tanker from Alaska to a domestic coastal market.

<u>PLANNING AREA</u>	<u>SHOREBASE FACILITY</u>	<u>TRANSPORTATION MECHANISM</u>
Beaufort Sea (ALT)	Barrow area, Pitt Pt., Oligtok Pt., and Pt. Thomson	Onshore Gathering System tied into TAPS
Hope Basin	Kivalina	Pipeline tie-in to the Trans-Alaska Pipeline System (TAPS)
Chukchi Sea	Point (Pt.) Belcher	Pipeline tie-in to TAPS
Beaufort Sea	West Dock or Oligtok Pt.	Offshore Gathering System tied into TAPS

The mean cumulative case, with 5,480 million barrels (5.48 BBO) resource, is programmed for 48 exploratory wells, 20 delineation wells, 11 production platforms, and 685 development wells, one-fourth of which are assumed to be service wells.

Three general areas within the Beaufort Sea Sale 124 boundary have been identified as primary targets for oil exploration and development--the eastern, central, and western Beaufort areas. The most likely choice for exploratory drilling vessels will be drillships with icebreaker support. Ice islands may be used in shallow water. Water depths in excess of about 50 feet make gravel island drilling pads cost prohibitive. Exploration in water 35 feet to about 80 feet deep could be accomplished using bottom-founded mobile drilling structures such as the Concrete Island Drilling Structure (CIDS) and the Single Steel Drilling Caisson (SSDC). Drilling rate would be one well per year per exploratory rig. Production platforms would be inverted cone shaped, gravity based concrete structures suitable for extreme ice conditions. Each platform will use two rigs to maximize well drilling rates. At least one rig will remain on each platform for remedial workovers.

Produced oil may be transported to the existing TAPS under two gathering system scenarios. The first scenario employs an onshore gathering system with oil being produced from platforms in each of the three target areas via subsea pipeline to landfalls at or near the Barrow area, Pitt Point, Oligtok Point and Point Thomson. Booster stations at each of these landfalls except Oligtok Point would be required to ship oil into the onshore gathering system, which would be constructed between the Barrow area and Pump Station No. 1 of TAPS and between Point Thomson and Pump Station No. 1. This scenario would require approximately 600 miles of pipeline; 275 miles would be offshore, 75 miles of which would be trenched. The remaining 325 mile onshore portion would be elevated. Pipe lay rate would be approximately 100 miles per year per crew.

The second scenario employs the use of an offshore gathering system at the 30 meter isobath and deeper, and a single landfall in the vicinity of Prudhoe Bay to minimize shipping distance to Pump Station No. 1. This would require approximately 525 miles of pipeline; 510 miles would be offshore, 30 miles of which would be trenched. The remaining 15 miles would be elevated onshore. This scenario would require oversized pipe since it assumes no offshore booster stations would be used.

In both scenarios, nearshore pipelines will be trenched and buried deep enough to avoid ice keel gouging and shallow enough to eliminate potential adverse effects due to the presence of permafrost. If the oil has less than optimum pour point quality, a shore connected causeway may be included for bringing the pipeline onshore.

Gas production is presently uneconomic in all cases, assuming it must be marketed on the U.S. West Coast. The cost of platforms, wells, pipeline, liquefaction plant, tankers, and regasification is much higher than any projected return based on current price forecasts for the gas. The market price is not forecast to rise sufficiently during the sale scenario to change this conclusion.

Also, no economically recoverable natural gas is indicated in a recently released Department of Interior document entitled Estimates of Undiscovered Conventional Oil and Gas Resources in the United States - A Part of the Nation's Energy Endowment (Mast et al, 1989). This NOGRA document received considerable review within the Department as well as peer review from outside agencies and organizations. It relates the Los Angeles future market price of natural gas to the Los Angeles future market price of oil, on a heat energy basis, with gas at an indicated discount.

Oil must be priced at about \$30 per barrel in that market, in 1987 money, for Alaska's lowest cost gas to be marketed there, and at about \$100 per barrel for Alaska's highest cost gas to be marketed there. Potential gas from Beaufort would fall in between but near the high end of these two price extremes. When using current price forecasts, Beaufort gas would clearly be even less economic, for a Los Angeles or West Coast market, throughout this lease sale scenario.

Additional insight into the economics of Alaska's natural gas may be gained by considering the status of known very large reserves of gas at Prudhoe Bay. The Yukon Pacific Corporation has endeavored to promote a complete pipeline, LNG plant, and tanker system for marketing about 2 billion cubic feet per day in the Orient. On December 3, 1987, an "Application of Yukon Pacific Corporation for Authorization to Export Liquefied Natural Gas from the United States" was placed before the Economic Regulatory Administration. This included a study paid for by ARCO, one of the Prudhoe gas owners, which concluded that the project was not economically feasible. Its scenario included favorable foreign flag vessels to a Japanese market, and its unfavorable heavy up-front cost was the pipeline at \$6.8 million per mile.

Exploration and delineation wells will average 10,000 feet (true vertical depth). Production wells will average 13,000 feet drilled depth.

Leases are assumed to be for 10 years. Year 1 in the schedules is the Sale Year. Note that the schedules assume no litigation or regulatory delays. Platform years shown on the schedules are the years of final placement of platforms on location and hooked up for commencement of drilling. The construction and placement of platforms and the subsequent production start-up have waits of 3 to 4 years.

## 2. Muds and Cuttings for Base Case

The average exploration well will use 630 short tons of dry mud and produce 820 short tons of dry rock cuttings.

The average delineation well will use 630 short tons of dry mud and produce 820 short tons of dry rock cuttings.

The average development well will use from 150 to 680 dry net short tons of mud and produce 1180 short tons of dry rock cuttings.

The mud discharged will have this typical composition:

<u>Component</u>	<u>Weight %</u>
Barite	63.0
Clay	24.0
Lignosulfonate	2.0
Lignite	1.5
Sodium hydroxide	1.5
Other	8.0
Total	100.0

Source: Petrazzuolo, 1983.

## 3. Change in the Level of Activity from the Base Case to the Deferral Alternatives

The estimated volume of hydrocarbon that is expected to be developed and produced in the Barrow Subarea Alternative shown in figure 1 is 900 million barrels of oil. An exploration and development schedule (E&D) for this alternative is shown in table 4.

The estimated volume of hydrocarbon that is expected to be developed and produced in the Barter Island Subarea Alternative shown in figure 1 is also 900 million barrels of oil. An E&D schedule for this alternative is shown in table 5. The routing of offshore subsea pipelines may penetrate both deferral areas.

Our current interpretation of available data suggests a negligible difference in resources expected to be developed and produced for Sale 124 between the two alternatives and the base case. However, this does not indicate a total lack of potential in the deferrals. In fact, we would expect some blocks in the deferrals to be leased and possibly drilled, and perhaps sub-economic volumes of hydrocarbons discovered. This would significantly contribute to area delineation of geology. Also, if an infrastructure is created for a major discovery in one of the alternatives, any sub-economic discoveries in the deferrals could become economic in the future by linking into the infrastructure. Furthermore, although our current interpretation of data does not provide any evidence to support a major discovery in the deferrals, it is certainly possible. Therefore, the blocks within the deferrals are important for the upcoming sale.

**SALE 124 BASE CASE**

Year	Exploration Wells	Delineation Wells	Explor/Delin Rigs	Prod/Service Wells	Prod/Service Rigs	Number of Shorebases	MMB BCF	Production Pipeline Miles
1*	2	2	2	2	2			
2	3	2	3	3	3			
3	4	2	3	3	3			
4	5	2	2	2	2			
5	6	2	2	2	2			
6	7							
7	8							
8	8							
9	9							
10	10							
11	11							
12	12							
13	13							
14	14							
15	15							
16	16							
17	16							
18	17							
19	19							
20	20							
21	21							
22	22							
23	23							
24	24							
25	25							
26	26							
27	27							
28	28							
29	29							
30	30							
TOTALS	10	4	0	4	0	120	0	600**

\* Sale Year 1 = Calendar Year 1991  
 \*\* Assumes primarily onshore gathering system. Subtract 75 miles (25 miles in each pipe lay year) for offshore gathering system.

**SALE 124 LOW CASE**

Year	Exploration Wells	Delineation Wells	Explor/Delin Rigs	Prod/Service Wells	Prod/Service Rigs	Number of Shorebases	MMB BCF	Production Pipeline Miles
1*	2	2	2	2	2			
2	3	2	3	3	3			
3	4	2	3	3	3			
4	5	2	2	2	2			
5	6							
6	7							
7	8							
8	8							
9	9							
10	10							
11	11							
12	12							
13	13							
14	14							
15	15							
16	16							
17	17							
18	18							
19	19							
20	20							
21	21							
22	22							
23	23							
24	24							
25	25							
26	26							
27	27							
28	28							
29	29							
30	30							
TOTALS	4	0	0	0	0	0**	270***	0

\* Sale Year 1 = Calendar Year 1991  
 \*\* Assumes drilling rigs are supplied from Deadhorse/Matwright/Katovik using existing facilities.  
 \*\*\* This resource is below the minimum economic resource required for development.

2. EXPLORATION AND DEVELOPMENT SCHEDULE

1. EXPLORATION AND DEVELOPMENT SCHEDULE

6-8

8-8

4. EXPLORATION AND DEVELOPMENT SCHEDULE  
SALE 124 BARNOW SUBAREA ALTERNATIVE

\* Sale Year 1 = Calendar Year 1991  
\*\* Assumes onshore gathering system. Subtract 100 miles (apportioned evenly over Years 7, 8, and 9) for offshore gathering system.

Year	Exploration Wells	Exploration	Destination Wells	Explor/Devel Rigs	Platform	Prod/Service Wells	Production Rigs	Number of Shorebases	Production MMB BCF	Pipeline Miles
1*	4									
2	4									
3	5									
4	5									
5	4									
6	3									
7	2									
8	2									
9	2									
10	3									
11	2									
12	40									
13	85									
14	85									
15	76									
16	218									
17	218									
18	218									
19	218									
20	14									
21	117									
22	104									
23	94									
24	83									
25	76									
26	68									
27	60									
28	55									
29	49									
30										
TOTALS	25	11	0	-	7	0	346	0	2600	0 650**

3. EXPLORATION AND DEVELOPMENT SCHEDULE  
SALE 124 HIGH CASE

\* Sale Year 1 = Calendar Year 1991  
\*\* Assumes primarily onshore gathering system. Subtract 75 miles (25 miles in each pipe lay year) for offshore gathering system.

Year	Exploration Wells	Exploration	Destination Wells	Explor/Devel Rigs	Platform	Prod/Service Wells	Production Rigs	Number of Shorebases	Production MMB BCF	Pipeline Miles
1*	2									
2	2									
3	2									
4	2									
5	2									
6	2									
7	1									
8	2									
9	6									
10	30									
11	50									
12	33									
13	8									
14	57									
15	66									
16	57									
17	51									
18	46									
19	46									
20	40									
21	36									
22	32									
23	29									
24	26									
25	23									
26	21									
27	19									
28	19									
29	17									
30	17									
TOTALS	10	4	0	-	4	0	120	0	900	0 600**

5. EXPLORATION AND DEVELOPMENT SCHEDULE  
 SALE 124 BARTER ISLAND SUBAREA ALTERNATIVE

Year	Exploration Wells	Exploration Delineation Wells	Explor/Devel Rigs	Platform Prod/Oil Gas	Prod/Service Wells	Production Rigs	Number of Shorebases	NMB	BCF	Oil Gas	Production Pipeline	Oil Gas
1*	2	2	2	2	2	2	2	200**	200**	200**	0	0
2	3	2	3	3	3	3	3	200**	200**	200**	0	0
3	4	2	3	3	3	3	3	200**	200**	200**	0	0
4	5	2	3	3	3	3	3	200**	200**	200**	0	0
5	6	2	2	2	2	2	2	200**	200**	200**	0	0
6	7	2	2	2	2	2	2	200**	200**	200**	0	0
7	8	2	2	2	2	2	2	200**	200**	200**	0	0
8	9	2	2	2	2	2	2	200**	200**	200**	0	0
9	10	2	2	2	2	2	2	200**	200**	200**	0	0
10	11	2	2	2	2	2	2	200**	200**	200**	0	0
11	12	2	2	2	2	2	2	200**	200**	200**	0	0
12	13	2	2	2	2	2	2	200**	200**	200**	0	0
13	14	2	2	2	2	2	2	200**	200**	200**	0	0
14	15	2	2	2	2	2	2	200**	200**	200**	0	0
15	16	2	2	2	2	2	2	200**	200**	200**	0	0
16	17	2	2	2	2	2	2	200**	200**	200**	0	0
17	18	2	2	2	2	2	2	200**	200**	200**	0	0
18	19	2	2	2	2	2	2	200**	200**	200**	0	0
19	20	2	2	2	2	2	2	200**	200**	200**	0	0
20	21	2	2	2	2	2	2	200**	200**	200**	0	0
21	22	2	2	2	2	2	2	200**	200**	200**	0	0
22	23	2	2	2	2	2	2	200**	200**	200**	0	0
23	24	2	2	2	2	2	2	200**	200**	200**	0	0
24	25	2	2	2	2	2	2	200**	200**	200**	0	0
25	26	2	2	2	2	2	2	200**	200**	200**	0	0
26	27	2	2	2	2	2	2	200**	200**	200**	0	0
27	28	2	2	2	2	2	2	200**	200**	200**	0	0
28	29	2	2	2	2	2	2	200**	200**	200**	0	0
29	30	2	2	2	2	2	2	200**	200**	200**	0	0
TOTALS	10	4	0	4	0	4	0	0	0	900	0	600**

\* Sale Year 1 = Calendar Year 1991  
 \*\* Assumes primarily onshore gathering system. Subtract 75 miles (25 miles in each pipe lay year) for offshore gathering system.

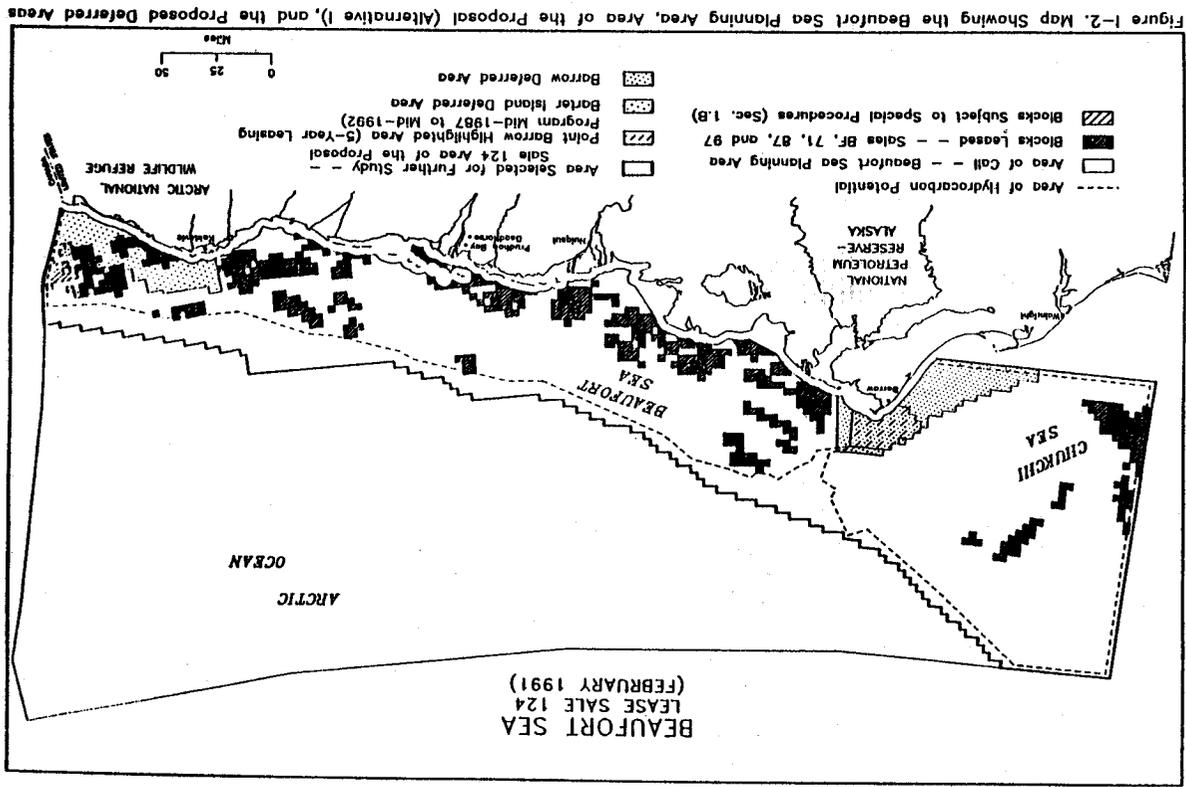


Figure 1-2. Map Showing the Beaufort Sea Planning Area, Area of the Proposal (Alternative I), and the Proposed Deferred Areas

**APPENDIX C**

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**SYNOPSIS OF THE**

**EXXON VALDEZ**

**SPIII**

**THE U.S. DEPARTMENT OF THE INTERIOR'S AUTHORITIES, RESPONSIBILITIES, AND  
RESPONSE ACTIONS ASSOCIATED WITH THE T/V EXXON VALDEZ OIL SPILL**

Shortly after midnight on March 24, 1989, the 987-foot vessel T/V Exxon Valdez struck Bligh Reef in Prince William Sound, Alaska. What followed was the largest oil spill in U.S. history. The resultant oil slick contacted coastlines in Prince William Sound, along the Kenai Peninsula, Cook Inlet, and the Shelikof Strait. Experts are assessing the environmental and economic implications of the T/V Exxon Valdez oil spill. The job of cleaning up the spill is a continuing process; and, although the initial response proceeded slowly, major steps have been taken.

The very large spill size, the remote location, and the character of the oil all tested spill-preparedness and -response capabilities. Government and industry plans, individually and collectively, proved to be wholly insufficient to control an oil spill of the magnitude of the T/V Exxon Valdez. Initial industry efforts to get equipment onscene were slow. And, once deployed, the equipment could not cope with the spill.

**Authorities and Responsibilities:** The U.S. Department of the Interior (USDOI) has four areas of responsibility for oil spills or releases of hazardous substances. Two entail response activities, and two are associated with USDOI's role as a trustee for natural resources. The authorities for these activities are the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, and the Clean Water Act (CWA) (amendments to the Federal Water Pollution Control Act) Section 311. Executive Order (EO) 12580 names the members of and delegates certain responsibilities to the National Response Team, of which USDOI is a member.

Following oil spills or releases of hazardous substances, the USDOI—as a member of the National Response Team and Regional Response Teams—provides response assistance along with other Federal agencies in support of the U.S. Coast Guard (USCG) or the Environmental Protection Agency (EPA) in the manner described in the National Contingency Plan and the Regional Contingency Plans. The USDOI's focus in response assistance is based on the full range of the Department's jurisdiction and expertise. (The USDOI also responds to oil spills or hazardous-substance releases on its own lands, in compliance with Superfund provisions for Federal facilities.)

As a trustee for natural resources, the USDOI is authorized to seek compensation for—or restoration of—natural resources under its trusteeship that may have been injured by releases of oil or hazardous substances. Federal trust responsibilities encompass those natural resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States. Under CERCLA/CWA and EO 12580, the USDOI is a trustee for migratory birds and certain marine mammals (e.g., walrus, polar bears, and sea otters) and for its park, refuge, and Native-allotment lands. Trustee activities may include participating in negotiations with potential responsible parties along with any other natural resource-trustee agency, EPA, USCG, and the Department of Justice to agree upon either compensation for injured natural resources or measures to be taken for the restoration or rehabilitation of injured resources.

Where injury to natural resources has resulted from the release of oil or hazardous substances, the USDOI is responsible for developing regulations that may be used by Federal or State natural resource trustees in assessing damages. Use of these regulations is not required, but trustee claims based on these regulations have the force and effect of a "rebuttable presumption" in court.

**Specific Responses:** Within the USDOI, notification of the T/V Exxon Valdez oil spill was first received by the Alaska

Bureau of Land Management (BLM) and immediately thereafter by the USDOI's Regional Environmental Officer (REO) in the Alaska Office of Environmental Project Review, the USDOI member on the Alaska Regional Response Team (ARRT). The REO's office became the central point for coordination of ARRT members in Anchorage and coordination for USDOI support to the response efforts led by the USCG. The Regional Environmental Assistant's (REA) office at the headquarters of the USCG's Federal On-Scene Coordinator (OSC) in Valdez became a key coordination point for natural resource-related activities and for USDOI logistical support throughout the first few weeks of the spill.

In addition to the Office of Environmental Project Review, USDOI's response involved five bureaus and the Office of Aircraft Services (OAS) on the basis of: (1) land, natural, and cultural resource jurisdiction (Fish and Wildlife Service [FWS], National Park Service [NPS], and Bureau of Indian Affairs [BIA]); and (2) expertise and logistical support (BLM, Minerals Management Service [MMS], and OAS).

- **Fish and Wildlife Service:** The FWS concentrated its short-term efforts on documenting the numbers, species, and locations of migratory birds and sea otters in areas affected or potentially affected by the spill and on documenting effects on sea otters and migratory birds and their habitats. The FWS provided resource information throughout the planning of cleanup operations, participated in aerial reconnaissance of proposed cleanup sites, and monitored onsite-cleanup operations. The FWS also monitored Exxon-funded rescue and rehabilitation operations for birds and sea otters and provided personnel and logistic support for capture of eagles and sea otters.
- **National Park Service:** The NPS, with the assistance of the Interagency Incident Command Team (ICT), organized and supervised documentation of prespill conditions at Kenai Fjords, Katmai, and Lake Clark National Parks and Aniakchak National Monument. Activities included water-quality sampling, shoreline-vegetation surveys, cultural resource surveys, and wildlife counts. The NPS documented wildlife effects and provided technical assistance in beach-cleanup operations. The NPS personnel worked closely with the USCG to establish priorities for placing oil-containment booms and monitoring onsite-cleanup operations.
- **Bureau of Indian Affairs:** The BIA provided information to Exxon to ensure that cultural resources were identified and protected during shoreline-cleanup operations.
- **Bureau of Land Management:** The BLM provided personnel and equipment to the REO's office in Anchorage and the REA's office in Valdez and mobilized ICT personnel and equipment to support response activities in the Seward, Kodiak, and Homer zones. In addition, BLM provided and deployed remote weather-tracking stations for the National Oceanographic and Atmospheric Administration (NOAA) and fuel bladders to support remote aerial and boat operations in Prince William Sound.
- **Office of Aircraft Services:** The OAS provided air support to USDOI bureaus and other Federal and State agencies.
- **Minerals Management Service:** The MMS initiated the following actions after the T/V Exxon Valdez oil spill: (1) assisted other bureaus and agencies during the oil spill, (2) funded studies (including data collection) associated with the spill, and (3) worked to improve oil-spill planning and response.

The Alaska OCS Region of MMS provided personnel assistance to meet other bureau needs during the Exxon Valdez oil spill. For example, they provided staff support to the REO during the first 3 weeks of the spill; and regional staff worked on otter capture and surveillance, assisted in bird identification and census at the bird-mortality centers, and participated on the Resource Assessment Team.

On April 18, 1989, Secretary of the Interior Lujan directed MMS to immediately review current oil-spill-planning and response requirements for OCS oil and gas operations. In response to this directive, the MMS Director organized a task force to evaluate spill planning, training, drill and inspection requirements, and procedures for each MMS OCS Region. The MMS task force undertook an intensive review of MMS regulations and policies to define needed changes in cleanup and oil-spill-containment provisions.

The Alaska OCS Region initiated two task forces to review current oil-spill-contingency plans (OSCP's) in relation to MMS regulations. The Shell Western Exploration and Production, Inc.'s, Chukchi Sea OSCP and the Amoco Production Company's Belcher OSCP were reviewed. Both plans met MMS requirements.

The Alaska OCS Region implemented a "tabletop" oil-spill-response drill. This response drill is a test for a major spill simulating a blowout with a 5,000-barrel-per-day flow. The objective is to walk through the response and to exercise the knowledge of the OSC. The MMS completed an exercise with Shell Western at the Burger Prospect in the Chukchi Sea.

The Alaska OCS Region also made a physical inventory of the oil-spill-response equipment at the oil-spill-response cooperatives. This inventory included a physical count to make sure equipment was onsite and to verify the usable condition of the equipment. These inventories were conducted at Alaska Clean Seas, at the Cook Inlet Response Organization, and in Canada.

On April 18, 1989, Secretary of the Interior Lujan announced that the USDOJ would expand its current research program for improving oil-spill-response technology. The funding planned for the program, \$6 million over a 3-year period, will be evenly shared by the American Petroleum Institute. The money will fund research in oil-spill detection, containment, and cleanup technology. These activities will be coordinated with other executive branch agencies including the Department of Transportation, EPA, and NOAA, as well as other countries, including Canada.

**APPENDIX D**

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**ALTERNATIVE-ENERGY SOURCES**

## ALTERNATIVE-ENERGY SOURCES

The description of energy alternatives is hereby incorporated by reference from Appendix C, Alternative-Energy Sources, of Volume 3 of the Final EIS for the Proposed 5-Year OCS Oil and Gas Leasing Program, 1987-1992. The following information is a summary of this document.

**Energy Conservation:** Vigorous energy conservation is an alternative that warrants serious consideration. Several studies have suggested that we could enjoy the same standard of living and yet use 30 to 50 percent less energy than we do now. Aside from these savings, it is not widely recognized that wasteful consumption habits impose social costs that can no longer be afforded, as do pollution and an inequitable distribution of fuel. Existing conservation programs include education, research and development, regulation, and subsidies.

In the residential and commercial sectors of the economy, more efficient energy consumption could be realized by improved insulation, more efficient heating and cooling systems, better designed appliances, and more efficient lighting. Incentives such as standards for improved thermal efficiency in existing homes and offices and minimum thermal standards for new homes and offices also could result in substantial energy savings.

In the industrial sector, more energy-efficient work schedules, better maintained equipment, equipment with better low-heat transfer efficiencies, and recycled heat and waste materials could result in energy savings.

Transportation of people and goods accounts for approximately 25 percent of nationwide energy use. In the transportation sector, short- and mid-term conservation measures, such as consumer education, lower speed limits, and rate and service improvements on public transit and rail-freight transit, could achieve considerable energy savings. Other policies that could encourage fuel conservation in transportation include standards for more efficient new automobiles and incentives to reduce miles traveled.

Significant energy savings are clearly possible through accelerated conservation efforts. In addition, several of the strategies mentioned above have been at least partially implemented by the Energy Policy and Conservation Act of 1975 (P.L. 94-163).

The environmental effects of a vigorous energy conservation program would be primarily beneficial. The exact nature and magnitude of these effects would depend on whether there is a net reduction in energy use or whether the reduction is accomplished through technological change and substitutions. Either case would result in the reduction of pollutants such as CO, hydrocarbons, particulates, NO<sub>x</sub>, and SO<sub>x</sub>.

**Conventional Oil and Gas Supplies:** Reserves and undiscovered deposits of oil and gas still exist in the United States. Proven reserves are currently estimated at 31.4 billion bbl of oil and 208.0 Tcf of natural gas, the lowest level since 1951. Since 1970, new oil discoveries have replaced less than one-half of production.

Ultimately recoverable reserves (all deposits known or believed to exist in such forms that economic extraction is currently or potentially feasible), in addition to proven reserves, are estimated to be about 82.6 billion bbl of oil (54.6 onshore/28.0 offshore; 13 years of consumption at current rates), and 593.9 Tcf of natural gas (426.9 onshore/167.0 offshore). This estimate is rising over time, mainly because of higher prices and new discoveries in unexplored areas. Unconventional hydrocarbons and recovery methods, especially enhanced recovery, could more than double these figures. The amount of ultimately recoverable reserves will depend on price, technology, geological information, and public policy such as price controls, access to Federal lands, and environmental standards.

Petroleum production is severely constrained in the short run and greatly affected by world prices in the long run. Although the long-run demand for fuel liquids is not forecast to decline significantly (feasible solid and gaseous substitutes do not appear to exist), consumption of conventional crude oil is expected to decline significantly as synthetic liquids are produced from shale, tar sands, and coal; as biomass sources are utilized; and as industry and utilities reduce oil facilities and shift to coal and possibly nuclear power. Synthetic liquid from coal is expected to be the major source of liquid fuel by 2020, supplying 50 percent of all liquid fuel and 10 percent of all consumed energy.

Conventional natural gas consumption is expected to decline due to depletion, higher prices, and competition with synthetic gas from coal. Enhanced gas recovery from unconventional sources such as tight sands and Devonian shale is expected to make a significant contribution to gaseous fuel production, providing 50 percent of all gaseous fuel and 5 percent of all energy consumption by 2020. Ultimately recoverable reserves from such sources are estimated at 3,000 Tcf.

A detailed description of the crude oil and natural gas systems is found in Chapters 3 and 4 of *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

To substitute directly for the proposed action, a combination of onshore and OCS production from other areas and continued foreign imports would be required to make up for the estimated total production of these proposed actions.

This substitution would entail environmental effects such as land subsidence, soil sterilization, and disruption of existing land use patterns. Equipment failure, human error, and blowouts also may impair environmental quality. Moreover, poor well construction, particularly in older wells, and oil spills can result in ground- and surface-water pollution.

The water pollutants from onshore oil production are oil and dissolved solids. The amounts of each vary over a wide range. A summary of onshore oil pollutants is available in *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

Air pollutants (particulates, NO<sub>x</sub>, hydrocarbons, and CO) result from blowouts and subsequent evaporation and burning. These are generally insignificant, except locally. Onshore or offshore effects are basically the same. Given the fact that onshore supplies are dwindling, users of hydrocarbons from these proposed actions would have to continue their reliance on other regions and foreign imports for needed oil and gas. The decline in these supplies, even with energy conservation, could mean industrial shutdowns, increased unemployment, higher consumer prices, and changes in the standard of living. The lack of natural gas will mean additional use of "dirtier" alternative fuels (oil and coal) with consequent effects on air quality and human health.

**Coal:** Coal is the most abundant energy resource in the United States. Proven domestic reserves of coal are estimated at 438 billion short tons. This constitutes over one-quarter of the known world supply, 80 percent of proven United States fuel reserves, and 130 times the energy consumed in 1980. Ultimately recoverable reserves are estimated at 3.9 trillion short tons. A detailed discussion of the coal resource system can be found in Chapter I of *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

Although domestic coal reserves could easily replace the energy expected to be realized from the proposed actions, serious limitations to coal development exist. In many uses, coal is an imperfect substitute for oil or natural gas. In many other cases, coal use and production is restricted by Government constraints, limited availability of low-sulphur deposits, inadequate

mining, conversion and pollution-abatement technology, and the hazardous environmental effects associated with coal extraction and from electricity generation. Coal production also is threatened by a unique set of labor problems associated with mining and new, strict standards for coal-mine safety.

Due to its relative price advantage over other fuels, competitive market structure, and large resource base, coal consumption and production are expected to increase significantly; and coal is expected to become the primary domestic energy source in the future.

Synfuels from coal also will be important. Synthetic oil and gas could contribute substantially to energy supplies by the year 2000. The most important contributions would be high Btu gas from coal, synthetic crude oil from oil shales, and coal liquefaction. The success of these energy sources will depend on developing technology, the cost of the effects, and the cost of conventional oil and gas. Technology for conversion of coal into gaseous and liquid hydrocarbons has been established for several decades, and a number of relatively low-capacity commercial plants exist in various parts of the world. However, few cost-effective, advanced technologies have progressed beyond the pilot-plant stage.

Coal gasification can produce gaseous fuels with low-, intermediate-, or high-energy content. Low and intermediate gases are produced in a two-stage process involving preparation and gasification, and the output is utilized as feedstock for electric generators. A third process, "upgrading," is required to produce high Btu gas, which produces an end-product usable by the consumer. Gasification processes have lower primary efficiency than direct coal combustion; more coal will have to be gasified to reach an equivalent Btu output. However, it is likely that coal gasification will achieve primary efficiencies of 70 percent, which is about twice that of coal to electricity end use.

Liquefied coal has the potential to replace conventional crude oil as the major source of liquid fuel and to provide 10 percent of total domestic-energy consumption by 2020. The available technologies have a recovery rate of 0.53 bbl of oil per ton of coal processed. As with coal gasification, production of liquid fuels from coal requires either the addition of hydrogen or the removal of carbon from the compounds in the coal. Coal liquefaction can be accomplished by hydrogenation, pyrolysis, or catalytic conversion. Only catalytic conversion is in commercial operation.

Although United States' coal resources are very large, as with other extractable mineral fuels, there is some geographic dislocation. Most of our new low-sulphur coal is found west of the Mississippi River or in Alaska, far from industrial areas. Also, much of the western coal is in arid or semiarid areas where scarcity of water could constrain development.

If an alternative to the proposed OCS sale is greater reliance on coal, it may be expected that mining would have to increase in the western states to provide the necessary fuel resources.

Adverse environmental effects from heavier reliance on coal would result from its direct utilization, surface mining, underground mining, transportation, and conversion to liquid or gaseous fuels. Combustion of coal results in various emissions, notably  $\text{SO}_2$  and particulates. If the expected production from these proposed actions is replaced by coal, there would be an increase in these pollutants, especially if coal is substituted for the natural gas presently used. Technology to control these emissions is available but has not yet been proven sufficient to be widely applied. Any large-scale shift to coal would require realization of emission regulations or improvement of technologies to convert coal to gaseous or liquid fuels.

The primary effect of surface mining is disruption of the land. This affects all local flora and fauna and water quality and increases landscape problems due to erosion and mine runoff. Reclamation is difficult in the western states due to the lack of

water to assist in revegetation. Other problems include acid-mine-water drainage, leaching from spoil piles, processing waste, and disturbances caused by access and transportation. Noise and vibration resulting from operations also can be expected. Finally, surface mining causes conflicts with other resource uses such as agriculture, recreation, water, and wildlife habitat.

The land use of strip mining ranges from 0.8 to 5.9 acres/1,012 Btu extracted, depending on seam thickness and Btu content of the coal.

Underground mining primarily affects land and water quality. The land effects are those that arise from subsidence, waste disposal, access, and transportation. Very little surface is disturbed. Subsidence can destroy structures, cause landslides and earthquakes, and disrupt groundwater-circulation patterns. The amount of subsidence can be controlled by the mining method used and the amount of coal removed. The utilization of certain mining methods and the restriction of the amount of coal extracted can have detrimental effects on the economics of the operation.

Water quality is affected by processing waste and the draining of acid-mine water into surrounding areas. These can be minimized through the proper methods of control both during and after operation. Waste piles can be replaced in the mine and the entrances sealed, which also would help to minimize subsidence. Other pollution problems are those associated with road and coal dust and the like, but these are minimal and easily controlled. Other disturbing aspects of mining have much less of an effect in an underground mine. Working conditions of underground mines have been improved under the Federal Coal Mining Health and Safety Act of 1969, although further efforts are needed to reduce health hazards. This program has resulted in increasing costs of underground mining when compared to surface mining, which has even more severe environmental consequences.

The five major coal transportation systems (road, rail, water, conveyor, and pipeline) all have some adverse environmental effects. These include air and noise pollution, safety hazards, land-use conflicts, trash-disposal problems, and aesthetic damage. However, since spill problems are not associated with coal, most of the effects can be controlled with greater care and consideration. A slurry pipeline also requires large supplies of water and must adequately dispose of this at the other end. Water availability is a problem in many areas of the United States, especially in the west where energy resources requirements will have to compete with existing commercial and private users for a limited and fragile resource.

The environmental effects of coal gasification are those of mining plus those resulting from the production process. Water effects of processing can be minimized by recycling and evaporation. However, large inputs of water are required for some of the technologies, thus creating the potential for conflicts in water-short areas.

Air pollution could include  $\text{SO}_2$ , particulates,  $\text{NO}_x$ , hydrocarbons, and CO. Land effects result from solid-waste disposal, as well as land use for the plant, coal storage, cooling sands, etc. Solid wastes include ash, sulphur, and minute quantities of some radioactive isotopes.

Again, the effects of liquefaction will be those of mining and those of the processing plants. Water effluents from liquefaction plants could contain amounts of phenols, solids, oil, ammonia, phosphates, etc. The wastewater could be treated to remove most of these products.

Air pollution could result from particulates, nitrogen,  $\text{SO}_2$ , and other gases. Pollution-control facilities would be required but would lower the economic attractiveness of the plants. Solid wastes would be mostly ash. If liquefaction plants were sited near mine openings, residue could be buried in the mines with

little further environmental effects.

**Nuclear Power - Fission:** The predominant nuclear system used in the United States is the uranium dioxide-fueled, light-water moderated and cooled nuclear power plant. Research and development are being directed toward other types of reactors, notably the breeder reactor.

Due to environmental concerns, the growth of nuclear energy may be slowing. At the end of 1980, there were 75 reactors in the United States, up from 19 in 1970. Although 4 reactors were licensed in 1980, 14 other planned units were canceled, and the Nuclear Regulatory Commission (NRC) closed 5 for modification to comply with revised seismic requirements and shut down 8 reactors comparable to Three Mile Island to determine the probability for a similar accident and to make required safety modifications. Nuclear energy output was down 16 percent in 1980. There are currently 102 reactors under various stages of construction, construction-permit review, or on order. Nuclear power development has encountered delays in licensing, siting, and environmental constraints as well as manufacturing and technical problems.

Future capacity will be influenced by the availability of plant sites, plant-licensing considerations, environmental factors, nuclear fuel costs, rate of development of the breeder and fusion reactors, and capital costs.

Domestic uranium resources are probably plentiful. Ultimately recoverable reserves are estimated to be 6.876 billion short tons, and large areas are unexplored. Twenty-one million short tons were consumed in 1980 domestic nuclear energy production.

Although fuel-cycle costs of nuclear reactors have increased only slightly in recent years, present trends in reactor capital costs are significantly narrowing the economic advantage offered by fuel-cycle costs over coal- and oil-fired plants.

Although nuclear plants do not emit particulates or gaseous pollutants from combustion, the potential for serious environmental problems exists. Some airborne and liquid radioactive materials are released to the environment during normal operation. The amounts released are very small, and potential exposure has been shown to be less than the average level of natural radiation exposure. The plants are designed and operated in such a way that the probability of harmful radioactivity release from accidents is very low.

Nuclear plants use essentially the same cooling process as fossil-fuel plants and thus share a similar problem of heat dissipation from cooling water. However, light-water reactors require larger amounts of cooling water and discharge greater amounts of waste heat to the water than comparably sized fossil-fuel plants. The effects of thermal discharges may be beneficial in some, though not all, cases. Adverse effects can often be mitigated by use of cooling ponds or cooling towers.

Low-level radioactive waste from normal operation of a nuclear plant must be collected, placed in protective containers, and shipped to a Federally licensed storage site for burial. High-level wastes created within the fuel elements remain there until the fuel elements are processed. Currently, spent fuel is stored at NRC-licensed facilities. Plans call for recovering unused fuels at reprocessing plants, solidifying the wastes, and placing them in storage at a Federal repository.

There also are effects on land, water, and air quality arising from the mining of these uranium ores. Dwindling amounts of high-grade reserves will increase the amount of land mined for lower grade radioactive ores—primarily in the western states. The mining operations will be similar to coal, but the nature and distribution of the deposits mean "lesser" effects, while radioactive tailings cause unusual problems for disposal, the environment, and human health. A more complete discussion of uranium mining and processing and the economics and environmental impacts, as well as nuclear fission and fusion, can

be found in Chapters 6 and 7 of *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

**Nuclear Power - Fusion:** The controlled fusing of atoms in a reactor is a long-term alternative-energy source. Scientific feasibility has yet to be proven but looks promising. Technological and commercial feasibility will have to follow, however. The main obstacles are obtaining a high enough temperature and containing the reaction. It is unlikely that fusion will be available to any significant degree before 2025.

Fusion is attractive for two reasons: abundant fuel sources and relative safety. The reaction is fueled by deuterium and tritium. Deuterium exists naturally in seawater and would be nearly cost-free; tritium can be inexpensively produced in a reactor from lithium, which is plentiful.

Because of the small neutron activation involved in fusion reactions, there would be lower radioactive inventories, fewer radioactive wastes, and less serious fuel-handling problems and accident risks.

A proposed hybrid fusion-fission fuel cycle would fuel fission reactors with fusion-produced isotopes and multiply the energy release of fusion tenfold, while demanding less of the fusion core and thus enhancing the safety characteristics of both reactors.

A proposed pure deuterium process, while possessing a lower reaction rate, would have a neutron fuel cycle; thus, all particles and products would be electrically charged and there would, in theory, be no radioactivity.

The environmental risks from fusion energy are probably less than fission, but the degree of reduction and the social acceptability of that degree cannot be determined presently.

**Oil Shale:** Oil shale is a fine-grained, sedimentary rock that, when heated, releases a heavy oil that can be upgraded to synthetic crude oil. The technology for exploitation currently exists. The resource base for shale is very large, perhaps as much as 360 billion bbl.

Large areas of the United States are known to contain oil-shale deposits, but those in the Green River Formation in Colorado, Wyoming, and Utah have the greatest commercial potential.

Oil-shale development poses serious environmental problems. With surface or conventional underground mining, it is very difficult to dispose of the huge quantities of spent shale, which occupy a larger volume than before the oil is extracted. Inducing revegetation growth in an area of oil shale development is difficult and may take more than 10 years. In-place processing avoids many of these environmental hazards. With underground mining, the spent-shale problem is much less severe.

Air pollutants from the mining will come from dust and vehicular traffic. These will be predominantly particulates, followed by NO<sub>x</sub> and CO, with minimal amounts of hydrocarbons, SO<sub>2</sub>, and aldehydes.

The mining of oil shale requires little water, both for operations and for reclaiming solid wastes. Water pollutants are considered negligible but may arise if saline water was encountered during the operations and had to be disposed of.

However, the processing (retorting) operations of oil shale consume large quantities of water and generate large amounts of wastewater. The wastewater must be treated and can be reused in the process. Therefore, it has been assumed that water pollution would not be a problem outside the processing complex. However, the limited availability of input water in the development area could lead to resource-use conflicts.

Air pollutants vary with the technology used. Solid waste

comprises the greatest problem of oil-shale processing. The volume of the waste is greater than the volume of the input. Therefore, backfilling and the like would not provide a sufficient disposal space. Finally, there are the effects of access and of transporting the products. These are analogous to those of coal mining in the case of access and to petroleum distribution in the case of transporting the product.

A more complete description of this energy source can be found in Chapter 2 of *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

**Tar Sands:** Tar sands are deposits of porous rock or sediments that contain hydrocarbon oils (tar) too viscous to be extracted by conventional petroleum-recovery methods. Large-scale production efforts have been developed in Canada, but ventures in the United States have been minor. United States' resources are concentrated in Utah, with some potentially commercial quantities in California, Kentucky, New Mexico, and Texas.

About 1.5 tons of rich tar sands yield about 1 bbl of tar, or bitumen, the equivalent of about  $6.3 \times 10^6$  Btu's. Tar can be recovered either from sands mined on the surface or underground or from direct underground extraction of the oil without mining. Recovery is followed by processing, upgrading to synthetic crude, and refining. Ultimately recoverable reserves may be 100 billion bbl, including other heavy oils.

Surface mining produces substantial residuals, including modification of surface topography, disposal of large amounts of overburden, dust and vehicle emissions, and water pollution. Reclamation can minimize these effects. Residuals are similar to those of coal.

The effects of processing tar sands are similar to those of oil shale. These include solid tailings from extraction, cooling water and blowdown streams, thermal discharges, and off-gases. Under controlled conditions, these residuals can be minimized.

Underground extraction without mining can result in thermal additions, contamination of aquifers, surface spills, surface-earth movements, noise pollution, and emission of gases.

**Hydroelectric Power:** Hydropower is energy from falling water, which is used to drive turbines and produce electricity. Conventional hydroelectric developments convert the energy of natural stream flows falling from a height into electric power. Pumped-storage projects generate electric power by releasing water from an upper to a lower storage pool and then pumping the water back to the upper pool for repeated use. A pumped-storage project consumes more energy than it generates but converts offpeak, low-value energy to peak, high-value energy. A more detailed discussion of this energy source is found in Chapter 9 of *Energy Alternatives: A Comparative Analysis* (University of Oklahoma, 1975).

Many of the major hydroelectric sites operating today were developed in the early 1950's. Thirty to forty years ago, hydroelectric plants supplied as much as 30 percent of the electricity produced in the United States. Although hydroplant production has steadily increased, thermal electric-plant production has increased at a faster rate.

From 1970 to 1980, hydroelectric-power production has fluctuated slightly between 220 and 300 billion kilowatt hours—about 4 percent of total United States' energy production. As a proportion of total United States' electricity production and installed generating capacity, hydroelectricity has dropped from 16 percent to 12 percent, although the latter has increased from 55.1 to 76.4 million kilowatts. Much of the recent hydroelectric development has been pumped-storage capacity.

It is likely that hydroelectric power will continue to represent a declining percentage of the total United States' energy mix due to high capital costs, seasonal variations in waterflows, land-use conflicts, environmental effects, competitive water use,

and flood-control constraints. Sites with the greatest production capacity and lowest development costs have already been exploited.

Construction of a hydroelectric dam represents an irreversible commitment of the land resource beneath the dam and lake. Flooding eliminates wildlife habitat and prevents other uses such as agriculture, mining, and free-flowing river reaction.

Hydroelectric projects do not consume fuel and do not cause air pollution. However, use of streams for power may displace recreational and other uses. Water released from reservoirs during the summer months may change ambient water temperatures and lower the oxygen content of the river downstream, thereby adversely affecting indigenous fish. Fluctuating reservoir releases during peak-load operation also may adversely affect fisheries and downstream recreation.

Screens placed over turbines prevent the entrance of fish; small organisms may pass through or may be killed. Fish may die from nitrogen supersaturation, which results at a dam when excess water escapes from the draining reservoir. High nitrogen levels in the Columbia and Snake Rivers pose a threat to the salmon and steelhead resources of these rivers. Other adverse effects to water quality include possible saline-water intrusion into waterways and decreased ability of the waters to accommodate moderate waste discharges.

Air quality will be affected only by dust and emissions during the construction phase. Afterwards, if the impoundment is used for recreation, motor exhaust could occur.

**Solar Energy:** Applications of solar energy must take into account the following:

- Solar energy is a diffuse, low-intensity source requiring large collection areas. Only a small portion of the potential energy is utilized.
- Its intensity is continuously variable with time of day, weather, and season.
- Its availability differs widely between geographic areas.

Potential applications of solar energy show a wide range. Among them are:

- Thermal energy or water heating, space heating, space cooling, and combined systems of the buildings.
- Renewable, clean-fuel sources; combustion of organic matter; bioconversion of organic materials to methane; pyrolysis of organic materials to gas, liquid, and solid fuels; and chemical reduction of organic materials to oil.
- Electric-power generation, thermal conversion, wind-energy conversion, and ocean-thermal difference.

Solar-energy-collection systems are now commercially available nationwide. Additional detail on this resource alternative is found in Chapter II of *Energy Alternatives: A Comparative Analysis* (United States Government Federal Policy Task Force Review Group, Solar Energy Analysis, 1978; Solar Energy Progress and Problems, EPA, USDOE, and Lawrence Berkeley Laboratories et al., 1978).

Among the disadvantages of solar energy are high capital costs, expensive maintenance of solar collectors, thermal-waste disposal, and distribution for local thermal balances.

The environmental effects so far identified with solar energy are relatively minimal. The primary effects of the use of this energy source on a wide scale will be land use. Due to the low density of the energy, large areas will be necessary for the collectors. However, the land use compares favorably with other forms of energy use, such as coal extraction.

To date, the only other known area of concern is thermal pollution. Direct use in space heating has no thermal effects. There may be some localized thermal pollution from solar electric-power generation, which will have to be collected and transferred to the generator, but the problem is not expected to be significant. Finally, solar plants can operate only intermittently, thus, the energy will either have to be stored or backup fossil-fuel plants will have to be built. These will have their own sets of environmental constraints.

**Oil Imports:** Spurred by new discoveries and competition, Middle East oil production expanded in the 1950's and 1960's. New markets were opened and prices softened. The real price of oil fell from 1948 to 1972. Simultaneously, United States consumption of oil increased while production stayed constant; imports were relied upon to make up the difference.

In 1973, the Arab-Israeli war was accompanied by an embargo imposed by OPEC against nations supporting Israel. The vulnerability of the importers to their own heavy demand became evident, and a huge price increase followed. This marked the end of the so-called era of "cheap energy," and efforts were made to curtail imports. Another large price increase occurred in 1979.

Three avenues were pursued for reducing imports: conservation, or reduced net-energy demand per unit output; alternative energy; and increased domestic production.

The results of these efforts for reducing imports seem to have been mostly successful. The underlying market structure for energy has been altered. World demand for oil peaked in 1977 and appears to be in an irreversible structural decline. Gross national products have been rising along with nonenergy output, alternative-energy sources, and non-OPEC production. Oil is wholly responsible for declines in energy use.

The OPEC produced 32 million barrels per day (mbd) in 1977. Current projections of energy consumption until the year 2000 show rates of one-half of that projected in 1972. The USDOE is currently projecting a 0.9-percent annual growth rate (actual growth was 1.9% annually from 1970-1979) and a 3 percent annual economic growth. The dimensions of the structural change for the United States in 1981 are as follows:

- Total energy consumption was down 5 percent.
- Petroleum consumption was down (8%) for the third straight year.
- Oil consumption as a percentage of total energy consumption was down 9 percent.
- Imports of petroleum were down for the fourth straight year. Imports in May 1981 were 5.2 mbd, the lowest in 10 years. This was 20 percent less than in 1980 and 38 percent less than in 1979.
- Imported petroleum as a percentage of total petroleum consumption was down 5 percent.
- Imported petroleum as a percentage of total energy consumption was down 27 percent.
- Dollar value of gross national product has been steadily declining since 1970.

It is reasonable to assume OPEC will affect the bulk of the world's oil production for the remainder of the century, due mainly to the short term in elasticity of the supply of substitutes, and will set prices based on factors besides price-cost relationships. Brief derivations from this leadership position may be noted in the short term due to world price adjustments. Thus, the less dependent the United States is on OPEC, the less vulnerable the United States is to large, erratic price changes. Imports from the Middle East also bring problems of

stability of supply, balance of payments, currency exchange rates, and United States' offloading capacity.

The United States will probably remain somewhat dependent on imported energy throughout this century and, as the 1970's showed, there are situations in the Middle East that could lead to major disruptions in supply or huge price increases. However, the propensity for such anomalies is less than in the past, due primarily to the following:

- As mentioned above, the underlying market structure for energy has been altered, and demand for oil has declined drastically. Associated with this, OPEC will have considerable spare capacity, and price cohesiveness will be difficult to maintain.
- All OPEC nations need to produce oil to finance development. The goal of many OPEC nations is to maximize oil's long-term contribution to the national economy rather than to maximize short-term profits. If revenue falls below a certain level where OPEC nations are not realizing an acceptable income, domestic tensions may ensue.
- The OPEC economies, especially Saudi Arabia's, are more interdependent with the West than previously. The OPEC has invested interest and financial reserves in the West, imports a large amount of goods from the West, and has its oil prices tied to Western currency-exchange rates.
- The presence of strategic stockpiles provides both a deterrent to international disruptions in world markets and a cushion for smoothing price and supply shocks. Current stockpile inventories on most Western nations are at record levels.

The OPEC's output and pricing structure also will depend on its balancing of:

- future vs. present proceeds;
- benefits vs. cost of rapid modernization; and
- discipline in the market vs. the political unit of OPEC.

The primary hazard to the natural environment of increased oil imports is the possibility of oil spills, which can result from accidental discharge, intentional discharge, and tanker casualties. Intentional discharges would result largely from uncontrolled unballasting of tankers. The effects of chronic, low-level pollution are largely unknown. The worldwide tanker casualty analysis indicates that, overall, an insignificant amount of the total volume of transported oil is spilled due to tanker accidents. However, a single incident such as the breakup of the Torrey Canyon in 1967 or the Amoco Cadiz in 1978 can have disastrous results. Of more concern than tanker spills is the effect on the social and economic environment. The potential for a future embargo under this option is such that American productivity and policy could become subservient to foreign influence, having both economic and security implications for the Nation. On a more subtle level, political alignments and policies of the United States could become tied to those of foreign oil powers. This option is the least acceptable for continued American energy independence.

**Natural Gas Imports:** Imports of natural gas via pipeline have come largely from Canada, with small amounts also coming from Mexico. In 1980, net pipeline imports from Canada were 881 billion cubic feet, about 4.4 percent of the total natural gas used in the United States. These imports were about 33 percent of Canada's natural gas production.

The natural gas-import situation continues to be highly uncertain. A major reason for this uncertainty is the disparity between prices for natural gas and alternative fuels in this country and the price of crude oil in world markets.

The United States and Canada concluded an agreement in March 1980 that established a formula for escalating the price of Canadian imports. The formula prices Canadian gas at the Btu-equivalent price of Canadian crude oil imports, minus an adjustment that reflects savings to Canada of certain transportation costs. In response to escalated Canadian prices, demand in the United States for Canadian gas dropped sharply. Consequently, Canada has foregone the opportunity to raise its export price. What modifications, if any, the Canadians will make to their pricing formula and what minimum amounts of Canadian gas Americans must take under existing contracts are matters currently being examined on both sides of the border.

Mexico could be a significant source of future imports because of its relatively large natural gas-resource base. Imports from Mexico were of a local nature until 1957 and have declined since 1969. In September 1979, an agreement was concluded between the United States and Mexico regarding the importation and pricing of natural gas. A base price was specified to be escalated in proportion to the average price of five crude oils traded on the world market. However, the rapid increase in world oil prices between the time the agreement was concluded and the time the price escalation began brought the price of Mexican gas substantially below both oil parity and the Canadian gas price. Consequently, Mexico requested and received the same price as the Canadians.

Natural gas imports are expected to be eliminated in the long run, as domestic natural gas production will nearly satisfy decreasing demand and synthetic gas from coal can provide the balance and replace imports.

The environmental effect of increasing gas imports derives mainly from the possible increased use of land for pipeline construction. A further effect is the risk of explosions and fires. Fluctuations of supply could influence quality of life, productivity, and employment. American policies also could become influenced by decisions of foreign gas producers, much as they could under the option of increasing oil imports.

**Liquefied Natural Gas Imports:** The growing shortage of domestic natural gas has encouraged projects to import liquefied natural gas (LNG) under long-term contract. Large-scale shipping of LNG is a relatively new industry. Several LNG projects are now under consideration on the Pacific, Atlantic, and Gulf Coasts. The security of foreign LNG is questionable. The complexity of the length of time involved in implementing these proposals has been increased by the need for negotiating preliminary contracts, securing the approval of the Federal Energy Regulatory Commission and the exporting country, and making adequate provision for environmental and safety concerns in the proposed United States' facilities. The authority to construct and operate facilities to implement imports and exports must be obtained separately from the Federal Energy Regulatory Commission. The cost of liquefying and transporting natural gas, other than overland by pipe, is high.

The United States imported 85 billion cubic feet of LNG from Algeria in 1978. In March 1980, Algeria announced that it was demanding oil-price parity, free-on-board, for gas it exported to the United States, and it subsequently discontinued deliveries. The free-on-board price does not include transportation, terminal, and regasification costs, which are substantial.

The environmental effects of LNG imports arise from tankers; terminal, transfer, and regasification facilities; and transportation of gas. The primary hazard of handling LNG is the possibility of a fire or explosion during transportation, transfer, or storage.

Receiving and regasification facilities will require prime shoreline locations and channel dredging. Regasification of LNG will release few pollutants to the air or water.

LNG imports will influence the United States' balance of

payments. This effect will depend on the origin and purchase price of the LNG, the source of the capital, and the country (United States or foreign) in which equipment is purchased and LNG tankers are built.

**Geothermal Energy:** Geothermal energy is primarily heat energy from the interior of the earth. It may be generated by radioactive decay of elements such as uranium or thorium and friction due to tidal or crustal plate motions. There are four major types of geothermal systems—hot-water, vapor-dominated, geopressured reservoirs, and hot-dry-rock systems.

In addition to electricity, geothermal energy can offer a potential for space heating, industrial processing, and other nonelectric uses in many areas that presently are highly dependent upon oil and gas for energy needs. However, geothermal electric-generating plants are smaller than conventional plants and require a greater amount of steam to generate an equal amount of energy. This is due to the fact that temperatures and pressures associated with geothermal areas are lower than those created at conventional power plants.

The greatest potential for geothermal energy in the United States is found in the Rocky Mountain and Pacific regions; some potential (geopressured-geothermal) exists in the Gulf Coastal Plain of Texas and Louisiana. The geyser field in California, which has been producing power since 1969, is the most extensively developed source of geothermal energy in the United States. Exploration efforts also are under way in Imperial Valley, Salton Sea, Mono Lake, and Modoc County, California.

Geothermal energy presently accounts for less than 1 percent of total United States' energy production. The environmental problems associated with geothermal energy principally result from a number of gases that are associated with geothermal systems and that may pose health and pollution problems. These gases include ammonia, boric acid, carbon dioxide, carbon monoxide, hydrogen sulfide, and others. However, adverse air-quality effects are generally less than those associated with fossil-fuel plants. Also associated with geothermal energy systems are saline waters that must be disposed of and isolated from contact with groundwater regimes.

Land-quality problems stem from disturbance due to construction of related facilities and possible ground subsidence which, in turn, can cause structural failures and loss of groundwater-storage capacity.

**Other Energy Sources:** The high cost and rapidly shrinking reserves of traditional energy fuels have encouraged research into new and different sources for potential energy. Some of these alternative sources have been known for decades, but high costs and technical problems have prevented their widespread use. These sources include tidal power, wind power, organic fuels, and ocean-thermal gradients, among others.

The date of commercial availability of such alternatives will depend on the cost of the traditional energy fuels, the level of federally subsidized research through Energy Research and Development Administration assistance, and the solution of engineering and technical problems.

Environmental effects of these alternatives are difficult to assess, especially since a great amount of research and development remain to be completed before operational scale systems can be developed, tested, and evaluated for production and application.

**Combination of Alternatives:** A combination of some of the most viable energy sources available to this area, discussed above, could be used to attain an energy equivalent comparable to the estimated production within the anticipated field life of these proposed actions. However, this combination of alternatives, in order to attain the needed energy mix peculiar to the infrastructure of this area, would have to consist of energy

sources attainable now or within the suggested timeframe that are transferable to the technology presently used. Viable substitutes would have to be available for the petroleum and natural gas required by the petrochemical industrial complex, the petroleum used for the transportation sector, and the electricity and fuels used in residential and commercial sectors.

**Part II of the Energy Alternatives:** A Comparative Analysis, particularly Chapter 16, "Comparing the Economic Costs of Energy Alternatives," discusses the factors that must be involved in developing technically and economically appropriate energy alternatives.

With favorable technologies and economies, the most viable domestically available energy alternative would probably consist of the use of coal, oil shale, tar sands, and biomass to produce synthetic liquids; nuclear energy and coal to compete for the utility market; and renewables to supply a sizable portion of total energy requirements. The environmental effects of each of these alternatives have been discussed briefly in the previous paragraphs of this section. The rest will be a long-term energy-supply transition from crude oil and less dependence on oil imports. Such patterns will require new, efficient technologies; major capital investments; and a high rate of growth in coal production.

The future United States' energy-source mix will depend on a multiplicity of factors—the identification of resources, research

and development efforts, development of technology, rate of economic growth, the economic climate, changes in lifestyle and priorities, capital investment decisions, energy prices, world oil prices, environmental quality priorities, government policies, and availability of imports.

It is unlikely that there will ever be a single definitive choice among energy sources or that development of one source will preclude development of others. Different energy sources will differ in their rates of development and the extent of their contributions to total United States' energy supplies. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the total national energy picture.

It is difficult to predict the extent to which the development of alternative energy supplies may be necessary since other factors are involved, such as the continuing success of energy conservation by the American public, overcoming technical and economic barriers that presently exist in developing other alternative-energy sources, and improving resource-recovery methods to increase the rate of recovery. For more information on these alternative approaches to our Nation's energy needs, refer to the following: Energy Alternatives: A Comparative Analysis (University of Oklahoma, 1975), which was prepared under contract for BLM; and the Final Environmental Statements for OCS Sales 58 (USDOI, BLM, 1979) and 70 (USDOI, MMS, 1982).

**APPENDIX E**

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**MAJOR PROJECTS CONSIDERED  
IN  
CUMULATIVE-EFFECTS ASSESSMENT**

## MAJOR PROJECTS CONSIDERED IN CUMULATIVE-EFFECTS ASSESSMENT

Information in this appendix supplements and updates material contained in Appendix B of the Final Environmental Impact Statements (FEIS's) for Sales 71, 87, and 97, which are incorporated by reference (USDOI, MMS, 1982, 1984, and 1987a, respectively). The 18 projects described in this section are depicted on Graphic No. 3 and summarized in Table IV-A-4-1. Projects in this table are numbered to correspond to the project number in the text. As on the table, projects are segmented under three broad categories: Existing Development (Projects 1 through 8), Exploration and Potential Development (Projects 9 through 16), and Future Lease Sales (Projects 17 and 18).

This appendix also contains a list of projects from the 5-Year Supplemental EIS (USDOI, MMS, 1989) that are used to assess the effects of projects and activities on migratory species in other parts of their ranges—this includes the Bering Sea, Prince William Sound and the Gulf of Alaska, and the Pacific coastal area of the U.S. and Canada.

### EXISTING DEVELOPMENT

1. **Trans-Alaska Pipeline (TAP):** Approximately 16.3 mi<sup>2</sup> are occupied by the 800-mi pipeline that runs between the Prudhoe Bay Unit and Valdez. Between Prudhoe Bay and Fairbanks, the Dalton Highway (Haul Road) was constructed parallel to the pipeline. Ten pump stations move about 1.7 million barrels of oil per day (MMbpd) through the pipeline. Two additional pump stations could be added and drag-reduction agents introduced that would take capacity past its design capacity of 2 MMbpd to approximately 2.4 MMbpd. The Alyeska Pipeline Service Company designed, constructed, and now operates the TAP (Alyeska Pipeline Service Co., 1984).

2. **The North Slope Borough (NSB) Capital Improvements Program (CIP):** One of the goals in the formation of the NSB was the improvement of living conditions in North Slope Inupiat villages. With revenues from the Prudhoe Bay field, a network of NSB and construction subcontractor management, and maximum participation of Inupiat men and women in each project, this massive CIP has been used to construct schools and housing in every village, acquire gravel and land, improve airport runways, improve fuel generation and water and sewer systems, acquire maintenance equipment and search-and-rescue helicopters, and initiate areawide communications and solid-waste-disposal improvements for every village of the North Slope during the 1970's and early 1980's. Many of the projects have been completed. The focus of future expenditures emphasizes health and human services, safety, and the maintenance of facilities already built (NSB Ordinance 86-10 et seq.).

Previously, the CIP proposed the development of conceptual master plans for service bases at Bullen Point and Kuparuk (NSB, 1983). Although these areas still may serve as industrial centers for North Slope oil and gas development, the focus of the CIP has been redirected.

3. **Prudhoe Bay Unit (PBU):** The PBU produces 1.5 MMbpd from the Sadlerochit formation, approximately 17 percent of the total U.S. production. Sixteen companies are included in the unitized field. ARCO Alaska, Inc., operates the east half of the field; and Standard Alaska Production Company operates the west half. Approximately 4,000 persons are employed for this field. Major facilities include base camps for Standard and ARCO personnel, a crude-oil-topping plant, a central gas facility, airstrip, flow stations, gas-injection facilities, two docks, seawater-treatment plant, water-injection plants, and a power system. Additional facilities for support activities have been located at Deadhorse. Approximately 348 km of roadways and 1,160 km of oil and gas pipelines have been constructed within the PBU (this includes 80 km of pipeline constructed for Lisburne production).

Original well spacing was based on 160 acres per well; spacing is being reduced to 80 acres per well. As the field matures and "infill drilling" increases, spacing in some locations may be reduced to 40 acres. Gravel pads, which typically are 46 m by 400 m, accommodate up to 40 wells. Waterflooding, a secondary recovery technique, is expected to increase production by approximately 1 Bbbl. Initially, the waterflood process was accomplished by reinjecting into the reservoir formation waters produced with Prudhoe Bay oil. Subsequently, seawater processed at the treatment plant has been injected. The processed seawater is distributed via 13 mi of 40-in-diameter pipe to the eastern injection plant and 11 mi of 36-in-diameter pipe to the western injection plant. Operating the waterflood system increased employment at Prudhoe Bay by 42 persons per shift. Waterflood equipment, including the world's largest seawater-treatment plant and two injection plants, was shipped by barge in the summer of 1983. The 26,000-ton, 11-story treatment plant is the largest module ever shipped to the PBU. By 1989, water-injection rates had reached 1.2 MMbpd, with 900 MMbbl of this amount composed of source water. Water-injection levels could reach 1.5 MMbpd by 1993 (Weeks, 1989).

In addition to waterflooding and infilling, production was increased further when the world's largest gas-processing plant came on line. During the 12-month period ending June 30, 1989, Prudhoe gas production totaled 1,418 Bcf. Of that figure, 1,133 Bcf were reinjected into the gas cap to maintain formation pressure, while another 125 Bcf were injected into the oil-field rim to further assist resource recovery (Weeks, 1989). As much as 50,000 bpd of liquefied natural gas (LNG) can be commingled with the Prudhoe Bay crude oil and piped through the TAP (Oil and Gas Journal [OGJ], 1987).

In addition to the main Prudhoe Bay field, the PBU also contains smaller satellite fields. Three are worthy of mention here: the West End (Eileen) field, Sag River, and Point McIntire. The West End field, as its name implies, is located to the west of the main Prudhoe field, between it and the Kuparuk field. The Eileen reservoir currently produces 52,000 bpd. By 1990, ARCO expects to have 72 producing wells and 4 gas-injection wells in operation on the West End field. The Sag River formation is located 50 ft above the Sadlerochit formation (the Prudhoe production formation). As of May 1989, the Sag was being serviced by 96 producer wells and 36 injector wells. Production in the Sag field is calculated at 15,000 bpd (Weeks, 1989). The Point McIntire field lies at the northern edge of the PBU about 400 to 500 yd to the west of the West Dock. Discovery of the field was announced in 1989; field reserves are estimated at 300 MMbbl. The McIntire field may be subunitized within the PBU; however, no development plans have been made public.

4. **Lisburne Field:** The Lisburne field is part of the PBU. ARCO committed \$575 million in 1984 to develop the first phase of a commercial field. Permits have been issued for expanding five onshore drill sites, roads, and gathering facilities; plans for an offshore drilling platform have been placed on hold. ARCO has constructed 80 km of pipeline and drilled approximately 80 wells on five pads for an initial production rate of 35,000 bpd in 1988. During the Lisburne production phase, ARCO plans to upgrade and expand housing and support facilities at the ARCO camp to accommodate workers for 60 permanent positions. Filling these positions could require 200 to 250 employees (Maynard and Partch et al., 1985).

5. **Kuparuk River Unit:** The Kuparuk River oil field lies approximately 30 mi northwest of Prudhoe Bay. ARCO, the major shareholder, operates the unitized field for the eight owner companies. Oil in place is estimated to range from 4 to 5 Bbbl. Total recoverable oil with a successful waterflood is estimated at 1.6 Bbbl; and, in 1983, a water-flood-demonstration project was begun. During 1989, 337,000 bpd are expected to be processed from the field, making Kuparuk second only to Prudhoe Bay in U.S. daily production. A total of 800 wells

(including oil, gas, water, and injection wells) ultimately will be drilled. Almost 500 persons will be employed at full production to operate the field. Facilities include living and dining quarters; a water- and sewage-treatment plant; warehouses; offices; a central processing plant; an operations center; construction camps; and a 1,700-ft gravel airstrip. A bridge across the Kuparuk River connects the 150 km of roads in the Kuparuk Field to those of the PBU. Oil is transported via 668 km of pipeline. Pipeline distance includes a 24-in pipeline running 26 mi to the TAP. In 1984, the 24-in pipeline replaced a 16-in pipeline that had been in operation since 1981 (Snapp, 1984).

6. **West Sak Formation:** The West Sak formation lies within the boundaries of the Kuparuk River Unit. Construction information is included in the totals for the Kuparuk River Unit. ARCO conducted a pilot project in this formation to determine the potential for full-scale production. ARCO used eight wells to produce the oil and five additional wells to inject hot water to drive the production. Through this project, ARCO demonstrated that the oil could be recovered by conventional methods; however, development would not occur until oil prices improved and became more stable (Anchorage Daily News, 1987). If the field is developed fully, wells spaced every 20 acres would produce between 100,000 and 200,000 bpd. Total production could reach 2 Bbbl. ARCO estimates 15 to 25 Bbbl are in place, of which 20 percent ultimately might be recovered (OGJ, 1984).

7. **Duck Island Unit:** Development drilling began on the unit's two causeway-connected islands in 1987. By February of 1989, the unit possessed 51 operational production wells, which produced at a rate of 100,000 bpd. Developmental drilling within the Duck Island Unit will continue into 1989 with only one rig allocated for both islands. Approximately 1.3 percent of Duck Island's production consists of natural gas liquids. With the exception of gas used for fuel and that used to extract LNG, all gas is reinjected into the formation water. In 1988, a waterflood project was begun in the unit, so 35,000 to 40,000 bbl of water per day are injected into the Endicott formation from each of four wells. This extensive waterflood project has repressured the Endicott, which lost its formation pressure in an unexpectedly rapid manner after production was initiated.

8. **Milne Point Unit:** Conoco operates Milne Point, an (approximate) 21,000-acre field that is located north of the Kuparuk River Unit. The field was identified by Conoco in 1970 but was not considered economic to develop until 1979 when the area was unitized. Housing modules for both the 50-person permanent camp and the 300-person construction camp were delivered in 1984. Development modules were shipped on three barges during the 1985 sealift. During the period of construction, approximately 300 persons resided in camp. The construction camp is located adjacent to the permanent camp and can be opened and closed in segments to facilitate accommodating varying sizes in the work force. About 30 km of roadways were built. Approximately 24 km of oil pipelines were constructed from the drilling sites in the Milne Point field to the West Kuparuk pipeline. Production from 24 wells located on two pads began in November 1985 at approximately 10,000 bpd. Production was suspended in 1986 and reinstated in 1988. Recoverable resources are estimated at 100 MMbbl (Anchorage Daily News, 1985, and Hastings, 1986, personal commun.).

## EXPLORATION AND POTENTIAL DEVELOPMENT

9. **Discovered Resources (Oil Fields, Gas Fields, and Mining):** Possible new projects that are described in Maynard and Partch et al. (1985) primarily include oil resources too viscous to produce and gas resources. Although these projects are not on the immediate horizon, given appropriate technology, market prices, and infrastructure, they could be processing commercial quantities of oil or gas on short notice.

**Oil Fields:** Gwydyr Bay oil is thought to be pooled in a very

small area between two faults. The 27,160-acre field, located north of the west operating area of the PBU, was unitized in 1979 and is still being evaluated. Conoco, Hamilton Brothers, Cities Service Company, and Mobil/Chevron have drilled approximately nine wells.

Between 6 to 11 Bbbl of oil have been identified in the Ugnu Sands, which lie in the northern part of the Kuparuk River Unit and the Milne Point Unit. Because the oil is extremely viscous, no plans to develop the field have been proposed.

The Simpson Lagoon Field consists of two wells drilled during the late 1960's. Although oil was found, no additional work on the field has been undertaken.

**Gas Fields:** Several gas fields contain resources that could be recovered should the infrastructure for transporting the gas be constructed. Two fields that fall in this category already are associated with oil production. Estimates for gas from the Prudhoe Bay gas cap indicate 2 Bcf per day could be extracted for 25 years without substantially affecting the production of oil. Proven resources total 28,183 Tcf. Estimates of gas resources at Endicott indicate initial production could reach 250 MMcf per day for 20 to 30 years. Other fields with significant gas potential include Point Thomson and Gubik. The Point Thomson Unit is located between the Canning River and Bullen Point Camp. Exploration began in 1975 and 15 wells have been drilled to date. Although 350 MMbbl of gas condensate have been estimated for the Point Thomson Unit, no announcements of field development have occurred. Production is contingent on a gas-marketing scheme for the North Slope (OGJ, 1985). Gubik is located near the eastern border of the National Petroleum Reserve-Alaska (NPR-A) on land owned by the Arctic Slope Regional Corporation (ASRC). Estimates of gas resources reach 317 Bcf.

The Kemik, Kavik, and East Umiat fields contain lesser accumulations of gas resources. Kemik and Kavik could be commercial only if a gas pipeline were constructed adjacent to them. East Umiat is considered noncommercial.

**Mining:** The Red Dog Mine, located in the Northwest Arctic Borough, currently is being developed by Cominco Alaska, Inc. The mine is owned by the Northwest Arctic Native Association (NANA) Regional Native Corporation. The port through which the ore will be shipped is south of Kivalina. The NANA shareholders will hold the majority of the jobs for this project.

Coal (and its development) also is a potential source for cumulative effects on the North Slope, especially near Cape Beaufort, along the Chukchi Sea coast from Cape Lisburne to Wainwright. A State-funded study of coal resources during 1984 in the western Arctic was conducted to determine if the resources could be used as an economic replacement for the fuel oil currently being imported into the villages. The coal deposit of the Deadfall Syncline, located 6 mi from the Chukchi Sea and about 40 mi south of Point Lay, was identified as the best source for this use. A detailed feasibility assessment was completed in 1986. Development of this resource has been recommended and awaits further funding (Arctic Slope Consulting Engineers, 1986).

10. **Seal Island:** Seal Island is a gravel island constructed on a lease obtained by Shell during the Joint Federal/State Beaufort Sea Lease Sale held in 1979. Recovery of 300 MMbbl of oil has been estimated from a discovery announced by Shell in January 1984. Shell would like to start producing about 100,000 bpd of oil, possibly by 1992. An oil discovery from the nearby Northstar gravel island was announced in January 1986. This discovery helps to define the Seal Island reservoir (Alaska Report, Jan. 22, 1986). Amerada Hess drilled one well and spudded a second from Northstar during the 1985 to 1986 drilling season (Van Dyke, 1987, personal commun.). In 1989, a proposal to unitize the Seal Island and Northstar Island fields as the Northstar Unit was submitted to the State of Alaska as well as the U.S. Department of the Interior (USDIO) by

Amerada Hess. Upon approval of the unitization plan, a development plan for the Northstar Unit will be forwarded for review and approval.

**11. National Petroleum Reserve-Alaska:** The NPR-A is administered by the USDOl. Resources are estimated at 6.4 Bbbl of oil and 11 Tcf of gas; recoverable reserves are estimated at 1.85 Bbbl of oil and 3.74 Tcf of gas.

More than 90 wells have been drilled on NPR-A (Schindler, 1983). Although none has proven commercial, the wells that have been drilled in Simpson Field (35 wells with an estimated 12 MMbbl in place) and Umiat (11 wells with an estimated resource of 66 MMbbl) may eventually become commercial (Maynard and Partch et al., 1985). In compliance with the 1981 Department of the Interior Appropriation Act, as amended, the USDOl has undertaken studies and initiated a leasing program in NPR-A. Two lease sales were held in 1982, in which the most promising areas were leased. Plans called for one lease sale a year for 5 years beginning July 20, 1983. However, no acreage was leased in 1984. Due to lack of interest, no sale has been held since then. Two areas have been deleted from lease-sale plans, removing approximately 3 percent of the estimated oil resources. One deletion is the core of the Western Arctic caribou calving area and the other includes approximately 85 percent of the black brant molting area north of Teshekpuk Lake. Leasing on the First Creek Delta salt-marsh waterfowl area has been deferred 5 years. In 1985, drilling began on areas leased under the NPR-A program. The first well, drilled on the Brontosaurus Prospect about 30 mi south of Barrow, was plugged and abandoned.

**12. Oil and Gas Leasing in the Arctic National Wildlife Refuge (ANWR):** The ANWR is situated in the northeastern part of Alaska. The boundaries of the coastal plains portion of the ANWR facing the Beaufort Sea extend from the Canning River Delta on the west to the Canadian border on the east. Controversy as to whether or not the coastal plain of ANWR should be open for oil and gas exploration and development led Congress to create Section 1002 of the Alaska National Interest Lands Conservation Act (ANILCA). This section laid out guidelines for the Secretary of the Interior to follow prior to reporting to Congress with recommendations for the use of the coastal plain, or 1002 area. The U.S. Fish and Wildlife Service (FWS) released its final legislative FEIS on the potential effects of exploration and development on the coastal plain in April 1987 (USDOl, FWS, 1987). The FEIS analysis was based on a 150-mi pipeline that would extend from the easternmost development hypothesized in ANWR to TAP Pump Station No. 1. The conditional, economically recoverable resource in the base case was estimated at 3.2 Bbbl with a 19-percent probability of oil being present. Approximately 12,650 acres, or 0.8 percent of the 1002 area, would be modified from its initial condition. Approximately 200 to 300 mi of all-season gravel roads within several oil fields and about 110 mi of road between the Canning River and the marine facilities at Pokok Lagoon are assumed.

The Secretary of the Interior recommended to Congress that the entire Arctic Refuge coastal plain (Alternative A) be made available for oil and gas leasing. Other alternatives identified in the ANWR FEIS for consideration by Congress are: (1) limited leasing of the 1002 area (Alternative B)—there would be no leasing or other oil and gas activities in the traditional core-calving area of the Porcupine caribou herd; (2) allow further exploration (Alternative C)—this would include exploratory drilling and allow permits for obtaining additional data by the Government, industry, or both to determine whether or not to authorize leasing of the 1002 area; (3) take no further legislative action (Alternative D)—this would allow the prohibition against oil and gas leasing, exploration, and development to continue; and (4) designate the area as wilderness (Alternative E)—no further study or public-review process would be necessary for this action.

Section 1003 of ANILCA states "production of oil and gas from

the Arctic National Wildlife Refuge is prohibited and no leasing or other development leading to production of oil and gas from the range shall be undertaken until authorized by an act of Congress." This prohibition on downhole-hydrocarbon exploration was modified as a result of the land exchange between USDOl, the Kaktovik Inupiat Corporation (KIC), and the ASRC. Through this exchange, the Native corporations received 92,000 acres within the refuge. As a result, the KIC was able to have a well drilled on refuge lands. No hydrocarbon discovery was announced. Up to three exploratory wells may be drilled on this acreage prior to congressional action. As noted above, however, no development can proceed without congressional approval.

Another activity permitted in ANWR is geophysical fieldwork. This work must be conducted consistent with USDOl guidelines developed to protect the renewable resources of the refuge (ANILCA Sec. 1002[d]). Three types of geologic surveys have been permitted—surface geology, gravity-magnetic, and seismic. Between 1983 and 1985, 18 permits were issued to conduct surface-geology studies. Some of these permitted work in multiple years. One permit was issued to conduct a gravity-magnetic and control-net survey. Only 1 of 12 applications for seismic surveys was issued. More than 2,460 km of seismic lines were run over the course of two winters (1984 and 1985). This work provided the FWS with the necessary data for the report on ANWR that was delivered to Congress in April 1987. No future seismic work is anticipated until authorized by Congress.

### **13. Recent State of Alaska Arctic Lease Sales:**

**Sale 34:** This sale was held in May 1982 for acreage in the Prudhoe Bay uplands. The lease area straddled the Arctic Slope and Northern Foothills petroleum provinces. The northeastern quadrant is adjacent to two significant discoveries at Point Thomson (State of Alaska, Div. of Policy Dev. and Planning [DPDP], 1982b).

The State offered 1.23 million acres in 261 tracts; 119 tracts were leased. Many of the leased tracts were along the Canning River, the western boundary of the ANWR. Two wells were drilled in 1984; both were abandoned. No further drilling has been proposed (Van Dyke, 1985, personal commun.).

**Sale 36:** This sale was held in September 1982. Acreage offered equalled 56,862 acres—41,500 acres were submerged lands north of Prudhoe Bay near Midway Islands and approximately 15,500 acres included both submerged lands in the Flaxman Island-Canning River area and uplands along the northwest border of the ANWR. Oil potential is considered high for the eastern tracts and low for the Midway Islands tracts. The scenario for this lease sale assumed development from the eastern tracts would begin within 10 years of the sale and that production would join a pipeline previously built to accommodate production from Point Thomson (State of Alaska, DPDP, 1982a). One well was drilled in the spring of 1983.

**Sale 39:** This sale, held in May 1983, was for 211,956 acres between the Colville River Delta and Gwydyr Bay. Nine tracts totalling 43,000 acres along the delta were eliminated for environmental reasons, and 5,000 acres along the boundary of the territorial sea were deleted because title to them was in dispute. Thirty-nine mitigating measures were stipulated to safeguard against environmental and sociocultural effects. Leases in Sale 39 are eligible for "exploration drilling credits" for the first exploratory well drilled on each tract (State of Alaska, Department of Natural Resources [DNR], 1983).

**Sale 43:** This sale, held in May 1984, offered tracts immediately west of Sale 9. Tracts extended west from the Colville River Delta to Pitt Point (at the east end of Smith Bay). Sale 43A, offering nine tracts at the mouth of the Colville and six tracts much farther south, was held concurrently. All tracts, except three offshore, received bids. Three stipulations and 41 additional terms of the sale are applied to these leases.

**Sale 47:** In May 1985, the eastern portion of the Kuparuk Uplands was offered in Sale 47. This area includes approximately 600,000 acres between the Kuparuk and Sagavanirktok Rivers. Petroleum potential is considered moderate to high.

**Sale 48:** In February 1986, the Kuparuk Uplands south of the Kuparuk oil field was offered for lease in Sale 48. Of 54 tracts offered, 104 received bids; 266,736 acres were leased.

**Sale 48A:** Eleven tracts totalling 42,053 acres in the Mikkelsen Unit were reoffered in February 1986. All tracts received bids.

**Sale 51:** The Prudhoe Bay Uplands lease sale was held on January 27, 1987. One hundred and nineteen tracts were offered; 26 were sold. Total acreage sold was 100,632. Petroleum potential in the lease-sale area is thought to be moderate.

**Sale 50:** The Camden Bay lease sale was held on June 30, 1987. Thirty-five tracts were offered and all were sold. Total acreage sold was 118,147. Petroleum potential in the lease-sale area is thought to be moderate to high.

**Sale 54:** The Kuparuk Uplands lease sale was held on January 26, 1988. Eighty-nine tracts were offered; 72 were sold. Total acreage sold was 338,687. Petroleum potential in the area is thought to be moderate.

**Sale 55:** The Demarcation Point lease sale was held on September 28, 1988. Fifty-six tracts were offered; 26 were sold. Total acreage sold was 96,631. Petroleum potential in the lease-sale area is thought to be moderate to high.

**Sale 69A:** The Kuparuk Uplands lease sale was held on September 28, 1988. One hundred and fifty-five tracts were offered; 75 were sold. Total acreage sold was 368,490. Petroleum potential in the lease-sale area is thought to be low to moderate.

**Sale 52:** The Beaufort Sea lease sale was held on January 24, 1989. The tracts were located between Pitt Point and Tangent Point and centered on Smith Bay. Forty-three tracts were offered; 15 were sold. Total acreage sold was 52,463.

#### **14. Postsale Activity on Areas Leased in Previous Outer Continental Shelf (OCS) Sales in the Beaufort and Chukchi Seas**

**Beaufort Sea:** Four sales have been held for Beaufort Sea OCS oil and gas leases. The first sale, a joint Federal and State Sale, held in December 1979, offered Federal and State submerged lands and State offshore islands. The second sale, held in October 1982, offered tracts primarily west of Prudhoe Bay and east of Smith Bay. The third sale, Sale 87, offered tracts between Barrow and Canada and generally out to the 200-m isobath. Leases were awarded on 372 tracts totalling 786,617 ha. The fourth and most recent OCS sale, Sale 97, resulted in the sale of 202 tracts totaling 449,551 ha. The mean, conditional, unleased, economically recoverable oil estimated for Sale 97 was 650 MMbbl. The mean, conditional, leased and unleased (cumulative mean) economically recoverable oil for the Arctic Region (Beaufort Sea, Chukchi Sea and Hope Basin Planning Areas) is estimated to be 3.82 Bbbl. Capacity in the TAP should be adequate for all oil coming from the North Slope. Production of natural gas in the Beaufort Sea is considered uneconomic at this time.

Most drilling from leases issued in the joint sale has been done on State tracts; the Duck Island Unit (Project 7) is located on the State tracts. On Federal tracts, two wells drilled at Beechy Point were determined to be producible and were plugged and abandoned. Two wells drilled from Tern Island were determined to be producible and were temporarily abandoned in 1987. Results from a third well drilled into lease OCS-Y-197 are not yet available. In regard to Seal Island, the Amerada Hess Corporation has submitted a proposal to unitize the field

as the Northstar Unit (see Project 10).

Seven wells have been drilled on leases issued in Sale 71. Both Mukluk (one well drilled from a gravel island) and the Antares Prospect (two wells drilled from the Concrete Island Drilling System were determined to be nonproducing and were plugged and abandoned.

Drilling from blocks leased in Sale 87 began in the summer of 1985. Including the summer of 1989, six wells have been drilled on the subject leases. The drillship then was moved to the Corona Prospect, located north of Camden Bay. The Corona Prospect was completed in the 1986 drilling season; and the drillship returned to the Hammerhead Prospect, where a second well was drilled. Drilling for each of the three prospects was supported by three ice-class vessels—two smaller vessels were used for supplies and ice management and the third vessel, the Robert Lemeur (an icebreaker-supply boat), was used to open the route to the drill site plus perform tasks similar to the smaller vessels. The Belcher Prospect, located near the Canadian border, was spudded from a drillship in September of 1988 and completed in the summer of 1989. Near Harrison Bay, Exxon has drilled a well on the Orion Prospect. The Prospect lies just north of Cape Halkett. Northwest of Oliktok Point, Tenneco used the Single Steel Drilling Caisson placed on a steel mat during the 1986 to 1987 season to begin a well that was completed in 1988. (See Roberts, 1987, for a more complete description of activities that have occurred on previously leased Federal tracts in the Beaufort Sea.)

**Chukchi Sea:** Sale 109, the first Federal offshore oil and gas lease sale in the Chukchi Sea, was held in May 1988. Of the tracts offered, bids were accepted on 350. The mean, conditional resource estimates for the sale were estimated at 2.68 Bbbl of oil and 15.1 Tcf of natural gas. To date, two wells have been drilled on Chukchi leases by the Shell Corporation—one well each on the Klondike and Berger Prospects. Both wells were plugged in 1988, and no report has been issued about either the producibility or existence of hydrocarbons.

**15. ASRC Oil and Gas Leasing:** The ASRC is a for-profit corporation created pursuant to the Alaska Native Claims Settlement Act of 1971. The Corporation has title to 4.9 million acres, both surface and subsurface estate, located in the northern part of the State. The ASRC lands are located principally to the west and to the south of the NPR-A boundaries. The ASRC has leased approximately half its acreage to various oil companies. Several exploratory wells have been drilled on ASRC leases to date; the most notable are the wells drilled in the ANWR and Gubik, east of NPR-A.

**16. Canadian Beaufort Sea:** In 1982, Dome Petroleum Limited; Esso Resources Canada, Limited; and Gulf Canada Resources Inc. prepared a Beaufort Sea-Mackenzie Delta EIS. This description summarizes the information found in the Sale 87 FEIS (USDOI, MMS, 1984), which was based on information from the Dome Petroleum Limited et al. (1982) EIS; Alaska OCS Region Technical Paper No. 7 (Roberts and Tremont, 1982); and the Beaufort Bulletin, June 1983.

In its EIS, Canadian industry anticipated four offshore and three onshore reservoirs would be online during the years of hydrocarbon production. Further assumptions in this EIS were: (1) for oil and gas delineation, production, and injection, 655 additional wells were expected; (2) between 1987 and 2000, the work force will increase gradually to approximately 8,500 persons; and (3) construction of a gas pipeline between 1989 and 1992 could employ 10,000 persons and would peak in 1990. The figures used for the 1982 EIS for Canadian development were based on the confirmation of a commercial field by 1983 or 1984, with production beginning as early as 1986 or 1987. Cumulative potential offshore and near offshore oil and gas resources have been calculated at 5.25 Bbbl of oil and 56.06 Tcf of natural gas according to a 1988 Geological Survey of Canada report (Dixon et al., 1988). In spite of these promising resource estimates and the optimism of the subject EIS, no

production or oil-field development has taken place. However, application has been made by the Canadian Beaufort operators to transport natural gas down a gas pipeline constructed through the Mackenzie River Valley from Norman Wells to the Tuk Peninsula.

For the transportation system, options that have been considered for full production include a tanker route through the Northwest Passage, an overland pipeline through the Mackenzie Valley, or a combined tanker-pipeline route. Plans to tanker Canadian crude to Asia through the U.S. Beaufort and Chukchi Seas were considered by Canadian operators but will not be utilized.

**Current Status:** Drilling began in the 1960's. By 1988, over 237 wells had been drilled in the Canadian Arctic, both offshore and onshore. Most oil shows, however, have been offshore. Among the promising fields is Amauligak; with resource estimates of 700 to 800 MMbbl, it is considered one of the cornerstones to commercial development. Other finds in the area include Tuk J-29, Pitsiulak, and Nipterk (OGJ, 1985b). Wells have been drilled from gravel islands, caisson-retained islands (Tarsuit), bottom-founded mobil units (Semi-Submersible Drilling Caisson and Mobil Arctic Caisson), and floating units (drillships and a conical drilling unit). Tuktoyaktuk and McKinley Bay are the primary service bases; additional facilities are on Hershel Island and have been proposed for King Point in the Yukon Territory. McKinley Bay's ship-repair facilities are adequate to service the entire range of vessels present in the Arctic (Evans, 1985, personal commun.).

#### FUTURE LEASE SALES

**17. Future State of Alaska Leasing Offshore and Onshore:** Seven lease sales in the Beaufort Sea and mid-Beaufort uplands are included in the State of Alaska's 5-year lease-sale schedule (State of Alaska, DNR, 1989). Offerings in the Beaufort Sea coastal area are considered to have moderate to high resource values.

**Sale 70A:** This sale is scheduled for September of 1990. The sale will include lands between the Colville and Canning Rivers and will reach 532,906 acres in extent. Petroleum potential of this area is thought to be low to moderate.

**Sale 64:** Proposed Sale 64 consists of approximately 771,840 acres of State acreage lying 30 mi from the coast between the Canning and Sagavanirktok Rivers. Most of the area was offered previously in Prudhoe Bay Uplands Lease Sale 34, held in September 1982. Some of these lands also were offered as part of previously held lease Sale 51. Additional acreage may be added to the sale, which is scheduled for May 1991, if certain active leases expire.

**Sale 65:** This sale reoffers submerged Beaufort Sea acreage between Pitt Point and Flaxman Island. The sale is scheduled for May 1991 after leases sold in the 1979 Joint Federal/State Beaufort Sea Oil and Gas Lease Sale expire. The acreage offered in Sale 65 is approximately 340,000.

**Sale 61:** The proposed Sale 61 area consists of about 875,000 acres southwest of the Kuparuk River oil field. The area is situated between the White Hills to the northeast and the Colville River to the northwest. Some of the acreage now included in the proposed sale has yet to be conveyed to the State; however, title to those lands is expected prior to the sale date. The sale is scheduled for January 1992.

**Sale 68:** The proposed Sale 68 area consists of approximately 393,000 acres of State-owned tide and submerged lands offshore of NPR-A. The seaward boundary of NPR-A is the subject of a dispute between the United States and the State of Alaska. The issue is pending before the U.S. Supreme Court. Should an agreement between the parties be concluded before the sale date, an adjustment in the sale acreage and boundaries may be necessary. The sale is scheduled for May 1992.

**Sale 75:** The proposed Sale 75 area will consist of approximately 110,080 acres of lands previously leased in State Sales 13, 48, and 54. The sale will include any lands formerly part of the Kuparuk River Unit and other acreage that becomes available as leases expire on the North Slope. The sale is scheduled for September 1992.

**Sale 77:** The proposed Sale 77 area will include North Slope lands about 70 miles south of the Kuparuk River oil field. The proposed sale area is bordered on the south by the North Slope Foothills Sale 57, on the east by the Trans-Alaskan Pipeline corridor, and on the west by the Chandler River. The proposed sale area consists of approximately 1,030,600 acres. More acreage is optional, depending on the availability of land from expiring or terminating North Slope leases. The proposed sale date is May 1993.

**Sale 57:** About 1,500,000 acres near the foothills of the Brooks Range between Umiat and Anaktuvuk Pass are to be offered in Sale 57, to be held in September 1993. The petroleum potential in the area is considered low to moderate.

**Sale 80:** The proposed Sale 80 area consists of approximately 500,000 acres of State-owned upland acreage on the north slope, lying between the Canning and the Sagavanirktok rivers. A major portion of the sale area consists of acreage that was offered but not leased in the previous State Lease Sales 34 and 51. Some of the acreage included in the proposed sale has yet to be conveyed to the State. Any acreage for which the State does not have at least tentative approval before the notice of sale will not be offered for sale. Petroleum potential in the proposed sale area is considered to be low to moderate.

#### 18. Future Federal OCS Leasing

**Chukchi Sea:** Under the proposed 5-Year OCS Oil and Gas Leasing Schedule for mid-1987 through mid-1992 (USDO, MMS, 1987c), two lease sales are proposed for the Chukchi Sea—Chukchi Sea Lease Sales 109, held in 1988, and 126, presently scheduled for 1991. Initial descriptions of activities that could ensue from a lease sale in the Chukchi Sea as well as the sale's resource potential are provided in the Sale 109, Chukchi Sea FEIS (USDO, MMS, 1987b).

**Beaufort Sea:** The proposed 5-year leasing schedule (USDO, MMS, 1987c) contains one lease sale for the Beaufort Sea, Sale 124, scheduled for 1991. The activities for developing the entire Beaufort Sea that are assumed in Section IIA of this EIS apply also to any future Federal leasing activity.

#### ADDITIONAL PROJECTS CONSIDERED IN THE MIGRATORY SPECIES' CUMULATIVE-EFFECTS ASSESSMENT

This section describes other OCS projects and proposals and existing oil and gas infrastructures that are part of the existing environment or are reasonably foreseeable future actions. These additional projects are used in assessing effects on migratory species within the range of the respective species.

#### 19. Dredging and Marine-Disposal Activities

**Alaska Region:** The Snake River, which enters Norton Sound at Nome, is dredged annually. Approximately 13,000 yd<sup>3</sup> of sediment are removed each year and deposited about 1/2 mi east of the mouth of the river. These dredge spoils are contaminated by mercury that was released into the environment during the years that mercury was used for the processing of gold. Data that have been made available recently have led the Environmental Protection Agency (EPA) to review the decision to use this offshore-disposal site. Nome harbor sediments were tested by the Army Corps of Engineers (COE) and the EPA in 1989 and were found to contain measurable levels of a number of chemical constituents. The COE and EPA are reviewing the new information regarding suitability of the material for continued ocean disposal.

**Pacific Region:** In the Pacific Region, a variety of materials have been and are being dumped offshore: dredge spoils, low-level radioactive wastes, obsolete munitions, and industrial and municipal wastes. Ocean dumping of acceptable waste materials is authorized under Title I of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401), and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251). The EPA administers the designation and management of ocean-disposal areas and permits for dumping of all acceptable wastes except dredged materials. The COE administers the permit program for transportation of dredged materials for ocean disposal, with independent review and concurrence by EPA.

**20. Commercial Fisheries:** Waters off the coast of Alaska support some of the most productive fisheries in the world. In 1986, the ex-vessel value of Alaskan commercial fisheries totaled about \$955 million. The salmon fishery was valued at \$404 million, with a 5-year (1982-1986) average value of \$354 million. Fisheries for groundfish (primarily pollock, sablefish, sole, cod, and other flounders) were valued at about \$268 million. Although below recent former harvest levels, the shellfish fishery, mainly for crab, has experienced increasing price levels and was valued at \$182 million (NPFMC, 1989). The ex-vessel value of the 1986 herring harvest was \$39 million (Smith, 1989, oral commun.).

All Alaska OCS Region planning areas support commercial fishing to some degree, although the fisheries in the Beaufort and Chukchi Sea Planning Areas are of relatively minor importance. To some degree, all coastal communities in Alaska derive economic benefit from commercial fishing; however, in landings and value, Dutch Harbor, Kodiak, Naknek, Cordova, Sitka, and Petersburg rank as the major fishing ports in the Region.

Alaskan commercial fisheries employ gillnets, seines, and trolling gear for harvesting salmon; longlines for halibut, sablefish, and rockfish; and trawls for other groundfish. Pots of various types are used in the crab fisheries. The limited spring and summer herring roe/bait fisheries also employ gillnets and purse seines. Commercial-fishing success varies considerably in time according to the species fished and fluctuations in the populations of such species.

Foreign commercial fisheries also may affect Alaskan stocks and recently, concern has been directed toward open-ocean nondiscriminant gear fisheries.

In addition to the commercial fisheries, there are saltwater coastal sport fisheries for salmon, halibut, and other marine fishes. Sport fishermen also harvest shellfish (crab, shrimp, and clams). While of lesser economic value than commercial fisheries, the value of the sport fishery is significant and projected to increase rapidly with the growth in population. For example, a sport-fishing economic study for southcentral Alaska, where most of the State's population is concentrated, showed that angler expenditures associated with all sport fishing in southcentral Alaska were estimated at \$127.1 million in 1986 (Jones and Stokes Associates, Inc., 1987).

**21. Anadromous Fish—Freshwater Habitat:** The freshwater spawning and rearing grounds and riverine migration routes used by anadromous salmonids such as Pacific salmon are especially critical portions of their habitat because the productivity of individual stocks is directly related to the amount and quality of this habitat. In southeastern Alaska, the Tongass National Forest supplies timber for mills at Ketchikan and Sitka and lesser volumes for smaller logging mills at several other locales. Some wood also is used for fuel and local construction. Logging can affect salmon streams and nearshore marine habitat through:

- Siltation that reduces gravel permeability in streams with consequent loss of salmon eggs and pre-emergent fry. This sometimes results from illegally operating logging equipment in

streambeds or across streams.

- Stream blockage as a result of buffer-strip blowdowns following cutting.
- Water warming from loss of shade after cutting, with possible adverse effects on adult spawners and rearing fry.

Over 200 watersheds in the southeastern Alaska Tongass National Forest have been affected to some degree (Netboy, 1980). A number of studies have been conducted by the Alaska Department of Fish and Game, the Alaska Department of Environmental Conservation, the U.S. Forest Service, the U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service.

In part, to prevent damage, to mitigate damages, and to perform the necessary research, the above-listed agencies, in cooperation with the timber industry and the Alaska Department of Natural Resources, have organized an interagency group. This Alaska Working Group on Cooperative Forestry and Fisheries Research, has functioned well; however, considerable fisheries-effects studies remain to be done before some definitive conclusions are reached.

The Pacific Fisheries Management Council (PFMC) (1981) reviewed historical problems with, and the status of, freshwater habitat for anadromous salmon stocks in California, Oregon, and Washington. In particular, the PFMC cited the many serious problems associated with hydroelectric dam construction and operation.

For example, construction of hydroelectric projects has flooded or blocked access to productive spawning habitat, while the operation of these facilities has resulted in reduced flows during migration and in spawning areas, increased turbidity and sedimentation of gravel, and temperature modifications. Such changes have completely eliminated many areas from salmon production and have seriously reduced salmon-production potential in other areas.

The PFMC review also cited poor land- and water-use practices such as logging, road building, water diversions, streambed alterations, and pollution as factors responsible for substantially reducing or degrading the critical freshwater-habitat. Based on the freshwater habitat review presented by the PFMC (1981), substantial historical reductions in critical spawning and rearing habitat have occurred for many salmonid stocks in the central valley of California (i.e., the Sacramento and San Joaquin system) and the Columbia River drainage systems. Based on the trend existing at the time of their review (1978), the PFMC (1981) estimated that habitat availability in all major river systems and coastal streams within California, Oregon, and Washington would continue to decrease, or at best remain unchanged, over the next 10 to 20 years. Even with habitat rehabilitation efforts, the PFMC (1981) estimated relatively little improvement in habitat availability would be likely to occur over the next 10 to 20 years.

Although there are no current estimates of habitat availability, many of the same activities (i.e., hydroelectric-plant operation and water diversions) that have resulted in habitat loss or degradation still continue. Efforts to mitigate or rehabilitate degraded freshwater habitat are in progress or planned in some areas (e.g., the Upper Sacramento River), and there is increasing recognition (California Advisory Committee on Salmon and Steelhead Trout, 1988) that substantial action is required to arrest the long-term trend of habitat loss and degradation and also of reduced salmon production.

**22. Subsistence Activities:** Subsistence hunting and fishing are important from both a cultural aspect and in terms of providing a major source of food for Native and rural Alaskans. The following information is summarized from the Proposed 5-Year Outer Continental Shelf Oil and Gas Leasing Program Mid-1987 to Mid-1992 FEIS (USDOI, MMS, 1987), which is

hereby incorporated by reference. The species used vary somewhat in different portions of the State and from community to community; however, in general, marine mammals and fish are important in most coastal areas.

Important subsistence resources for those communities bordering the Gulf of Alaska, Cook Inlet, and Prince William Sound include salmon, halibut, other marine fishes, freshwater fishes, shellfishes, intertidal resources, small marine mammals, waterfowl, and upland game.

Communities along the southern Bering Sea harvest salmon, halibut, shellfishes, intertidal organisms and plants, fur seals, hair seals, sea lions, birds and bird eggs, and caribou. Communities bordering the northern Bering Sea use salmon and other fishes; shellfishes; bearded, ringed, and spotted seals; walrus; bowhead and belukha whales; waterfowl; moose; reindeer; and caribou.

Communities bordering the Chukchi and Beaufort Seas depend heavily upon marine mammals. Resources used include bearded, ringed, and spotted seals; walrus; bowhead and belukha whales; polar bears; freshwater and ocean fishes; waterfowl; birds and bird eggs; caribou; moose; Dall sheep; berries; and vegetation.

**23. Municipal Wastes and Other Onshore Effluent:** Historically, the Nation's rivers, estuaries, and coastal waters have received municipal-waste discharges since collection and treatment of domestic wastes were initiated. Prior to the 1970's, ocean disposal was largely unregulated, and adverse effects on human health and the environment were observed.

The major point-source discharges of waste materials into nearshore and coastal areas come from sewage-treatment facilities, industrial facilities, and electric-generating facilities. These discharges are regulated by the EPA. The effluent from the industrial and sewage-treatment facilities may contain, even after treatment, substantial quantities of synthetic organics, heavy metals, suspended solids, oxygen-consuming materials, and nutrients. Sewage effluent also may contain fecal coliform and potentially pathogenic microorganisms, and cooling-waste discharges from power plants may be elevated in temperature and have increased chlorine levels.

Contaminants from marine-transportation activities enter the sea intentionally as a result of routine operational discharges and unintentionally as a result of accidental spills. With respect to ships that maintain sizable crews, the pollutants are the large amounts of domestic-waste products such as sewage, food waste, plastic debris, and trash from human activities on board. For recreational vessels, sewage disposal from marine-sanitation devices in highly populated, confined harbors and anchorages is the primary pollution concern.

In contrast to the important progress made during the 1970's in controlling industrial point-source discharges and in upgrading municipal sewage-treatment facilities, progress with nonpoint sources is negligible (CEQ, 1980). Nonpoint-source pollution is primarily the result of precipitation falling and moving over and through land and into surface waters. In some cases, nonpoint-source pollution is the result of human practices such as agriculture and irrigation. All land use activities are potential nonpoint sources of pollution. Such sources are classified as urban and nonurban runoff. Pollution discharges from nonpoint sources greatly exceed the discharge from point sources.

**24. Loss of Habitat in California Due to Coastal Development:** California's population is estimated to be 28 million, with a potential 50 percent increase in the State's coastal population (within 50 miles of the coast) between 1980 and 2010. It was estimated that California had 381,000 acres of prime coastal wetlands at the turn of the century. Within 75 years, about two-thirds of this acreage had been lost to a variety of developments along the coast. These developments

have caused disturbances that have ranged from large-scale, whole-ecosystem elimination to small-scale, habitat-specific alterations. They include, for example, urban development, harbor construction, dredging, dike and levee development, and marina development (Speth, 1979; Zedler, 1982; Zentner, 1988).

This dramatic loss of habitat is not without corresponding loss in plant and animal species. In fact, the declines of almost all of the species listed as threatened, endangered, or candidate by FWS can be traced to past overhunting or habitat loss by coastal development.

## **25. Federal and State Oil and Gas Activities:**

**Postlease Sale Activities in the Beaufort Sea and Chukchi Sea Planning Areas:** See Major Project No. 14 for a summary of postlease-sale activities in the Beaufort Sea and Chukchi Sea Planning Areas.

**Oil and Gas Activities in Other Alaska OCS Planning Areas:** The following lease sales have occurred in other planning areas of the Alaska OCS Region. Exploration activities have occurred within each of the sale areas except the North Aleutian Basin. Active leases remain within these sale areas, and additional exploration activities could be forthcoming.

Lease Sale 57 - Norton Sound  
Lease Sale 70 - St. George Basin  
Lease Sale 83 - Navarin Basin  
Lease Sale 87 - Diapir Field  
Lease Sale 92 - North Aleutian Basin

Exploration activities could include exploratory drilling from a jackup rig, semisubmersible drilling unit, drillship, bottom-founded drilling unit, or artificial island; helicopter-support operations; support-vessel operations, including ice management in the northern sale areas; and high-resolution shallow-hazard seismic surveys.

To date, there have been no proposals for development and production within the Alaska OCS Region. Should oil and/or gas be discovered in commercially producible quantities on leases within one or more of the aforementioned sale areas, development and production activities could occur. Transportation of produced product may occur by pipeline or tanker; the pipeline or tanker routes may pass through several planning areas.

**State of Alaska Oil and Gas Activities:** See Major Projects Numbers 13 and 17 for a summary of activities associated with past and future State of Alaska oil and gas lease sales.

**Northern and Central California Federal Oil and Gas Activities:** From July 1964 when Exxon drilled the first well off the coast of Humboldt County through November 1966, a total of seven exploratory wells were drilled in the Northern California Planning Area. Following the 1963 OCS lease sale, Shell drilled three wells in 1965 to 1966 in the Point Arena Basin. In the offshore Eel River Basin, four exploratory wells were drilled between 1964 and 1965. There has been no development or production in the area.

Between September 1963 and September 1967, Shell Oil Company drilled 12 exploratory wells in the Central California Planning Area. Of these, 10 wells were drilled in the Bodega Basin, beginning in 1963, and 2 wells were drilled in the Ano Nuevo Basin, beginning in 1967, on leases issued in the 1963 OCS lease sale. All oil and gas leases in the area have now expired.

**Southern California Federal Oil and Gas Activities:** While oil production in State waters off southern California commenced in 1896 with the development of the Summerland Field, the first exploratory wells in Federal waters were drilled in the Santa Maria Basin following the first Pacific oil and gas lease sale in May 1963. Chevron Oil Corporation drilled the first well in

Federal waters in September 1964, off the coast of San Luis Obispo County. Twelve fields are located in the onshore portion of the basin, with one field on production in the offshore portion. One COST well was completed in 1978. As of September 1988, 296 exploratory wells had been drilled in the Southern California Planning Area.

Following the discovery of the Dos Cuadros oil field by Phillips Petroleum Company in 1967, exploration activities in the Pacific OCS focused on the Southern California Planning Area. A record number of 38 exploratory wells were drilled in the Pacific OCS in 1968. This exploratory activity in 1968 led to the discovery of the Hondo, Government Point, Pescado, and Secate Fields in the Santa Ynez Unit and increased industry's interest in the oil and gas potential of the Pacific OCS Region.

Exploration activities increased from 1974 through 1977, as industry further defined the oil and gas potential of the Southern California Planning Area. After a slight decline, exploration began a steady increase in the early 1980's as lease sales offered new acreage for offshore operators to explore. Since that time, the pace of exploratory drilling in the Pacific OCS has declined, as offshore operators focused their attention on development and production operations.

Twenty-four offshore fields are located in five major areas of the Southern California Planning Area. Among them are: Point Arguello/Gaviota, Santa Ynez/Las Flores Canyon, Point Pedernales/Lompoc, San Miguel/South Nipomo Mesa, and Santa Clara/Ventura. Fourteen fields capable of commercial production have been discovered in Federal waters in the Santa Barbara Channel since the advent of drilling there in 1967. Further fields are currently on production.

Two oil fields have been discovered offshore San Pedro in the inner-banks area of the southern California borderlands. Of the total wells in the planning area, only nine exploratory wells, commencing in 1976, have been drilled in the outer banks area. As of September 1988, 661 development wells have been drilled from 21 permanent production platforms. The cumulative production from this area, from its beginning in 1968 through 1987 has been approximately 403 MMbbl of oil and slightly less than 284 Bcf of natural gas. Annual production is about 33 MMbbl of oil and 45 Bcf of gas.

Development and production plans have been approved or are under consideration for four additional field projects involving six new platforms. In the Santa Ynez Unit, three additional platforms are proposed for installation; i.e., Harmony/60 well slots/in 1992, Heritage/60 well slots/in 1992, and Heather/28 well slots/in 1995. Platform Julius was proposed to be installed with 70 well slots in the San Miguel Field in 1988. However, San Luis Obispo voter initiative disapproved the onshore processing and transportation facilities of Platform Julius. Platform Independence is proposed to be installed in 1992 with 60 well slots in the Point Pedernales Field but may not be needed for development. Platform Hacienda is under consideration for the Rocky Point Field, but no official development and production plan has been received. Shell Western Exploration and Production Inc. is considering a relocation of planned onshore facilities to Santa Barbara County.

**Southern California State Oil and Gas Activities:** The 51 active leases on State offshore lands cover 161,000 acres. Of these leases, 29 are off Santa Barbara County, 10 are off Orange County, and 12 are off Ventura County. Nine platforms and seven production islands are presently operating on these leases. Four of the manmade islands are inside the Los Angeles/Long Beach Harbor Breakwater. The last State offshore lease sale was held in 1969.

**Canadian Beaufort Sea Oil and Gas Activities:** See Major Project No. 16 for a summary of Canadian Beaufort Sea oil and gas activities.

## 26. Transportation of Oil and Gas

**Cook Inlet Tankering:** An increase in Cook Inlet-produced oil may be shipped to markets in the Far East if allowed by Congress. Laws currently restrict the export of oil produced from Federal and State leases in Cook Inlet to 3,000 bbl per day (about two tanker trips per year), the current level of export. However, efforts are under way by Alaska's congressional delegation to end these restrictions. If the restrictions are removed, it is estimated that 36 MMbbl of oil may be transported by tankers over the life of the Cook Inlet Field. This could amount to an average of about 14 tanker trips per year. It is believed that the tankers would travel the great circle route from Cook Inlet to Pacific Rim markets, which would result in tankers traveling through Unimak Pass and then westward just north of the Aleutian Islands. Alaska OCS planning areas likely to be affected would include the Gulf of Alaska/Cook Inlet, Kodiak, Shumagin, and St. George Basin.

**Trans-Alaska Pipeline:** See Major Project No. 1 for information about the Trans-Alaska Pipeline.

**Trans-Alaska Gas System:** The Yukon Pacific Corporation proposes to construct the Trans-Alaska Gas System (TAGS). This system would transport natural gas from Alaska's North Slope via a 36-inch outside-diameter pipeline to a tidewater facility at Anderson Bay, Port Valdez, Alaska. The proposed TAGS would closely parallel the existing TAP oil pipeline. Up to 2.3 Bcf of conditioned natural gas per day would be moved through TAGS. At Valdez, the natural gas would be converted to liquefied natural gas (LNG) for export by tanker to markets in the Asian Pacific Rim. Approximately 80 to 100 LNG tankers would be expected to visit the Valdez port per year.

## 27. Nonenergy Minerals

**Federal Offshore Mining Program--Norton Sound Lease Sale:** The following information regarding the OCS Mining Program Norton Sound Lease Sale, and offshore mining in State waters was derived from the OCS Mining Program Norton Sound Lease Sale DEIS (USDOJ, MMS, 1988), which is hereby summarized and incorporated by reference. The proposed action consists of 40 blocks to be offered for lease in July 1989. The total areal extent of the proposed Norton Sound Lease Sale is about 72,148 ha (approximately 178,282 acres). The blocks that comprise the proposed action are located about 5 to 22 km offshore in water depths that range from about 20 to 30 m. The MMS has estimated that placer deposits of gold in the proposed lease-sale area for a mean case could be 530,000 troy ounces. It is projected under the mean case that one dredge would be used for mining. About 60 acres per year would be dredged for a period of 14 years, with total dredging to include about 800 acres.

**State Offshore Mining Program:** Two areas along the northern shore of Norton Sound have valid mining leases--the area adjacent to the city of Nome and a small area off the coast near Bluff, about 85 km east of Nome. Permits have been applied for along much of the coast within 50 km to the east and west of Nome. These permits have been pending for several years. As a result of the success of the current mining operation off the coast of Nome, the State may take action on these permits in the near future.

Western Gold Exploration and Mining Co., Limited Partnership (WestGold) is mining for gold on 8,802 ha (21,750 acres) of offshore leases that extend from about 1.6 km east of Nome to about 16 km west of Nome. The leases extend approximately 4 km offshore. WestGold uses the Bima, the largest bucketline offshore-mining vessel currently active. Minimum digging depth is 9 m; maximum digging depth is 45 m.

The dredge footprint for the 1987 season covered an area of approximately 22 ha (53.83 acres). The current offshore-mining operation uses no beneficiation chemicals and yet appears to be exceeding EPA National Pollutant Discharge Elimination System (NPDES) limitations for two trace metals (mercury and nickel) and also for turbidity in the water column. Data from

compliance monitoring by industry indicate that turbidity standards frequently are exceeded at the edge of the 500-m mixing zone.

The length of the operating season is anticipated to be 160 days. It is assumed that WestGold will continue to use the Bima on the leases off the coast of Nome and that a shallow-water dredge will be added by 1990.

Pending the results from the smaller shallow-water dredge, it is assumed that lessees holding the leases off the coast of Bluff

also would begin to operate a smaller shallow-water dredge; the lease is only 518 ha (1,280 acres), and water depth is less than 20 m. During each drilling season, the two smaller dredges (the one operated by WestGold and the other by the lessees off Bluff) would dredge less than the 25 ha (60 acres) assumed for the Bima. The use of mercury during these operations is uncertain. The Bima has successfully mined gold without using mercury. However, the State has no categorical exclusion on the use of mercury offshore. Previous operations off the coast near Bluff have been unsuccessful.

**APPENDIX F**

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**MMS ALASKA OCS REGION  
STUDIES PROGRAM**

## MMS, ALASKA OCS REGION, STUDIES PROGRAM

### I. Introduction to the Alaska Environmental Studies Program

A. Mandate: The Alaska Environmental Studies Program (ESP) was initiated by the U.S. Department of the Interior (USDOI) in 1974 in response to the Federal Government's decision to propose areas of Alaska for offshore oil and gas development. Federal management of the Outer Continental Shelf (OCS) is guided by several legislative acts. Regulations implementing the OCS Lands Act (OCSLA) of 1953, as amended in 1978 (OCSLAA), designated the Bureau of Land Management (BLM) as the administrative agency responsible for leasing and the United States Geological Survey as responsible for supervising development and production of mineral resources on submerged Federal lands. The offices under BLM and USGS responsible for offshore leasing were reorganized as the Minerals Management Service (MMS) in 1982. One of the goals of OCSLA was to provide for the protection of the environment concomitant with development of mineral resources. Also, the Secretary of the Interior is required to conduct environmental studies to obtain information pertinent to sound leasing decisions as well as to monitor the human, marine, and coastal environments (OCSLAA, 1978 [P.L. 95-372, Sec. 20]). The National Environmental Policy Act of 1969 requires that all Federal Agencies use a systematic, interdisciplinary approach that will ensure the integrated use of the natural and social sciences in any planning and decision making that may have effects on the environment. Federal laws such as the Coastal Zone Management Act; Federal Water Pollution Control Act Amendments; Marine Mammal Protection Act; Endangered Species Act; and the Marine Protection, Research, and Sanctuaries Act impose additional requirements on the offshore leasing process.

B. Purpose: The ESP is unique among the various components of the offshore leasing program. It is the largest, single-agency, mission-oriented, marine-studies program in the Federal Government. About \$209.5 million have been spent on studies conducted by the Alaska OCS Region since 1975. The purpose of the studies program is to establish information needs and implement studies to assist in predicting, assessing, and managing potential effects on the human, marine, and coastal environments of the OCS and coastal areas that may be affected by oil and gas development. Lease-management decisions are enhanced when current, pertinent, and timely information is available. To attain the program goals, data on specific environmental, social, and economic concerns arising from offshore leasing are required. The ESP then monitors any effects during and after oil exploration and development.

The MMS also sponsors TARP (Technology Assessment and Research Program), an engineering-oriented program that provides information for permitting decisions for offshore operations. The ESP and TARP complement one another by bringing information into the decision process for offshore oil and gas leasing.

C. Organization: The Alaska ESP is in the Leasing and Environment Office of the MMS's Alaska OCS Region in Anchorage, Alaska. It is one of four regional environmental study programs responsible for providing information in support of offshore leasing and management processes. Other offices cover the Pacific, the Atlantic, and the Gulf of Mexico OCS Regions.

When the Alaska ESP began in 1974, BLM requested that the National Oceanic and Atmospheric Administration (NOAA) institute a marine environmental studies program to provide necessary assessment information on the biological and physical sciences. A Basic Agreement between BLM and NOAA provided a framework for administration (by NOAA) of the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The current MMS-funded NOAA/OCSEAP office is presently located in NOAA's National Ocean Service Alaska

Office in Anchorage. The office administers a major portion of the Alaskan biological and physical science studies.

The Social and Economic Studies Unit (SESU), a component of the ESP, was established in 1975 because of the unique characteristics of Alaska's Native population and the relative isolation, remoteness, and nonindustrial nature of the State of Alaska. Initially, Peat, Marwick, Mitchell and Company managed these studies under contract.

As the Alaska studies program has evolved, its increased capabilities in information gathering and marine-resource assessment have led to direct contracting for certain studies. For example, studies of endangered species, marine mammals, the design and implementation of hydrocarbon monitoring, pollutant-transport studies, and seabird monitoring are under MMS direct-contracting responsibility. The SESU management and contracting functions have been performed in-house since Fiscal Year (FY) 1980.

D. Environmental Studies Program Development: Early in the development of the program, the focus was on obtaining baseline information on the vast biological resources and physical characteristics of the Alaskan environment for prelease decision making. Included in these studies were biological surveys of marine species, basic oceanography and meteorology, and geologic and sea-ice phenomena. As a broader base of information was established, it became possible to focus on more topical studies in smaller areas to answer specific questions and fill identified information needs. In addition, a number of generic studies were initiated on the potential effects of oil contamination on biological resources and on the probable transport and dispersion of oil that might be spilled in the marine environment. These latter analyses are used to predict areas likely to be at greatest risk from possible pollution incidents. As more disciplinary data were collected and analyzed, the importance of taking an integrated, interdisciplinary look at complete ecosystems in sensitive areas became apparent.

During this time, the leasing program was maturing. As a number of sales were held and exploration activities begun, postlease studies to monitor the possible effects of oil and gas activities on the environment and resources of these areas were initiated. This has been the most recent change in the focus of the Alaska ESP. The program has begun to provide information for the development of the 5-year leasing schedule, continues to provide information for prelease and lease-related decisions, and develops monitoring information necessary for postlease management.

As studies information has amassed, improved focus has required greater integration of various scientific disciplines. The MMS has initiated planning workshops to gather maximum expertise, assess the status of existing information, identify indicator species and missing information, and plan the best possible approach to a study within the constraints of time and resources. As more pertinent information is collected by the MMS and other Federal and State agencies, studies are funded to search and evaluate existing literature and data prior to initiation of field efforts. This prevents duplication of effort and saves valuable resources by focusing later study efforts only on the areas of greatest information need and highest usefulness to MMS decision needs. Such evaluations were conducted as the first phase of recent ecosystem studies and other habitat characterizations.

The use of computer-modeling techniques has increased to aid in the assessment of potential oil-spill and other pollutant risks to the environment and to key species such as fur seals, sea otters, and endangered whales. Modeling also has been used in the ecosystem studies, especially where extrapolation to other areas seemed warranted.

E. Environmental Studies Disciplines: From the initiation of the Alaska program, environmental studies have been categorized into several broadly defined subjects. Baseline information on the distribution, abundance, and migratory patterns of marine species; potential disturbances to the marine environment; and oceanographic and meteorological conditions was integrated into the design of multidisciplinary studies. Major categories of study have included the following:

1. Environmental Geology: The cold climate of the Alaskan offshore area results in extensive sea ice and permafrost. These conditions pose complications for oil and gas development, which in turn might lead to damage to the habitats of various species. The studies program has investigated bottom gouging by ice ridges; ice-ridge and lead formations; ice motion; and, to a lesser degree, marine-permafrost behavior. In FY 1986, long-term studies of geologic processes and hazards of the Beaufort and Chukchi shelf and coastal regions were completed. The information from these studies is used in defining potential areas of exploration difficulty.

2. Pollutant Transport: The possibility of oil spills is one of the principal items evaluated as part of an environmental assessment. The studies program has continued to simulate hypothetical oil-spill transport in open and ice-covered waters by means of a circulation model. These simulations are key to sale-specific environmental impact statement (EIS) preparation. Related physical oceanographic studies have investigated currents, tides, sea-ice motion, and meteorological forcing. The results of these studies are used in computing probabilities of oil-spill contact for different coastal areas. A model and users' manual are complete for oil weathering in open water and are being expanded to include ice-filled waters. Another model has quantified losses of commercially important fisheries to oil spills. An effort is under way to model movements and distribution of oil in surf-zone environments.

3. Living Resources: The studies program has investigated the life history, food habits, and abundance and distribution of marine mammals, seabirds, fish, and invertebrates, as well as aspects of their interaction with oil and gas activities. Recent emphases have focused on the study of effects of on-ice seismic exploration on ringed seal behavior and distribution. Other studies have investigated the sensitivity of belukha whales to noise and disturbance. The results of these studies have been used in devising and evaluating potential mitigating measures. In addition to important studies on marine mammals, studies contracted by OCSEAP for MMS have addressed commercial and subsistence fisheries and marine birds. Fisheries studies were targeted at important Bering Sea commercial fisheries species such as salmon and red king, blue king, tanner, and Korean hair crabs. Work has been conducted on simulation modeling of fisheries with the intent to quantify potential damage to commercial fisheries if accidental oil spills were to occur. Nearshore fisheries studies have been conducted in the Bering, Beaufort, and Chukchi Seas. Major studies of seabirds have been completed, including population studies in the Bering Sea and reproductive ecology and trophics of marine birds of the Gulf of Alaska. Seabird studies also have been conducted in areas of the Beaufort and Chukchi Seas and shorebird research in the southern Chukchi Sea.

4. Endangered Species: The Alaskan offshore provides habitat to several endangered species, notably the bowhead whale. In recent years in Alaska, much public and governmental attention in Alaska has been given to the potential effects of oil and gas activities on the status and behavior of the bowhead whale. Studies have concentrated on observations of bowhead-migration routes, potential feeding areas, and behavior. One of the unique roles of bowhead-study components has been to support seasonal drilling and geophysical-survey monitoring-program needs. During fall months, information on the status of the bowhead migration is transmitted from the field directly to MMS regulatory authorities.

Other recent studies on endangered species include emphasis on surveys of distribution and abundance of endangered whales, feeding ecology of gray whales, experimental research on gray and humpback whale behavior in response to oil and gas activities, and peregrine falcon-nest surveys in western Alaska.

5. Ecosystems: Recently, several study efforts performed field analyses of key ecosystems including areas of the North Aleutian Basin, Yukon River Delta, Unimak Pass, eastern Beaufort Sea, and a coastal area of the northern Chukchi Sea.

6. Environmental Monitoring: Since 1981, the Alaska OCS Region of MMS has performed monitoring studies initiated as part of aerial surveys and behavioral studies of bowhead whales. In a unique information transfer, MMS investigators pass data on the status of the whale migration and whale behavior directly to MMS and National Marine Fisheries Service regulatory authorities. These daily status reports have been used by MMS authorities to make decisions regarding timing and location of offshore operations, such as geophysical exploration and exploration drilling.

In recent years, the Alaska OCS Region initiated efforts to develop additional targeted monitoring programs. Through an Interagency Agreement with NOAA/OCSEAP, the studies staff participated in planning and conducting the Beaufort Sea Monitoring Workshop, the results of which have been used by the MMS studies staff for the direct contracting of a Beaufort Sea Monitoring Program. The goal of this program is to test hypotheses regarding long-term change in sediments and lower-trophic levels. A workshop to consider monitoring needs in the Bering Sea was held in January 1987. These and other targeted study efforts are expected to provide the basic framework by which the Alaska OCS Region will meet environmental monitoring needs.

7. Oil-Spill Fate and Effects: A vital portion of the studies program is centered on determination of the fate and weathering of spilled oil and the effects that oil spills may have on marine habitats and biota. Recent studies have investigated the effects of hydrocarbons on king and tanner crabs and on salmonids. The MMS and NOAA participated in the Baffin Island Oil Spill test program in the Canadian Arctic and investigated the weathering of spilled oil in open water and in sea ice.

8. Program Support: The draft Alaska Regional Studies Plan (RSP) for FY 1991-1992 proposes more than 43 studies in eight subject areas, covering the three Alaska leasing regions. The size and scope of this program necessitates mechanisms to integrate study results from multiple disciplines in order to make them more useful to managers and decision makers. Several projects digitize their physical and biological field data into standardized formats for submission to a national archive. These data are quality controlled for accuracy and consistency by a data-processing contractor. Once stored, data from multiple projects can be merged for subsequent retrieval by subject or area. Computer-generated tables and maps are then produced for use in environmental assessment of the entire planning area. These products have been generated for marine mammal and bird sightings and hydrocarbon concentrations for various Alaskan lease-sale areas.

During FY's 1991-1992, in cooperation with NOAA/OCSEAP and depending upon the new lease schedule, MMS anticipates scheduling three information-update meetings. The results of these meetings provide direct input to the environmental assessment process and also are used by other MMS staff involved in sale planning, environmental and field operations, and resource evaluation. Summaries of these meetings are published as reports. Beginning in FY 1985, information-transfer meetings (ITM's) have been held to provide a public forum to place all information about OCS regions in context. It is likely that an ITM will be scheduled for 1991 and

1992. The ITM's will focus on a major study topic or OCS region. Future ITM's will occur at intervals commensurate with the acquisition of new information.

10. Social and Economic: Studies in this discipline were initiated in 1976 at the urging of the State of Alaska and with recognition by the USDOJ that the societies of rural Alaska were especially vulnerable to the influences of industrial development. Also, social and economic studies are mandated by Section 20 of the OCSLAA, which includes monitoring of the human environment. Very little data existed to allow MMS social scientists to confidently predict social effects from offshore development. Because of the nature of subsistence dependence in the communities of coastal Alaska and the essentially nonwestern character of the Native culture, the study of the effects of offshore petroleum development goes beyond conventional economic considerations. To meet these needs, several core-study topics were undertaken for nearly every lease-sale area in the State. These included petroleum-technology assessments, Statewide and local economic and demographic forecasts, commercial-fishing effects, regional socioeconomic and sociocultural systems studies, and transportation-system effects.

As the understanding of social systems and the predictions of the potential effects caused by development have evolved, social and economic studies are now more focused and issue-oriented, emphasizing the critical points between OCS development and the social systems with which such development interacts. Special topical studies that are focused on analyzing the effects of western economic development on specific aspects of a social or cultural system include forecasts of rural structural-economic change and the relationship between market and subsistence economies. Studies that acquire time-series data designed to correspond to very specific MMS requirements in support of other study efforts are conducted. A series of monitoring studies are now also a component. In addition to the time-series-data studies, which are a form of monitoring, information about social indicators as measures of local community and regional well-being is being gathered. Sociocultural monitoring studies begun in FY 1985 will track community cultural change, social health, and values. These monitoring studies also contribute to current assessments of OCS effects in the EIS's for ongoing sales, in that they provide empirical data upon which the assessments are based.

F. Environmental Studies Information Use: The integration and synthesis of multiagency, multidisciplinary studies result in a regional overview that is an important element of the overall studies-planning process in Alaska. The wealth of information collected throughout this long-term program is continually synthesized and updated to be meaningful to decision makers. Since 1978, MMS and NOAA jointly have conducted synthesis meetings to bring investigators and managers together to review the status of knowledge in a given area, such as the Beaufort Sea, and to discuss the implications of proposed oil and gas development. Since multiple sales have now been held in many areas of Alaska, the basic synthesis task has been performed for most regions on the OCS surrounding Alaska.

However, new information must still be relayed to decision makers in a timely manner, and the question of cumulative effects from these successive sales must be considered. Information-update meetings are scheduled for each planning area to allow integration of multidisciplinary data from the social and natural sciences into the assessment process. The results of these efforts are published as regional reports and provide input to EIS's. These publications and lists of current and completed projects are available for all of the major Alaskan lease-sale planning areas in the Arctic, Bering Sea, and Gulf of Alaska. The studies program maintains a computerized bibliography of reports based on MMS-funded research.

The MMS also supports publication of study results in peer-reviewed literature. This both improves the quality of study

reports and improves the distribution and availability of study results to a wide audience.

G. Environmental Studies in Relation to the Leasing Process: The MMS offshore leasing program is a primary determinant of studies-information needs. There are many steps in the leasing process that require environmental information. Prelease events include:

- area identification
- draft and final EIS's
- public hearings
- Secretarial Issue Document

Additional postlease events that require environmental data and assessment are:

- exploration plans
- drilling permits
- transportation plans
- development and production plans
- pipeline permits
- lease termination or expiration

At each step of the offshore-lease-management process, a variety of potential resource-use conflicts may be encountered. Consequently, basic management questions serve to further define the information needs that environmental studies must address. To focus the studies, several multiple-use-conflict questions have been formulated. Two questions are fundamental: (1) What is the expected reduction in benefits derived from man's use of the environment due to major multiple-use conflicts of the proposal and (2) can this loss be minimized by mitigating measures? Use conflicts include subsistence living, commercial fishing, recreation, social infrastructure, ecological relationships, air and water quality, archaeological and historical resources, shipping conflicts, and environmental hazards to technology.

H. The Leasing Schedule: The Alaska ESP includes three broad regions: the Arctic, the Bering Sea, and the Gulf of Alaska. Twelve sales have been held: five in the Arctic (Sales BF, 71, 87, 97, and 109), four in the Gulf of Alaska (Sales 39, 55, CI, and 60), and three in the Bering Sea (Sales 57, 70, and 83). The 5-year leasing schedule remains the major consideration for the design and management of the studies program. The ideal environmental studies program in a frontier area provides a minimum 4-year period preceding a sale to obtain information needed for an assessment of potential offshore effects. For most second- and third-generation sales, a shorter period is plausible. However, in a frontier region such as the Alaskan Arctic—with large planning areas, potential environmental hazards associated with offshore activities, and still-developing technology required for hydrocarbon extraction—maximum lead time is necessary to conduct adequate environmental assessments. The studies and schedules recommended in this study plan may require modification to reflect the addition or deletion of sales and the modification of timing for a particular sale.

Prior to FY 1982, most studies of the Alaskan offshore were planned, conducted, and concluded before a sale was held to provide decision information for the EIS. However, it is apparent that not all informational needs can be obtained prior to a sale. Since oil and gas production usually occurs 8 to 15 years after leasing, postlease studies may continue to address environmental concerns and acquire additional information for the development-and-production-phase environmental analyses. Future study plans may become as closely related to development schedules and monitoring and evaluation needs as they now are to leasing schedules. In the past, rapid lease-schedule changes have disrupted the orderly progression of the studies program and resulted in an information lag for various offshore leasing events because of the time needed to plan and conduct studies. Because the Alaskan offshore leasing program ranges from a northern temperate climate to the Arctic, a systematic,

orderly studies approach is a necessity.

I. Annual Environmental Studies Planning: The Alaska RSP is prepared biannually to provide guidance to MMS and NOAA in accomplishing program objectives. Information needs are reviewed by diverse organizations and committees, including the Scientific Committee of the National OCS Advisory Board; the Regional Technical Working Group; the State of Alaska; and several Federal agencies such as the Environmental Protection Agency, the Fish and Wildlife Service, NOAA, and MMS. Further critiques result from program reviews and disciplinary workshops. The RSP links the information needs of the decision maker with the environmental studies that are to be conducted. The plan identifies existing and potential offshore management decisions and specifies relevant objectives in the studies to aid in making those decisions. Following RSP guidance, NOAA prepares an annual Technical Development Plan (TDP) for studies to be conducted by OCSEAP. In the TDP, individual research units are designed to answer specific environmental study objectives. Later, NOAA and MMS issue contracts or interagency agreements to investigators to conduct the studies. Principal Investigators are drawn from private organizations as well as from universities and State and Federal Government agencies. A core of experienced investigators who are familiar with the task of working under arctic and subarctic conditions is available for the Alaska program.

Preparation of the RSP is the culmination of a 12-month process carried out in the Alaska OCS Region by the Environmental Studies Section. This plan describes the recommended program for Alaskan environmental and social and economic studies for a given period (2 years). The RSP provides all the information needed by the MMS Branch of Environmental Studies to develop the Alaska portion of a National Studies List (NSL) and budget for presentation to the Director of MMS, the Secretary of the Interior, and the Office of Management and Budget (OMB).

It is important to note that this FY's 1991-1992 RSP was begun 2 years in advance, during FY 1989. Long-term planning is required because of (1) the scope and significance of the OCS oil and gas leasing process carried out by MMS for the Secretary of the Interior and (2) the time needed for budget planning and completion of studies. Proposed leasing schedules cover a 5-year period but are often adjusted to meet the concerns of affected states and the constraints of available Federal funds. Because of the need for advance planning, the program must try to anticipate all study needs based on the current and projected 5-year schedules; and it must also provide a suggested ranking of studies because the budget is not yet defined at this early stage. The OMB has established national ranking criteria used by all MMS OCS regions to establish study priorities. Primary criteria include legal mandates and scientific needs for the study and timing of the information needs. The national criteria allow MMS to merge regional study needs based on the RSP's into an NSL for funding and procurement.

In addition to justifying Alaskan priorities for the national offshore studies program, the Alaska RSP provides necessary guidance for conducting the program at the regional level. It assures an integrated framework and establishes priorities for MMS staff who prepare, contract, and monitor the individual studies. This integration is particularly important because many of the Alaskan environmental studies are managed for MMS through an Interagency Agreement with NOAA. The NOAA/-OCSEAP contracts monitor and provide logistics, under MMS guidance, for specific studies proposed in the RSP. The OCSEAP's annual TDP, which provides detailed information on the next year's studies, is based on the Alaska RSP that is published a year earlier. The timing of these several planning documents (the national 5-year leasing schedule, the Alaska RSP, and the OCSEAP TDP) is shown in Table 1 below.

Table 1  
Timeline of Overall Planning Process for  
FY's 1991-1992 Alaska Studies Program

1987-1992 5-Year OCS Oil and Gas Leasing Program	Apr 1988
1991-1992 Draft RSP	Jul 1989
FY's 1991-1992 Final RSP	Feb 1990
FY's 1992 TDP	Aug 1990
FY's 1991-1992 Program	Oct 1990

Finally, at the regional as well as the national level, the RSP provides clear studies descriptions, discussion of regional needs, and ranking priorities that provide the basis for formulating regional and national budget requirements and for adjusting, as necessary, to budget limitations.

The Alaska RSP introduces the planning process; describes the environmental characteristics of the three major subregions of the Alaskan OCS; provides overviews of the proposed studies to be conducted in these areas, as well as generic studies; charts the relationship of these proposed studies to the sale process; and provides a general picture of the annual budget and suggested ranking for environmental studies.

J. Summary: The FY's 1991-1992 RSP will respond to needs identified following more than 17 years of studies efforts. Modifications to the program have often resulted from changes in lease schedules and funding levels, redirection in various disciplines due to newly identified informational needs, and programmatic decisions to eliminate or reduce categories of studies from Government responsibility. The program has shown flexibility under often-changing requirements and is responsive to valid criticisms. The information acquired through this program is in the forefront of subarctic and arctic studies. Thus, the program is fulfilling the role for which it was designed: the gathering of significant and pertinent information in support of offshore leasing and management decisions.

## II. Environmental Studies by OCS Region - Arctic Region

A. Oil and Gas Exploration Activities: The offshore Arctic Region extends across the OCS off Alaska from the Bering Strait to the Canadian border. Since the mid-1940's, it has been an area of great geologic interest and significant oil and gas discoveries, culminating in the development of the onshore Prudhoe Bay and adjacent Kuparuk, Lisburne, Endicott, and Milne Point fields. There is continuing limited exploration, both onshore and offshore. Five Federal offshore sales have been held in the Arctic Region. To date, 19 wells have been drilled in the Beaufort Sea Planning Area. About 2,041,248 hectares of Federal offshore tracts have been leased through 1989. Below are the Arctic Region planning areas and the status of their respective lease sales.

### Beaufort Sea

Sale BF - Dec 1979  
Sale 71 - Oct 1982  
Sale 87 - Aug 1984  
Sale 97 - Mar 1988  
Sale 124 - Mar 1991

### Chukchi Sea

Sale 109 - May 1988  
Sale 126 - Jul 1991

### Hope Basin

Sale 133 - May 1992

**B. Physical Features:** The Alaskan Arctic offshore region is composed of the Beaufort and Chukchi Seas. The Beaufort and Chukchi Seas are environmentally different from all other offshore regions of the United States in that they are usually ice covered. This ice cover, which is almost total for 9 to 10 months each year, freezes to a 2.4-m (7.9-ft) average thickness in one season.

Multiyear ice, nominally 4-m (13-ft) thick, and ice ridges with drafts of several tens of meters are present in the Beaufort and Chukchi Seas. The ice pack is moved westward past the Alaskan coast by the clockwise Beaufort eddy and shears against the stationary landfast ice, forming an extensive shear-pressure-ridge system. Pressure ice (ridges and hummocks) may exceed 10 m (33 ft) in height. Ice-movement forces on offshore structures in the Beaufort and Chukchi Seas can exceed the ice forces on Cook Inlet platforms by a factor of 100. The ice ridges are matched on the underside by ice keels that are several tens of meters deep and scour the seafloor of the continental shelf, forming deep gouges. Ice gouges of indeterminate age have been found as far out as the edge of the continental shelf, though they are more numerous and frequent in shallower waters, especially along the ice-shear zone.

The ice season is somewhat shorter in the Chukchi Sea than in the Beaufort Sea, but the ice conditions and ice hazards are equally severe in both areas. The width of landfast ice along the Chukchi Sea coast between Barrow and Cape Lisburne is much less than in the Beaufort Sea. Thus, severe pack-ice conditions are encountered much closer to the coast in the Chukchi Sea than they are in the Beaufort Sea.

Oceanographic processes are a major component of environmental studies. Oceanographic processes on the Beaufort Sea continental shelf are greatly influenced by the circulation patterns of the Arctic Ocean. Surface-ocean currents beyond the shelf edge flow westward between Mackenzie Bay and Point Barrow under the influence of the clockwise Beaufort Gyre. An easterly current from the Chukchi Sea has been observed along the 50-m isobath. Nearshore, local summer winds may reverse the general wind-driven westward drift and set the surface current easterly. The surface currents influence the extent of ice-free open water in summer and the trajectories of possible oil spills. Storms are frequent during summer and occasionally generate storm surges and wave heights that have a large destructive potential.

The Chukchi Sea circulation is influenced by ocean currents flowing predominantly northward from the Bering Sea into the Arctic Ocean. At times, a reversal of flow in the Bering Strait occurs and a southerly flow of ice and water takes place; but the volume of arctic water outflow during these periods is low. The northward coastal currents, together with a westward drift along the southern margin of the arctic ice pack, combine to establish a broad, counterclockwise circulation in the Chukchi Sea. Wave heights and storm surges are more severe hazards in the Chukchi Sea than in the Beaufort Sea, primarily due to the longer reaches of open water in summer and fall.

**C. Living Resources:** The variety and distribution of animals along the arctic coast reflect the combined effects of ice movements, watermasses, bottom characteristics, and availability of suitable food. The presence or absence of ice profoundly affects fish, bird, and marine mammal-movement and behavior in this region. Many of these species congregate near the edge of the pack ice and move in response to ice motion. Biologically, the shallow coastal environment along and within the barrier islands is more productive than the open seas.

Arctic nearshore waters are also important to most waterfowl in the Arctic; two-thirds of the bird population of the Canadian Arctic islands pass through this region, including large numbers of black brant, oldsquaw, gulls, and shorebirds. Eider ducks, shorebirds, and gulls nest in high densities on some of the barrier islands. Seabird colonies of puffins, murre, kittiwakes, and gulls are found at Cape Lisburne and Cape Thompson and

in Kotzebue Sound. Cape Lisburne supports the northernmost major bird colony on the west coast of North America, with an annual production of about 100,000 birds. Fish species include arctic char, whitefish, cisco, cod, smelt, flatfish, and sculpin. Salmon runs in the Chukchi Sea support a modest commercial fishery centered in the Kotzebue area. Marine mammals of the area include bowhead, gray, and belukha whales; bearded, ringed, and harbor seals; walrus; and polar bears. Endangered whales present in Arctic Region offshore-sale areas include bowhead and gray whales, with occasional sightings of fin and humpback whales in the Chukchi Sea. Bowhead whales migrate through all Arctic Region planning areas. In the spring and fall the whales move between their overwintering areas in the northern Bering Sea and their summer-feeding areas in the Canadian Beaufort Sea. The spring and fall migratory routes are different. In the spring, the bowheads generally follow the area surrounding nearshore leads through the Chukchi Sea and offshore leads through the Beaufort Sea; in the fall, the bowheads move closer to shore in the Beaufort Sea and farther west in the Chukchi Sea. Also in the fall, some nearshore areas between Barrow and Pitt Point and between Kaktovik and Demarcation Bay are believed to serve as secondary feeding locations because groups of bowheads are frequently sighted there and presumed feeding. Gray whales are also seasonal visitors to arctic waters. The Chukchi and northern Bering Seas are the primary feeding grounds for the world's population of gray whales. From June through October, groups are scattered throughout the Chukchi Sea, and a few have been observed well into the eastern Beaufort Sea.

**D. Social and Economic Aspects:** Most of the areas of potential OCS development lie offshore of a broad, flat coastal plain. The North Slope Borough (NSB), whose jurisdiction encompasses this coastal plain as well as much of the Brooks Range and its northern foothills, includes eight communities—six of which may be considered coastal—and the oil industrial enclaves in and around Prudhoe Bay. Since the 1960's, the North Slope's social, economic, and cultural life has changed, largely in response to the Alaska Native Claims Settlement Act, oil and gas development, and the internal-restructuring process that resulted from this development. The growth of the NSB, the Inuit Circumpolar Conference, the Alaska Eskimo Whaling Commission, and other local institutions reflects the increasing social complexity of the region. The interplay of Federal, State, and local concerns in coastal zone planning and environmental protection have also been important during this period of rapid change. Studies of the region are set in this context of rapid change, high resource levels, and potentially high environmental and social costs. Protection of the Inupiat culture, whaling traditions and privileges, areas used for subsistence-resource harvests, and locally based decision making are all recurrent themes around which data have been collected.

**E. Previous Studies:** From 1975 through March 1988, a total of \$120.3 million have been expended on environmental studies in the Arctic. This total includes generic studies and studies in other OCS regions or in adjacent OCS planning areas that have applicability to the Arctic. The studies conducted have investigated all the major disciplines: geology, sea ice, pollutant transport, living resources, endangered species, ecosystems, oil-spill effects, noise effects, sociocultural systems, socioeconomic, transportation, and monitoring, as well as essential integration and synthesis efforts. Particularly noteworthy accomplishments have been ecosystem studies in the Beaufort and Chukchi lagoonal systems, definitive studies of bowhead whale migration, state-of-the-art pollutant-transport modeling and supporting oceanographic and meteorological information, study of sea-ice dynamics, monitoring of hydrocarbon and trace metals, and subsea investigation of the arctic-shelf geological characteristics. Recent studies also have addressed the feeding ecology of bowhead whales in the eastern Beaufort Sea off Alaska and the responses of gray and bowhead whales to underwater sounds, and they have compared the behavior of bowheads from the Western Arctic and Davis Strait stocks. Many of the above study efforts also have direct application to the southern Chukchi Sea (Hope Basin) informa-

tion needs.

F. Study Needs Associated with Offshore Leasing: Since 1975, a large portion of the Alaska OCS Region environmental and socioeconomic studies has been directed toward the Arctic Region. These studies have supported pre- and postlease information needs for sales previously conducted and proposed.

Information from environmental studies is used in a variety of ways, including draft and final EIS environmental-effects analyses, development of mitigating measures, pre- and post-lease regulatory-decision requirements, application in non-Federal decision making, and other scientific applications. A schedule of recent, current, and planned Arctic Region studies, in the context of lease sales, is given at the end of the previous section. The current focus of Arctic Region studies, as mentioned above, is developed in the context of past study accomplishments and future study needs. The proposed study needs for FY's 1991-1992 are summarized below.

1. Environmental Geology and Sea Ice: Remote-sensing imagery of regional sea-ice distribution and dynamics will continue to be archived and analyzed and to be used to support other studies.

2. Pollutant Transport: Circulation and oil-spill-trajectory modeling will continue to be a studies need in the Arctic Region. The modeling will be supported by information on sea-ice motion from the Remote Sensing Data study, Arctic Ocean Buoy Program, and Beaufort Sea Mesoscale Circulation study. The buoy program was an ongoing sea-ice-buoy investigation funded by several U.S. Federal agencies, Canada, and Norway. The Mesoscale Circulation study, which was completed in 1989, will provide annual synoptic-circulation measurements on the Beaufort Sea Continental Shelf. Because the mesoscale study does not extend closer to shore than the 20-m isobath, existing nearshore data will be compiled and examined by an integration study on Circulation in the Beaufort Nearshore. This will extend the record across the width of the shelf.

3. Living Resources: Fish habitats and the relationship between fisheries and OCS development are subjects of concern in the Arctic. In conjunction with information from non-MMS efforts, studies are proposed or under way to examine Arctic Fish Habitats and Sensitivities, Fisheries Oceanography and OCS Development in the Arctic, and Fish Habitat Use of OCS Development Areas in the Chukchi Sea. An examination of Kasegaluk Lagoon, one of the principal coastal habitats in the Chukchi Sea, is ongoing. The lagoon extends 50 to 70 km along the coast and sustains numerous seabirds, marine mammals, and fishes. Proposed studies will attempt to develop methods of keeping cetaceans and pinnipeds

out of oil spills if they should occur. Effects of production noise on belukha whale behavior also will be studied.

4. Endangered Species: Proposed studies of bowhead whales include continued aerial surveys. Efforts will be restricted primarily to nearshore areas in most of the Beaufort Sea, but broad-scale monitoring will be required in the Chukchi and western Beaufort Seas. More specific investigations also are planned to examine the effects of oil- and gas-production noises on bowhead whale behavior and to investigate acoustic-response principles and criteria. The under-ice distribution of bowheads during the spring migration will be important in determining the degree of dependencies on open-water areas. Identifying feeding areas and certain migration routes will require use of isotope analysis, satellite tagging, and other state-of-the-art techniques. The abilities of free-ranging endangered whales to avoid oil spills is an important topic. Finally, a book summarizing knowledge of bowhead whales has been completed.

5. Ecosystems: Work has previously been done on lagoon systems of the nearshore Chukchi and Beaufort Sea environments. However, there is a definite need to complete the data integration on the habitats of the Bering Strait area, an important transportation corridor. This integration will be coordinated with the National Science Foundation's Inner-Shelf Transfer and Recycling Program.

6. Environmental Monitoring: Some Beaufort Sea Planning Area tracts are likely to come into production. Public concern about the possible environmental effects of petroleum production remains high, especially in frontier areas where development has not previously occurred. Because of this public concern and because the USDOJ is committed to monitoring the effects of oil and gas development (as required on the OCS), the Alaska OCS Region developed a multifaceted monitoring approach for the Arctic Region that includes studies of hydrocarbons in sediment, benthic organisms, whales, and ringed seals. The initial 3-year monitoring period for hydrocarbons was 1984 to 1986. This effort is planned to be repeated every 3 years, beginning in 1989 with a subsequent program in FY 1992. A portion of avian monitoring studies may be dedicated to Beaufort Sea waterfowl and Chukchi Sea seabird colonies.

7. Social and Economic: While information from many previous Beaufort Sea socioeconomic and sociocultural studies will still be pertinent during FY 1990, the region is included in studies that cover all Alaskan regions. Announcements of the discovery of oil on the OCS in 1989 and 1990 could result in site-specific studies and the need to monitor actual OCS development and production in selected villages.

**BEAUFORT SEA  
ENVIRONMENTAL STUDIES LIST**

**NOAA/OCSEAP Environmental Studies (Completed)**

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END

**APPENDIX G**

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**OIL-SPILL-RISK ANALYSIS**

## OIL-SPILL-RISK ANALYSIS

**I. Oil-Spill-Trajectory Simulations:** Oil-spill trajectories for the proposed action and the deferral alternatives were simulated by the Rand Corporation in Santa Monica, California, using Rand's three-dimensional circulation, weather, and spill-trajectory models (Liu and Leendertse, 1987). The description of models and model documentation as contained in Liu and Leendertse (1987) are incorporated by reference; a summary of this description, as augmented by additional material, as cited, follows.

Essential components of the models and their interrelationships are shown in Figure G-1. Aspects of weathering, toxicity, and oil dispersion are considered and taken into account in this EIS, but not as part of the trajectory analysis; see Section IV.A.2. The actual modeled trajectories are center-of-mass trajectories. Rand Corporation transmitted 12-hour-trajectory positions to Minerals Management Service (MMS), Branch of Environmental Modeling (BEM). The BEM applied trajectories to land/boundary segments and to environmental-resource areas identified by MMS to determine the environmental-risk factors.

**A. Winter Trajectories:** For winter, the Rand Corporation simulated 20 trajectories from each of 25 hypothetical spill sites (L-1 through L-17 and L-26 through L-33, Fig. IV-1). Launches were staggered, starting on three dates during the winter—October 1, January 1, and April 1—that represent different seasonal ice conditions. The number of trajectories started at each of these dates was proportioned by the period of time and duration of ice conditions that the dates represented. Winter trajectories were simulated for the entire winter period when oil could be frozen into winter ice (see Sec. IV.A.2) until breakup. Thus, some winter trajectories were modeled for up to 9.5 months. At the end of the winter season, at breakup, the trajectories were converted into summer trajectories and modeled for an additional 30 days.

Conditions of ice in the model for the three winter periods are different. The areal extent of landfast ice in the model changes through the winter, based on data from LaBelle et al. (1983) and other sources. During the cooling and breakup periods, significant areas of open water persist in polynyas and leads. In midwinter, ice coverage exceeds 90 percent in the landfast-ice zone.

In the modeled winter, oil moves with ice or water depending on the differential velocity of ice and underlying water. For smooth first-year ice, the differential velocity of the water has to be greater than about 15 cm per second to strip oil from the underside of the ice. Rough first-year ice or multiyear ice requires greater velocities to strip oil. Because ice and underlying water are being moved by the same forces, the necessary differential velocity is seldom reached, and oil almost always moves or stays with the ice, regardless of whether the oil was spilled onto, into, or underneath the ice (see Sec. IV.A.2).

The trajectories of simulated winter spills were stopped when (1) the oil contacted land, (2) the oil moved beyond the boundaries of the model, or (3) breakup occurred. The end points of trajectories in the third category were converted into summer spills. Because of several factors, a winter spill—or whatever portion of a winter spill is not cleaned up—would become a fresh, unweathered spill when the ice melts during early summer breakup.

The end points of trajectories in the model that persisted through the winter were used to define another set of spill sites that would represent the new starting positions of groups of overwintering oil spills after breakup. These new starting points were derived from the distribution of winter end points, using as a new starting point one of the original 25 winter spill sites or one of 14 new spill sites specifically added to represent winter end points. This modification permitted the consolida-

tion of about 500 trajectory end points into 39 summer spill sites.

**B. Summer Trajectories:** These 39 spill sites were used by BEM to model hypothetical breakup and summer-season spills. The Rand Corporation reported simulated trajectory positions to BEM for every 12 hours of 30 model-days. The BEM analyzed 55 trajectories per summer spill site. All contacts from these 39 spill sites were attributed to the original 25 spill locations, not to locations of the hypothetical spills at breakup. In the modeled summer, if a trajectory contacted land or a boundary segment of the model, the trajectory was ended.

We emphasize that the trajectories simulated by the model represent only pathways of hypothetical oil slicks. They do not involve any direct consideration of cleanup, dispersion, or weathering processes that could determine the quantity or quality of oil that might eventually come in contact with targets.

**C. Conditional Probabilities:** Results of the trajectory simulations are presented in terms of conditional and combined probabilities. The probability that if an oil spill occurred at a specific spill site, it would contact either a land/boundary segment or an environmental-resource area is termed a conditional probability. Conditional probabilities assume a spill occurs; they do not consider the likelihood of a spill occurring—a function of the presence and amount of oil and transportation assumptions. In calculating conditional probabilities, the assumption is made that a spill has occurred from the respective spill site. The conditional probabilities give the percentage chance of oil from that hypothetical spill site contacting specific land/boundary segments and environmental-resource areas. The conditional probabilities are useful in identifying those areas that pose the highest chance of contact to specific environmental-resource areas and land/boundary segments, should spills occur.

Two sets of conditional probabilities are used in this EIS: (1) contacts with winter spills during winter (this appendix, Tables G-1 through G-6) and (2) open-water contacts with summer or overwintering spills during the open-water season (Tables G-7 through G-12). Conditional probabilities have an appreciable Monte Carlo error range at the 90-percent level of significance (Table G-13). For individual winter conditional probabilities, this range is about +6 to +18 percent and for open-water conditional probabilities about +2 to +10 percent.

**II. Estimated Quantities of Resource and Reserves:** Considerable uncertainties exist in estimating the volume of oil resource that may be discovered and produced as a result of an OCS lease sale. The search for oil is known as "wildcatting" because of these uncertainties. This EIS uses three levels of resources to represent a qualitative range of how much oil could be found if economic quantities of oil were discovered (Sec. IIA).

There is a 16-percent chance that commercial quantities of hydrocarbons would be found as a result of proposed Sale 124. For the low case, only exploration is assumed, but for the base and high cases, the estimated resource is assumed to be leased, found, and produced. The projected number of spills and, accordingly, the results of the oil-spill-risk analysis reflect the expected oil-spill risk based on the resource estimates for the base and high cases.

An oil resource is assigned only to those spill sites associated with the most prospective oil structure in the sale area. In this EIS, the oil resource is projected to be produced from four platforms and, therefore, from no more than four structures in the base case and from seven platforms and no more than seven structures in the high case. The additional production platforms in the high case may represent multiple platforms on

the same structures rather than additional oil fields. The exact numbers of structures assumed in the construction of the resource estimates, structure locations, and the amount of oil resource assigned to each spill site are based on proprietary information and are not disclosed even to writers of this EIS.

The structures in the sale area that are assumed to contain the oil resource are those considered most attractive from the PRESTO database (Appendix A, Sec. III): "These prospects usually have high industry interest and are the most likely to yield the highest rate of financial return by reason of size, distance from shore, proximity to transportation, water depth, etc., and are thus the most likely to be leased as a result of the sale." Spill sites away from these most prospective structures are arbitrarily assumed to contain a nominal amount of oil (0.001 MMbbl) each. Note that this assignment of only negligible oil to spill sites away from the chosen structures implies only that these areas are less prospective and not that they necessarily have negligible oil potential.

No spills of 1,000 bbl or greater are assumed for the low (exploration-only) case.

The oil-spill-risk analysis for the cumulative case includes only the estimated numbers of spills of at least 1,000 bbl and the probabilities of having one or more such spills: no trajectory analysis and, therefore, no conditional or combined probabilities are calculated. The cumulative spillage is based on resource estimates for the U.S. arctic OCS and known oil reserves (Table IV-A-1-2). Discoveries for which no oil-reserve estimate is available—for example, OCS discoveries at Tern, Sandpiper, and Hammerhead Prospects—are not included in these spillage estimates. Additional offshore lease sales have been held or are planned by the State of Alaska, but no reserves or resources have been reported for these State sales, and these sales have not been factored into the cumulative number of spills. The Geological Survey of Canada estimates Canadian Beaufort Sea reserves at 1.74 Bbbl and (undiscovered) resources at an additional 3 Bbbl (Dixon et al., 1988). This oil-spill-risk analysis assumes only the discovered 1.74 Bbbl; the speculative additional 3 Bbbl of resources are not included in the calculation of projected spillage.

**III. Probability of Oil Spills Occurring:** The procedures and statistics used by MMS to calculate frequencies and probabilities of spillage have been described and discussed in detail in Nakassis (1982), Lanfear and Amstutz (1983), Amstutz and Samuels (1984), and Anderson and LaBelle (1990). This information is incorporated by reference; a summary of this information, as augmented by additional material, as cited, follows. The expected numbers of spills of 1,000 bbl or more are calculated as proportionate to the volume of oil produced and transported and to the number of port calls by tankers (Table G-14). The probabilities of such spills occurring are calculated from the expected numbers through use of standard (Poisson) statistical distributions governing the occurrences of rare, random events.

**A. Transportation Assumptions:** In the analysis for this proposed sale, the obvious transportation scheme is assumed: oil is transported by offshore and onshore pipelines to connections with TAP. From there, it is transported south by TAP to Valdez and then shipped to the continental U.S., Panama, Hawaii, or the U.S. Virgin Islands by tankers. In the oil-spill-risk analysis for the base case and high case, pipelines are assumed to come ashore at Point Belcher, Pitt Point, Oliktok Point, and Point Thomson (see Fig. IV-A-1-1). These four pipeline landfalls in the oil-spill-risk analysis and general platform locations plus four pipeline landfalls assumed elsewhere in this EIS, as summarized in Section II scenarios, are based on nonproprietary data only and do not reflect the proprietary knowledge that went into assigning oil resource to individual spill sites in the oil-spill-risk analysis.

In addition to the proposed action (Alternative I), two block-de-

ferred alternatives are considered in this oil-spill-risk analysis: the Barrow Deferral Alternative (Alternative IV) and the Barter Island Deferral Alternative (Alternative V). These alternatives were described in Section II.B. The resource estimates and transportation scenarios for these deferral alternatives are almost identical to those in the base case. The portions of the oil-spill-risk analysis for the deferral alternatives dealing with the total number of spills of at least 1,000 bbl, and the probability of at least one such spill occurring and contacting shoreline or biological resources (combined probabilities) are identical to those for the base case and are not separately reported in this analysis.

Although a spill-trajectory analysis is not included in this EIS for the cumulative case, an assumed transportation scenario is still necessary in order to calculate total cumulative spillage. Oil estimated to be produced from the U.S. arctic OCS (undiscovered-resource) cumulative case is assumed to be transported by the same TAP and tankers (see Table IV-A-1-2).

Landfalls in the OCS cumulative case would be at the following locations: Kivalina, Point Belcher, Pitt Point, Oliktok Point, and Point Thomson. Oil from offshore portions of the Lisburne Reservoir, Point McIntyre, and the Colville River Delta is assumed to be produced onshore from wells drilled directionally offshore. Oil from the Endicott Field is piped ashore and oil from Point Thomson, Seal/North Star, and Niakuk Fields is assumed to be piped ashore. Reserve estimates are not available for OCS discoveries on Tern, Sandpiper, and Hammerhead Prospects; and these discoveries are not included in the projected cumulative spillage. The oil discovered in the Canadian Beaufort Sea to date is assumed to be piped ashore in Canada to a pipeline constructed through the Mackenzie River Valley. Thus, in summary, any oil discovered in the U.S. Arctic would be piped south through TAP, but any oil discovered in the Canadian Arctic would be piped south through the Mackenzie River Valley. An assumption is made for the oil-spill-risk analysis that only 50 percent of the at-sea risk of oil spills from the TAP tankers (see Table G-14) occurs in Prince William Sound or the Gulf of Alaska. This is because only a portion of the entire tanker route lies within the study area. The remaining 50 percent of risk is assumed to occur elsewhere—in the Pacific Ocean (south of the Gulf of Alaska) and in the Atlantic Ocean.

Note that most of these transportation scenarios are hypothetical and are put forth only to aid in analyzing possible effects. Use of any transportation route would depend upon finding commercial quantities of oil, where that oil is found, and subsequent environmental and economic analyses of transportation modes and routes.

**B. Projected Spillage:** Spill frequencies were calculated for proposed Sale 124. Table IV-A-1-2 shows the statistically expected number of spills of 1,000 bbl or greater that could occur as a result of the base and high case for the proposed sale, the deferral alternatives, and the cumulative case. Spills are separately tabulated for tanker spillage out of Valdez.

**C. Most Likely Number of Spills:** In this EIS, analysts use the "probability of one or more spills" occurring or contacting a resource. For situations where the probability of two or more spills becomes greater than the probability of one spill, the analysts also refer to and use the "most likely number of spills."

The relationship between the most likely number of spills (mode), the expected number of spills, and probability distribution for various numbers of spills is shown in Figure G-2 for the base case, in Figure G-3 for the high case, and in Figure G-4 for the cumulative case. An illustration for either deferral alternative would be almost identical to that for the base case. For the base case (and the deferral alternatives), the most likely number of spills of 1,000 bbl or greater in the Beaufort Sea Planning Area is 1. For the high case, the most likely number

of spills of 1,000 bbl or greater in the Beaufort Sea Planning Area is 3 (4-5 including Prince William Sound and the Gulf of Alaska). For the cumulative case, the most likely number of spills of 1,000 bbl or greater in the coastal Arctic Ocean is 10 (26 including Prince William Sound and the Gulf of Alaska).

**D. Probability that Spills of at Least 1,000 Barrels Would Occur:** The likelihoods that one or more spills of 1,000 bbl or greater would occur under the base or high cases are high as a consequence of the high projected resource. For the base case, MMS estimates a 68-percent chance that one or more oil spills of at least 1,000 bbl would occur in the Beaufort Sea Planning Area over the life of the field (Table IV-A-1-2) and a 45-percent chance that one or more such spills would occur in Prince William Sound or the Gulf of Alaska. For the high case, MMS estimates a 96-percent chance that one or more spills of at least 1,000 bbl would occur in the coastal Arctic Ocean and an 82-percent chance that one or more such spills would occur in Prince William Sound or in the Gulf of Alaska. For each of the deferral alternatives, MMS estimates a 68-percent chance that one or more oil spills of at least 1,000 bbl would occur in the Beaufort Sea Planning Area over the life of the field (Table IV-A-1-2) and a 44-percent chance that one or more such spills would occur in Prince William Sound or the Gulf of Alaska. For the cumulative case, 26 spills are estimated with a most likely number of 10 in the Beaufort and Chukchi Seas and a most likely number of 15 to 16 in Prince William Sound and the Gulf of Alaska.

**E. Probability that Spills of at Least 1,000 Barrels Would Occur and Would Contact Shoreline or Environmental-Resource Areas:** Conditional probabilities are probabilities that if a spill occurred (= the condition) it would contact the shoreline or environmental-resource areas. In the analysis, the conditional probabilities are combined with the expected spill-rate constants, transportation scenarios, unrisksed base-case and high-case resource estimates, and the assumed allocation of these resources to the most prospective oil structures to yield overall, combined probabilities for contact with spills of 1,000 bbl or greater. Thus, these probabilities include both the likelihood that a spill would occur and whether the spill would con-

tact shoreline or environmental-resource areas.

The combined probabilities are of limited value in estimating the reduction in oil-spill risk for the deferral alternatives in this analysis. This limitation is because the no-oil structures are assumed to be developed within the areas to be deferred in the oil-spill-risk analysis. This assumption is based on proprietary analysis indicating that the most prospective structures lie elsewhere and is not meant to imply that (less) prospective structures are not present within the areas to be deferred.

The associated Monte Carlo error for combined probabilities, because all trajectories and spill information for all spill sites are incorporated, is much lower than that for conditional probabilities, ranging from  $\pm 1$  to  $\pm 2$  percent.

Both combined and conditional probabilities are reported for 3, 10, and 30 days after a summer spill and/or meltout of an overwintering spill during the open-water season and for 3 and 10 days and all winter for spills during the winter season.

There is an additional caveat regarding the winter combined probabilities. These were calculated from winter conditional probabilities and total (= 12 months a year)—not winter (= 9.5 months a year)—oil production and transportation. The number of spill contacts is thus overestimated in winter by 26 percent (12/9.5). The resulting combined probabilities calculated from the Poisson distribution for winter contacts are overestimated by a variable factor of up to 26 percent. Combined probabilities for the open-water season are based on spills that originate at any time of the year and contain no similar overestimate of risk.

Combined probabilities for the proposed lease sale are introduced in Section IV.A.1 and are used by EIS analysts to evaluate the likelihood of effects throughout Section IV. Tables of combined probabilities are provided for the base case and the high case in this appendix, Tables G-15 to G-18. Land/boundary segments are identified in Figure IV-A-1-1 and environmental-resource areas in Figures IV-C-4-1, IV-C-5-1, IV-C-6-1, and IV-C-10-1.

Appendix G  
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**Table G-8** Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Environmental Resource Within 10 Days of a Summer Spill or Meltout of an Overwintering Spill. Environmental Resources Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

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**Table G-11** Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Land Segment Within 10 Days of a Summer Spill or Meltout of an Overwintering Spill. Segments Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

**Table G-12** Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Land Segment Within 30 Days of a Summer Spill or Meltout of an Overwintering Spill. Segments Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

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**Table G-16** Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on winter trajectories only, but assuming total base- and high-case resource produced and transported in winter.

**Table G-17** Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting environmental resources over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on open-water trajectories only for contacts within 3, 10, or 30 days of summer spills or meltout of overwintering spills.

**Table G-18** Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on open-water trajectories only for contacts within 3, 10, and 30 days of summer spills or meltout of overwintering spills.

Table G-1

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Will Contact a Certain Environmental Resource Within 3 Days

Environmental Resource	Hypothetical Spill Site																										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33		
Land	n	n	n	15	35	5	n	n	25	10	n	5	10	25	n	n	15	5	10	n	5	5	55	n	n		
Sub. Res. Area A	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	64	n	n	n	n	n	n		
Sub. Res. Area A-Spring	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	24	n	n	n	n	n	n		
Sub. Res. Area B	n	n	n	**	80	n	n	n	n	n	n	n	n	n	n	n	n	n	**	**	14	25	n	n	n		
Sub. Res. Area B-Spring	n	n	n	33	29	n	n	n	n	n	n	n	n	n	n	n	n	n	33	33	5	10	n	n	n		
Sub. Res. Area C	n	n	n	n	n	n	n	n	n	53	n	28	25	**	47	n	70	n	n	n	n	n	n	**	n		
Gray Whale Area-October	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	25	n	n	n	n	n	n		
Gray Whale Area-April	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	33	14	n	n	n	n	n		
Bhead Spring Mig. Cor. A	n	n	33	29	14	n	n	n	n	n	n	n	n	n	n	n	n	n	29	33	19	5	n	n	n		
Bhead Spring Mig. Cor. B	n	n	n	n	5	24	33	33	n	5	33	n	n	n	5	n	n	n	n	n	33	19	5	n	5		
Bhead Mig. Area A-Oct.	n	n	n	n	n	25	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n		
Bhead Mig. Area B-Oct.	n	n	n	n	n	n	n	n	n	25	n	25	19	6	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 1-Spring	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 2-Spring	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	27	5	n	n	n	n	n		
Ice/Sea Seg. 3	n	n	31	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n		
Ice/Sea Seg. 3-Spring	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 4	n	n	n	47	14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	19	6	n	n		
Ice/Sea Seg. 4-Spring	n	n	n	14	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n		
Ice/Sea Seg. 5	n	n	n	n	25	43	47	n	n	n	n	n	n	n	n	n	n	n	n	n	n	62	n	n	n		
Ice/Sea Seg. 5-Spring	n	n	n	n	5	24	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	n	n	n		
Ice/Sea Seg. 6	n	n	n	n	n	77	n	19	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11	n	n		
Ice/Sea Seg. 7	n	n	n	n	n	n	n	9	14	6	9	n	n	n	n	n	n	n	n	n	n	n	20	14	n		
Ice/Sea Seg. 8	n	n	n	n	n	n	n	n	n	38	**	22	13	n	n	n	n	n	n	n	n	n	n	9	n		
Ice/Sea Seg. 9	n	n	n	n	n	n	n	n	n	19	n	81	62	22	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 10	n	n	n	n	n	n	n	n	n	n	n	n	16	20	47	19	n	n	n	n	n	n	n	n	37		
Ice/Sea Seg. 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	86	n	41	n	n	n	n	n	n	n	47		
Ice/Sea Seg. 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	16		

Note: \*\* = Greater than 99.5 percent  
n = less than 0.5 percent  
Spring = April 1 through June 15

Table G-2

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Will Contact a Certain Environmental Resource Within 10 Days

		Hypothetical Spill Site																									
Environmental Resource		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33	
Land		n	n	n	15	45	15	n	n	70	30	n	15	15	35	n	n	25	5	10	n	25	40	80	5	n	
Sub. Res. Area A		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	64	n	n	n	n	n	n	
Sub. Res. Area A-Spring		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	24	n	n	n	n	n	n	
Sub. Res. Area B		n	n	n	**	84	30	14	n	5	5	n	n	n	n	n	n	n	**	**	19	39	16	n	n	n	
Sub. Res. Area B-Spring		n	n	n	33	29	5	n	n	5	5	n	n	n	n	n	n	n	n	33	33	5	10	10	n	n	n
Sub. Res. Area C		n	n	n	n	n	n	n	n	n	53	n	33	30	**	47	n	70	n	n	n	n	n	n	n	**	n
Gray Whale Area-October		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	25	n	n	n	n	n	n	
Gray Whale Area-April		n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	33	14	n	n	n	n	n	
Bhead Spring Mig. Cor. A		n	n	33	29	19	10	10	5	5	n	n	n	n	n	n	n	n	n	29	33	19	14	10	n	n	n
Bhead Spring Mig. Cor. B		n	n	n	n	5	29	33	33	5	14	33	24	24	19	29	33	24	n	n	33	19	19	n	29	n	
Bhead Mig. Area A-Oct.		n	n	n	n	n	25	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	n	6	6	n	n
Bhead Mig. Area B-Oct.		n	n	n	n	n	n	n	n	n	25	n	25	19	6	n	n	n	n	n	n	n	n	n	n	n	n
Ice/Sea Seg. 1		n	n	5	20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	31	20	n	n	n	n	n	
Ice/Sea Seg. 1-Spring		n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	n	n	n	n	n	n	
Ice/Sea Seg. 2		n	n	n	16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	50	5	n	n	n	n	n	
Ice/Sea Seg. 2-Spring		n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19	n	n	n	n	n	n	
Ice/Sea Seg. 3		n	n	31	39	23	11	10	n	n	n	n	n	n	n	n	n	n	n	6	28	34	31	n	n	n	
Ice/Sea Seg. 3-Spring		n	n	5	14	10	5	10	n	n	n	n	n	n	n	n	n	n	n	5	10	14	n	n	n	n	
Ice/Sea Seg. 4		n	n	n	47	28	22	25	5	5	n	n	n	n	n	n	n	n	n	14	19	46	11	n	n	n	
Ice/Sea Seg. 4-Spring		n	n	n	14	5	5	10	5	5	n	n	n	n	n	n	n	n	n	n	5	24	5	n	n	n	
Ice/Sea Seg. 5		n	n	n	n	25	56	47	14	9	n	n	n	n	n	n	n	n	n	n	n	n	62	25	5	n	n
Ice/Sea Seg. 5-Spring		n	n	n	n	5	24	19	n	5	n	n	n	n	n	n	n	n	n	n	n	14	10	n	n	n	
Ice/Sea Seg. 6		n	n	n	n	n	77	n	23	9	n	14	5	n	n	n	n	n	n	n	n	n	n	39	5	n	n
Ice/Sea Seg. 7		n	n	n	n	n	n	n	n	9	25	31	23	14	9	n	n	n	n	n	n	n	n	20	20	5	n
Ice/Sea Seg. 8		n	n	n	n	n	n	n	n	n	52	**	41	36	20	5	n	5	n	n	n	n	n	n	9	25	n
Ice/Sea Seg. 9		n	n	n	n	n	n	n	n	n	19	n	81	62	36	14	n	9	n	n	n	n	n	n	n	42	n
Ice/Sea Seg. 10		n	n	n	n	n	n	n	n	n	n	n	n	16	25	61	23	45	n	n	n	n	n	n	n	52	n
Ice/Sea Seg. 11		n	n	n	n	n	n	n	n	n	n	n	n	n	n	86	n	45	n	n	n	n	n	n	n	n	30
Ice/Sea Seg. 12		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	39
Ice/Sea Seg. 13		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19
Ice/Sea Seg. 14		n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	16

Note: \*\* = Greater than 99.5 percent  
 n = less than 0.5 percent  
 Spring = April 1 through June 15

Table G-3

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Over the Entire Winter Season Will Contact a Certain Environmental Resource

Environmental Resource	Hypothetical Spill Site																										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33		
Land	n	n	n	15	45	20	n	n	70	35	n	15	15	35	5	n	30	5	10	n	25	40	80	5	10		
Sub. Res. Area A	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	64	n	n	n	n	n	n		
Sub. Res. Area A-Spring	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	24	n	n	n	n	n	n		
Sub. Res. Area B	n	n	n	**	84	30	14	9	9	9	n	5	n	n	n	n	5	**	**	19	39	20	n	n	5		
Sub. Res. Area B-Spring	n	n	n	33	29	5	n	n	5	5	n	n	n	n	n	n	5	33	33	5	10	10	n	n	5		
Sub. Res. Area C	n	n	n	n	n	n	n	n	n	53	n	33	30	**	47	n	70	n	n	n	n	n	n	**	5		
Gray Whale Area-October	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	25	n	n	n	n	n	n		
Gray Whale Area-April	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	33	14	n	n	n	n	n		
Bhead Spring Mig. Cor. A	n	n	33	29	19	10	10	5	5	n	n	n	n	n	n	n	5	29	33	19	14	10	n	n	n		
Bhead Spring Mig. Cor. B	n	n	n	n	5	29	33	33	5	14	33	24	24	19	29	33	24	n	n	33	19	19	n	29	29		
Bhead Mig. Area A-Oct.	n	n	n	n	n	25	n	n	6	n	n	n	n	n	n	n	n	n	n	n	n	6	6	n	n		
Bhead Mig. Area B-Oct.	n	n	n	n	n	n	n	n	n	25	n	25	19	6	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 1	n	n	5	20	n	n	n	n	n	n	n	n	n	n	n	n	n	31	20	n	n	n	n	n	n		
Ice/Sea Seg. 1-Spring	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	14	n	n	n	n	n	n	n		
Ice/Sea Seg. 2	n	n	n	16	n	n	n	n	n	n	n	n	n	n	n	n	n	50	5	n	n	n	n	n	n		
Ice/Sea Seg. 2-Spring	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	19	n	n	n	n	n	n	n		
Ice/Sea Seg. 3	n	n	31	39	28	16	28	5	9	5	5	5	5	5	n	n	n	6	28	34	45	16	n	n	n		
Ice/Sea Seg. 3-Spring	n	n	5	14	10	5	10	n	5	n	n	n	n	n	n	n	n	n	5	10	14	5	n	n	n		
Ice/Sea Seg. 4	n	n	n	47	28	22	25	19	9	n	n	5	5	n	n	n	5	n	14	19	46	16	n	n	n		
Ice/Sea Seg. 4-Spring	n	n	n	14	5	5	10	5	5	n	n	n	n	n	n	n	5	n	n	5	24	5	n	n	n		
Ice/Sea Seg. 5	n	n	n	n	25	56	47	14	9	5	14	5	5	5	n	n	n	n	n	n	62	25	5	n	10		
Ice/Sea Seg. 5-Spring	n	n	n	n	5	24	19	n	5	n	n	n	n	n	n	n	n	n	n	n	14	10	n	n	10		
Ice/Sea Seg. 6	n	n	n	n	n	77	n	23	9	5	14	19	14	5	n	n	n	n	n	n	n	39	5	n	n		
Ice/Sea Seg. 7	n	n	n	n	n	n	n	9	25	31	23	14	14	9	9	n	n	n	n	n	n	20	20	14	n		
Ice/Sea Seg. 8	n	n	n	n	n	n	n	n	n	52	**	41	36	25	9	n	9	n	n	n	n	n	9	25	n		
Ice/Sea Seg. 9	n	n	n	n	n	n	n	n	n	19	n	81	62	36	14	n	9	n	n	n	n	n	n	42	n		
Ice/Sea Seg. 10	n	n	n	n	n	n	n	n	n	n	n	n	16	25	61	23	45	n	n	n	n	n	n	52	23		
Ice/Sea Seg. 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	86	n	45	n	n	n	n	n	n	n	30		
Ice/Sea Seg. 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	39		
Ice/Sea Seg. 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19		
Ice/Sea Seg. 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	16		

Note: \*\* = Greater than 99.5 percent  
n = less than 0.5 percent  
Spring = April 1 through June 15

Table G-4

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Will Contact a Certain Land Segment Within 3 Days

Land/Boundary Segment	Hypothetical Spill Site																																			
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33											
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
20	n	n	n	10	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
21	n	n	n	5	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
23	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
24	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
28	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n		
33	n	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n		
34	n	n	n	n	n	n	n	n	n	15	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	40	n	n	n	n		
35	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	n	n		
37	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
38	n	n	n	n	n	n	n	n	n	n	n	n	5	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
41	n	n	n	n	n	n	n	n	n	n	n	n	n	n	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
42	n	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
43	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
81	n	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
82	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

Table G-5

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Will Contact a Certain Land Segment Within 10 Days

Land/Boundary Segment	Hypothetical Spill Site																								
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n
20	n	n	n	10	20	5	n	n	n	n	n	n	n	n	n	n	n	10	n	15	5	n	n	n	n
21	n	n	n	5	20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n
23	n	n	n	n	5	5	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n
24	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n
27	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	n
28	n	n	n	n	n	n	n	n	25	5	n	n	n	n	n	n	n	n	n	n	n	20	10	n	n
29	n	n	n	n	n	n	n	n	10	n	n	5	n	n	n	n	n	n	n	n	n	n	15	n	n
30	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n
33	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
34	n	n	n	n	n	n	n	n	15	10	n	n	5	n	n	n	n	n	n	n	n	n	40	n	n
35	n	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n
36	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n
37	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n
38	n	n	n	n	n	n	n	n	n	n	n	5	5	5	n	n	5	n	n	n	n	n	n	n	n
39	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n
41	n	n	n	n	n	n	n	n	n	n	n	n	n	15	n	n	5	n	n	n	n	n	n	n	n
42	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	10	n	n	n	n	n	n	n	n
43	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n
81	n	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
82	n	20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
83	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
86	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
87	n	15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
88	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Notes n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

Table G-6

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location (During the Winter Season) Will Contact a Certain Land Segment Over the Entire Winter Season

Land/Boundary Segment	Hypothetical Spill Site																								
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n
20	n	n	n	10	20	10	n	n	n	n	n	n	n	n	n	n	n	n	10	n	15	5	n	n	n
21	n	n	n	5	20	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
22	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n
23	n	n	n	n	5	5	n	n	n	5	n	n	n	n	n	n	5	n	n	n	n	5	n	n	5
24	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	5
27	n	n	n	n	n	n	n	n	10	5	n	n	n	n	n	n	n	n	n	n	n	10	n	n	n
28	n	n	n	n	n	n	n	n	25	5	n	n	n	n	n	n	n	n	n	n	n	20	10	n	n
29	n	n	n	n	n	n	n	n	10	n	n	5	n	n	n	n	n	n	n	n	n	n	15	n	n
30	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	5	n
33	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n
34	n	n	n	n	n	n	n	n	15	10	n	n	5	n	n	n	n	n	n	n	n	n	40	n	n
35	n	n	n	n	n	n	n	n	n	10	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n
36	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n	n
37	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n	n
38	n	n	n	n	n	n	n	n	n	n	n	5	5	5	n	n	5	n	n	n	n	n	n	n	n
39	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	n	n
41	n	n	n	n	n	n	n	n	n	n	n	n	n	15	n	n	5	n	n	n	n	n	n	n	n
42	n	n	n	n	n	n	n	n	n	n	n	n	n	10	n	n	10	n	n	n	n	n	n	n	n
43	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n
73	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5
74	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	5	n	n	n	n	n	n	n	n	10
75	n	n	n	n	n	n	n	n	n	n	n	n	n	5	5	25	5	n	n	n	n	n	n	5	20
76	n	n	n	n	n	n	n	n	n	n	n	5	5	5	20	15	5	n	n	n	n	n	n	n	15
77	n	n	n	n	n	n	n	n	n	5	10	n	5	10	5	5	20	n	n	n	n	n	n	20	10
78	n	n	n	n	n	n	5	20	n	10	35	15	20	5	20	20	15	n	n	n	n	n	5	20	20
79	n	n	n	n	n	5	25	25	10	10	n	25	20	15	20	20	5	n	n	15	n	5	10	10	5
80	n	n	5	5	5	25	15	10	10	5	10	5	n	n	5	10	5	n	5	15	25	15	5	20	n
81	n	15	25	10	20	10	5	10	n	5	15	10	10	10	15	n	10	n	n	25	5	15	n	15	5
82	5	20	10	25	n	10	20	5	10	10	10	15	20	10	n	n	n	n	25	30	5	5	n	5	n
83	10	10	5	10	n	n	n	5	n	10	15	5	n	n	n	n	n	15	5	n	5	n	n	n	n
86	n	5	5	n	n	n	5	n	n	5	5	n	n	n	n	n	n	10	5	n	n	n	n	n	n
87	35	35	10	20	15	20	15	10	n	n	n	n	n	n	n	n	n	10	30	15	20	5	n	n	n
88	25	15	30	15	15	10	10	5	n	5	n	5	5	5	n	n	n	40	10	n	15	5	n	n	n
89	10	n	10	n	n	n	n	5	n	n	n	n	n	n	n	n	n	15	10	n	n	10	n	n	n
90	15	n	n	n	n	n	n	5	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n

Notes n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

Table G-7

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Environmental Resource Within 3 Days of a Summer Spill or Meltout of an Overwintering Spill. Environmental Resources Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Environmental Resource	Hypothetical Spill Site																										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33		
Land	n	n	n	5	9	2	n	n	10	11	n	6	8	26	n	n	11	1	2	n	3	1	32	n	n		
Sub. Res. Area A	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	19	n	n	n	n	n	n	n		
Sub. Res. Area B	n	n	1	33	53	15	n	n	n	3	n	n	n	n	1	1	1	25	29	1	20	7	n	n	n		
Sub. Res. Area C	n	n	n	n	n	n	n	n	2	18	n	16	18	47	12	n	30	n	n	n	n	n	3	21	n		
Bhead Summer Feed. Area	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	7		
Bhead Fall Feed. Area A	n	n	n	22	37	8	n	n	n	6	n	n	n	n	n	n	n	n	1	1	21	9	n	n	n		
Bhead Fall Feed. Area B	n	n	n	n	n	n	n	n	n	n	n	n	n	41	4	n	33	n	n	n	n	n	n	n	n		
Bhead Mig. Area A	n	n	n	n	n	9	2	1	17	2	n	2	n	n	2	n	n	n	n	n	n	6	9	2	n		
Bhead Mig. Area B	n	n	n	n	n	n	n	n	n	21	1	21	11	4	n	n	2	n	n	n	n	n	n	2	n		
Fall Bowhead Area	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	21	n	n	n	n	n	n	n	1	n		
Gray Whale Area	n	n	n	2	4	4	n	n	n	n	n	n	n	n	n	n	n	25	7	n	4	2	n	n	n		
Seabird Offshore Area	n	n	21	28	30	8	n	n	n	1	n	n	n	8	8	12	8	21	28	21	17	5	n	n	n		
Lagoon Area 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n		
Lagoon Area 2	n	n	n	11	16	9	n	n	n	1	n	n	n	n	n	n	n	n	15	n	12	5	n	n	n		
Lagoon Area 3	n	n	n	n	n	n	n	n	n	36	13	n	2	4	n	n	n	n	n	n	n	12	56	n	n		
Lagoon Area 4	n	n	n	n	n	n	n	n	n	2	n	5	8	4	n	n	4	n	n	n	n	n	n	n	n		
Lagoon Area 5	n	n	n	n	n	n	n	n	n	n	n	n	1	29	n	n	10	n	n	n	n	n	n	1	n		
Lagoon Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	4	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 2	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	4	1	n	1	n	n	n	n		
Ice/Sea Seg. 3	n	n	2	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 4	n	n	n	3	2	n	n	n	n	n	n	n	n	n	2	3	2	n	n	6	2	n	n	n	n		
Ice/Sea Seg. 5	n	n	n	n	n	8	6	n	13	3	n	2	n	n	2	n	n	n	n	n	10	10	7	2	n		
Ice/Sea Seg. 6	n	n	n	n	n	18	1	n	30	3	n	3	n	n	3	n	n	n	n	n	n	10	17	3	n		
Ice/Sea Seg. 7	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 8	n	n	n	n	n	n	n	n	n	2	21	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 9	n	n	n	n	n	n	n	n	n	n	n	8	6	2	n	n	2	n	n	n	n	n	n	8	n		
Ice/Sea Seg. 10	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	2	n		
Ice/Sea Seg. 11	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14	1	1	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		

Note: n = less than 0.5 percent

## IV.C. Public Hearing Comments and Responses

Public hearings on the Sale 124 DEIS were held in the following Alaskan communities in April 1990: Barrow on the 17th, Kaktovik on the 18th, Nuiqsut on the 19th, and Anchorage on the 20th. At the hearings in the NSB communities of Barrow, Kaktovik, and Nuiqsut, MMS arranged for the services of a professional translator from the Inupiat History and Language Commission of the NSB to translate testimony spoken in Inupiaq to English for the hearing record; 12 testimonies were presented in Inupiaq and translated into English.

Because of the volume, transcripts of the oral testimonies are not reproduced in the EIS; instead, significant issues discussed by the speakers have been excerpted and presented in this section. A copy of the complete transcript for each of the hearings is available at the Alaska OCS Region, Public Information Library, in Anchorage. Also, a copy of the hearing transcript was mailed to the mayor in each of the NSB communities in which the hearings were held.

During these hearings, many residents of the NSB expressed concerns about how their culture, lifestyle, and subsistence resources might be affected by oil and gas development in the Beaufort Sea. The MMS is making a very strong effort to ensure that the government and industry are aware of the importance of the subsistence lifestyle to the Inupiat.

Information-gathering (scoping) meetings and public hearings were held in all communities of the NSB potentially affected by the MMS OCS oil and gas leasing program. The MMS presently is sponsoring and previously has sponsored social and environmental studies that directly relate to the Beaufort and Chukchi Seas and adjacent coastal communities.

The testimony given at the Sale 124 public hearings will help in the understanding of the importance of culture, lifestyle, and subsistence resources to the peoples living along the coasts of the Beaufort and Chukchi Seas.

Speakers at the public hearings are listed below in the order of their appearance. Speakers whose presentation has been excerpted are identified by a •; presentations spoken in Inupiaq are identified by an \*.

### 1. Barrow Public Hearing

- Don Long
- Arnold Brower, Jr.
- Warren Matumeak
- Eugene Brower
- Tom Lohman
- Robert Aiken
- Daniel Leavitt\*
- Joash Tukle
- Marie Adams
- Walter Akpik, Sr.\*
- Author Neakok\*
- Delbert Rexford

- Burton Rexford
- Henry Huntington
- Nate Oleman\*
- Charlotte Brower
- George Edwardson
- Raymond Neakok, Sr.\*
- Marth Aiken
- Beverly Hugo
- Charles Okakok
- John George
- Benfer Simmonds
- Douglas Edwardson

### 2. Kaktovik Public Hearing

- George Tagerook
- Fenton Rexford
- Issac Ahkootchik\*
- Jonas Ningeok\*
- Alfred Lynn
- Jane Thompson

- Nolan Soloman
- Joe Sopl
- Herman Aishana
- Robert Thompson
- Eddie Rexford

3. Nulqsut Public Hearing

- Nelson Ahvakana
- Isaac Nukapigak
- Thomas Napageak  
Sarah Kunaknana  
Joesph Ericklook

- Joe Kasak  
Margaret Gegoseak
- Berniece Pasula
- Maynie Ahnupknak\*

4. Anchorage Public Hearing

- Richard Ogar
- Don Hartman
- Sharon Sturges

- Jane Degnan  
Tom Cook

## BARROW PUBLIC HEARING

### Excerpts from the Public Testimony of Donald Long:

#### Comment BAR-1:

My point is that most of the people who live and die in Barrow were and are here because of the bounty of the sea. Any attempt of offshore drilling against the objection of the people without proven oil spill contingency plans could be construed as a first step of genocide against the Inupiat people of the North. The only basic -- the only and basic reason why we live here is because of the ocean. Remember, these whales and other animals will migrate; it's their instinct, and Point Barrow is their only route.

### Excerpts from the Public Testimony of Arnold Brower, Jr.:

#### Comment BAR-2:

Continued operations of offshore operations by the oil and gas industry harasses the Inupiat whalers from their subsistence catch limits.

#### Comment BAR-3:

Any accidents of oil spill would have a devastating impact to the bowhead population if encountered by a large migrating school that happens to want to pass through their natural migratory pattern and time it needs to move itself from the Beaufort Sea.

#### Comment BAR-4:

Since we have not seen any form of assurance of cleanup capability by the industry, no leases should be activate -- no leases should be resolved -- wait a minute -- activated for exploration until this has been resolved. If it is not resolved, the industry and the federal government will finally initiate a plan that will not work under harsh arctic environmental conditions because you would finally, perhaps, like they did in Valdez area that initiates some kind of program that has not been tested here.

#### Comment BAR-5:

There needs to be training of the Arctic residents for oil spill containment programs in each village, from Kaktovik to Point Hope. You spoke of training oil and gas industry employees. I think that should not be limited because they have their own limitations of knowledge to this Arctic harsh -- to these harsh environments that we are so used to. This program has to belong to the communities and remain there for the benefit of the local residents that depend on the sea for livelihood.

#### Comment BAR-6:

Again, I want to go on record to oppose the offshore drilling without a safe oil spill contingency program and a provisional schedule of the migratory bowheads' pass either at Point Barrow or Point Franklin on the Chukchi Sea in the fall migration each year, also a communication program that will activate the oil spill contingency program. With declining revenues, the dependence of our subsistence resources, it is even more critical now and in time to come. These are in our best interests as local residents of the Arctic coastal communities.

For instance, in the migration of the bowhead whales, that if there is no limit and these things are not adhered to for allowing the natural migration of the bowhead whale, it can cause it to alter or stop by certain activities, influx, especially

influx of activity offshore. And the -- if they are stopped like that for a course of a week for instance, and the Arctic flows and it freezes fast, and those are some of the things that I am concerned about so that these animals, these endangered species be allowed to go down to their westward migration down south before they are trapped in the Arctic. I'm count -- especially like the ones that were trapped there, the gray whales there. Unfortunately, those -- that issue has been demonstrated once.

#### Comment BAR-7:

I'd like to make some concluding remarks in hearing and reviewing some of your pamphlets. In the event that oil spills occur and cleanup is done on our beaches, using dispersants on the beach to clean up the -- will have a detrimental impact to other living marine resources. So there needs to be an exploration of -- and research to clean up these type of beaches with non-toxic dispersants so that these little fish eggs that are trying to grow -- I'm especially going to name one that has been depleting since the encroachment of offshore activity, one, the -- namely, the Arctic cisco (ph), which is still caught, barely caught, in Barrow since that -- since the beginning of oil industry, offshore industry.

I'm very adamant about this because I feel that there has been a lack of care in making stipulations because of wanting to receive the dollars for the benefit of the departments of the United States, and I think that the United States must view all of its environmental impact statements so that these dispersants do not kill off the resources that we depend upon on our coastlines off Alaska and the rest of the United States. Using toxic dispersants to clean up our beaches will further endanger all of the other marine resources.

A decline of catch limits of Arctic cisco has been very predominant. It's been so evident that I keep bringing it up at these hearings, that they are doing investigations, research related to this west stock (sic) for instance, those type of things. And that's why I'm speaking and, namely, on that one critical issue.

#### Comment BAR-8:

I have not discussed that too much. I think this is one of my first statements here because I have learned that they are trying to put these training programs in there. But I would like to see that the permanent people, permanent residents people be here, that they learn and become a part of the cleanup activities in the event. But this is very important because people, Arctic residents, from here are more knowledgeable of the adverse impacts and the adverse weather conditions, sea ice conditions, here more than they do from Texas.

### Excerpts from the Public Testimony of Warren Matumeak:

#### Comment BAR-9:

The MMS, in my view, should not lease anything beyond the land-fast ice area because the floating structures that are used out there poses a lot of risk, and if there is a blow-out from one of those floating structures, let's say if the blow-out occurs in October, at freezing time, the relief well would not take place at the time because it is freezing. And so anything blowing out would continue all through the winter until the next drilling season. Now, that poses a very grave risk, and it would damage a lot of our subsistence animals.

#### Comment BAR-10:

So I also want to state that the MMS should not allow any drilling with floating structures when there is a plan to use a conical-shaped bottom founded structure which can be used in deeper waters. Global Marine has that plan, and most of the industry knew about it, and I guess you people know about it. The two safest rigs, drilling platforms, that are being used up here are the CIDS, what we call CIDS, and the SSDC. These are bottom founded structures, and that is into gravel islands and ice islands. The blow-out preventor is on top, and if there is a blow-out after freeze-up, the oil would be contained on top without oil going away and -- with the current and stuff like that. And it can be saved; it can be used. But if there's a blow-out in the ice-infested waters, the industry nor MMS, or anybody, have the capability of cleaning spilled oil, as demonstrated in the Valdez spill.

Comment BAR-11:

But I would like to state that anything outside of the land-fast area be deleted until the MMS and the industry come up with a drilling structure that can safely drill beyond the land-fast area.

Comment BAR-12:

And you made an excuse; you're saying that you did everything possible to make the risk less by putting people on the rig or having a lot of people review the oil spill contingency plan. These things cannot stop a blow-out; a blow-out will come in accidentally or the equipment failure. These reviews will not do it. The person on the ship will not prevent it. It's the accident by a person or the failure of the equipment, and with the ice conditions up here, a 200-barrel-a-day -- 200,000-barrel-a-day blow-out will -- if it continues over the winter, will be a devastating -- will have devastating effect to our food, food chain.

Comment BAR-13:

And also frown at using dispersants because it only turns transfer of that dispersant into the water, which would then go into the ecosystem that the larger animals eat and then it could pass on to us. You know, these things are going to be done without having a full knowledge of what effect it will have on human consumption, or at least these are -- these fears are real to me.

Excerpts from the Public Testimony of Eugene Brower:

Comment BAR-14:

Why are you having lease sales while the incidental take permit issue, it has not been resolved yet? Are they not still pending? It has been resolved on an incidental take permit request by the district? While that is pending, I think there should be no lease sales on your federal lands out there.

Comment BAR-15:

And also, what guarantees do we have on the impacts from the drilling platforms or the ships or the contaminants that are going to be coming from these drilling vessels or these platforms, i.e., the drilling width, oil? Those are going to happen, and there's -- if anybody says that they -- it doesn't happen, I don't know who they're trying to pull the wool over. But my biggest question is, What happens if the drilling mud and the other contaminants that are -- and where are they stored if they are removed from these sites? Are they drilling a hole down in the ground and blowing them into the ground? If so, is that area safe, or are they seeping through? Those questions have never been answered, and nobody has brought these up before you, if I'm not mistaken, up here.

Comment BAR-16:

What about the multi-year ice? We haven't seen the -- any of the multi-year ice up here for quite a few years. About three or four years ago, United States super-icebreaker, the Polar Star, couldn't break its way through the Point out there. We were watching it ramming that ice day in, day out, and it couldn't even make a headway. What's going to happen when that ice comes around in this sale area you're proposing to sell? What kind of guarantees are we going to have? That multi-year ice is heavy, and they don't break easy, much to the embarrassment of our federal government, our supertanker couldn't even penetrate even how many feet into that ice? That's one of the things that should be looked at.

Comment BAR-17:

Also, what is your proposed drilling window once you have your lease sale? Is it going to be year-around or what? And also, you talk about the oil industry saying that they have the know-how and the technology to clean an oil spill. I've never seen it work up here. Have they found a way to do it underneath the ice, underneath the pressure ridges, where it's going to go? This ice is constantly moving, either northeast or southwest depending on the current up here. To this day, I don't think the industry has, or the federal government has, the technology to clean oil underneath our polar cap up here.

Excerpts from the Public Testimony of Tom Lohman:

Comment BAR-18:

Very flatly, the North Slope Borough does not believe that the industry has the capability to clean up oil in good environmental conditions and, much less, in the difficult environmental conditions which are the norm up here. I've got right here a copy of the report that was prepared by the Alaska Oil Spill Commission focusing on the Exxon Valdez spill. It obviously does not talk too extensively about spills in Arctic regions, but I'd like to read just a couple of things into the record that it does say, referring to Arctic regions.

Comment BAR-19:

Talking about regional oil spill risks -- and this is something that Arnold brought up -- you need to talk about oil spill risks in our area, not oil spill risks or oil spill scenarios, or models, that have been formulated in other environments. The report says, and I quote:

"The picture is bleak for remote areas. An effective response effort for a large spill from a drill ship or a tanker accident very far from Prudhoe Bay or Barrow would be extremely difficult. If the drill ship or tanker were saved, the oil spill would probably be uncontrollable by that time. Sacrificing the vessel by burning is the only option offered by most who have experience in the Arctic."

Comment BAR-20:

In your preferred scenario, and in the scenarios developed in the EIS, there are amazing lengths of subsea pipelines discussed, several hundreds of miles of subsea pipelines which are supposed to be laid. We have very little confidence that this can be done either in the construction phase so as not to disturb the subsistence activities or the resources, but once those things are in, we don't have the confidence that they can be operated safely. And if you have a spill or leak or a break in the pipe during the winter, as Warren said, you are not going to be able to address it until the following open-water season. You're going to have water -- you're going to have oil under the ice, which is going to spread a very long

way, you are going to have springtime activities which are critical to this community and the communities in the Beaufort Sea affected very severely.

Comment BAR-21:

You've got safer alternatives onshore; we understand that you cannot lease areas which have not been opened by Congress. As Eugene said, we don't think you should be leasing if you can't deal with that final step in a safe manner. And we understand that oil development has provided benefits to the North Slope, and we hope it will continue to do so, but in the areas that are most sensitive to the livelihood, and the welfare, the continued cultural viability of these people, who, as Arnold said, live and die here, we don't think you should be operating out there in an environment that is difficult at best and in which you cannot assure these people that you can do it safely.

Excerpts from the Public Testimony of Robert Aiken:

Comment BAR-22:

I am very opposed to this. My grandpa, if he was alive, he'd back me up, and he'd tell you one thing or two. I'm sure I'm talking about our ancestors' wisdom when I say I've seen this happen. I've seen boats wrecked; I've seen ships stopped. And I've seen a lot of things, what he was talking about, and it's very true. We are dealing with very hard-packed ice that we never seen for how many years now. It's bound to come in sooner or later, and I hope it don't come in when you start drilling 'cause it's going to take that floating thing right up -- way up, way past the Point, and it's going to take it down, probably take it out there, the North Pole. 'Cause a lot of people, when they get lost out on the ice, when that ice floe comes through here, it don't stay here, it goes way out past the Point. And it's been know to happen when the ice comes together from the Beaufort Sea to the Chukchi Sea, when that -- when they come crashing together, and nothing going to stop them. All you'll see is just big piles of ice.

Excerpts from the Public Testimony of Daniel Leavitt:

(Mr. Leavitt's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-23:

I am very concerned on how much -- how -- what should be done on how to stop should there be a -- to stop the blow-out if it should happen. And should there be a blow-out in one of the oil rigs, it is very possible that much of the oil will spread out in the water before it goes out in the open air.

Comment BAR-24:

But me, as I have lived in my Inupiat way of livelihood, that's the only -- that's the only thing that drives me on is to get something for my family to fill up their stomachs from what -- from what I catch.

And if I should go out hunting, leaving my family with nothing to eat, and if I should catch something from the sea, like a sea mammal that has been taken in the oil spill and it has been contaminated from this oil spill, this thing that I caught to feed my family, when all the while when I left them, there was nothing in the house for them to eat, and that's very bad. It really hurts me even to think about it.

Comment BAR-25:

And not too long ago, from the caribou family, my -- my sons have been killing off some caribou that has been sick.

Because of these radios that have been attached right around the neck of the caribou, that has bothered them so much that they're -- they haven't been able to eat like they should, and therefore, they die.

And when we confront the officials about these, maybe we have -- maybe they just laugh behind our backs about these conditions that these animals are in.

Comment BAR-26:

And prior to this meeting, I have -- I have listened to what the oil companies -- companies have to say ....

That it is not our problem. We're not -- we have nothing to do with this oil that has spread around the water and in the ice.

If I understood them correctly, I -- I understood them to say that the cleanup job is for the federal government.

In these meetings, you have always said that all precautions have been taken to take care of any blow-out, but I have not seen a demonstration on how it can be done.

Excerpts from the Public Testimony of Marie Adams:

Comment BAR-27:

There's ongoing discussions of incidental take; that issue has not been resolved.

Comment BAR-28:

I'm very concerned that you are planning -- especially in the Chukchi Sea area where the ice dynamics are more extreme, and you don't have the experience there; no one has that experience. I'm very concerned that considering the amount of activity we've seen in the past and the chances are we'll probably see an oil spill if that -- if they start drilling and going into any activity on the Chukchi Sea area.

Excerpts from the Public Testimony of Walter Akpik, Sr.:

(Mr. Akpik's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-29:

So if you plan to drill from a ship....

We don't know what the ice conditions will be and how the ice conditions will handle that rig.

Because when the currents and the ice, there's no force to hold it once it starts moving, and no matter how big a ship there is that is used to drill in our waters, we are very concerned of what will happen to it should the ice conditions and the current start carrying that ice where it -- where it will.

Comment BAR-30:

And so from experience, I have watched how these pressure ridges pile up. They don't stop on the land -- land-locked ice, but they do come up on -- on top the ground and then they continue to pile up.

Comment BAR-31:

So as I have watched this, seen it from experience, there's no

telling. No matter how big a ship there is that's - that has - that has this break drilling for oil down there, there's no telling what will happen to it once you've struck oil and what will happen to it should these ice conditions pile up on it.

Excerpts from the Public Testimony of Arthur Neakok:

(Mr. Neakok's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-32:

So if you plan - if there are plans to - to put up an oil rig on a boat, a ship, whatever, I want you to know that even if there is no sign of ice anywhere, there can - it can come up on you without notice and without any - without any warning. And when that happens, all this water is covered by ice, and there is nowhere that a boat or a ship can travel when ice conditions come in like that.

If this rig is on a ship, whatever, these ice conditions, when they come in that fast, can take it anywhere with its current, can take - the ice can take this oil rig, the ship, whatever. It can take it with it because there is no stopping when the ice conditions and the currents start going in one direction.

Excerpts from the Public Testimony of Burton Rexford:

Comment BAR-33:

The three active currents that we deal with here in Barrow, one is mentioned. I hear it on the radio - or two of them - from the west and east. The other one goes directly north; that's right at the Point. Now, these currents are very active, and they can change any direction, the two currents, any way from the east and west, without a moment's notice. The one coming from the east, generally, this time of the year, we'll make a test of the land shore-fast ice, and we'll test it for its strength and power. It has taken it out many a times in my years right through the sandbar, the land shore-fast ice. That's how much force that carries when it comes this time of the year.

Comment BAR-34:

So in the event there's a spill, we have these currents to be concerned with. The people before me that testified, there is no clean-up under the ice. This is very true. There was also a mention of the year-around ice. The year-around ice that was not mentioned, and the next current from here, it takes about six hours on full speed with a 70-horse and about an 18-foot Lund full speed, I would say about 60 miles at 270 degrees, six hours without slowing down. That is where you will find what we call the glacier ice. I don't know how many years old that ice is, but it's out there. With a strong west wind, high winds, it can come in to the beach here while I'm sleeping during the night. It doesn't give any warning; it comes in through, between here and Franklin Point. This glacier ice doesn't come in from the north; it comes in between here and Franklin Point.

Those are the currents. If there was a spill, I don't see how you can clean it up. The Eskimo has a right to be concerned about any offshore activity. They know their sea, land, ice; they have been conditioned for years and years. They learned from their forefathers. Their forefathers went through the same thing, the harsh times out in the ocean; they slept out there. So do we; we sleep out there on ice floes. We don't make an attempt to go home on some of those ice floes when we get caught out there merely because of safety of a younger generation. You don't dare try to go home in a big hurry, just - we just take your - just take our time. We know where we're going to hit land. If we get

caught on that north current that's going north, that's very easy to figure out for an Eskimo; we know where we're going to hit land.

Excerpts from the Public Testimony of Henry Huntington:

Comment BAR-35:

Section 4(n) also says that 20 spills or greater than 1,000 barrels have occurred since 1964 in Outer Continental Shelf activities. That means that since you expect eight spills in the Arctic, the Arctic spills would be equal to 40 percent of the spills that have already happen in the past 26 years. That seems like a lot of spills. The largest of these 20 spills was 160,000 barrels. The chances of a spill of that magnitude may not be great, but let's look again at the Exxon Valdez.

Comment BAR-36:

According to the Alaska Oil Spill Commission report quoted by Tom Lohman earlier, there have been more than 8,700 transits of Prince William Sound by oil tankers; only one spilled. One out of 8,700 is .01 percent. That sounds minimal, but with enough transits by tankers, the chances of a spill become great. If you said that .01 percent was the chance that a given well here would produce a major spill, you would probably go on to say that it wasn't worth worrying about. I don't think anyone would agree with that from Prince William Sound, and considering the devastating consequences of a spill to the Arctic environment, I don't see why it should be tolerated here.

Comment BAR-37:

In the oil spill report, it also states that the procedures developed in 1977 for tankers in the Sound were not being followed by them mid-1980s. Things got sloppy. You have mentioned procedures to minimize the risks of oil spills, but who is to say that they will be followed? Who is to say that things won't get sloppy here? Who is to say that a disaster won't materialize here? The oil spill clean-up techniques discussed in Section 4(a) of the Environmental Impact Statement include such measures as portable rope mops and manual removal. This brings to mind people in Prince William Sound wiping rocks with paper towels. That's not very reassuring. The only thing the Environmental Impact Statement promises is the 99-percent chance of a greater - of an oil spill greater than 1,000 barrels.

Excerpts from the Public Testimony of Nate Oleman:

(Mr. Oleman's testimony was presented in Inupiaq and translated into English by the translator.)

Comment BAR-38:

I'm going to use as an example of what's in our background right now, in our back yard, of what the federal government has done. At Shooting Station, they have buried their debris into the spit going to the Point and sank some of the metal and other debris into our lagoon out there. We use that lagoon to go inland and to go hunting. We use the Shooting Station all summer for hunting in our ocean, in the lagoon, and on the land.

Not by cleaning up the debris, we the community have to suffer, and we see it every summer.

Back in '77, through a request from the community, I wrote a letter to the Navy since USE was run by the Navy - not USE, USE now was run by the Navy, and we knew it as a Navy camp. The Navy respond and pass it down to U.S. Air Force at the DEW Line site saying it was their responsibility

to clean up the debris in the lagoon and along the spit since they were running the DEW Line site. The Air Force in turn respond and said that the debris was cleaned up around the DEW Line site and their responsibility wasn't the bay or the spit, it was the Coast Guard's responsibility.

And the Coast Guard looked into the matter because they mentioned the lagoon quite a bit, but when they investigated, some of the debris was along the coastline, both in the ocean and the lagoon and buried along the spit. So they determined that the responsibility lay on the U.S. Army Corps of Engineers to be cleaned up. The Corps did the same thing; they investigated and reported back that since the property was designated to the Navy and was under the jurisdiction of the Navy, and it was the Navy's responsibility to clean up the debris.

To this day, the debris is still out there, and that's just a example of how the government's version of coming in and saying they have the technology to clean up before they leave. The only technology they have is they know how to pass the buck. They know it's the government's responsibility, but they don't know who is to blame it on. The oil spill, if it occurs out in the ocean, is going to be routed the same way.

#### Excerpts from the Public Testimony of Charlotte Brower:

##### Comment BAR-39:

We're allocated so many strikes that we have to negotiate with the National Oceanic Atmospheric Administration, and within the last recent few years, due to Steven Brown Associates, we were able to convince the federal government and the IWC that there is a need to increase the quota so that the people throughout the nine villages could have, based on their nutritional needs, the number of strikes. The villages that are affected with lower number of strikes still feel that the Steven Brown Associates study is still inadequate because it has not met their nutritional needs.

##### Comment BAR-40:

We have the same problems that United States have, and that is in alcoholism, drug abuse, and then you have number of people that are going to be out there, whatever they're going to be doing, out in the ice, they're going to come with those problems, and then those problems will be our problems.

##### Comment BAR-41:

And right now, I think Sale 124 is a real important issue that the Barrow Whaling Captains are going to be faced with, and it is going to impact them, not only during their spring but in fall whaling in the next coming few years, and that's a reality that we have to face. Kaktovik Village and Nuiqsut Village had to endure all what they've done because of the Prudhoe Bay. The Prudhoe Bay area that is there has impacted their way of whaling that they have done throughout the number of years in the past. They have to go out of their way to go other places to go whaling, and they have to tow that whale from that place to their butchering site, and sometimes it takes them at least a good day if -- if not, to butcher that whale.

#### Excerpts from the Public Testimony of George Edwardson:

##### Comment BAR-42:

And if you want to talk about law, laws, this MMS has to follow the same federal laws and international treaties we have, don't we? You have the Endangered Species Act you're violating, and right there, right on the map behind

you, you're showing us where the bowheads and the other whales rest. You have 29 endangered specie animals living within the lease sale area where you're trying to say you want to sell. You're violating this Endangered Species Act you marine mammals protect -- your marine mammals -- Minerals Management Service, excuse me. And also the Marine Mammal Protection Act, you're violating that too. MMS is violating these acts also: the International Migratory Bird Treaty you're also violating to try to conduct your Lease Sale 124.

##### Comment BAR-43:

And to make it worse, I didn't even know about this hearing here, and I hadn't received your draft resolution or been, you know, notified except through the newspapers, and my villages, the only way they can find out is through the newspapers. Why weren't we properly notified you were going to go out and sell our ocean?

##### Comment BAR-44:

Now, you want to talk about, you know, how good you're going to clean up. You can't even start about that 'cause you, as America, claimed the last time those two icebreakers came up here they were the strongest in the world -- you couldn't even make it to Christmas. And here one of them was just following the other one back and both of them stuck in the ice. This is the most powerful ships you're going to use to take care of your clean-up crews?

##### Comment BAR-45:

Technology. You say you have technology -- you're still drilling with a piece of iron pipe. And we -- we all understand what happens when you heat one end of a piece of iron, the heat transfers to the other end. The permafrost is less than 12 degrees below freezing, and it's just -- just to give you an example how much permafrost, when a pipe sits in the ground and don't even move, ever since the Navy drilled at Onakpah (ph), the permafrost was at 1,900 feet. Just -- just this past year they tested it and found out it's up to 1,300 feet now. You just melted a spot in the permafrost just by leaving a pipe in the ground.

##### Comment BAR-46:

When the industry and the government decides to go look for oil, there is oil. You have satellites with infrared capabilities that can look below the surface. You have airplanes that can smell the air that comes -- that oil comes out of the ground with, even over the ocean. You worked on some of them there, John, while you were up here at Narl (ph).

##### Comment BAR-47:

And on your clean-up boats, your skimmer boats, back in the beginning of the 1970s, I spent better than seven and a half years in the oil industry. I was the person in charge of the first skimmer boat that ever came to Alaska in the beginning of the 1970s, and the skimmer boat they gave me to clean oil with in the Cook Inlet was a house pontoon boat without the house, and in order to make it stay afloat in the Cook Inlet, we had to fill the pontoons with styrofoam. That was the first clean-up boat that ever came to Alaska. And when you look at your clean-up equipment, it has not improved -- and you're talking about better than 20 years of experience that's supposed to refine your technology.

##### Comment BAR-48:

And if you want some facts on this matter, where you're going to go drill, that is the ice that feeds one-third of the world's fish, between Greenland and Canada, the currents flowing that way. You make a mess, you lose -- you lose

some oil, the toxicity of the oil does not deteriorate because it's cold. We don't have the warm weather like down in Valdez or down in Mexico where you lost it before. The -- the toxic gases will not disappear; they will stay there. And every time the ice rotates, we're going to get hit with it again. You're talking about threatening two-thirds of the world's fisheries, you know, identified by the International Beaufort Sea synthesis that was conducted in Seward a few years ago.

Comment BAR-49:

And for -- for the Inupiat as a people, we have never received any royalties in any extract -- any mineral extraction or even renewable extractions from our region, and we have a legal, legitimate jurisdiction recognized by Congress countless times. Yet when industry decides to go out, or the federal government, either from the federal government level or from the State level, there is no talk about how much royalties we're going to get 'cause we've never received any. Right now we just entered into the Department of Justice through a U.S. attorney, appealing the United States' actions and asking, 'Where's our royalties for Prudhoe Bay? Which the Department of Commerce has notified us, and so far, it's up to 44 billion and we haven't even been able to touch it; now you're talking about going out in our whole ocean, and you haven't even come to talk to us about that.'

Comment BAR-50:

Alcohol problems. When you look at the people, right now I'm -- have to deal with -- without any federal monies, without no help, not from churches, not from the state governments or from the federal governments -- we have to deal with over 250 child cases every six months without no help, and a major portion of them is alcohol related because the parents are worried about, 'Where am I going to feed my kids from? I can't find a job.' And here we're sitting in the richest oil field in North America. And major portions of our population are unemployed and can't get work, with the biggest oil field sitting right to the east of us here. And the PRA, we've never received any royalties. Pet for (sic) when the Navy held it and kept us off our land, we never received any, neither from Prudhoe Bay.

Excerpts from the Public Testimony of Raymond Neakok, Sr.:

(Mr. Neakok's testimony was presented in Inupiat and translated into English by the translator.)

Comment BAR-51:

Before I go too far, what I am saying is we have been telling you all of these years that you have extract -- started extracting oil from our lands. You have very small disregard (sic) for the people in the North. America law only works for the Americans. We have hollered, we have cried when we see the industry literally destroying your homes right in front of your eyes. We have seen them dig up your brothers, your sisters, your grandfathers out of the ground and literally just walk over them with tractors.

We as Inupiat are treated by the Americans as an obstacle to steal our oil, our lands, our own burial grounds. Justice for Inupiat is not evident by a white man's law because white man is illiterate in the Inupiat law. You've been with us since the early 1700s, and yet not even 2 percent of you has even took the opportunity to learn our language, which is our way of life. Our culture, since time immemorial, has always looked at the ecosystem as one, not divided on (indiscernible) of a different environment.

Comment BAR-52:

Last, I want to say, if the federal agencies are going to be required to make an Environmental Impact Statement, you must include the Inupiat's recommendations, the stipulations, and recognize the Inupiat Tribal Government as government not just an instrument that you use to get your own recognition. We're a tribal government, and we are recognized in the Lower 48 as government. Traditional governments have been born before the United States, tribal governments in 1936, only to contract with the United States for our protection, and it has never been used.

Excerpts from the Public Testimony of Beverly Hugo:

Comment BAR-53:

And these are values that are real important to us; to me, this is what makes me who I am. And the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others; we respect other people; and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility for our tribe, humility.

These are some of the values that are -- that we have -- that make us who we are, and these values have co-existed for thousands of years, and they are good values, and maybe it's about time that some of the oil industry or the United States government start to recognize these things. You know, these have kept us in balance with other people, with our land, and with the animals that we hunt. And these are good values, and if you are going to be in our homeland, or in the circumpolar region, we are of a same group, the Inuits -- Inuit people of the circumpolar region, we have these same values. And if anybody is going to be drilling out in our Beaufort Sea or Chukchi Sea, they have no business out there 'cause it's our business.

Excerpts from the Public Testimony of John George:

Comment BAR-54:

There's something that we've more recently -- I hate to use the word 'discovered' but -- become aware of is that, through examination of landed whales, we have evidence that -- of two whales that have been -- had collisions with large ships, and that data is not published. I presented a paper on that at the -- on the Fifth Conference of the Bowhead Whale, and these two animals showed, in one case, a large area of evulsed tissue off the flukes, and in another case, there was screw marks down the one side of an animal. The incidence is low, but if we can use North Atlantic right whales as a model of what the effects of increased industrial activity or shipping activity, let's say associated with a lease sale might be, the researchers working with North Atlantic rights think that perhaps that ship collisions may be the most significant source of man-induced mortality on the particular group and even think that it may be preventing the population from recovering despite protection from hunting for over 70 years, I believe.

So that's something that should be treated in the EIS that -- the connection is -- the scenario might be that with increased activity offshore, there'd be increased ship traffic and a greater potential of collisions with whales, particularly if ships were using lead systems, which I assume they would if -- because, obviously, they would be more navigable than moving through pack ice for instance.

Comment BAR-55:

In terms of the assessment of the effect of an oil spill on the

stock, the risk was considered to be low; however, it seems to me -- I'm generally not an alarmist, but it seems to me that you have as all -- all the -- you have a perfect situation to really affect this -- the entire herd in a dramatic way should somehow oil get into the spring lead system near here. In 1988 when we did a census, 95 percent of the whales, what we think is the entire population, went through was -- in roughly a two- to three-week period, it was a -- what we consider a pretty accelerated migration. Generally, we start seeing whales about now and end of June, and it's roughly bell-shaped through that and peaking in mid-May. However, in '88 and in '87, for some reason, the animal- -- well, there's a nice open lead system, and they all chugged through in a pretty rapid matter.

So in other words, if you had oil in the lead in a situation like that for even a week or two, you could significantly affect potentially the entire herd. So that should be pointed out. And that'll be published in an IWC paper that is in press at the moment. We did an analysis where we showed the percent counted by 15 May for -- from 1976 to '88.

Comment BAR-56:

I really think that's something worth considering. And Scott Crouse (ph) did a very nice summary of the work on the North Atlantic right whales and examined strandings, and he shows pretty conclusively that ship collisions and -- are a serious problem for these types of whales, right whales in general. They tend to be -- when they're in these social aggregations on the surface, they, for some reason, become unaware of approaching vessels, and there was some dramatic footage shown at the last conference where they nosed a vessel right up to one of these groups of socializing, breeding animals, and they were -- it was as if they were completely unaware of the presence of the ship. And what they think is, during these periods, that collisions are -- would be strictly, you know, a random event, and it'd just be a matter of the probability of the ship and the whale being in the same place at the same time.

## Responses to Comments from the Barrow Public Hearing

### BAR-1:

This concern is addressed in Responses AK-6 and N-4.

### BAR-2:

The MMS recognizes and is sensitive to the fact that there will be some degree of interference with bowhead whaling activities from oil and gas exploration, development, and production (see Sec. IV.C.10); consequently, MMS has proposed stipulations to mitigate these effects.

### BAR-3:

The effects of an oil spill on migrating bowhead whales (particularly in the spring-lead system) was analyzed in Sec. IV.C.6.a. Also, see Responses AK-1, AK-2, and N-13.

### BAR-4:

This concern is addressed in Responses AK-6, N-4, and NAEC-7.

### BAR-5:

The MMS encourages petroleum companies to include in their oil-spill-contingency plans provisions to use the local knowledge and resources of communities that might be affected by an oil spill from operations associated with OCS oil and gas lease sales. In this regard, MMS has approved an oil-spill-contingency plan for ARCO's Fireweed Prospect in the Beaufort Sea that included trained village oil-spill-response teams.

### BAR-6:

These concerns are addressed in Responses AK-1, AK-2, AK-6, N-4, and NAEC-7.

### BAR-7:

Use of dispersants on beaches allows oil to penetrate farther into the beach profile, and in most spills—the Exxon Valdez spill being a major exception—dispersants are not used or recommended for beach cleanup. The site-specific oil-spill-contingency plans for OCS drilling in the proposed sale area will undergo a 30-day public review. This will allow for additional input by the commenter if, in fact, any of these plans propose use of dispersants on the shoreline.

Usually, dispersants are not used or recommended for use in beach cleanup. If they were used on beaches in the Beaufort Sea when capelin eggs or larvae were found on beaches or in the nearshore environment, then presumably the eggs or larvae could be negatively affected. The Arctic cisco found in Alaskan waters are believed to spawn only in the MacKenzie River; therefore, their eggs should not be exposed to any dispersants that might be used to clean up an oil spill originating from offshore activities. Historical catch data from the commercial fishery in the Colville River do not indicate any obvious decline in Arctic cisco numbers.

### BAR-8:

See Response BAR-5.

### BAR-9:

Blowouts result in the sudden, uncontrolled escape of gas, oil, or other well fluids at high pressure from a well. The MMS records for a 17-year period from 1971 through 1988 indicate that blowouts during drilling operations occur infrequently

and release only a relatively minor amount of oil (Harris and Thurston, 1989). During this period, 18,593 wells were started, and there were 37 blowouts from exploration wells and 30 blowouts from development wells. Blowouts during the drilling of two development wells resulted in 70 bbl of oil being spilled. In addition, there have been 42 nondrilling blowouts during production, workover, or completion operations; the amount of oil spilled as a result of these blowouts is estimated to be about 830 bbl.

Blowouts may last from less than an hour to several months. However, most of the OCS blowouts have been controlled within 7 days; most of these blowouts lasted less than 1 day (Tracey, 1988). In only a few instances has it been necessary to drill relief wells to stop a blowout. Many blowouts cease flowing when material from the well caves into the borehole and provides an obstruction to the flow of fluids. If a natural obstruction does not occur in a borehole, other methods can be used to stop a blowout; these include the use of blowout preventers, drilling muds, and other techniques, or a combination of these.

The MMS feels that the regulations and inspections provide assurance that OCS oil and gas operations are conducted in a manner that emphasizes safety and minimizes the risk of pollution. Regulations in 30 CFR 250 apply to drilling and well-completion and -workover operations and require the use of best available and safest technologies; they also include requirements for well-control and safety-device training of personnel. In Alaska, MMS inspectors are at exploration drill sites during all drilling operations.

### BAR-10:

See Responses NSB-14 and BAR-9.

### BAR-11:

See Response NSB-14.

### BAR-12:

This concern is addressed by the analysis of a very large oil-spill event in Section IV.N of the EIS. Such a spill is unlikely; but, if it occurred, the effects would propagate through the food chain resulting in a VERY HIGH effect on subsistence-harvest patterns.

### BAR-13:

This concern is addressed in Responses MOHR-7, BAR-7, and NSB-11. The issue of dispersant use in sale-area spill response is also addressed in Section III.D of Appendix M.

### BAR-14:

The "incidental-take permit" application was made by industry in compliance with the MMPA as advised in ITL No. 1 (see Sec. II.G.2.). This is a process after the lessee(s) obtains a lease. Therefore, the lack of an incidental-take permit is not a criteria for delaying a sale.

### BAR-15:

Before exploration drilling can occur on a lease, the lessee must submit to MMS for approval an exploration plan in accordance with regulations in 30 CFR 250.33. The exploration plan must include a list of the proposed drilling fluids, including components and their chemical compositions, information on the projected amounts and rates of drilling fluid and cuttings discharges, and method of disposal. The disposal of these materials will be primarily at the drilling

site under conditions prescribed by the EPA's pollutant-discharge permit. Exploration plans are sent to the Governor and the NSB for review and comment.

#### BAR-16:

Sea ice is a major factor influencing operations in the Beaufort Sea Planning Area, and there are several strategies that can be used to contend with this constraint. One strategy is to limit operations to a time and areas in which sea ice is absent or covers only a small amount of the sea surface. Vessels operating under these conditions may need to be only ice-strengthened or capable of breaking relatively thin ice.

If, on the other hand, operations are going to be conducted year-round, permanent facilities will have to be designed and constructed to withstand the ice force; and vessels operating in such an environment must be capable of traveling steadily through level ice that is at least 8 feet thick and breaking through thicker ridges.

The USCGC Polar Sea completed the first winter passage to Point Barrow in February 1981. During operations west of Point Barrow, the ship's rudder system was damaged while backing and ramming in multiyear ice. This transit to Point Barrow was only one feature of the cruise. Another feature was the collection of data on icebreaker-design criteria and performance and on the hull structural response during icebreaking. The lesson of the Polar Sea is just one of many experiences involved in the design and construction of icebreakers that can successfully operate in the sea-ice environment.

#### BAR-17:

This concern is addressed in Responses MMC-16, NSB-9, NSB-10, NSB-11, and N-2.

#### BAR-18:

This concern is addressed in Responses MMC-16 and NSB-9.

#### BAR-19:

This concern is addressed in Responses MMC-16, NSB-9, NSB-11, and N-1.

#### BAR-20:

This concern is addressed in Responses NSB 12 and BAR-12.

#### BAR-21:

See Responses NSB-12 and 14.

#### BAR-22:

The characteristics of sea ice are described in Section III.A.4 of the EIS, and the strategies for operating in the Beaufort Sea Planning Area are discussed in Section II.B.

#### BAR-23:

This concern is addressed in Response N-2.

#### BAR-24:

The MMS recognizes that oil and gas exploration, development, and production activities could have an effect on subsistence harvests—as well as on Inupiat culture. In the base case (see Sec. IV.C.10), the analysis for effects on subsistence harvests has determined that HIGH and MODERATE levels of effect are likely to occur. The MMS

also has proposed a number of stipulations to mitigate the intensity of some of these effects.

#### BAR-25:

The matter of radio collars affecting caribou should be taken up with the local State fish and game biologist. If a radio-collared caribou dies, be sure to notify the ADF&G of the specific location of the caribou. Also, keep a record of what you have observed and a record of the names of other people who have seen the caribou.

#### BAR-26:

The concern regarding responsibility for responding to spills is addressed in Section IV.A.2.c of the EIS. Blowouts were addressed in Response N-2.

#### BAR-27:

See Response BAR-14.

#### BAR-28:

Although operating experience is more limited in the Chukchi Sea than in the Beaufort Sea, three wells have been drilled, using an ice-strengthened drillship, on three different tracts in the Chukchi Sea that were leased as a result of Sale 109 in the Chukchi Sea Planning Area. The ability to operate in the Chukchi Sea is based, in part, on investigations of the oceanographic, meteorological, and sea-ice regimes and also on operating experiences in the Beaufort Sea.

#### BAR-29:

The ability of drillships to operate in the sea ice environment of the Beaufort Sea Planning Area is based on past operating experiences in the Canadian and Alaskan Beaufort Sea. The drillships can use ice forecasting techniques, based on knowledge of global and local meteorological and oceanographic conditions, to warn of potential risks from moving sea ice. If future or approaching sea ice threatens a drilling operation, the drilling unit can safely shut in the well and move away the site. When conditions are safe, the drillship can return to the site and continue drilling. Also, the drillships utilize icebreaking vessels to break up ice floes that could threaten the drillship.

#### BAR-30:

The characteristics of the sea ice, including pressure ridges and pileups, are described in Section III.A.4 of this EIS.

#### BAR-31:

Drillships are not designed to operate year-round in the Beaufort Sea. If a discovery is made and the drillship is forced to relocate because of a threat from ice, the well can be shut in, preventing the oil from flowing out, until the ship can safely return to the site and complete work on the well. Some drilling units operate year-round in the Beaufort Sea. These units sit on the seafloor and are designed to withstand the forces, to a certain magnitude, of moving ice. In the event the ice forces become greater than those the unit was designed to withstand, the well also can be shut in until the threat passes.

#### BAR-32:

Drilling units operating in the Beaufort Sea use forecasts that predict the weather and ice movement. Also, radar units on board the units are used to determine ice movement, and aircraft might be used to determine the location of ice beyond the range of the radar units. The drilling units have contingency plans for the orderly shutting in of a well in the

event ice threatens the drilling operations. See also Response BAR-31.

**BAR-33:**

The currents and circulation patterns in and adjacent to the Beaufort Sea Planning Area are described in Section III.A.3 of the EIS.

**BAR-34:**

These concerns are addressed in Responses MMC-16, NSB-10, NAEC-5b, and NAEC-7.

**BAR-35:**

This concern is addressed in Response NSB-23.

**BAR-36:**

The Exxon Valdez spill was the second major tanker spill in Prince William Sound in 1989, not the only spill (see also Response AOGA-15). Tankers do pose greater risk than do either oil platforms or pipelines; however, no crude tankering is projected for the Proposal.

**BAR-37:**

This concern is addressed in Responses N-4 and AOGA-15.

**BAR-38:**

The MMS requires the lessee to remove all structures in a manner that assures the location has been cleared of all obstructions to other activities in the area.

**BAR-39:**

The MMS does not have the authority to increase or decrease the bowhead whale quota. The quota is set by the IWC in conjunction with NOAA and a Federal interagency commission, of which MMS is not a participant. Once the overall quota is set, the AEWC decides how many strikes each village receives.

**BAR-40:**

The MMS recognizes that there are social problems among the Alaskan Natives and that these problems can be exacerbated by oil and gas development (see Sec. IV.C.9).

**BAR-41:**

See Responses BAR-2 and N-17.

**BAR-42:**

The MMS is in compliance with the ESA by consulting with NMFS and FWS to determine any recommendations to protect the species (see Appendix K). Also, several of the mitigating measures presented in the DEIS and FEIS were formulated due to recommendations made by these agencies (see Responses AK-1 and AK-2). The lessees are advised in the mitigating measures (ITL No. 1) to comply with the provisions of the MMPA.

**BAR-43:**

The MMS considers newspapers, radio, and television advertisements an appropriate way to inform the public of hearings on proposed oil and gas lease sales.

The MMS is not selling the ocean but proposing to lease the subsurface for oil and gas exploration and possible development and production. The OCS oil and gas leasing

program was authorized by the OCSLA, as amended. In this act, Congress declared it was the policy of the United States that:

The outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

The OCSLA directs the Secretary of the Interior to establish policies and procedures for managing the oil and natural gas resources of the Outer Continental Shelf. The Act notes:

Management of the outer Continental Shelf shall be conducted in a manner which considers economic, social, and environmental values of the renewable and nonrenewable resource contained in the outer Continental Shelf, and the potential impact of oil and gas exploration on the other resource values of the outer Continental Shelf and the marine, coastal, and human environments.

The Secretary has designated MMS as the agency within the Department of the Interior responsible for the management of the OCS oil and gas leasing program.

**BAR-44:**

Icebreakers with greater icebreaking ability than currently available in the U.S. fleet can be constructed, as evidenced by the success of the U.S.S.R. icebreakers in freeing the whales. See also Response N-4.

**BAR-45:**

See Responses NSB 12 and 14.

**BAR-46:**

At present, the only way of determining if a subsurface geological feature contains petroleum is to drill a hole and test the rocks and produced fluids. Satellite images and geophysical records may help locate potential sites for exploration drilling.

**BAR-47:**

This concern is addressed in Responses N-4 and MOHR-2.

**BAR-48:**

See Response MMC-20.

**BAR-49:**

A large portion of revenues received by the United States Government through oil and gas leasing on the OCS is passed on to the State of Alaska, a portion of which is then returned to local communities, including the NSB, through various State assistance and spending programs.

The OCS Lands Act requires that 27 percent of all OCS revenues received by the Federal Government be paid to the State for all leases that are between 3 and 6 mi from the coast. As of December 1989, over \$389 million has been paid to the State as a result of bonuses, rentals, and royalties collected by the Federal Government from this zone. Likewise, when production occurs in this zone, 27 percent of the royalties derived from this area will also be paid to the State.

There are two other Federal programs funded in whole and

in part by OCS revenues from which the State of Alaska receives money. The Land and Water Conservation Fund must have at least \$900 million in it each year. About 85 percent of this money comes from OCS revenues. So far, this fund has received more than \$13 billion; about \$11 billion has come from money received directly from OCS activities. The State of Alaska has been paid over \$26 million from this fund. The other fund is the Historic Preservation Fund. This fund receives all of its money from OCS revenues. The State of Alaska has received about \$5 million from this account. The State must award at least 10 percent of its annual fund allocation to certified governments as subgrants.

The State distributes these monies through various procedures administered by the State of Alaska, Department of Natural Resources, Division of Parks and Outdoor Recreation.

**BAR-50:**

See Response BAR-40.

**BAR-51:**

See Response BAR-24.

**BAR-52:**

The MMS solicits participation in outlining the scope of the EIS very early in the process. All concerned individuals, organizations, and governments (including tribal governments) have the opportunity to assist in the planning process. A Notice of Intent to prepare an EIS for Sale 124 was published on September 14, 1988, with written comments due by October 31, 1988. This notice announced the beginning of the scoping process, which serves to assist in defining the scope of the EIS and in identifying significant issues related to the proposed action. Scoping comments for Sale 124 were solicited through newspaper, radio, and television advertisements in the NSB area. In addition, a scoping meeting was held in Barrow on December 7, 1988, which provided additional opportunity for anyone concerned to voice their concerns. As a result of the scoping process, MMS analyzed a number of mitigating measures for this and past sales in the Beaufort and Chukchi Sea areas to help eliminate or reduce the threat that petroleum exploration may pose. All comments received during the scoping process and in response to the draft EIS, written or spoken, are used to identify major issues, to evaluate potential stipulations and potential deferral areas, and to revise the EIS when necessary. The scoping process is discussed in Section I.A.4 of this EIS.

It is our goal to incorporate any new and additional information in our EIS's and make every effort to assure that this is accomplished. A mailing list has been established to assist us in our efforts. The designated representative for the Inupiat Tribal Government will be added to that list when we receive the name and address of that individual.

**BAR-53:**

The MMS recognizes the strong Inupiat values that continue to be important in Inupiat culture today (see Sec. IV.C.9) and also how very difficult it must be for the Inupiat to see their culture changing at such a rapid pace. It would, however, be incorrect to assume that all of this change is created by oil and gas exploration activities. These changes have occurred all over Alaska and can be attributed to other factors such as television, education, in- and outmigration, etc., besides "oil money." The MMS has proposed a number of stipulations that would mitigate some of the effects on subsistence and the Inupiat culture.

**BAR-54:**

See Responses N-15 and NSB-24 and 25.

**BAR-55:**

See Responses N-6, TFA-6, and MMC-7.

**BAR-56:**

See Response BAR-55.

## KAKTOVIK PUBLIC HEARING

### Excerpts from the Public Testimony of George Tagerook:

#### Comment KAK-1:

And what -- whatever the outcomes of the oil spill will be, bound to be all disastrous, and there's no way -- how you going to clean up a oil spill during ice floes, currents, and that stuff is pretty impossible. I don't know if you guys ever done that before, but, you know, I haven't witnessed it.

### Excerpts from the Public Testimony of Penton Rexford:

#### Comment KAK-2:

I oppose Lease Sale 124. After briefly reading the draft EIS, I noted, or I noticed, that there is not enough information on subsistence and/or cultural -- our culture protection if there was to be oil spilled or any -- any adverse impact on -- on there. I noticed on all the alternatives that there is only a paragraph or less than a page addressing the socio-economic and also cultural effects on -- on any of the alternatives, whether it's no lease sale or deferred -- deferrals like around Barter Island.

I just noticed that there is not much information on the subsistence, resource, archeological protection, and just, that's all I have on that. I just oppose Lease Sale 124 (sic) on account that it does not address in detail the protection of our subsistence, cultural, and -- and also the animals if there were to be an oil spill. That's all I have. Thank you.

### Excerpts from the Public Testimony of Isaac Ahkootchik:

(Mr. Ahkootchik's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment KAK-3:

There is no demonstration or the proper clean-up of an oil spill where there's ice, where ice is involved. And so I have a lot of questions about that, and I would really like to know how that could -- how the clean-up could be taken care of to pick up all this oil that's under the ice or in the water should it occur.

#### Comment KAK-4:

As we were growing up, there was a lot of game plentiful, namely the caribou. But when development started in the years that he mentioned, they have been declining. Since this development of the oil companies started, there has been a very noticeable decline on the caribou. You have to travel way up, go up all the way to the mountains to catch any caribou nowadays.

### Excerpts from the Public Testimony of Jonas Ningeok:

(Mr. Ningeok's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment KAK-5:

And from experience, I can say that when pressure ridge is forming, even when there's no wind to help it along, the ocean currents can be such that they can pile up this ice that no matter how quick or how -- if you -- in your words, if you can say that evacuation must be done in a moment's time, even if you're that swift, there can be nothing you can do because, from experience, I can say something can happen

once the oil rig has reached all this oil down on the ocean floor, and then this pressure ridge starts forming. There can -- there there have been times when you can do nothing no matter how swift you think you are.

### Excerpts from the Public Testimony of Alfred Lynn:

#### Comment KAK-6:

I'm opposed to this lease sale because I feel that the oil companies, you know, they don't have -- they don't have enough technology to handle any blow-outs during exploration of oil in the Beaufort Sea. Would like to say that -- you know, let me put this theoretical scenario before you is, say some drilling rig is drilling for oil in the Beaufort Sea and at the very point where this exploration discovers oil there is a -- an earthquake, and, you know, they have oil blow-out. And it's just starting winter and they're drilling on the bottom of the ocean. Now, how is the oil company going to be able to handle the blow-out? You know, suppose that oil that they've just -- just discovered just now is all going out under the sea, and just the impact of this thing is that it will impact the very culture that I live in because I have -- because the very food that -- that I hunt for each spring would be hurt.

Now, the scene would be that it's summertime, and when all this oil that's coming out, now, how is the oil companies going to clean this out? You know, and this is why I'm very opposed to these lease sales. That's all I have....

### Excerpts from the Public Testimony of Nolan Solomon:

#### Comment KAK-7:

And if you have a floating structure, which I've seen in the -- over at Beaufort Sea, at Canada area, I have -- I have been to few of them just for -- just for the -- just to look at them, and I know how the -- how they put their anchors to this ship so it will never move. And it -- it's a -- they put great big anchors, probably more than six, I don't know. Probably if there's big current, they'll put more anchors. And ice is pretty strong. I don't think any anchor of anything that contains a great big cable would -- would stand any -- any ice pressure with a current anywhere, and that's what I'm afearod (sic) of. I've seen this inside the Beaufort Sea right by a demarcation, where the oil company put their ships out and drilled with these -- with the big anchors, and I don't think it would stand out there.

### Excerpts from the Public Testimony of Herman Aishana:

#### Comment KAK-8:

Okay. Knowing that you'll be using the floating drill ships, I'm pretty leery about the safety of this program. You're going out in some deep waters. But I would like to see in place before the lease sale is held an oil spill contingency plan in place and also oil spill clean-up equipment in place in each drilling -- drilling ship if that's at all possible.

#### Comment KAK-9:

But for safety matters in case of an oil spill, a massive one or a little one, I think the oil industry should have a plan in place in Arctic drilling, especially out -- quite a ways out where it's quite deep, not using gravel islands or these -- the ships that are -- the ships they use in the fairly shallow -- shallow areas. The people are reluctant to have drill ships,

floating drill ships, drilling out there and especially in the wintertime.

So my main concern, for me, is the drill -- I mean the oil spill contingency plan should be in place and also a clean-up equipment and crew in place. That's about all I ask for. I can't -- I know my subsistence is jeopardized by your proposal, which is -- would be devastating if something happens, like a major oil spill they had down in Prince William Sound. There's all kinds of animals out there which we live on, and I presume that the federal government will do their best not to harm the resources, animal resources, out there.

Excerpts from the Public Testimony of Robert Thompson:

Comment KAK-10:

Also, I've read part of the Beaufort Sea Planning Area Oil Lease Sale 124, and I don't believe a lot of this is based upon factual data. Theories about oil movement under the ice, I don't know if it's based upon any actual situations. There seems to be a lot of theory; the theory seems to accommodate the purpose the oil companies have of trying to make it sound like they can do it without any problems. I don't believe that some of the data in this has been researched, such as the -- the level at which the oil will flow through the water. For some species, the documentation says that they won't be affected because the oil won't -- the spilled oil won't travel at those depths that those particular animals have for a habitat. But I believe the oil will travel at all different depths, and until such time that there's more research on -- on the oil behavior, I don't believe that this exploration should continue.

Comment KAK-11:

Also, it doesn't cover -- you know, it's not really into this oil sale, but the -- the method that industry will use to get the oil from where it's found to the shore, and you know, that -- that wasn't covered. And also this -- this is, I believe, a federal sale, and it will have to be crossing state -- state waters, and that hasn't been addressed. The State's held that it's -- some of the previous sales that they had, that data had to be provided, and I haven't seen that. Of course, I haven't got -- had much chance to look at this.

Comment KAK-12:

The other objection that I have about this -- this hearing is the time wasn't published, and I just got off work, so I missed most of the hearing. I question the legality of a hearing as such a time when many, many people will miss it because of work. If the time had been posted, maybe people could make their plans accordingly, but it -- I don't -- it wasn't to my knowledge.

Comment KAK-13:

I -- I haven't had a chance to really study this thoroughly 'cause I just got a copy of it yesterday, but the things that I did study, it seemed to not be based upon any actual factual data -- more theory than knowledge. Also, I don't believe that there's been many studies on the effects that oil -- the effects of oil pollution in colder waters, the long-term effects, the -- the effects that they have on whales. It was mentioned that in theory, the oil -- the whales would be able to avoid oil contaminated area. I don't know how the whales will know where -- what areas are contaminated and what areas are not, but somehow, the study presumed that the whales would be able to know and wouldn't be affected.

The -- the theory about the effects of the oil on the baleen, it -- the study admitted, weren't conclusive, but there is a

theory that the oiled baleen could separate from the whale's mouth and -- and be ingested and -- and could cause fatalities in whale. This -- this, if it is a theory that it could happen, I don't know how it could be studied, but that alone should be considered as a reason not to have the sale.

Comment KAK-14:

The -- the ocean currents, I believe, are parallel to the -- to the coast and along the same -- the same routes that the whales travel. So they -- the whales would have to be in the oil-contaminated area for a -- for four or five hundred -- or the whole length of the Arctic coast. And the studies -- apparently presume that it would be just a very casual confrontation with the oil. I -- I also am not sure just how accurately the ocean currents have been studied. I believe they should be thoroughly studied and so that all people will be able to know just how they -- they will be affected.

## Responses to Comments from the Kaktovik Public Hearing

### KAK-1:

This concern is addressed in Responses MMC-16, NSB-8, and NAEC-7.

### KAK-2:

The EIS describes the subsistence and sociocultural systems at length in Sections III.C.2 and 3. Sections IV.C.9 and 10 analyze the potential effects of the base case of the proposed lease sale on these important issues. These sections are the largest and most detailed—the low and high cases, cumulative, and alternatives build on the analyses in the base case.

### KAK-3:

This concern is addressed in Responses MMC-16, NSB-10, and NAEC-7.

### KAK-4:

Caribou herds on the North Slope have increased coincidentally with oil development (including the Porcupine Caribou Herd from about 100,000 in the 1970's to a recent estimate of about 180,000). Some local changes in the distribution of caribou have occurred. See Section IV.C.7.a(1) for a discussion of general effects of disturbance on caribou.

### KAK-5:

The sea-ice regime of the Beaufort Sea is discussed in Section III.A.4 of the EIS. This discussion notes the formation of ridges and of ice riding up and piling up along the coast.

### KAK-6:

This concern is addressed in Responses NSB-10 and N-2.

### KAK-7:

This concern is addressed in Response BAR-29.

### KAK-8:

Such plans and onsite-response equipment are required of a lessee by MMS after the lease sale but prior to drilling. Where wells will be drilled, who will drill them, and which drilling platform will be used are questions that cannot be answered until after a lease sale but must be known before a contingency plan can be written. See also Response BAR-7.

### KAK-9:

This concern is addressed in Responses NAEC-8 and KAK-8.

### KAK-10:

This concern is addressed in Response NAEC-5b.

### KAK-11:

The technologies that might be used to exploit the petroleum resources of the Sale 124 area are discussed in Section II.B of the EIS. State of Alaska oil and gas lease sales are noted in Table IV-A-4-1 and described briefly in Appendix E; the locations of these sales are shown on Graphic 3. The effects of the State oil and gas lease sales are considered in the cumulative-effects section of the EIS—Section IV.I.

### KAK-12:

Arrangements for the public hearing were made through the Mayors office in May. Also, publicity for the meeting appeared in the Barrow Sun and was broadcast over the Barrow radio and TV stations.

### KAK-13:

See Responses MMC-20, NOAA-24, and N-5.

### KAK-14:

The oceanographic conditions in and adjacent to the Beaufort Sea Planning Area are discussed in Section III.A.3 of the EIS.

## NUIQSUT PUBLIC HEARING

### Excerpts from the Public Testimony of Nelson Ahvakana:

#### Comment NUI-1:

It's very hard for our people to address, time after time after time, the concerns that they have. And when a meeting like this, which calibrates the concerns of our people, they never receive or hear what -- what really happened to those -- those statements that they had made. A lot of the people here don't speak English, and they don't write either. So it's very hard for them to -- to understand whether or not their concerns are -- are considered wholeheartedly by MMS.

#### Comment NUI-2:

Another concern that -- that draft EIS may not address -- I don't know whether it did or not -- is the fishing of the coastal villages, especially this village. They fish for whitefish, and they fish for -- for Arctic cisco, and these are practically a daily consumption requirements for -- you know, for these people here.

#### Comment NUI-3:

What adverse effects is this going to have on the whaling? It's so stated on the Alaska Offshore Oil and Gas Leasing Program, and I kind of laughed about it, on the question about, What about oil spills? It stated here that MMS also is responsible for ensuring that OCS oil and gas operations here do not pollute the environment. I hope this is -- this is true, but it made me to wonder of what happened down at -- at Valdez area and the problem that -- that they incur on an oil spill there through the tanker. I know that we're not talking about tankers here, but it would have probably about the same adverse effect in this area and maybe more.

#### Comment NUI-4:

I don't believe that -- that MMS (sic) -- MMS should be security in their minds of the industry, and indication that they do have these -- these people available, that they are well trained, that these things will never happen. It's so stated here that -- that there have never been -- been an oil spill in Alaska from the -- from the drilling, the offshore. That may be true, but it only takes one to show whether or not people that is well educated, well able to put everything on paper, let's say, and the actuality of what they say when it comes to the reality of this thing. I think this could be a concern for the draft EIS.

#### Comment NUI-5:

And another concern should be the addressing of the Inupiat people. We're part of the habitats of this area. I don't believe that whoever is writing the EIS should be concerned just -- just of the animals and the species that are here in the North Slope; they should be concerned about the Inupiat people as well 'cause presently, we're surrounded here in this village, and before too long, once the total sale is completed and drilling takes place, there's going to be some restrictions that will be handed out to us again.

Like a good example is Prudhoe Bay. They say that that area is open for subsistence, and it's not. It's written on paper that it is, but the actuality, you go and take a rifle over there, the first things -- first thing that you're going to find out is -- is that the security's going to take care of you. They're not going to let you go anywhere, even though that you may say that I'm out here on subsistence hunt. They don't have no concern whatsoever about that; their concern primarily is the protection of that field, and this is exactly what's going to happen down there.

### Excerpts from the Public Testimony of Isaac Nukapigak:

(Mr. Nukapigak's testimony was presented in Inupiaq and translated into English by the translator.)

#### Comment NUI-6:

Well, the only concern I really have right now on the Beaufort Sea Lease Sale 124 is the -- I know that for the fact is the federal government nor the Minerals Management Service don't have the technology of an oil spill clean-up. If an oil spill happened to occur out in the Beaufort Sea during the winter months, I know it's going to -- I know it's going to be hard cleaning up -- cleaning that oil.

Oil companies, the U.S. federal come and don't have the technologies; I know for a fact. They don't have the technology still. They may have the manpower and the equipment to clean up the oil spill, but the technology, is still -- hasn't there (sic).

#### Comment NUI-7:

That Exxon Valdez had killed a lot of migrating birds; beavers were killed. They were in thousands. If an oil spill happened to occur in the Beaufort Sea, we're looking at our subsistence resource. We have lot of migrating birds along the Peril (ph) Islands. If an oil spill happened to occur, that's what going to happen too.

#### Comment NUI-8:

Actually also the -- also the commander of Nuiqsut Oil Spill Response Team. I definitely have went through training on the oil spill, and from the -- the experience what I learned from this training, technology, it still needs to be there (indiscernible). Oil companies say that you may have -- they may say that they have the capability to cleaning a spill, but -- but if the oil spill occurred in the winter, in the winter months, underneath the ice, we're talking, 'cause of the different -- 'cause I know that the current moves any direction out in the Beaufort Sea, and the ice is so thick and rough, it's going to be hard trying to clean up the spill. The oil companies say they have the equipment and the manpower to do it. Federal government, I know that for a fact, they still needs to do more research on the technology of oil spill clean-up.

### Excerpts from the Public Testimony of Thomas Napageak:

(Mayor Napageak's testimony was presented in Inupiaq and in English.)

#### Comment NUI-9:

Further study in this area is necessary because reduction in the bowhead stock may result in reduction or elimination of bowhead quotas for subsistence hunters in the Inupiat community. Throughout the EIS, the draft concludes that effect on bowhead whales from noise disturbance will be very low or low; however, the effect on subsistence harvest patterns are expected to be very high in Nuiqsut area as a result of effect on bowhead whale harvest due to construction activities at Point Thompson, while moderate effects are expected at Barrow, Atkasuk, Wainwright, and Kaktovik.

On one hand, the draft states that the effect on bowhead whales from noise disturbance will be low; on the other hand, the same draft states that the effect on the subsistence harvest from the reaction of bowhead whales to noise

disturbance will be high. These findings are eternally inconsistent.

In Nuiqsut, the effect of subsistence harvest patterns will be very high because not only will the bowhead whale always be reduced or eliminated by construction activities.

Comment NUI-10:

The caribou hunt will be reduced as well by construction activities and the pipelines.

Comment NUI-11:

There's a -- there is a high likelihood that the reduction or elimination of whaling could have severe ramifications of the socio-cultural and family network system of the Inupiat community. Therefore, it is absolutely imperative that the Inupiat community and the oil industry work together to mitigate and -- mitigate the adverse impact on subsistence hunting. A way of life that has existed for centuries could not be eliminated in 30 years -- 30 years over which the leases on the Beaufort Sea will run.

Comment NUI-12:

In conclusion, Oil and Gas Lease Sale 124 should be postponed for several years while further research is conducted and, in particular, the bowhead whale. The sale should also be postponed until more scientific knowledge and more advanced equipment is available concerning the Arctic Ocean and its related temperatures and weather conditions. Delaying the sale may be the best possible solution to save but a fragile ecosystem of the Arctic Ocean and the Native subsistence hunting.

Comment NUI-13:

Additionally, if the sale was delayed long enough, fewer leases could be operating on the ecosystem at the same time. If the sale is finalized, individual Inupiat communities should be given more control in the process -- in the process from the beginning until the end. Mitigating measures, such as limiting drilling offshore to 80 feet, allowing -- only allowing bottom-founded drilling, and reducing industrial activities during the whale hunt seasons, should be agreed upon. The mitigating measures should be clearly detailed, and oil companies should be required to abide by the plan and sanctioned if they don't comply.

Comment NUI-14:

Recent emergency plans for oil spill containment and clean-up have not proved to be effective. In general, experience shows that response to oil spills are slow and inadequate in remote areas with severe conditions. Even well designed contingency plans are likely to be difficult to implement.

Excerpts from the Public Testimony of Joe Kasak:

Comment NUI-15:

Yes, I'd just like to point out what -- had a question. What was causing all these caribous to die off last summer and this summer -- and, I mean, this winter too? And how much relationship you got with the Fish and Game personnel? And what developments they give you from all the findings they have been finding from these dead caribou? Like last summer, there was a herd of caribous coming out from the east and they were crossing the Nerluk (ph) Channel, and some people were killing some caribous. And they find that the -- the skinny ones they found were discolored on their meat. And what would cause that discoloration of the meat they found?

And what I guess would be caused by that laying around over there by Prudhoe Bay where all that burning that gas with their chemical mixed with it may have caused that or something. And some of these -- when the people go out to Prudhoe Bay for a clean-up job, you know, volunteer type, you know, with small pay, they always have something to say about these birds being dead out there.

Excerpts from the Public Testimony of Bernice Pasula:

Comment NUI-16:

And right now, what we are talking about is the ocean. Nobody owns the ocean except what you guys say you guys do, the federal government, just like what they're doing in Prudhoe Bay. So therefore then, you guys are battling us, the whole community, and I'm just concerned about what we have to fight with. We have no -- no -- we have no deeds to that ocean but to tell you that it's being used year after year for whaling for so long. It goes way back to 1800s, and it's still being used. And as far as I'm concerned, the impact of sale to open up -- open it up for drilling would hurt us.

Comment NUI-17:

You guys have no promises in writing that you'll guarantee us jobs, security, because as far as I know, you guys look for qualification in paper. Are you a qualified operator? Do you have proof? Have you gone to school, or can you speak English? And as far as I know, in Prudhoe you have to be so much qualified to be working over there. And the people around here, how can you get experience without going on the job and training? How do we know what kind of opportunities we will have? What -- what do we gain from this? Just like you say you have everything in writing, what do we gain from it in writing? Can we have it in writing? 'Cause if we have it in writing and you go back on your word, then we could go to court and tell you you've said it.

Comment NUI-18:

What kind of studies is there in the Arctic Slope that has done drilling in the Arctic Slope? What -- what's the success rate? Has there been any drilling in the Arctic Slope in the ocean? How do we know it'll work?

Excerpts from the Public Testimony of Majorie Ahnupknak:

(Ms. Ahnupknak's testimony was presented in Inupiaq and translated into English by the translator.)

Comment NUI-19:

True, there are times you are taking every precaution, but there are also times when the inevitable happens -- happens. And so should the blow-out occur, what -- what technology or what equipment can go under the ice and clean up this spill?

## Responses to Comments from the Nuiqsut Public Hearing

### NUI-1:

The MMS considers the comments of the residents of the NSB communities important to our understanding of concerns they have regarding the OCS leasing program; by having an interpreter available at the hearings, we hope to reinforce this conviction. Comments and concerns that are expressed at the public hearings are reviewed by the authors who prepare the analyses and respond to comments. These comments are evaluated to determine if changes need to be made to the alternatives or mitigating measures, descriptions of the affected environment, or environmental consequences and what, if any, these revisions should be.

### NUI-2:

The EIS describes Nuiqsut fishing activities in Section III.C.3.b(4)(g) and analyzes the effects of the proposed lease sale on fishing in Sections IV.B.10., IV.C.10.b(4) and c(3), IV.D.10, IV.E.10; IV.F.10, IV.G.10, IV.H.10, and IV.I.10. See also Response ANC-10.

### NUI-3:

The MMS activities on the OCS are aimed at assuring operational safety and preventing pollution, with major emphasis on preventing oil spills. An MMS inspector is at the site during all exploratory-drilling operations. For development and production, MMS inspects all OCS oil and gas operations at least once each year, and more often if necessary, for compliance with stringent safety and pollution-prevention regulations.

This concern also is addressed in Responses NSB-8 and NSB-23.

### NUI-4:

This concern is addressed in Responses NSB-23, N-1, and N-4.

### NUI-5:

See Responses ANC-10 and N-17.

### NUI-6:

This concern is addressed in Responses MMC-16, NSB-8, NSB-10, N-2, NAEC-7, and MOHR-2.

### NUI-7:

The MMS recognizes that if an oil spill were to occur in the Beaufort Sea such as occurred in Prince William Sound, large quantities of subsistence resources would be harmed and that the oil would be difficult to clean up. This has been analyzed in Section IV of the EIS.

### NUI-8:

This concern is addressed in Responses NUI-6 and N-4.

### NUI-9:

See Response N-16.

### NUI-10:

The caribou population (Central Arctic Herd) has greatly increased (from about 3,000 in the early 1970's to about 18,000 at present) since oil development in the Prudhoe Bay

area has begun. Restrictions on subsistence hunting have occurred in this area and are expected to occur near development facilities assumed under the Proposal (see Sec. IV.C.10.b[3]), last paragraph). See Section IV.C.7 for effects of the Proposal on caribou.

### NUI-11:

See Response N-17.

### NUI-12:

While more information may be useful, MMS believes it has an adequate database with which to analyze the potential effects on the environment of the proposed sale. The MMS prepared EIS's for four previous oil and gas lease sales in the Beaufort Sea Planning Area.

### NUI-13:

See Response N-18.

### NUI-14:

This concern is addressed in Responses MMC-16 and NSB-8.

### NUI-15:

The die off of caribou is often caused by natural diseases; however, any die off such as that described should be reported as soon as possible to the nearest State ADF&G biologist (in Fairbanks, telephone 452-1531, or in Barrow the biologist named John Trent). Hopefully, the State biologist will investigate to determine the cause of death. The MMS does not have any direct connections with State fish and game authorities. Anyone observing such die offs of caribou or other animals should record their observations and also the names of the persons who saw the die off. This information should be given to the State fish and game biologist. It is very important to convey as much information as possible to ADF&G so that they will investigate and determine if the die off was caused by natural disease or could be related to pollution.

### NUI-16:

Through the OCSLA, as amended, Congress authorized jurisdiction of the Federal Government over the submerged lands of the OCS. The Congressional declaration of policy, 43 U.S.C 1332, states:

It is hereby declared to be the policy of the United States that--

(1) the subsoil and seabed of the outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this subchapter; and

(3) the outer Continental Shelf is a vital national resource reserve held by the Federal Government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.

In addition to petroleum exploitation, other activities that involve the submerged lands of the OCS and the overlying waters are subject to applicable laws, regulations, and international treaties of the United States.

For Alaskan Natives who reside in Alaska and dwell along the coast of the North Pacific Ocean or the Arctic Ocean, Federal law (Marine Mammal Protection Act of 1972) recognizes the taking of marine mammals for purposes of subsistence or creating and selling authentic Native articles of handicrafts and clothing.

In deciding if a lease sale should be held, the Secretary of the Interior must consider the economic, social, and environmental values of the renewable and nonrenewable resources and balance the benefits of oil and gas exploration and possible development and production with potential risks to the environment.

**NUI-17:**

The MMS recognizes the frustration North Slope residents must feel when they are unable to attain employment in the oil industry. The issue of local hire is a problem throughout Alaska, not just in Prudhoe Bay. Companies may decide they will hire a certain percentage of local residents, but this is not a requirement MMS can attach to the lease.

**NUI-18:**

As noted in Section I.B.2 of the EIS, 22 wells have been drilled on Federal leases in the Beaufort Sea; MMS has determined that 8 of these wells are producible (this determination indicates that the well is capable of producing petroleum but does not indicate a commercial discovery). Also, as of December 1, 1989, 62 wells have been drilled on State of Alaska coastal lands and in State waters.

**NUI-19:**

This concern is addressed in Responses MMC-16, NSB-10, and NAEC-7.

## ANCHORAGE PUBLIC HEARING

### Excerpts from the Public Testimony of Richard Ozar:

#### Comment ANC-1:

Tract Deferral Alternatives IV and V are not justified by the MMS analysis in the DEIS, which conclude there -- that there is no significant change in potential adverse impact by deferrals. Although resource estimates have been made in the DEIS, deferral areas could contain significantly greater resources. Only the drilling of exploratory wells will determine if oil is indeed present.

#### Comment ANC-2:

As to a seasonal drilling limitation during times when bowhead whales may be present, AOGA submits that limitations on exploratory drilling such as required by Stipulation No. 8 are not necessary, particularly in light of Stipulation 5 and 6, which require whale monitoring and consultation with Native whalers. Moreover, industry has established a precedent of establishing formal, cooperative agreements with whalers to avoid conflict with subsistence whaling.

### Excerpts from the Public Testimony of Don Hartman:

#### Comment ANC-3:

We believe that Alternatives IV and V, which would delete large areas from the vicinities of Barrow and Barter Island, are not supported by the discussion in the DEIS. The conclusion of the MMS analysis is that there is little effect on potential impacts of the sale by these deletions, and there is the possibility that these areas may contain significant oil reserves.

### Excerpts from the Public Testimony of Sharon Sturges:

#### Comment ANC-4:

Trustees' opposition to Lease Sale 124 is based, in part, on the lack of scientific data supporting the DEIS impact conclusions. This failure is especially glaring in the DEIS analyses of the potential environmental impacts of oil exploration and development activities on marine mammals. Regrettably, the DEIS treatment of impacts to marine mammals was highly selective in that it failed to evaluate or, in many cases, even mention the present scientific data examining the effects of exploratory and development activities on marine mammals.

#### Comment ANC-5:

Point No. 1: The DEIS failed to consider the extremely efficient sound propagation characteristics of the Beaufort Sea in its consideration of potential effects of marine seismic and industrial noise on marine mammals. This failure is especially disturbing in light of the huge surface areas that will be surveyed. Moreover, the best available scientific evidence demonstrates that bowhead whales, a listed endangered species, exhibit strong avoidance behavior when encountering operating seismic vessels in Arctic waters, even at substantial distances. Nonetheless, the DEIS optimistically concludes that the effect of acoustical disturbances on bowhead whales would be very low.

#### Comment ANC-6:

Point No. 2: The DEIS failed to consider the full impact of

helicopter traffic on seal and walrus pup survivability. Flight responses of hauled-out adult seals and walrus will certainly decrease pup survive- -- excuse me -- survivability due to pup trampling during adult flight responses from helicopter traffic. Seal and walrus rookeries are areas of high animal concentration, and thus, large numbers of pup deaths can be expected.

#### Comment ANC-7:

Point No. 3: Many of the noises produced by exploratory and production activities occur at low sound frequencies, under 100 hertz. This is also the range of whale vocalization. The DEIS fails to analyze, or even mention, the potential for hearing and navigational impairment to whales from industrial noise.

#### Comment ANC-8:

Point No. 4: The DEIS fails to adequately address the impacts of increased vessel traffic on whale navigation. Specifically, there is no treatment of the potential impact on the ability of whales to assess ice conditions acoustically. There is evidence which indicates that bowhead whales determine areas of thin or thick ice by perceiving the relative level of their own call as it is reflected off the ice. Drill ships and attendant vessels may distort the sounds produced by whales, thus, impairing their ability to detect ice thin enough to be pierced for a breathing hole; without this ability, whales may drown.

#### Comment ANC-9:

Point No. 5: The DEIS fails to consider the effects of oil spills on the reproductive capacity and health of marine mammals. This is an extremely important consideration in light of the DEIS's conclusions that the effects of an oil spill on marine mammals would be merely a moderate effect because any fatal- -- excuse me -- fatalities would be replaced in one generation.

### Excerpts from the Public Testimony of Jane Degnan:

#### Comment ANC-10:

I'm not saying we're against development, but I think what the voices want to reiterate is that we need a safe and sane approach to what we do on land and sea. I listened to the testimony of the two gentlemen ahead of me saying it wasn't necessary to consult with the whale hunters or necessary to protect subsistence. I disagree with that because we all know that the subsistence issue is a hot, politically debated issue at this point.

## Responses to Comments from the Anchorage Public Hearing

### ANC-1:

As noted in Section II.A.2, the resource estimates for the Sale 124 area were revised after publication of the DEIS. The amount of oil estimated to be present in the sale area for the base case for Alternative I is 900 MMbbl; for each of the deferral alternatives, Alternatives IV and V, the amount also is estimated to be 900 MMbbl.

Estimates of the petroleum resources for each of the deferral alternatives are obtained after the deferred areas have been determined; and, until exploration and delineation wells are drilled, these resource estimates remain very speculative. Even though they might contain only negligible or small amounts of petroleum resources, exploration drilling could occur in the deferred areas if they were offered for lease; and if a discovery were made, development and production might follow. The analyses of the potential environmental effects of the lease sale take into consideration the possibility of some level of petroleum-industry activity in the deferred areas. Because the deferred areas may be important for a variety of biological and sociocultural reasons, the elimination of possible exploration and development and production activities from these areas by deleting them from the lease sale could be significant.

### ANC-2:

See Responses BP-2, AOGA-11, and MMC-11.

### ANC-3:

See Response ANC-1.

### ANC-4:

The EIS analysis on the effects of oil and gas exploration and development on marine mammals is based on relevant scientific information and a synthesis of this information—see Sections IV.C.5.a and IV.B.5(1) and 2(2), General Effects of Oil and General Effects of Noise and Disturbance, respectively.

### ANC-5:

See Responses TFA-4, TFA-5, and N-14.

### ANC-6:

See Response TFA-13.

### ANC-7:

See Responses N-9, N-11, and N-14.

### ANC-8:

See Response N-11.

### ANC-9:

See Response TFA-16.

### ANC-10:

The MMS agrees that the effect of the proposed lease sale on subsistence harvests is an important issue. Effects on subsistence harvests are estimated to be HIGH. Stipulations Nos. 3, 5, 6, and 8 have been proposed to mitigate some of these effects.

# **SECTION VI**

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## **CONSULTATION AND COORDINATION**

## VI. CONSULTATION AND COORDINATION

### A. Development of the Proposal

The proposed Beaufort Sea Planning Area oil and gas lease Sale 124 is one of 38 proposed Outer Continental Shelf (OCS) sales included in the current 5-Year OCS Oil and Gas Leasing Schedule. Official coordination with other government agencies, industry, and the public regarding this proposed action began on September 14, 1988, with a Call for Information and Nominations and Notice of Intent to Prepare an Environmental Impact Statement (EIS), which requested expressions of industry interest in blocks within the Call area and requested comments on environmental issues related to possible oil and gas leasing in the area. Responses were received from nine companies, the State of Alaska, the North Slope Borough (NSB), U.S. Fish and Wildlife Service (FWS), National Park Service, U.S. Navy, and the National Oceanic and Atmospheric Administration (NOAA).

Following evaluation of the area nominations and environmental information received in the process described above, together with other relevant information, the Minerals Management Service submitted a recommendation for area selection to the Secretary of the Interior. On December 23, 1988, the Department of the Interior announced the area selected for further environmental study. (See Sec. I.A for more details.)

### B. Development of the EIS

During preparation of this and past EIS's for the Beaufort Sea Planning Area, Federal, State, and local agencies; industry; and the public were consulted to obtain descriptive information, to identify significant effects and issues, and to identify effective mitigation measures and reasonable alternatives to the proposed action. The comments received during the scoping process for Sale 124 also noted that issues raised and mitigating measures and alternatives suggested for past Beaufort Sea Planning Area lease sales were relevant to Sale 124. All of the information received has been considered in preparing the Sale 124 EIS. In addition, a scoping meeting was held in Barrow, Alaska, with local agencies and the public to identify more clearly and specifically issues and alternatives to be studied in the EIS. Scoping information can be found in Section I.D. Departmental agencies with interest and expertise in the OCS were consulted during the development of the potential mitigating measures for this proposed action (see Sec. II.G.1). Public hearings on the Sale 124 draft EIS (DEIS) were held in the NSB communities of Barrow, Kaktovik, and Nuiqsut and in Anchorage during April 17 to 20, 1990.

### C. List of Contacts for Review of the EIS

Federal, State, and local government agencies, academic institutions, industry, special-interest groups; other organizations; and private citizens were consulted prior to and during the preparation of this EIS. These agencies, institutions, groups, and individuals are listed below and were sent copies of the DEIS for review and comment.

#### Federal

##### Executive Branch - Departments

Department of Commerce  
National Oceanic and Atmospheric  
Administration  
Department of Defense  
Deputy Assistant Secretary for Environment  
and Safety  
U.S. Army  
Corps of Engineers  
Waterways Experiment Station  
Cold Regions Research and  
Engineering Laboratory  
Alaska District  
Department of Energy  
Technical Information Center

Department of Health and Human Services  
Centers for Disease Control  
Department of the Interior  
Bureau of Indian Affairs  
Bureau of Land Management  
Bureau of Mines  
Fish & Wildlife Service  
Geological Survey  
National Park Service  
Office of Environmental Assessment  
Department of State  
Office of Environment and Natural Resources  
Department of Transportation  
Commandant, U.S. Coast Guard  
Office of Pipeline Safety

Legislative Branch

U.S. House of Representatives  
Committee on Interior & Insular Affairs  
Committee on Merchant Marine & Fisheries  
Subcommittees on Panama Canal &  
OCS

U.S. Senate  
Committee on Energy and Natural Resources  
Congressional Budget Office  
Library of Congress  
Congressional Research Services

Administrative Agencies and Other Agencies

Environmental Protection Agency  
Marine Mammal Commission  
National Science Foundation  
Division of Polar Programs  
Nuclear Regulatory Commission  
Division of Site, Safety, and Environmental  
Analysis

Other Organizations

Smithsonian Institution

State of Alaska

Alaska State Legislature  
Senate Resources Committee  
Alaska Oil & Gas Conservation Commission  
Department of Community & Regional Affairs  
Department of Commerce & Economic Development  
Department of Environmental Conservation  
Department of Fish & Game  
Department of Labor  
Department of Natural Resources  
Department of Health and Social Services  
Office of the Governor  
Division of Governmental Coordination  
University of Alaska  
Arctic Environmental Information and Data Center  
Elmer E. Rasmuson Library  
Fossil Energy Research Council  
Geophysical Institute  
Institute of Social and Economic Research  
Institute of Arctic Biology  
Institute of Marine Science  
Marine Advisory Program  
Petroleum Development Lab  
Water Research Center  
Department of Civil Engineering

Local Governments, Native Organizations, and Libraries

Alakanuk Public Library  
Alaska Eskimo Whaling Commission  
Aleut Corp.  
Arctic Slope Regional Corp.  
Bristol Bay Coastal Resource Service Area  
City of Barrow  
City of Kaktovik  
Kaveolook School Library  
City of Kotzebue  
George Francis Memorial Library  
City of Nuiqsut  
City of Point Hope  
Cenaliurrit Coastal Management District  
Davis Menadelook Memorial Library, Diomede  
Eskimo Walrus Commission  
Eyak Corporation  
Inalik Native Corporation, Little Diomede Island  
Kegoyah Kozga Public Library, Nome  
Kenai Community Library  
Kingikme Public Library, Wales  
Koyuk City Library  
Kuukpik Corporation, Nuiqsut  
Maniilaq Association, Kotzebue

Matanuska-Susitna Borough  
Municipality of Anchorage  
Z.J. Loussac Public Library  
NANA Regional Corporation, Inc.  
Native Village of Barrow (Inupiat Traditional  
Government)  
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North Slope Borough  
Northwest Arctic Borough  
Savoonga Public Library  
Shishmaref Native Corporation  
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Special-Interest Groups

Friends of The Earth  
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National Audubon Society  
Natural Resources Defense Council  
Northern Alaska Environmental Center  
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Trustees for Alaska

Petroleum Industry

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Alaska Oil and Gas Association  
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## APPENDICES

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- A Resource Estimates**
- B Exploration and Development Report**
- C Synopsis of the Exxon Valdez Spill**
- D Alternative-Energy Sources**
- E Major Projects Considered in Cumulative-Effects Assessment**
- F MMS Alaska OCS Region Studies Program**
- G Oil-Spill-Risk Analysis**
- H Exploration, Development and Production, and Transportation Estimates and Assumptions**
- I Archaeological Analysis Prepared by MMS**
- J Supporting Tables for Section III.C.1, Economy of the North Slope Borough, and Section IV.C.8, Effects on the Economy of the North Slope Borough**
- K Endangered Species Act Section 7 Consultation and Documentation**
- L Fate and Effects of Exploratory Phase Oil and Gas Drilling Discharges in the Beaufort Sea Planning Area, Lease Sale 124**
- M Aspects of Spilled Oil**

Table IV-B-1 and Appendix L present chemical concentrations in discharged drilling muds in the Beaufort Sea. The EPA generally requires a chemical analysis of drilling mud for each exploration well as a permit condition. Concentrations of pollutant concentrations in drilling muds are limited by toxicity criteria and direct limitations of pollutant concentrations noted in NPDES permits. Formation waters are not being discharged from the single producing field in the Beaufort Sea. Formation waters are highly variable in pollutant content, and maximum pollutant concentrations in discharged formation waters are limited by EPA as described in Section IV.B.1. These limitations allow maximum allowable discharges of some constituents to be estimated in the EIS. A much more accurate estimate of discharges—if discharges are even proposed—can be made at the time of a developmental EIS for a field, based on measured concentrations in muds, cuttings, and formation waters for that field.

#### MOHR-11:

The MMS assumes that all laws and regulations that apply to OCS oil and gas operations are properly administered by those Government agencies that have enforcement responsibilities. The purpose of the EIS is to analyze the potential environmental effects of petroleum development on the OCS and not provide a forum for criticism of the action of other agencies; there are other means of informing the public about the actions of those agencies that might be negligent in performing their statutory or regulatory responsibilities.

#### MOHR-12:

This concern is addressed in Appendix L. The EPA NPDES permits for Alaskan waters allow discharge of only low-toxicity drilling muds and prohibit the discharge of muds contaminated with diesel. The EPA studied the diesel-spill issue and made the determination not to allow discharge of muds that have had a diesel pill added and then removed, because studies had demonstrated significant diesel contamination of the residual mud.

#### MOHR-13:

The EPA NPDES permits now prohibit the use of metal-contaminated barite. Barium ions are detoxified in seawater by the immediate precipitation of highly insoluble barium sulfate. If barium halides were exceedingly poisonous, as claimed by the commenter, they would not be used internally as a cardiac stimulant or bone-scanning agent in humans or for treatment of constipation in horses (Windholz et al., 1976).

#### MOHR-14:

Low toxicity of drilling muds is assured by limiting the ingredients that are allowed in discharged drilling muds. The permitted ingredients in discharged drilling muds are listed in Table 6 of Appendix L. Acrolein is not listed. Any substance that is an intentional component of a mud formulation and is not on the list would require authorization of the Regional Director, EPA.

Potential discharges of formation waters containing hydrocarbons were evaluated in Sections IV.C.1 and IV.D.1. See also Responses MOHR-9 and MOHR-10.

#### MOHR-15:

Produced waters are being reinjected primarily to enhance production rather than as a pollution-control measure in Alaskan oil fields. Once capital expenditure is made in reinjection equipment, a company is unlikely to discard that investment and not reinject produced waters. In addition,

although the analysis of water quality suggests that discharge of produced waters may not occur in the proposed sale area, such discharge of produced waters is conservatively assumed to occur for a MODERATE LOCAL and VERY LOW REGIONAL effect in the base case.

#### MOHR-16:

We have thus far been unable to determine if foraminiferans have been successfully used as indicators of oil pollution or other activities associated with oil exploration, production, or development. The effects of oil on bacterial assemblages in the Beaufort Sea have been examined by Atlas, and this work and the general issue are covered in Section IV.B.1 of the Sale 97 FEIS (USDOI, MMS, 1987).

#### MOHR-17:

The potential for disruption of chemically-mediated behaviors has been discussed in Section IV.C.2.a.2. Also, some findings of Dr. Dan Morse of the University of California at Santa Barbara have been added to the discussion of effects of drilling discharges (Sec. IV.C.2.c). You are correct in your conclusion that at the present we can make only crude guesses about the possible extent and importance of these types of effects.

#### MOHR-18:

Hydrofluoric and hydrochloric acids are used only for specific reservoir acidification requirements, and large quantities are not stored on a production platform. Furthermore, it may not be economical to produce petroleum from a reservoir requiring large quantities of either acid.

#### MOHR-19:

The potential environmental effects of Sale 124 are analyzed mainly on the basis of events that are likely to happen given the major scoping issues, Section I.D.1, and the scenarios, Sections II.B through F. Also, an event that has a low probability of happening but with potentially high effect levels is analyzed in Section IV.N.

Regulations for implementing the procedural provisions of the NEPA note the following (40 CFR 1502.1):

The primary purpose of an environmental impact statement is to serve as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts. . . .

Furthermore, Sale 124 is a broad action that involves leasing a geographical area for possible petroleum exploitation; it is not a site-specific action, with designated technologies and operations, where the effects of specific actions, or series of actions, could be appropriately analyzed.

Thus, MMS considers the analyses in the Sale 124 EIS fulfill the purpose of the EIS and are appropriate for the type of action proposed.

The MMS recognizes a single accident might cause a series of other mishaps and is aware of the environmental factors and constraining activities in and adjacent to the sale area.

Harry E Wilson  
2120 N Callow Ave  
Bremerton, WA 98312-2908  
May 4, 1990

Richard V Roberts  
EIS Coordinator  
Minerals Management Service  
949 E 36th Ave  
Room 110  
Anchorage, AK 99503-4302

Dear Sir

Thank you for the opportunity to comment on the Draft Environmental Impact Statement for Beaufort Sea Planning Area Oil and Gas Lease Sale 124 (OCS EIS/EA MMS 90-0006).

I would like Alternative II - No Sale to be the preferred alternative but realize that it probably will not happen. In that case Alternative III - Delay the Sale should be the preferred alternative. The sale should be delayed until the United States has an energy policy.

I believe that the transportation times listed in table M-6 for storage locations, Seattle, Concord, Santa Barbara, Long Beach and Stockton are low and should be increased.

WIL  
1

The section on oil spills needs to be expanded.

WIL  
2

Thank you for your time and consideration.

Sincerely

*Harry E Wilson*

Harry E Wilson  
2120 N Callow Ave  
Bremerton, WA 98312-2908

WIL-1:

The listed transportation times are those provided to MMS in the cited oil-spill-contingency plans. The MMS accepted but did not independently verify these industry estimates, and such verification is not required of industry by MMS contingency-plan guidelines (see Allen, Hale, and Prentki, 1984).

WIL-2:

This concern is addressed in Responses MMC-16, MMC-20, MMC-22, and NAEC-5b.

## **APPENDIX A**

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### **RESOURCE ESTIMATES**

## Estimates of Quantities of Undiscovered Resources

### I. Resource Assessment Methodology

Estimates of potential quantities of undiscovered oil and gas are vital to essential long-range national planning. The Federal Government's offshore oil and gas leasing program depends in part on projections of the potential amounts of undiscovered hydrocarbon resources on the Outer Continental Shelf (OCS) and estimates of those resources which may be technologically and economically recoverable. The pace of discovery and development of these resources affects national security, the economic health of a large sector of the economy, the balance of trade, and many other important national issues.

The Minerals Management Service (MMS) develops estimates of the undiscovered oil and gas resource base and economically recoverable undiscovered hydrocarbons in support of the OCS leasing program. These estimates are used in a number of public and internal documents related to leasing, such as sale-specific Environmental Impact Statements (EIS), Secretarial Issue Documents (SID), the Biennial Report to Congress (Section 606, OCS Lands Act), formulation of the 5-Year Leasing Program, and technical publications.

The EIS's for specific lease sales and events such as the development of a 5-Year Leasing Program use the estimates as a basis for analyzing potential environmental impacts of a proposed activity, e.g., oil spill risk analysis, sale alternatives and deferral options, or any other requirement for which the potential resources in specific areas may serve as the basis for evaluating potential actions. In the SID, estimates of the amounts and locations of potential resources are used to assist the Secretary of the Interior in balancing the economic benefits of development against the environmental consequences resulting from the leasing of offshore areas for petroleum exploration and development. Estimates provided in the Biennial Report to Congress may be used by the legislative branch and others for national strategic and economic planning purposes.

Estimating the undiscovered resource base and economically recoverable amounts of oil and gas remaining to be discovered on the OCS is a difficult task because of the uncertainties inherent in the process. The actual existence of hydrocarbon accumulations is not known with certainty prior to exploratory drilling. The only information concerning the existence of a potential producing field is derived from inferences, extrapolations, and subjective judgments. Geophysical data provide clues as to the existence and location of possible traps (prospects) and their general dimensions, but geologic data on the quality of any potential reservoir rocks or source materials are usually absent. Generally, until drilling operations commence, no data will be available on the nature and distribution of included hydrocarbons, or indeed whether hydrocarbons are present at all. Obviously, an exact prediction of resource quantities under such circumstances is impossible because the uncertainties in the input data set translate directly to uncertainties in the estimates.

Two main types of undiscovered resource estimates are commonly used, conditional and risked, each responding to different needs. Conditional,

undiscovered resource estimates represent the amount of resources anticipated if a certain condition exists, the condition being that recoverable quantities of oil and/or gas are present in the area of study. In other words, if oil and/or gas are found to exist in an area, the conditional estimates represent the amount of hydrocarbons determined to be ultimately recoverable. These estimates are used, for instance, to assess the full range of potential environmental impacts in an area if leasing, exploration, development, and production were to occur; the condition that hydrocarbons exist must be assumed, otherwise impacts would not be a concern.

However, if the economic value of a resource is being considered, conditional estimates are not the appropriate measure. In these cases, such as the economic analyses prepared for sale-specific SID's, the resource estimates must incorporate the probability (or risk, which is often extremely high in frontier areas) that recoverable hydrocarbons may not be present in the entire area. The conditional estimates are modified by consideration of this probability that recoverable resources do not exist (that is, factoring in the risk) and are then said to be risked resource estimates.

Considering the uncertainty of geologic and engineering variables associated with hydrocarbon traps, resource estimates are usually presented as a range or distribution of values; reporting just one value lends a false sense of precision to the estimate. If a single estimate is required, the mean value of the distribution of possible values is the single best indicator of central tendency, since it reflects both the probability and magnitude of the estimates. The mean, also known as the expected value, is the arithmetic average of all values in the distribution. It is not the "most likely" estimate. The most likely estimate is a probability-weighted average called the mode. Another indicator is the median, which is the value that divides a probability distribution into two equal parts; it corresponds to the 50th percentile on a cumulative frequency distribution. The figure below is a diagram depicting these three measures on a sample probability density curve, which displays the amount of resources versus the relative probability of occurrence. The 95 percent estimate shown on the graph indicates a low estimate having a 19-in-20 chance that the actual amount will be greater. The 5 percent value is a high estimate with a 1-in-20 likelihood that the actual amount will be greater.

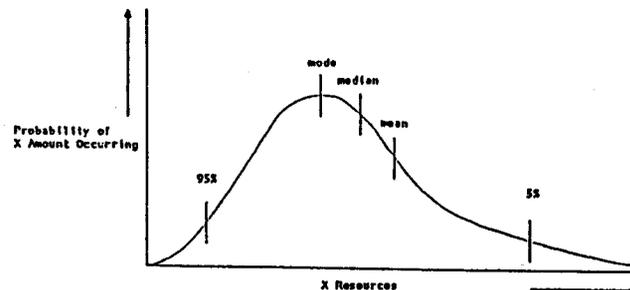


Table G-8

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Environmental Resource Within 10 Days of a Summer Spill or Meltout of an Overwintering Spill. Environmental Resources Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Hypothetical Spill Site	
Environmental Resource	L1 L2 L3 L4 L5 L6 L7 L8 L9 L10 L11 L12 L13 L14 L15 L16 L17 L26 L27 L28 L29 L30 L31 L32 L33
Land	n n n 7 25 10 n n 38 29 n 18 21 35 2 n 22 4 3 n 10 21 60 3 n
Sub. Res. Area A	n n n n 1 n n n n n n n n n n n n 20 n n n n n n n
Sub. Res. Area B	n n 1 33 55 22 1 n 12 8 n 2 n 1 2 2 2 25 29 4 35 21 6 2 n
Sub. Res. Area C	n n n n n n n n 2 18 n 20 25 48 13 n 35 n n n n n 3 21 n
Ehead Summer Feed. Area	n 14
Ehead Fall Feed. Area A	n n n 22 37 11 n n 6 6 n 1 n n 1 n n n 1 n 23 13 3 1 n
Ehead Fall Feed. Area B	n n n n n n n n n n n n n n 41 5 n 33 n n n n n n n
Ehead Mig. Area A	n n n n n 10 2 3 18 4 n 2 n n 2 n n n n n n 7 11 2 n
Ehead Mig. Area B	n n n n n n n n n 21 1 21 14 10 2 n 6 n n n n n 6 n
Fall Bowhead Area	n n n n n n n n n n n n n n n 9 21 1 n n n n n 2 n
Gray Whale Area	n n n 4 8 4 n n n n n n n n n n n 25 8 n 5 2 n n n
Seabird Offshore Area	n n 21 28 35 22 7 n 22 6 n 2 n 8 10 12 8 23 28 21 31 20 13 2 n
Lagoon Area 1	n n n n n n n n n n n n n n n n 5 n n n n n n n
Lagoon Area 2	n n n 11 27 13 n n 1 3 n n n n n n n n 15 n 15 8 1 n n
Lagoon Area 3	n n n n n n n n 36 19 n 7 6 1 n n 1 n n n n 13 56 n n
Lagoon Area 4	n n n n n n n n n 3 n 10 12 8 n n 6 n n n n n 1 n
Lagoon Area 5	n n n n n n n n n n n n 2 30 1 n 17 n n n n n 1 n
Lagoon Area 6	n n n n n n n n n n n n n 2 1 n 6 n n n n n n n
Ice/Sea Seg. 1	1 n n n n n n n n n n n n n n n 5 n n n n n n n
Ice/Sea Seg. 2	n n n 2 5 3 n n n n n n n n n n n 9 6 n 4 2 n n n
Ice/Sea Seg. 3	n n 6 3 2 n n n n n n n n n 2 4 6 4 n 2 10 2 n n n
Ice/Sea Seg. 4	n n n 4 5 7 4 n 11 3 n 2 n n 4 4 3 n n n 7 13 10 6 2 n
Ice/Sea Seg. 5	n n n 1 1 16 8 n 28 6 n 3 n n 3 n n n n n 14 18 15 3 n
Ice/Sea Seg. 6	n n n n n 18 2 3 32 3 n 3 n n 3 n n n n n n 13 17 3 n
Ice/Sea Seg. 7	n n n n n n n 4 1 2 4 2 n n n n n n n n 1 1 n n
Ice/Sea Seg. 8	n n n n n n n n n 3 21 4 3 2 1 n 1 n n n n n 1 6 n
Ice/Sea Seg. 9	n n n n n n n n n 1 n 9 7 6 3 n 5 n n n n n n 12 n
Ice/Sea Seg. 10	n n n n n n n n n n n n n n 12 5 2 n n n n n 4 n
Ice/Sea Seg. 11	n n n n n n n n n n n n n 1 14 1 2 n n n n n n n
Ice/Sea Seg. 12	n 5
Ice/Sea Seg. 13	n n
Ice/Sea Seg. 14	n 1

Note: n = less than 0.5 percent

Table G-9

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Environmental Resource Within 30 Days of a Summer Spill or Meltout of an Overwintering Spill. Environmental Resources Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Environmental Resource	Hypothetical Spill Site																										
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33		
Land	n	n	n	7	25	12	n	n	46	36	n	23	26	42	4	n	31	4	3	n	12	28	67	5	4		
Sub. Res. Area A	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n	n	n	n	n	n		
Sub. Res. Area B	n	n	1	33	55	26	6	n	21	10	n	3	n	1	3	2	2	25	29	4	36	28	11	2	n		
Sub. Res. Area C	n	n	n	n	n	n	n	n	2	18	n	20	25	48	13	n	35	n	n	n	n	n	3	21	4		
Bhead Summer Feed. Area	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	14		
Bhead Fall Feed. Area A	n	n	n	22	37	12	1	n	9	8	n	1	n	n	1	n	n	n	1	n	23	16	5	1	n		
Bhead Fall Feed. Area B	n	n	n	n	n	n	n	n	n	n	n	n	n	41	5	n	33	n	n	n	n	n	n	n	6		
Bhead Mig. Area A	n	n	n	n	n	10	2	3	18	5	2	5	3	1	2	n	2	n	n	n	n	7	11	4	n		
Bhead Mig. Area B	n	n	n	n	n	n	n	n	n	21	1	21	14	10	2	n	8	n	n	n	n	n	n	7	1		
Fall Bowhead Area	n	n	n	n	n	n	n	n	n	n	n	n	n	n	9	21	3	n	n	n	n	n	n	2	13		
Gray Whale Area	n	n	n	4	8	4	n	n	1	1	n	n	n	n	n	n	n	25	8	n	6	4	1	n	n		
Seabird Offshore Area	n	n	21	28	35	25	13	4	29	8	n	4	n	8	11	12	8	23	28	21	31	25	15	3	n		
Lagoon Area 1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	5	n	n	n	n	n	n	n		
Lagoon Area 2	n	n	n	11	27	14	n	n	3	4	n	n	n	n	n	n	n	n	15	n	16	11	2	n	n		
Lagoon Area 3	n	n	n	n	n	n	n	n	36	20	n	7	7	2	n	n	1	n	n	n	n	13	56	1	n		
Lagoon Area 4	n	n	n	n	n	n	n	n	n	3	n	10	12	8	1	n	7	n	n	n	n	n	n	2	n		
Lagoon Area 5	n	n	n	n	n	n	n	n	n	n	n	n	2	30	2	n	18	n	n	n	n	n	n	1	n		
Lagoon Area 6	n	n	n	n	n	n	n	n	n	n	n	n	n	2	1	n	6	n	n	n	n	n	n	n	1		
Ice/Sea Seg. 1	1	n	n	3	5	2	n	n	n	n	n	n	n	n	n	n	n	11	6	n	4	2	n	n	n		
Ice/Sea Seg. 2	n	n	n	3	5	4	n	n	2	n	n	n	n	n	n	n	n	9	6	n	4	3	1	n	n		
Ice/Sea Seg. 3	n	n	6	5	5	11	8	n	19	4	n	3	n	2	7	8	6	n	2	14	10	12	10	2	n		
Ice/Sea Seg. 4	n	n	n	4	5	12	9	2	20	5	n	3	n	n	5	4	3	n	n	7	13	15	11	2	n		
Ice/Sea Seg. 5	n	n	n	1	1	16	9	4	29	7	1	5	1	1	3	n	1	n	n	n	14	19	16	4	n		
Ice/Sea Seg. 6	n	n	n	n	n	18	2	4	33	7	5	6	3	1	4	n	2	n	n	n	n	13	19	5	n		
Ice/Sea Seg. 7	n	n	n	n	n	n	n	4	1	3	5	3	3	3	3	n	3	n	n	n	n	1	1	5	n		
Ice/Sea Seg. 8	n	n	n	n	n	n	n	n	n	4	21	5	5	4	3	1	4	n	n	n	n	n	1	8	n		
Ice/Sea Seg. 9	n	n	n	n	n	n	n	n	n	1	n	9	7	7	4	n	7	n	n	n	n	n	n	12	1		
Ice/Sea Seg. 10	n	n	n	n	n	n	n	n	n	n	n	n	n	1	13	6	4	n	n	n	n	n	n	4	7		
Ice/Sea Seg. 11	n	n	n	n	n	n	n	n	n	n	n	n	n	1	14	1	3	n	n	n	n	n	n	n	11		
Ice/Sea Seg. 12	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	11		
Ice/Sea Seg. 13	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n		
Ice/Sea Seg. 14	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1		

Note: n = less than 0.5 percent

Table G-10

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Land Segment Within 3 Days of a Summer Spill or Meltout of an Overwintering Spill. Segments Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Land/Boundary Segment	Hypothetical Spill Site																								
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33
16	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n
19	n	n	n	1	2	1	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	2	n	n	n
20	n	n	n	4	2	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	2	n	n	n
22	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
23	n	n	n	n	3	1	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
32	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
33	n	n	n	n	n	n	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n
34	n	n	n	n	n	n	n	n	8	8	n	3	1	n	n	n	n	n	n	n	n	n	27	n	n
35	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n
37	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n
38	n	n	n	n	n	n	n	n	n	n	n	2	6	2	n	n	2	n	n	n	n	n	n	n	n
41	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	1	n	n	n	n	n	n	n	n
42	n	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n	6	n	n	n	n	n	n	n
83	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
87	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Note: n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

Table G-11

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Land Segment Within 10 Days of a Summer Spill or Meltout of an Overwintering Spill. Segments Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Land/Boundary Segment	Hypothetical Spill Site																									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33	
15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	
19	n	n	n	1	2	1	n	n	n	n	n	n	n	n	n	n	n	n	1	n	2	1	n	n	n	
20	n	n	n	5	10	2	n	n	n	1	n	n	n	n	n	n	n	n	1	n	3	2	n	n	n	
21	n	n	n	n	5	2	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	n	2	1	n	n
22	n	n	n	n	3	1	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n
23	n	n	n	n	4	2	n	n	2	1	n	n	n	n	n	n	n	n	n	n	1	2	1	n	n	
24	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	n	
26	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
27	n	n	n	n	n	1	n	n	5	1	n	n	n	n	n	n	n	n	n	n	n	5	4	n	n	
28	n	n	n	n	n	n	n	n	8	2	n	n	1	n	n	n	n	n	n	n	n	6	7	n	n	
29	n	n	n	n	n	n	n	n	7	2	n	n	1	n	n	n	n	n	n	n	n	1	8	n	n	
30	n	n	n	n	n	n	n	n	3	1	n	n	1	n	n	n	n	n	n	n	n	n	4	n	n	
31	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	
32	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	
33	n	n	n	n	n	n	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	
34	n	n	n	n	n	n	n	n	8	11	n	4	2	n	n	n	n	n	n	n	n	n	27	n	n	
35	n	n	n	n	n	n	n	n	n	4	n	2	2	n	n	n	n	n	n	n	n	n	3	n	n	
36	n	n	n	n	n	n	n	n	n	1	n	1	2	n	n	n	1	n	n	n	n	n	n	n	n	
37	n	n	n	n	n	n	n	n	n	2	n	1	2	1	n	n	1	n	n	n	n	n	n	n	n	
38	n	n	n	n	n	n	n	n	n	n	n	7	9	6	n	n	4	n	n	n	n	n	n	1	n	
39	n	n	n	n	n	n	n	n	n	n	n	1	1	2	n	n	1	n	n	n	n	n	n	n	n	
40	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	
41	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	3	n	n	n	n	n	n	n	n	
42	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n	8	n	n	n	n	n	n	n	n	
43	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	
44	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	
45	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	
75	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	
82	n	2	n	n	n	n	n	n	n	1	1	1	1	n	n	n	n	n	n	n	n	n	n	1	n	
83	n	1	n	n	n	n	n	2	n	1	2	1	1	n	n	n	n	n	n	n	n	n	n	1	n	
86	n	n	n	n	n	1	2	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	
87	n	n	n	n	n	3	9	3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	6	n	n	
88	n	n	n	n	n	1	2	2	n	n	1	n	n	n	n	n	n	n	n	n	n	n	2	n	n	
89	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	

Notes n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

Table G-12

Conditional Probabilities (Expressed as Percent Chance) That an Oil Spill Starting At a Particular Location Will Contact a Certain Land Segment Within 30 Days of a Summer Spill or Meltout of an Overwintering Spill. Segments Are Contacted During the Open-Water Season (Approximately Mid-July Through September).

Land/Boundary Segment	Hypothetical Spill Site																									
	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16	L17	L26	L27	L28	L29	L30	L31	L32	L33	
15	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	3	n	n	n	n	n	n	n	
19	n	n	n	1	2	1	n	n	n	n	n	n	n	n	n	n	n	n	1	n	2	1	n	n	n	
20	n	n	n	5	10	3	n	n	2	2	n	n	n	n	n	n	n	n	1	n	5	3	1	n	n	
21	n	n	n	n	5	2	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	2	1	n	n	
22	n	n	n	n	3	1	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	1	1	n	n	
23	n	n	n	n	4	2	n	n	3	1	n	n	n	n	n	n	n	n	n	n	2	3	2	n	n	
24	n	n	n	n	n	n	n	n	2	1	n	n	n	n	n	n	n	n	n	n	1	2	2	n	n	
25	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	
26	n	n	n	n	1	n	n	n	1	1	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	
27	n	n	n	n	n	1	n	n	5	2	n	n	n	n	n	n	n	n	n	n	n	5	4	n	n	
28	n	n	n	n	n	n	n	n	9	4	n	3	1	1	n	n	n	n	n	n	n	8	8	n	n	
29	n	n	n	n	n	n	n	n	7	3	n	n	1	n	n	n	n	n	n	n	n	1	10	n	n	
30	n	n	n	n	n	n	n	n	3	2	n	n	1	n	n	n	n	n	n	n	n	n	4	n	n	
31	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	
32	n	n	n	n	n	n	n	n	2	1	n	n	n	1	n	n	n	n	n	n	n	n	2	n	n	
33	n	n	n	n	n	n	n	n	2	1	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	
34	n	n	n	n	n	n	n	n	8	11	n	4	3	n	n	n	n	n	n	n	n	n	27	1	n	
35	n	n	n	n	n	n	n	n	n	4	n	2	3	1	n	n	1	n	n	n	n	n	3	n	n	
36	n	n	n	n	n	n	n	n	n	1	n	1	3	2	n	n	1	n	n	n	n	n	n	n	n	
37	n	n	n	n	n	n	n	n	n	2	n	2	2	1	n	n	1	n	n	n	n	n	n	1	n	
38	n	n	n	n	n	n	n	n	n	n	n	7	9	7	1	n	7	n	n	n	n	n	n	1	n	
39	n	n	n	n	n	n	n	n	n	n	n	1	1	3	n	n	3	n	n	n	n	n	n	n	n	
40	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	n	n	n	n	
41	n	n	n	n	n	n	n	n	n	n	n	n	n	4	n	n	4	n	n	n	n	n	n	n	n	
42	n	n	n	n	n	n	n	n	n	n	n	n	n	20	n	n	8	n	n	n	n	n	n	n	n	
43	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	n	n	n	n	n	n	n	n	
44	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	
45	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	n	n	n	n	n	n	n	n	
48	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	
75	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	1	
76	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	
77	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	
78	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	4	
79	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	2	
81	n	n	1	1	1	n	n	n	n	n	n	n	n	n	1	2	1	n	n	3	1	n	n	n	n	
82	n	3	1	2	2	1	n	n	n	1	1	1	1	1	1	1	1	1	2	1	1	n	n	1	n	
83	n	2	1	1	1	1	n	2	n	1	2	1	1	1	n	n	n	n	2	n	1	n	n	1	n	
86	1	1	n	n	n	1	2	1	n	1	1	1	1	n	n	n	n	n	n	n	n	n	1	n	1	n
87	6	9	n	n	n	3	9	6	n	3	5	3	3	n	n	n	n	n	n	n	n	6	n	3	n	
88	4	3	1	n	n	1	2	2	n	2	2	2	2	n	n	n	n	n	n	n	n	2	n	2	n	
89	3	3	1	n	n	n	n	1	n	1	2	1	1	n	n	n	n	n	n	n	n	n	n	1	n	

Notes n = less than 0.5 percent  
 Rows with all values less than 0.5 percent are not shown.

**Table G-13**  
**Monte Carlo Error as a Function of the Number of Trials and the Estimated Probability**

PROB	NUMBER OF TRIALS								
	10	20	40	50	100	200	500	1000	2000
0.02	0.07	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01
0.04	0.10	0.07	0.05	0.05	0.03	0.02	0.01	0.01	0.01
0.06	0.12	0.09	0.06	0.06	0.04	0.03	0.02	0.01	0.01
0.08	0.14	0.10	0.07	0.06	0.04	0.03	0.02	0.01	0.01
0.10	0.16	0.11	0.08	0.07	0.05	0.04	0.02	0.02	0.01
0.12	0.17	0.12	0.08	0.08	0.05	0.04	0.02	0.02	0.01
0.14	0.18	0.13	0.09	0.08	0.06	0.04	0.03	0.02	0.01
0.16	0.19	0.14	0.10	0.09	0.06	0.04	0.03	0.02	0.01
0.18	0.20	0.14	0.10	0.09	0.06	0.04	0.03	0.02	0.01
0.20	0.21	0.15	0.10	0.09	0.07	0.05	0.03	0.02	0.01
0.22	0.22	0.16	0.11	0.10	0.07	0.05	0.03	0.02	0.02
0.24	0.22	0.16	0.11	0.10	0.07	0.05	0.03	0.02	0.02
0.26	0.23	0.16	0.11	0.10	0.07	0.05	0.03	0.02	0.02
0.28	0.23	0.17	0.12	0.10	0.07	0.05	0.03	0.02	0.02
0.30	0.24	0.17	0.12	0.11	0.08	0.05	0.03	0.02	0.02
0.32	0.24	0.17	0.12	0.11	0.08	0.05	0.03	0.02	0.02
0.34	0.25	0.17	0.12	0.11	0.08	0.06	0.03	0.02	0.02
0.36	0.25	0.18	0.13	0.11	0.08	0.06	0.04	0.03	0.02
0.38	0.25	0.18	0.13	0.11	0.08	0.06	0.04	0.03	0.02
0.40	0.26	0.18	0.13	0.11	0.08	0.06	0.04	0.03	0.02
0.42	0.26	0.18	0.13	0.12	0.08	0.06	0.04	0.03	0.02
0.44	0.26	0.18	0.13	0.12	0.08	0.06	0.04	0.03	0.02
0.46	0.26	0.18	0.13	0.12	0.08	0.06	0.04	0.03	0.02
0.48	0.26	0.18	0.13	0.12	0.08	0.06	0.04	0.03	0.02
0.50	0.26	0.18	0.13	0.12	0.08	0.06	0.04	0.03	0.02

Level of significance = 90 percent

**Table G-14**  
**Spill-Rate Constants per Billion Barrels of Oil Produced  
or Transported for Platforms, Pipelines, and  
Tankers, Based on Historical Trends**

Source	Rate
	(1,000 Barrels or Greater)
Platforms	0.60
Pipelines	0.67
Tankers, Total	1.30
At Sea	0.90
Per Port Call <sup>1/</sup>	0.20

Source: Anderson and LaBelle, 1990.

<sup>1/</sup> Calculated assuming two port calls per tanker trip; i.e., one half of the "At Port" spill-rate constant.

Table G-15 Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting environmental resources over the assumed production life of the lease area, Beaufort Sea Lease Sale 124, base case and high case, based on winter trajectories only, but assuming total base and high-case resource produced and transported in winter.

Environmental Resource	-----Within 3 days-----				-----Within 10 days-----				-----Entire Winter-----			
	BASE CASE		HIGH CASE		BASE CASE		HIGH CASE		BASE CASE		HIGH CASE	
	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean
Land	6	0.1	16	0.2	9	0.1	23	0.3	9	0.1	23	0.3
Sub. Res. Area A	3	0.0	7	0.1	3	0.0	7	0.1	3	0.0	7	0.1
Sub. Res. Area A--Spring	1	0.0	3	0.0	1	0.0	3	0.0	1	0.0	3	0.0
Sub. Res. Area B	18	0.2	44	0.6	20	0.2	48	0.6	20	0.2	48	0.6
Sub. Res. Area B--Spring	7	0.1	19	0.2	7	0.1	19	0.2	7	0.1	19	0.2
Sub. Res. Area C	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Gray Whale--October	1	0.0	3	0.0	1	0.0	3	0.0	1	0.0	3	0.0
Gray Whale--April	1	0.0	4	0.0	1	0.0	4	0.0	1	0.0	4	0.0
Bhead Spring Mig. Cor. A	9	0.1	24	0.3	11	0.1	28	0.3	11	0.1	28	0.3
Bhead Spring Mig. Cor. B	6	0.1	17	0.2	6	0.1	17	0.2	6	0.1	17	0.2
Bhead Mig. Area A-Oct.	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Bhead Mig. Area B-Oct.	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 1	n	0.0	n	0.0	2	0.0	5	0.1	2	0.0	5	0.1
Ice/Sea Segment 1-Spring	n	0.0	n	0.0	1	0.0	2	0.0	1	0.0	2	0.0
Ice/Sea Segment 2	1	0.0	3	0.0	2	0.0	6	0.1	2	0.0	6	0.1
Ice/Sea Segment 2-Spring	n	0.0	1	0.0	1	0.0	2	0.0	1	0.0	2	0.0
Ice/Sea Segment 3	3	0.0	9	0.1	13	0.1	33	0.4	15	0.2	37	0.5
Ice/Sea Segment 3-Spring	1	0.0	2	0.0	4	0.0	12	0.1	4	0.0	12	0.1
Ice/Sea Segment 4	5	0.0	13	0.1	10	0.1	26	0.3	10	0.1	26	0.3
Ice/Sea Segment 4-Spring	1	0.0	4	0.0	3	0.0	9	0.1	3	0.0	9	0.1
Ice/Sea Segment 5	8	0.1	23	0.3	8	0.1	23	0.3	8	0.1	23	0.3
Ice/Sea Segment 5-Spring	2	0.0	5	0.1	2	0.0	5	0.1	2	0.0	5	0.1
Ice/Sea Segment 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Notes: n = less than 0.5 percent; Spring = April through June 15.

Table G-16 Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on winter trajectories only, but assuming total base and high-case resource produced and transported in winter.

Land/Boundary Segments	---- Within 3 days ----				---- Within 10 days ----				---- Entire Winter ----			
	BASE CASE		HIGH CASE		BASE CASE		HIGH CASE		BASE CASE		HIGH CASE	
	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean
16	n	0.0	1	0.0	n	0.0	1	0.0	n	0.0	1	0.0
20	2	0.0	6	0.1	4	0.0	12	0.1	4	0.0	12	0.1
21	2	0.0	6	0.1	3	0.0	9	0.1	3	0.0	9	0.1
22	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0
23	1	0.0	2	0.0	1	0.0	2	0.0	1	0.0	2	0.0
24	n	0.0	1	0.0	n	0.0	1	0.0	n	0.0	1	0.0
79	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	5	0.1
80	n	0.0	n	0.0	n	0.0	n	0.0	5	0.1	14	0.1
81	1	0.0	4	0.0	1	0.0	4	0.0	10	0.1	27	0.3
82	n	0.0	1	0.0	2	0.0	5	0.1	9	0.1	24	0.3
83	n	0.0	n	0.0	4	0.0	10	0.1	8	0.1	20	0.2
86	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	4	0.0
87	n	0.0	n	0.0	1	0.0	4	0.0	26	0.3	57	0.9
88	n	0.0	n	0.0	n	0.0	1	0.0	21	0.2	49	0.7
89	n	0.0	n	0.0	n	0.0	n	0.0	7	0.1	19	0.2
90	n	0.0	n	0.0	n	0.0	n	0.0	8	0.1	21	0.2

Notes: n = less than 0.5 percent; segments with less than 0.5-percent probability of one or more contacts within 30 days are not shown.

Table G-17 Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting environmental resources over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on open-water trajectories only for contacts within 3, 10, or 30 days of summer spills or meltout of overwintering spills.

Environmental Resource	--- Within 3 days ---		--- Within 10 days---		--- Within 30 days ---							
	BASE CASE		HIGH CASE		BASE CASE		HIGH CASE					
	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean				
Land	2	0.0	5	0.0	5	0.0	13	0.1	5	0.0	13	0.1
Sub. Res. Area A	1	0.0	2	0.0	1	0.0	3	0.0	1	0.0	3	0.0
Sub. Res. Area B	10	0.1	27	0.3	12	0.1	31	0.4	12	0.1	31	0.4
Sub. Res. Area C	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Bhead Summer Feed. Area	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Bhead Fall Feed. Area A	7	0.1	19	0.2	7	0.1	20	0.2	7	0.1	20	0.2
Bhead Fall Feed. Area B	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Bhead Mig. Area A	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Bhead Mig. Area B	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Fall Bowhead Area	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Gray Whale Area	2	0.0	5	0.1	3	0.0	7	0.1	3	0.0	8	0.1
Seabird Offshore Area	11	0.1	29	0.3	13	0.1	33	0.4	13	0.1	33	0.4
Lagoon Area 1	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0
Lagoon Area 2	3	0.0	10	0.1	5	0.1	14	0.2	5	0.1	15	0.2
Lagoon Area 3	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Lagoon Area 4	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Lagoon Area 5	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Lagoon Area 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 1	n	0.0	n	0.0	1	0.0	2	0.0	2	0.0	6	0.1
Ice/Sea Segment 2	n	0.0	1	0.0	1	0.0	4	0.0	1	0.0	4	0.0
Ice/Sea Segment 3	n	0.0	1	0.0	2	0.0	7	0.1	4	0.0	11	0.1
Ice/Sea Segment 4	1	0.0	3	0.0	3	0.0	7	0.1	3	0.0	7	0.1
Ice/Sea Segment 5	1	0.0	2	0.0	1	0.0	4	0.0	1	0.0	4	0.0
Ice/Sea Segment 6	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 7	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 8	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 9	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 10	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 11	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 12	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 13	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0
Ice/Sea Segment 14	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0	n	0.0

Notes: n = less than 0.5 percent.

**Table G-18** Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels, and the estimated number of spills (mean) occurring and contacting land/boundary segments over the assumed production life of the lease area, Beaufort Sea Lease Sale 124 base case and high case, based on open-water trajectories only for contacts within 3, 10, and 30 days of summer spills or meltout of overwintering spills.

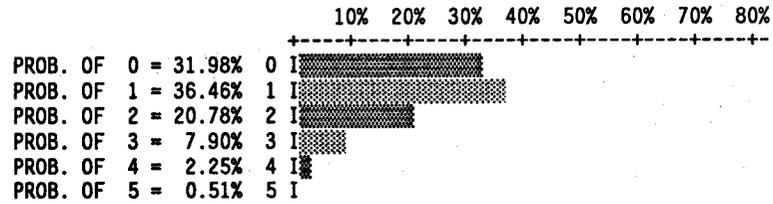
Land/Boundary Segments	---- Within 3 days ----				---- Within 10 days ----				---- Within 30 Days ----			
	BASE CASE		HIGH CASE		BASE CASE		HIGH CASE		BASE CASE		HIGH CASE	
	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean	Prob.	Mean
19	n	0.0	1	0.0	n	0.0	1	0.0	n	0.0	1	0.0
20	n	0.0	1	0.0	2	0.0	5	0.1	2	0.0	5	0.1
21	n	0.0	n	0.0	1	0.0	2	0.0	1	0.0	2	0.0
22	n	0.0	n	0.0	n	0.0	1	0.0	n	0.0	1	0.0
23	n	0.0	1	0.0	1	0.0	2	0.0	1	0.0	2	0.0
81	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	2	0.0
82	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	3	0.0
83	n	0.0	n	0.0	n	0.0	1	0.0	1	0.0	2	0.0
86	n	0.0	n	0.0	n	0.0	n	0.0	1	0.0	2	0.0
87	n	0.0	n	0.0	n	0.0	n	0.0	4	0.0	11	0.1
88	n	0.0	n	0.0	n	0.0	n	0.0	3	0.0	7	0.1
89	n	0.0	n	0.0	n	0.0	n	0.0	2	0.0	6	0.1

Notes: n = less than 0.5 percent; segments with less than 0.5-percent probability of one or more contacts within 30 days are not shown.



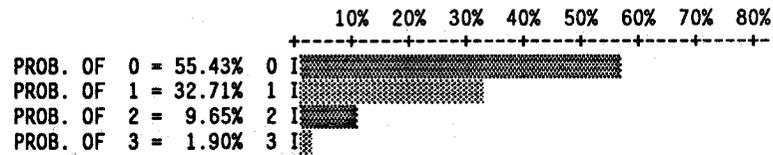
(a) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 1.14  
Probability of One or More = 68%  
Most Likely (Mode) = 1



(b) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 0.59  
Probability of One or More = 45%  
Most Likely (Mode) = 0



(c) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 1.73  
Probability of One or More = 82%  
Most Likely (Mode) = 1

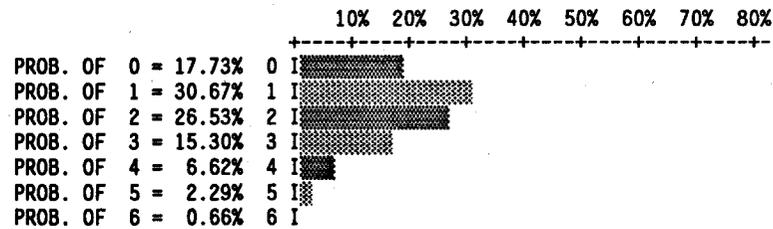
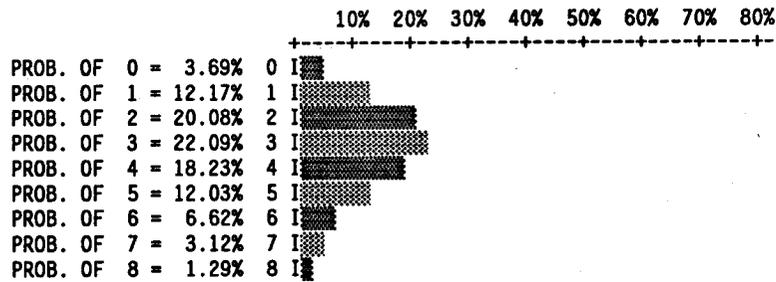


Figure G-2. Most Likely Number and Poisson Distribution of Spill Probabilities for the Base Case and Deferral Alternatives in (a) Beaufort Sea Planning Area, (b) Prince William Sound and Gulf of Alaska, and (c) Any of These Locations.

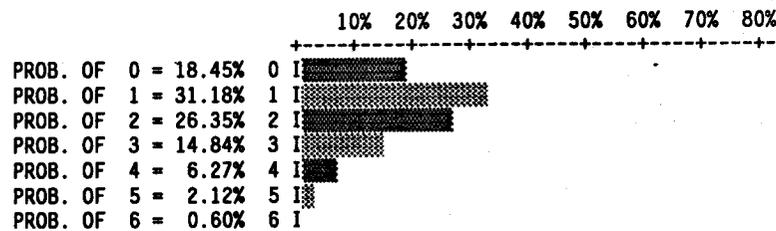
(a) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 3.30  
 Probability of One or More = 96%  
 Most Likely (Mode) = 3



(b) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 1.69  
 Probability of One or More = 82%  
 Most Likely (Mode) = 1



(c) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 4.99  
 Probability of One or More = 99%  
 Most Likely (Mode) = 4

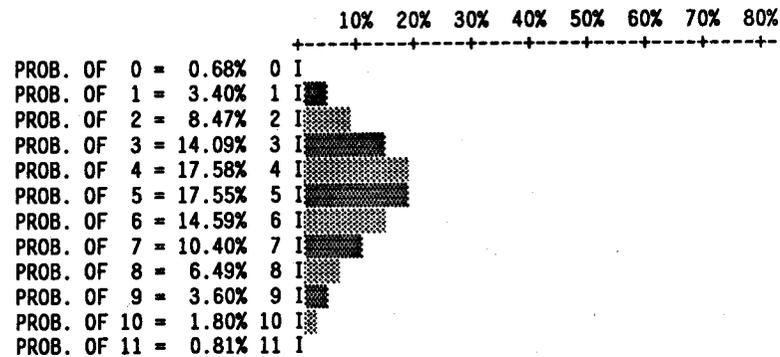
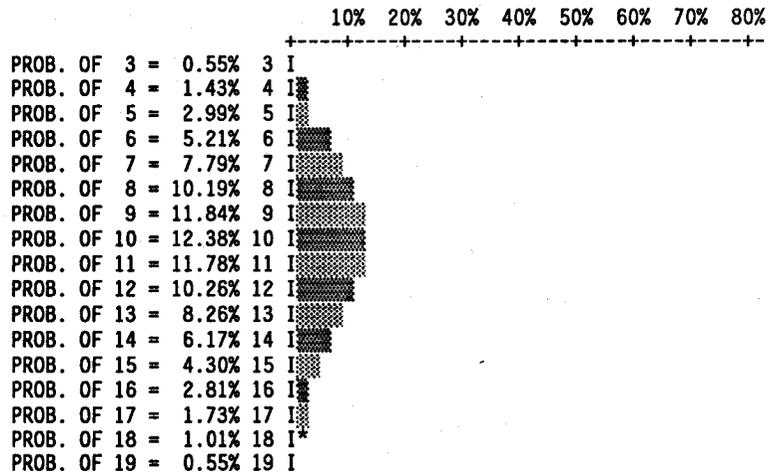


Figure G-3. Most Likely Number of Spills and Poisson Distribution of Spill Probabilities for the High Case in (a) Beaufort Sea Planning Area, (b) Prince William Sound and Gulf of Alaska, and (c) Any of These Locations.

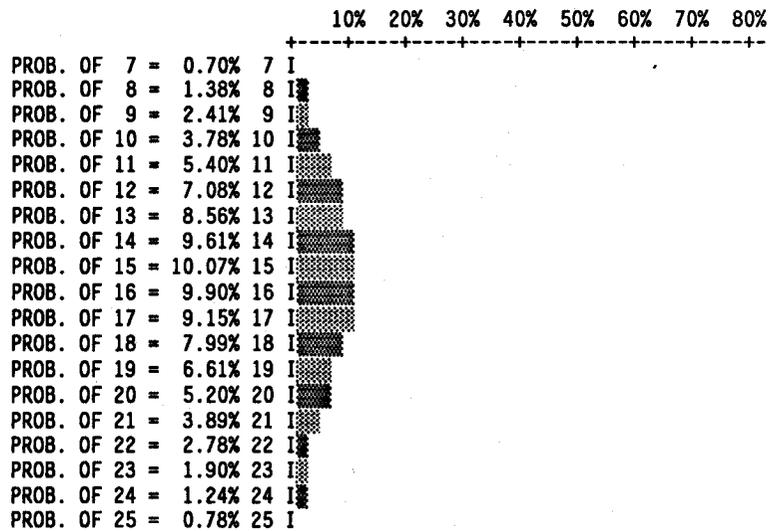
(a) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 10.46  
Probability of One or More = >99%  
Most Likely (Mode) = 10



(b) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 15.72  
Probability of One or More = >99%  
Most Likely (Mode) = 15



(Continued on the next page)

(c) Spills of 1,000 Barrels or Greater

Expected Number (Mean) = 26.18  
 Probability of One or More = >99%  
 Most Likely (Mode) = 26

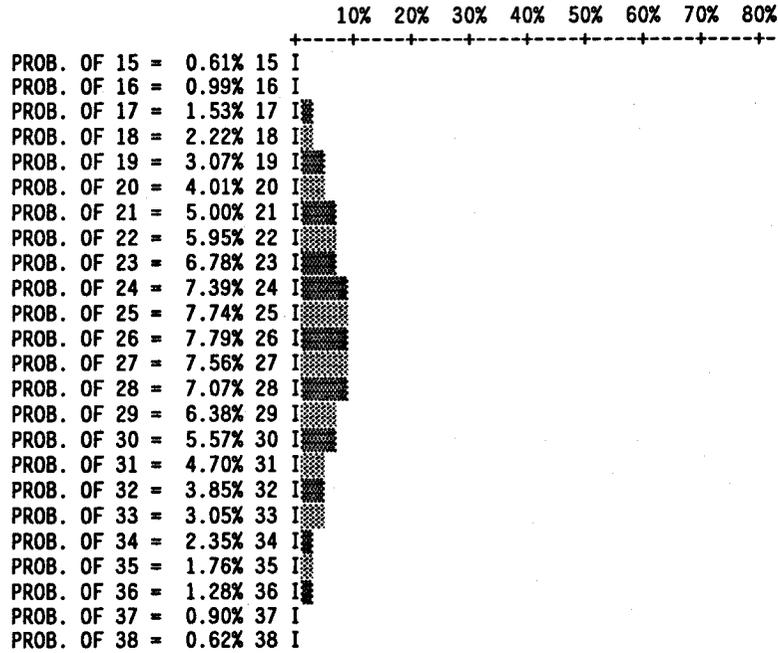


Figure G-4. Most Likely Number and Poisson Distribution of Spill Probabilities for the Cumulative Case in (a) Beaufort and Chukchi Seas, (b) Prince William Sound and Gulf of Alaska, and (c) Any of These Locations.

**APPENDIX H**

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**EXPLORATION, DEVELOPMENT AND PRODUCTION,  
AND TRANSPORTATION  
ESTIMATES AND ASSUMPTIONS**

Table H-1  
Summary of Previous Federal OCS Lease Sales in the Beaufort Sea Planning Area

Lease Sale <sup>1/</sup>	Sale Date	Number of Blocks or Bidding Units		Area		Resource Estimates Mean Case, Proposal	
		Offered	Leased	Offered (Hectares)	Leased (Hectares)	Oil (MMbbl)	Gas (Tcf)
BF, Beaufort Sea <sup>2/</sup>	Dec 1979						
Federal		23	4	35,273	34,713 <sup>3/</sup>	750	1,625
Federally Managed--Disputed		23	20	34,910			
State of Alaska		67	62	130,787	115,618 <sup>4/</sup>		
State-Managed--Disputed		4	0	7,125			
71, Diapir Field	Oct 1982	338	121	738,879.16	268,256	2,380	1,780
87, Diapir Field Lease Offering	Aug 1984	1,419	227	3,145,870.83	488,755 <sup>5/</sup>	3,000	7,750
BF, 71, 87 (Revised)						600 <sup>6/</sup>	
97, Beaufort Sea	Mar 1988	3,344	202 <sup>7/</sup>	7,396,926	449,511 <sup>8/</sup>	650	"
124, Beaufort Sea	Apr 1991					1,450(900) <sup>9/</sup>	"

Sources: USDOl, MMS, 1988 and 1989.

<sup>1/</sup> Sale numbers are used throughout this EIS.

<sup>2/</sup> Those tracts within the BF lease area where there are conflicting and unresolved jurisdictional claims of the Federal and State governments have been designated as disputed tracts.

<sup>3/</sup> Total area leased from Federal and Federally Managed--Disputed Tracts.

<sup>4/</sup> Total area leased from State of Alaska and State-Managed--Disputed Tracts.

<sup>5/</sup> Does not include four blocks (9,216 ha) affected by a Canadian Claim of Jurisdiction.

<sup>6/</sup> Revised resource estimate for all tracts leased in Sales BF, 71, and 87.

<sup>7/</sup> Does not include 16 blocks (35,353 ha) affected by a Canadian Claim of Jurisdiction.

<sup>8/</sup> Natural gas production in the Beaufort Sea currently is considered uneconomic.

<sup>9/</sup> For Sale 124 the mean-case resource estimate is 1,450 MMbbl of oil and the base-resources estimate is about 900 MMbbl; 830 X 0.64 = 530 (see Appendices A and B).

**Table H-2**  
**Summary of Beaufort Sea Wells and Drilling Units**

Type of Drilling Unit <sup>1/</sup>	Number of Wells Drilled			
	State Leases	Federally Managed Disputed Tracts Sale BF	Federal Tracts	
			Sale 71	Sale 87
Barrier and Natural Islands (14)	22	--	--	--
Artificial Islands--Water Depths 1-15 Meters				
Constructed in State Waters (12)	19	2 <sup>2/</sup>	--	--
Constructed in Federal Waters (4)	--	6	3	--
Ice Islands	1	--	--	--
Flood (1)	--	--	--	--
Spray (1)	--	1	1	--
Bottom-Founded Mobile Drilling Units	--	--	--	--
Concrete Island Drilling System (CIDS) (1)	--	--	2	1
Single-Steel Drilling Caisson (SSDC) (1)	--	--	1	1
Ice-Strengthened Drillship (1)	--	--	--	3
Conical Drilling Unit (CDU) (1)	--	--	--	1

Source: MMS, Alaska OCS Region.

<sup>1/</sup> The number of drilling units used is shown in parentheses.

<sup>2/</sup> Two wells were drilled from Seal Island--an artificial island constructed in State waters.

**Table H-3**  
**Site-Clearance Seismic-Survey Requirements and Assumptions**

Survey Types <sup>1/</sup>	Area (km <sup>2</sup> )	Length (km)
Site-Specific Survey		
Approximate Grid Area	23 <sup>2/</sup>	
Approximate Length of Seismic Grid Lines		64.2
Blockwide Survey		
Approximate Grid Area	92	
Approximate Length of Seismic Grid Lines		304.2
Prospectwide Survey <sup>2/</sup>		
Approximate Grid Area	variable	
Approximate Length of Seismic Grid Lines		variable

Source: MMS, Alaska OCS Region.

<sup>1/</sup> The type of survey conducted is subject to approval by the Regional Supervisor, Field Operations, MMS.

<sup>2/</sup> An area that is about equal to one full OCS lease block.

<sup>3/</sup> The area and length of the seismic lines depend on the size and shape of each prospect.

Table H-4

Assumptions Used to Determine the Seafloor Area  
Disturbed by Pipeline Trenching for the  
Base and High Cases

Interval	Midwater	Trenching	Horizontal Width (Slope 1:2.5) (5 times Trenching Depth)	Segment Length <sup>1/</sup> (ft) (mi)	Surface Area (ft <sup>2</sup> )	Surface Area (mi <sup>2</sup> )	Volume (yd <sup>3</sup> )	Surface Area of Dumped Material <sup>4/</sup> (Slope 1:10) (mi <sup>2</sup> )	Total Area Dis- (mi <sup>2</sup> )
Pipelines from Platforms (75 Miles Trenched)									
98-131	115	20	100	95,040 (18)	9,504,000	0.34	3,520,000	1.36	
66- 98	82	16	80	95,040	7,603,200	0.27	2,252,800	1.08	
33- 66	49	10	50	95,040	4,752,000	0.17	880,000	0.68	
0- 33	16	7	35	110,880 (21)	3,880,800	0.14	503,067	0.56	
Totals				396,000 (75)	25,740,000	0.92	7,155,867	3.68	4.60

Source: USDO1, HMS, Alaska OCS Region.

- <sup>1/</sup> Pipeline routes from the production platforms to the shore are divided into 33-foot water-depth segments.
- <sup>2/</sup> (a) Trenching depths are only estimates. The actual trenching depth for each pipeline will depend on a number of factors, which include water depth, average gouge depth, average gouging rate, pipeline length for each water-depth interval, and expected operation life of the pipeline.
- (b) Trenching depth is assumed to be of the mid-water depth for each 33-foot segment.
- (c) Trenching depths are based on data in Han-Padron (1985).
- (d) Side slopes of the trench are assumed to be 1:2.5.
- <sup>3/</sup> Each pipeline is assumed to be divided into an equal number of length segments based on the number of 33-foot water-depth segments between the platform and the shore. The pipeline lengths are from Table II.A.1 of the EIS.
- <sup>4/</sup> The seafloor area that is disturbed by dumping the material from the trench is assumed to be four times the area disturbed by trenching.

**APPENDIX I**

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**ARCHAEOLOGICAL ANALYSIS**

**PREPARED BY MMS**

AUG 18 1989

1

Prehistoric Resource Analysis  
Proposed Sale 124, Beaufort Sea

Purpose

In accordance with the Minerals Management Service (MMS) Handbook for Archaeological Resource Protection (#620.1-H, June 17, 1985), this archaeological analysis was prepared for offshore lease Sale 124 for the Beaufort Sea area. The analysis is intended to identify areas of possible prehistoric archaeological site potential and to aid the MMS in making recommendations to the Secretary on archaeological resource lease stipulations.

Project Area Description

The area of the proposed lease offering (Fig.1) is off the north coast of Alaska in the Arctic Ocean. It extends laterally from the Canada/United States border in the east to 162°00" W. longitude in the west. The area extends from the three geographical mile limit (except 71°00" N. latitude in the Chukchi Sea) in the south to 73°00" N. latitude in the north.

The proposed lease area is approximately 22.1 million acres and contains 4,095 blocks. All blocks are included in this archaeological analysis.

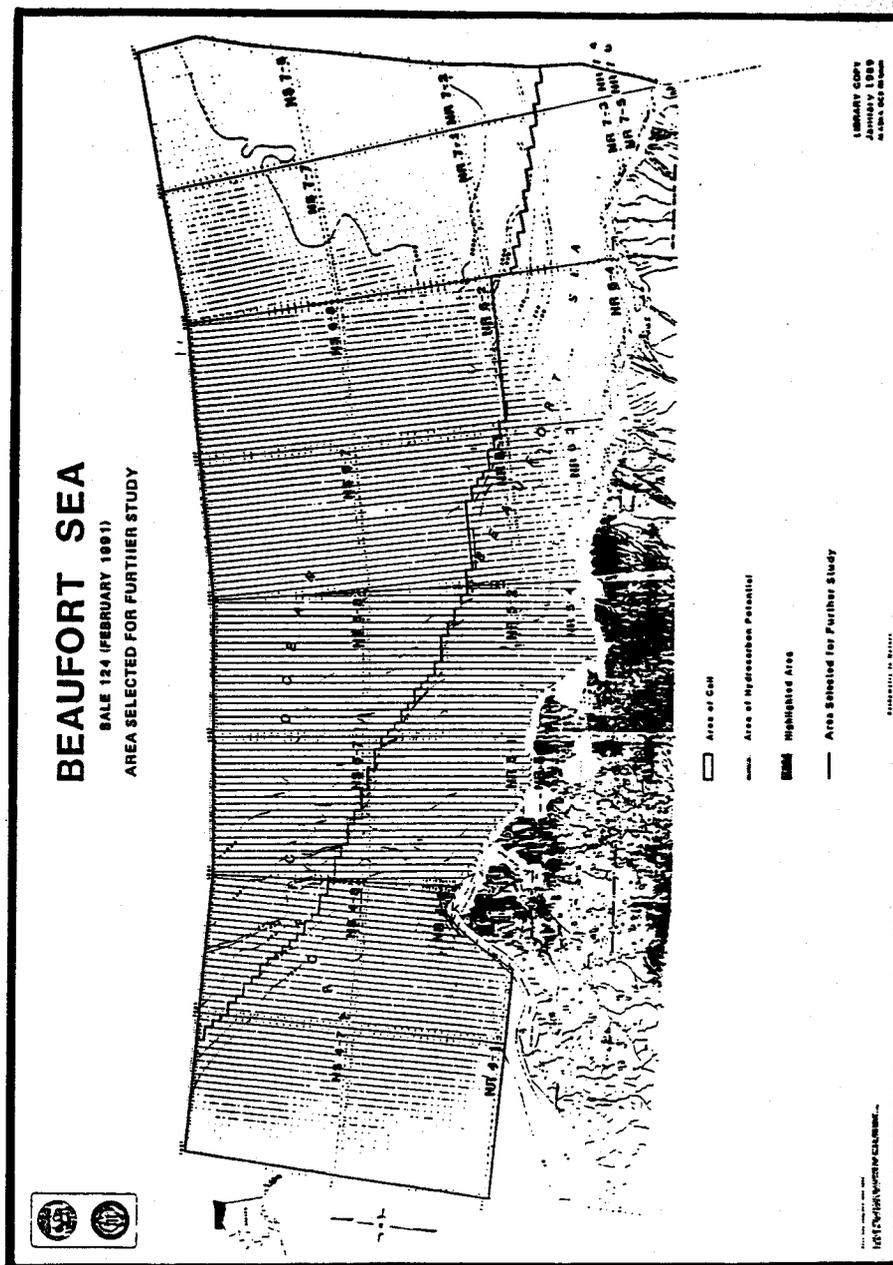
Method

The method used to develop the archaeological analysis was established in the Handbook for Archaeological Resource Protection (MMS 620.1-H, June 17, 1985).

The procedures outlined in Chapter 2, Section D.1-4 of the handbook are:

Integration of the geophysical/geological and archaeological information is the focus of the prehistoric resource analysis. It includes a technical interpretation of existing geophysical/geological data in order to establish sea level changes and to identify relict landforms. This technical interpretation will provide the basis for evaluating the potential for prehistoric resource occurrence (habitability) within the proposed lease sale area. The process of integration begins at the broadest data-base level and proceed toward the specific. Preparation of the analysis is conducted in the following manner:

(1) Review the baseline study. If the regional baseline study indicates that the entire proposed lease sale area lies within an area of low probability for the occurrence of prehistoric resources, and no new data exist which contradict the regional baseline study findings, then no further prelease prehistoric



resource analysis or postlease prehistoric resource reports will be required.

(2) Review the sea-level data in the proposed lease sale area to establish the best estimate of paleo-sea level when blocks of medium or high probability occur in the proposed lease sale area. Blocks which a regional baseline study indicates are medium or high probability, but were not above sea level during times of potential human habitation (habitability), will require no further prelease prehistoric resource analysis or postlease prehistoric resource report.

(3) Examine the geophysical/geological literature for information regarding forces or processes that might have destroyed potential prehistoric resources (survivability) or rendered them unrecoverable. Examples of such forces and processes are:

- (a) glacial scouring;
- (b) sea ice gouging;
- (c) subaerial exposure;
- (d) inlet migration;
- (e) transgressive seas; and
- (f) sedimentation.

The block will require no further prelease prehistoric resource analysis or a postlease prehistoric resource report if the block exhibits any of these processes to an extent that it would be expected that prehistoric resources did not survive and/or are not recoverable.

(4) Examine the USGS geology report, existing shallow hazards survey data, etc., for indications of significant landforms. If sufficient data exist to make a determination, those blocks that do not contain significant relict Pleistocene or Holocene landforms will require no further prelease prehistoric resource analysis or postlease prehistoric resource report. Those blocks that are not excluded from further consideration shall require a prehistoric resource report under the archaeological lease stipulation or ROW permit requirements.

#### Analysis

##### Step 1 - Review of the Baseline Study

Using the above method, 4,095 blocks contained in this proposed action were reviewed. Baseline studies which cover portions of the study area include:

- Bering Land Bridge Cultural Resource Study (Dixon et al. 1976);
- Alaska Outer Continental Shelf Cultural Resource Compendium, Technical Report #119 (Dixon et al. March 1986)

The baseline studies have developed a general model which delineates areas likely to contain archaeological sites on the Outer Continental Shelf (Dixon et al., 1976). The criteria used for designating probability zones are:

##### Areas of High Probability

(1) Non-glacial river mouths and constricted marine approaches to these river mouths. Such areas would have concentrated anadromous fish and their predators.

(2) Natural terrestrial conditions, such as passes, which funnel large mammal movements.

(3) Prominent spits, points, rocky capes, headlands, and islands that may have provided habitats for seals and marine birds. Such habitat is only considered high probability if it occurs in conjunction with one or more additional habitat types or if there is a natural constriction which would tend to concentrate these species.

(4) Areas of possibly enhanced marine coastal habitat diversity and availability.

##### Areas of Medium Probability

(1) Lake margins. Although the presence of fish and waterfowl resources enhances these areas as settlement locales, they are less likely to be as productive (and less likely to foster winter settlements) as those listed above.

(2) North- and south-facing slopes. Guthrie (in Dixon et al., 1976) indicated that south-facing slopes tend to concentrate grazing mammals during early spring plant maturation and that many times north-facing slopes provide wind-blown, snow free winter ranges. However, neither of these habitat types concentrate grazers into specific locations where large aggregates of animals can be harvested. Although these areas are generally more productive, the mammals are scattered over a comparatively large area.

##### Areas of Low Probability

- (1) Any habitat type not listed above.

##### Step 2 - Review of Sea Level Curves to Determine Habitability

In the previous archaeological analysis prepared by MMS for Sale 97, a sea level lowering of 90 meters was assumed for the study area. The baseline studies however, have evaluated a maximum sea level lowering of 125 meters.

Since the 125 meter lowering of the sea floor is estimated to have occurred over 130,000 years ago, any blocks occurring below the 90 meter lowering are believed to have been emergent prior to the arrival of man. Therefore, blocks lying below 90 meters were rejected from further analysis (see Appendix 1, p.5).

#### **Step 3 - Review of the Geological/Geophysical Data to Determine Survivability**

In the analyses done for Sales 87 and 97, Friedman and Schneider discussed four factors in the arctic and subarctic environment which could affect the survivability of sites during and subsequent to submergence. They are: 1) general flatness and gentle slope of the seafloor, 2) shallow depth of the arctic and subarctic OCS, 3) ice gouging and shoreline ice scouring, and 4) lack of sediment cover. These are discussed in more detail in Appendix 1, p. 5-6.

Recent work by Phillips (1986) has shown that there may be some areas in the southern Chukchi Sea that represent non-marine deposits which have survived the marine transgression. Further analysis by MMS, however, suggests that there is very little likelihood that prehistoric sites in the sale area could have survived the ice gouging common in the region (Friedman and Schneider, 1984).

#### **Step 4 - Review to Identify Significant Landforms**

A total of 192 blocks were identified by Dixon (et al., 1986) to have a medium or high potential of prehistoric site occurrence. These blocks are listed in Appendix 1, Table 1, p.4.

#### **Step 5 - Prehistoric Site Potential Recommendation**

While the Sale 124 area contains 192 blocks which have a medium or high potential for prehistoric site occurrence, none of these blocks are expected to contain prehistoric sites which have survived the Holocene transgression and subsequent coastal processes. Therefore, no further assessment of prehistoric resources is required unless new data becomes available.

2

**Summary of Geomorphological Processes  
Pertaining to Survivability of Archaeological  
Resources in the Beaufort Sea Sale 124 Area**

**INTRODUCTION**

This report is written in accordance with the Minerals Management Service (MMS) Handbook for Archaeological Resource Protection. Previously, Friedman and Schneider had prepared an archaeological analysis of the Sale 87, Beaufort Sea area, the conclusions of which were applied to the Sale 97 area.

The Beaufort Sea, Sale 124 area, incorporates all tracts previously evaluated for the Sale 97 area and additional tracts to the northeast. This summary updates and expands on the work of Friedman and Schneider concerning the geomorphological processes pertaining to survivability of prehistoric archaeological resources and shipwrecks in the Beaufort Sea, Sale 124 area.

The previous work by Friedman and Schneider found no tracts in the Sale 97 area to possess a potential for survivability of prehistoric archaeological resource sites. This report reevaluated the area studied by Friedman and Schneider, taking into consideration new data on the potential for site survivability and the severity of ice gouging. This reevaluation confirmed Friedman's and Schneider's conclusions for tracts in the Sale 97 area. The reevaluation also extended the conclusions of Friedman and Schneider to previously unanalyzed tracts in the northeastern part of the Sale 124 area.

This report reflects a new baseline study as well as a re-interpretation of the area's sea-level history and the natural forces limiting site survivability. The geomorphological forces which have acted upon the floor of the Beaufort Sea are summarized with regard to the survivability and detectability of potential prehistoric resource sites and shipwrecks.

**Review of the Baseline Studies**

A baseline study "Alaska Outer Continental Shelf Cultural Resource Compendium," by E.J. Dixon, S. Stoker, and G. Sharma, was published in March 1986. A previous report, "Bering Land Bridge Cultural Resource Study - Final Report," prepared by E.J. Dixon, S. Stoker, and R.D. Guthrie in 1976 was used in previous archaeological assessments. These two baseline studies analyze the scientific data base for the Beaufort Sea in order to predict where any prehistoric archaeological sites might occur.

The first study (Dixon, et al., 1976) utilized a broad-based analytical approach to evaluate the Outer Continental Shelf (OCS) for "archaeological potential." Using this approach, the OCS

protraction diagrams were each assigned a value of prehistoric archaeological potential of either low, medium, or high.

This study did not evaluate the area east of Barrow. The OCS area west of Barrow was found to have a low potential.

The more recent study (Dixon, et al., 1986) evaluated tracts to the east of Barrow, but west of Kaktovik, which was more detailed than the previous report. The Dixon, et al. report identified 192 tracts with a medium or high potential of prehistoric site occurrence. Tracts so identified are listed on Table 1. However, the study did not analyze some areas due to the unavailability of data (Dixon, personal communication). These areas included tracts on protraction diagrams NR 4-1, NR 7-5, NR 7-2, NR 7-3, NR 7-4, NR 7-5, and NR 7-6.

Tracts excluded from review in previous studies have been evaluated by the same criteria for low, medium, or high potential of prehistoric archaeological site occurrence. No tracts were found to have a potential for archaeological site occurrence other than low.

The criteria for significant landforms with a high or medium potential were reiterated by Friedman and Schneider (1984) as follows:

**Significant Landforms With a High Potential of  
Archaeological Site Occurrence**

1. Nonglacial river mouths and constricted marine approaches to these river mouths, river margins, and lake outlets. Estuaries and rivers, particularly those issuing from lakes, would have concentrated anadromous fish and their predators.
2. Natural terrestrial constrictions, such as passes, which funnel large mammal movements.
3. Prominent spits, points, rocky capes, headlands, and islands that may have provided habitat for Phocid and Otariid seals and for marine birds. Such habitat is only considered high probability if it occurs in conjunction with one or more additional habitat types or if there is natural constriction which would tend to concentrate these species.
4. Areas of habitat diversity and general high marine intertidal productivity, particularly those which might have prompted extensive macrophyte development. An example of this type of environment would be deep sinuous embayments.

Significant Landforms With a Medium Potential of  
Archaeological Site Occurrence

1. Lake margins. Although the presence of fish and water-fowl resources enhances these areas as settlement locales, they are less likely to be as productive (and consequently less likely to foster winter settlements) as those listed above.

2. North- and south-facing slopes. Guthries (1976) indicated that south-facing slopes tend to concentrate grazing mammals during early spring plant maturation and that many times north-facing slopes provide wind-blown, snow-free winter ranges. However, neither of these habitat types concentrate grazers into specific locations where large aggregate of animals can be harvested. Although these areas are generally more productive, the mammals are scattered over a comparatively large area.

TABLE 1

Blocks within the Lease Sale 124 area with a medium or high potential of prehistoric site occurrence, as reported by Dixon.

<u>Protraction</u>	<u>Diagram</u>	<u>Lease Block</u>
NR 4-2	High Potential	418-419, 461-463, 503-506, 545-548, 587-590, 631-633
	Medium Potential	507, 549-551, 675-676, 719, 763
NR 5-1	High Potential	335-339, 378-383, 420-424, 462-465
	Medium Potential	425-428, 466-472, 506-516, 550, 559-561, 603-605, 647-649, 652, 692-697, 738-742, 745-748, 786-792
NR 5-2	Medium Potential	749-754, 793-809, 839-853, 883-897, 984-986
NR 5-4	Medium Potential	16-18, 60-62
NR 6-3	Medium Potential	291, 334-336, 337-375, 423-424, 469-471, 515
NR 6-4	Medium Potential	728, 771-772, 802-804, 813-815, 847-849, 857-858, 893
Total High Potential Blocks:		40
Total Medium Potential Blocks:		152

#### Review of Sea Level Curves to Determine Habitability

In the previous archaeological analysis for the Sale 97 area by Friedman and Schneider, op. cit., a sea-level lowering of 90 m was assumed for the Bering Sea. This value was quoted by Hopkins ("Aspects of the Paleoecology of Beringia, During the Late Pleistocene," in Paleoecology of Beringia, 1982) on the basis of abandoned shorelines observed on the southern Bering Sea shelf. Abandoned shorelines which are hypothesized to document sea-level lowstands are generally believed to be formed by the rapid rise of sea level which abandons the beach. Such a rapid rise is thought to have occurred 18,000 years ago when the sea level stood near 82 m, so relic beaches near this depth would be expected on the southern Bering Sea shelf. The baseline studies, however, have evaluated blocks 125 m below modern sea level. The 125 m lowering of sea level is currently believed to have occurred during the penultimate glaciation (Illinoian) over 130,000 years ago. Tracts lying below 90 m bathymetry would have been emergent only before the arrival of people in the arctic. Tracts which were considered as having a medium or high probability of settlement by ancient people, but lying below 90 m, were rejected for further analysis.

As a result of this review, tracts NR 4-2 #418 and NR 5-1 #335 were deleted from further consideration in agreement with Friedman and Schneider's earlier report.

#### Review of Potential for Survivability of Prehistoric Sites

Friedman and Schneider recognized four factors in the arctic and subarctic environment which could affect the survivability of sites during and subsequent to submergence:

1. The general flatness and gentle slope of the sea-floor over much of the arctic and subarctic Outer Continental Shelf (OCS), which would allow a long period of time over which wave erosion could take place during the Holocene transgression. Also mentioned in this regard was the slow rate of onshore sediment disposition.
2. Shallow depth of the arctic and subarctic OCS, which averages 70 m, . . . allows waves to break far from shore. . . . This turbulence serves to churn and winnow the seafloor sediments.
3. Winter storms during periods of sea ice, which would cause ice gouging and shoreline scouring. Ice scour areas have been observed at depths of up to 90 m along the northern coast of the Alaska Peninsula.

4. Exposure of bedrock on the seafloor with resultant lack of sediment cover enhances all of the previously considered effects. (Friedman and Schneider, 1983)

From these observations, the Archaeological Analysis for Sale 87 concluded: "There is only a low probability that a prehistoric site could have survived the destructive effects of the Holocene transgressive seas." (Friedman and Schneider, 1983)

Recent research by Phillips, "Vibrocure Stratigraphy of the Northeastern Chukchi Sea," USGS Circ. 998, pp. 157-160 (1986), identified nonmarine sediments directly below post-transgression marine sediments. The nonmarine sediments were described as an iron-stained, well-rounded, quartz sand with brown peat laminae and beds, scattered isolated pebbles and pebble lags, and thin muddy gravel beds. The organic-rich laminae contained abundant insect remains, ostracodes (nonmarine), algal fragments, seeds and wood. These sediments varied from 19 to 245 cm and formed a blanket deposit thinning to the west over the survey area. The sediments were found in water depths of from 30 to 50 m. The presence of laminae could suggest the lower portion of the sequence was not reworked during the Holocene marine transgression (Phillips, personal communication).

The area described by Phillips lies in the southern Chukchi Sea. The oxidized sands are believed to represent nonmarine tundra, fluvial, and aeolian deposits of the exposed coastal plain. The deposit is not continuous and does not extend into the deeper water of the Chukchi Sea. The extent of the deposit to the northeast along the coast is hypothetical and it would not be expected to occur as far north as Barrow where ice gouging and related coastal processes are more severe.

While Phillips' work demonstrates that to the south some nonmarine deposits may have survived the transgression, continuing research in the sale area has confirmed the conclusions of Friedman and Schneider:

An analysis of various data sources, including fathograms, sub-bottom seismic profiles, and side-scan sonar records, indicate that there is very little likelihood that pre-historic sites in the proposed Lease Sale No. 87 area (sale area) could have survived the extensive ice gouging experienced in this part of the OCS. The data demonstrate that only limited portions of the shelf have been free from ice gouging since the retreat of the Pleistocene ice sheet approximately 18,000 years before present. A dynamic environment, which ice plays the dominant role in shelf morphology, exists year round. Repeated scouring and plowing of the bottom by ice rotate blocks of sediment,

homogenize the sediments, and disturb or obliterate any soil structure developed. (Friedman and Schneider, 1984)

As a result of this analysis no prehistoric sites are expected to have survived the transgression. Therefore, none of the tracts listed in Table 1 were retained for analysis.

#### Review of Potential Prehistoric Resource Site Detectability

Detectability was not considered by Friedman and Schneider since no tracts were determined to possess a medium or high potential for prehistoric resource occurrence and survival. A prehistoric resource site could not be detected by available geophysical methods including a side-scan sonar or sub-bottom profiler. Such a combination of tools could possibly detect significant landforms and whether a blanket-sand deposit, which may contain a resource, is present. However, it is extremely unlikely that an actual prehistoric resource site, even if it existed, would be detected since the site would be expected to be buried and its features would be too small to be identified even if it were exposed on the seafloor.

#### Review of Potential for Survivability of Shipwrecks

##### Ice Gouging

The processes which result in ice gouging vary. The fast-ice zone lies along the coast. Seaward of this zone, pressure and sheer ridges are formed within the Stamukhi zone in response to the interactions between the stationary fast ice and the motion of the offshore pack ice. Beyond the Stamukhi zone, the drift of the arctic-pack ice is guided by winds and currents.

The fast-ice zone forms where ice freezes to the shore. Within this zone bottom-fast ice occurs where the sea ice grounds on the seafloor. Since this sea ice grows up to 2 meters in thickness during one season, the bottom-fast ice zone is found within the 2-meter isobath. The seafloor of the bottom-fast ice zone is extensively scoured by current-induced ice motion. Where the fast-ice is not thick enough to ground on the seafloor, it forms the floating fast-ice zone. This zone extends from the 2-meter isobath to the pressure ridges of the Stamukhi zone generally located seaward of the 10-meter isobath. Within the floating fast-ice zone, remnants of huge ice blocks derived from the Stamukhi zone are frozen into the seasonal ice canopy. The rotation of the ice field during winter causes the incorporated ice blocks to gouge the seafloor. Seafloor gouging has also been observed during the summer when wind and currents drive the ice blocks. Most observed ice gouges are linear and trend parallel to the seafloor isobaths.

The seaward edge of the floating fast-ice zone, the Stamukhi zone, is formed by a series of major grounded ice ridges. Shear ridges, pressure ridges, and hummock fields characterize the Stamukhi zone. Between the 10- and 25-meter isobaths, these ridges intensely gouge the seafloor. Beyond the 25-meter isobath, the intensity of ice-gouging decreases. (Barnes and Rearic, 1986). The character of gouging also changes as the pattern of multiple gouging, typical of the grounding of ridges, is replaced by the solitary keels of ice blocks incorporated into the polar pack. Ice gouges formed by these solitary keels have been reported in water depths of 50 meters. Although the destruction of shipwrecks by ice gouging has not been documented, the density of ice gouging within the 25-meter isobath would probably serve to destroy a shipwreck. Beyond the 25-meter isobath, ice gouging frequencies gradually decrease and shipwreck destruction is more speculative.

##### Sedimentation

Nearshore processes such as intensive ice gouging, coastal erosion, and strudel scour excavate the seafloor and provide a copious source of sediments. The resulting surface sediments form a "gouge till" unit, with a mixture of modern and ancient sediments. Recent investigations have suggested that anchor-ice formation may play a major role in sediment transport within the sale area. (Reimnitz, Kempema, and Barnes, 1986). When fall storms agitate the sea surface to the extent that an ice cover does not form, sea water becomes slightly supercooled and ice nucleates on the seabed. Observations following storms have revealed pillow-size masses of ice covering the bottom. The ice pillows are composed of a rind of ice platlets surrounding a massive sediment-laden core. In addition to anchor ice formation, sediments may be entrained within the ice canopy by the formation of frazil ice. The rapid erosion of the coast and shelf is now known to be accompanied by rapid bedload movement far beyond the surf zone. Previously, the rate of sedimentation within the Beaufort Sea was believed to be quite low. It has been speculated that, rather than storm waves, the concurrent formation of anchor and frazil ice may account for most of the observed sediment transport. The absence of long term sediment sinks on the Beaufort Shelf suggests that shipwreck burial by ice transported sediments would not occur. (E. Reimnitz, personal communication.)

##### Review of Detectability of Shipwrecks

If shipwrecks exist and have survived destruction by ice gouging, they would remain exposed on the sea floor as sedimentation rates are not significant enough for burial. These shipwrecks will be detectable using side-scan sonar or an equivalent instrument in conjunction with a geohazards survey.

### Conclusions

As a result of this review no blocks within the sale area have been found to possess a high or medium potential of prehistoric site occurrence which survived the Holocene transgression and subsequent coastal processes intact. It is unlikely that shipwrecks would survive ice gouging and related ice forces if they occurred shoreward of the 25-meter isobath. Beyond the 25-meter isobath, the chances of a wreck surviving increase with distance from the Stamukhi Zone. Any such wrecks, if they exist, would still be exposed and detectable by side-scan sonar or equivalent instrument employed in a geohazards survey.

## SHIPWRECK UPDATE ANALYSIS FOR PROPOSED SALE 124, BEAUFORT SEA

### Purpose

In accordance with the MMS Handbook for Archaeological Resource Protection (621. 1-H) the following report was prepared per discussions at the MMS Archaeological Workshop in Anchorage, Alaska on July 16 through 18, 1990 and Melanie J. Stright's "Reassessment of Shipwreck Potential and Archaeological Survey Recommendations for Sale 109 Leases, Chukchi Sea, Alaska", 1990. As stated in the MMS handbook the purpose of the shipwreck update is to provide an assessment of the potential for locating historic resources in a proposed lease sale area. A regional baseline study or equivalent data is used in the preparation of this document. All new data which may serve to update the regional baseline study is also incorporated in this report.

### Known Shipwrecks Within the Sale Area

The majority of known shipwrecks within the Chukchi Sea and Beaufort are documented losses of the nineteenth century Arctic whaling fleet (refer to Tables 1 through 4). Information that was reviewed to determine the locations of known shipwrecks within the Sale area includes the Draft MMS in-house baseline report "Shipwrecks of the Alaskan Shelf and Shore" by Evert Tornfelt, 1990; "Steam Whaling in the Western Arctic," Bockstoce, 1977; and "Whales, Ice, and Men: the History of Whaling in the Western Arctic," Bockstoce, 1986 (Bockstoce is considered by most to be the world authority on whaling in the Arctic). Using these sources, shipwreck locations in the Sale area were remapped on a basemap showing the OCS lease block grid and bathymetry at a 1:1,000,000 scale.

There are 54 shipwrecks in the Proposed Sale 124 area. The location of the 16 shipwrecks (Table 1) in the proposed Sale 124 lease area is uncertain and cannot be assigned to blocks:

Table 1

#### Shipwrecks Which Cannot be Assigned to Blocks

Houqua	John P. West
Bramin	Pioneer
Mexican	Sophia
Susan	Mary Sachs
Iris	Baychimo
Rainier	Arctic
James A. Hamilton	Clara Light
Abraham Barker	Mary Mitchell

The probability that these may have survived ice gouging if they are located within the 25-meter isobath is low. If located beyond the 25-meter isobath, ice gouging frequencies gradually decrease and shipwreck destruction is more speculative. (See Summary of Geomorphological Processes Pertaining to Survivability of Archaeological Resources in the Beaufort Sea Sale 124, Prepared by MMS in this Appendix). Given the large number of imprecisely located wrecks a cautious exploration process would involve a pre exploration survey.

The location of the 19 shipwrecks (Table 2) is more precise.

Table 2

#### Shipwrecks which can be assigned to Blocks

Almira	Camilla
Massachusetts	Cornelius Howland
Roscoe	Desmond
Three Brothers	Java 2nd
Young Phoenix	Josephine
Navarch	Marengo
Laura Madsen	Onward
Arnold Liebes	St. George
C. B. Brower	Elvira
Acors Barnes	

Given the large number of assigned wrecks a cautious exploration process would invoke the archaeological stipulation on blocks relevant to these shipwrecks. The blocks where these are likely to be located are shown in Table 3.

Table 3

#### Blocks which have Shipwreck Potential

NR 4-2 Blocks 502-505, 546-549, 589, 590, 593;
NR 7-3 Blocks 936-938, 981, 982;
NR 7-5 Block 15.

No ship in the above blocks can be assigned to a particular block since locational data is not that precise for these ships. All of the ships in Table 2 except the Elvira are believed to be located in the NR 4-2. The Elvira is somewhere in the other blocks listed in Table 3. There are enough ships in the blocks listed in Table 3 which may have survived that invoking the stipulation for these blocks is prudent action to protect them.

There are 19 other ships shown in Table 4 that are all believed to be in state waters and therefore are not within OCS Jurisdiction (See Solicitors opinion on Onshore Facilities, Memorandum MMS.ER.0227, Received August, 1987).

Table 4

#### Shipwrecks which are in State Waters or Onshore near the Lease Area

Reindeer	Florence
Duxbury	Spy
Rosario	Wm. Lewis
Daniel Webster	Grampus
Mary and Susan	Ivy
North Star	Hibernia
Fleetwing	Ino
W.A. Farnsworth	Transit
William H. Allen	Arctic
Lady Kindersly	

### Possible Locations of Unreported Shipwrecks Within the Sale Area

The most prevalent cause of shipwrecks within the sale area was shipwrecks being caught and crushed by the pack ice. As the ships often followed near-shore leads through the pack, most often they were crushed or ran aground when shifting winds caused the pack ice to begin moving shoreward. Once trapped in the ice, strong ocean currents either would move the ships around Pt. Barrow into the Beaufort Sea or would carry them northwestward from Pt. Barrow into the Arctic.

The whaling fleets of the nineteenth century would sail narrow leads up the coast of Alaska from Icy Cape and make their way to Pt. Barrow by late July or August. Later, particularly after the advent of steam powered ships, they began making their way into the Beaufort Sea following a route between the coast and the pack ice to the north. In later years, whale ships began wintering at Hershel Island in the eastern Beaufort. On leaving the Beaufort Sea at the end of the summer season, many of the ships would head westward from Pt. Barrow, following the southern edge of the pack ice to Herald Island, which was the autumn feeding grounds of the Bowhead whale.

There are no reports of ships being wrecked along this western route through the Chukchi Sea, although two ships, the "Mount Wollaston" and the "Vigilant" were caught in the ice and lost in the vicinity of Herald Island in 1879. Herald Island lies well west of the Sale area.

The distribution of known shipwrecks in the Sale area indicates that most of the ships were trapped by ice or ran aground within very shallow coastal waters. This observed distribution is due to the fact that ships were generally forced to sail within narrow strips of open water between the pack ice and shore due to the numerous capes and shoals off the coast. Therefore, it is probable that most unreported shipwrecks within the Sale area will occur close to shore in shallow water.

### Preservation Potential of Shipwrecks Within Sale Area

First to be considered in the preservation of shipwrecks in the sale area is the human factor. According to the accounts reported in Bockstoe (1986), many ships were extensively salvaged after wrecking. Following the whaling fleet disaster of 1871, commercial salvagers organized expeditions to the Arctic to remove whatever was of value from the 31 wrecked ships. There are also several accounts of ships having been condemned due to damage from ice, then being towed to shore and auctioned off to raise money for the owners. These salvage actions had the effect of diminishing the apparent shipwreck resource from what otherwise might be expected. These actions have been taken into consideration in the lists of Tables 1 through 4.

Geologic and oceanographic factors which may contribute to the preservation or destruction of shipwreck remains in the Chukchi Sea and Beaufort Sea include bottom sediment type and thickness, water depth, strong currents and ice gouge intensity. As the effects of these physical processes on the remains of sunken vessels in the Chukchi Sea and Beaufort Sea have not been directly observed, the following discussion is hypothetical.

The processes which result in ice gouging vary. The fast-ice zone lies along the coast. Seaward of this zone, pressure and shear ridges are formed within the Stamukhi zone in response to the interactions between the stationary fast ice and the motion of the offshore pack ice. Beyond the Stamukhi zone, the drift of the arctic-pack ice is guided by winds and currents.

The fast-ice zone forms where ice freezes to the shore. Within this zone bottom-fast ice occurs where the sea ice grounds on the seafloor. Since this sea ice grows up to 2 meters in thickness during one season, the bottom-fast ice zone is found

within the 2-meter isobath. The seafloor of the bottom-fast ice zone is extensively scoured by current-induced ice motion. Where the fast-ice is not thick enough to ground on the seafloor, it forms the floating fast-ice zone. This zone extends from the 2-meter isobath to the pressure ridges of the Stamukhi zone generally located seaward of the 10-meter isobath. Within the floating fast-ice zone, remnants of huge ice blocks derived from the Stamukhi zone are frozen into the seasonal ice canopy. The rotation of the ice field during winter causes the incorporated ice blocks to gouge the seafloor. Seafloor gouging has also been observed during the summer when wind and currents drive the ice blocks. Most observed ice gouges are linear and trend parallel to the seafloor isobaths.

The seaward edge of the floating fast-ice zone, the Stamukhi zone, is formed by a series of major grounded ice ridges. Shear ridges, pressure ridges, and hummock fields characterize the Stamukhi zone. Between the 10- and 25-meter isobaths, these ridges intensely gouge the seafloor. Beyond the 25-meter isobath, the intensity of ice-gouging decreases. (Barnes and Rearic, 1986). The character of gouging also changes as the pattern of multiple gouging, typical of the grounding of ridges, is replaced by the solitary keels of ice blocks incorporated into the polar pack. Ice gouges formed by these solitary keels have been reported in water depths of 50 meters. Although the destruction of shipwrecks by ice gouging has not been documented, the density of ice gouging within the 25-meter isobath would probably serve to destroy a shipwreck. Beyond the 25-meter isobath, ice gouging frequencies gradually decrease and shipwreck destruction is more speculative. (See MMS Geophysical Report in this Appendix)

In summary, ice gouging on the Chukchi and Beaufort Sea shelves is most intense along topographic highs and near-shore slopes, the same areas where shipwrecks tend to concentrate. This is a negative factor for shipwreck preservation. Outside the areas of intense ice gouging, gouges are sparse and gouge depths are shallow (maximum depth of 1.3 meters with an average depth of 0.3 meters or less, Phillips, 1986). Ice gouge intensity decreases rapidly with increasing water depth and is most prevalent in water depths of less than 30 meters.

The coarse-grained gravels present at the seafloor along much of the coast of the eastern Chukchi and the Beaufort Sea, the Alaskan Coastal Current and storm-generated currents which rework the seafloor sediments out to a distance of possibly 70 km offshore, and the intensive ice gouging which occurs in water depths of 25 meters or less and concentrates on shoals and near-shore slopes, all are factors which act negatively on the preservation of shipwreck remains in the Seas. Beyond the 25-meter isobath, the chances of a wreck surviving increase with the distance from the Stamukhi Zone. Any such wrecks, if they exist, would still be exposed and detectable by side-scan sonar or equivalent instrument employed in a geohazards survey. Areas having the highest preservation potential will be those areas which have the thickest accumulations of unconsolidated muds and sands.

### Effectiveness of Remote Sensing Survey Instruments

In areas having only a thin sequence of unconsolidated sediments at the seafloor, the side scan sonar should detect evidence of any shipwrecks present within a survey area. Although it was reported by Claussen and Arnold (1975) that the shipwrecks discovered at Padre Island, Texas were completely buried in only 1.5 meters of unconsolidated sediments, these ships were about 300 years older (dating from 1554) and were much smaller than the ships expected to be found in the Chukchi Sea. At 300-meter linespacing, the side scan sonar, operating at a per-channel range of 200 meters, will have an overlap of 100 meters between survey lines and will resolve objects on the order of one meter in size. This should be sufficient to detect any historic shipwreck remains protruding above the seafloor.

Where surficial unconsolidated sediments are thick enough to have completely buried historic shipwreck remains, the magnetometer becomes the primary instrument of shipwreck detection. The survey linespacing required to completely search an area depends upon the amount of ferrous material associated with a shipwreck. Closer linespacing would be required to locate a wooden sailing ship having only ferrous fastenings and fittings than would be required to locate a steam whaler with iron pots of the tryworks, and with iron boiler and smokestack. For example, one ton of iron would cause a magnetic anomaly of only 5 gammas at a distance of 24 meters from the magnetometer sensor (Breiner, 1973). This anomaly intensity is barely above the background noise level under ideal conditions. At high northern latitudes such as the Chukchi Sea, increased interference from magnetic storms makes detection of such small intensity anomalies problematic. Although permanent magnetic base stations such as the one operated by the U. S. Geological Survey at Point Barrow, Alaska, can provide continuous data on magnetic storm conditions, correlating the date factor from these base stations to a specific data set in order to mathematically factor out noise would be extremely difficult because the two data sets would have to be precisely time correlated. Of more utility might be to use a gradiometer which involves towing two magnetometer sensors in a fixed horizontal or vertical configuration. Such a system allows two sets of magnetometer data to be collected simultaneously. The differences between the two data sets then provide real information on magnetic anomalies within the survey area.

The subbottom profiler is of very limited utility in the detection of shipwrecks for the reason that it collects only a singleline of acoustic information directly under the survey vessel. It would be possible to see evidence of a shipwreck on the subbottom profiler data only if the survey vessel passed directly over the wreck. As a shipwreck may represent a relatively hard object within the seafloor sediments, it might produce a parabolic diffraction on the profiler data similar to those seen when passing over a pipeline or shell bed (Stright, 1990).

In summary, the side scan sonar is the most practical instrument for shipwreck detection when bottom conditions are such that shipwreck remains would be visible at the seafloor. If shipwreck remains are completely buried, a magnetometer is essential for shipwreck detection. While 300-meter linespacing is adequate for 100 percent coverage of the seafloor with a side scan sonar, much closer linespacing (probably a minimum of 50 meters) is necessary to ensure detection of buried shipwreck remains with a magnetometer. The effectiveness of the magnetometer at this linespacing is dependent on the amount of ferrous material present on a shipwreck.

#### Survey Recommendations for the Beaufort Sea

The archaeological survey stipulation should be invoked by the RSFO on the blocks listed in Table 3:

NR 4-2 Blocks 502-505, 546-549, 589, 590, 593;  
NR 7-3 Blocks 936-938, 981, 982;  
NR 7-5 Block 15;

In the absence of particular leased blocks having shipwrecks reported on them it is also necessary for the lessee to determine if any of the uncertainly-located shipwrecks in Table 1 could be on their blocks and with consultation with the RSFO determine the appropriate action.

In the event an anomaly, which might indicate the presence of a shipwreck, were identified on remote sensing records from a site-specific geohazards survey, and the lessee did not propose to move the location of operations to avoid the anomaly, the lessee would be required to prepare an archaeological report in accordance with the MMS Handbook for Archaeologic Resource Protection and the Alaska State Historical Preservation Officer would be notified. Based on an analysis

of the archaeological report, the lessee would be required to move the site of operations, modifying operations to avoid damage to the potential resource; or ensure that the potential resource would not be affected by the proposed activities.

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**APPENDIX J**

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**SUPPORTING TABLES FOR SECTION III.C.1,  
ECONOMY OF THE NORTH SLOPE BOROUGH,  
AND SECTION IV.C.8,  
EFFECTS ON THE ECONOMY OF THE  
NORTH SLOPE BOROUGH**

Table J-1. Direct Employment Assumptions Per Unit of Work for Proposed Sale 124--by Work Type

TYPE OF WORK (one unit) AND ASSOCIATED TASKS	CREW SIZE (a)	SHIFT FACTOR (b)	ROTA- TION FACTOR (c)	NUMBER OF AIRCRAFT OR BOATS	TOTAL WORKFORCE (d)	DURATION (MONTHS)	TOTAL WORK-MONTHS	OF OUT- OF-STATE COMPUTERS (percent)
<b>DRILLING AN EXPLORATION OR DELINEATION WELL</b>								
Drilling Crew Activities	50	2	2.0	-	200	3.0	600	79.0
Helicopter Support for Drilling	5	1	2.0	1.5	15	3.0	45	47.5
Supply/Anchor Boats for Drilling Support	12	1	2.0	3.0	72	3.0	216	58.0
Longshoring Support for Drilling	6	1	2.0	-	12	3.0	36	35.0
Other Onshore Work in Support of Drilling	4	1	2.0	-	8	3.0	24	79.0
<b>CONSTRUCTING AN EXPLORATION SHORE BASE</b>								
OPERATING AN EXPLORATION SHORE BASE (1 YEAR)	67	1	2.0	-	133	12.0	1600	79.0
CONDUCTING A GEOLOGICAL-GEOPHYSICAL SURVEY	10	2	2.0	-	40	6.0	240	79.0
CONSTRUCTING AN EXPLORATION ISLAND	30	1	2.0	1.0	60	3.0	180	79.0
<b>CONSTRUCTING AN EXPLORATION ISLAND</b>								
Construct Ice Road	6	2	2.0	-	24	2.00	48	70.0
Haul Gravel in Trucks	136	2	2.0	-	544	2.16	1175	70.0
Haul Gravel in Barges	125	2	2.0	-	500	1.33	665	70.0
Construct Island from Barge Mounted Camp	44	2	2.0	-	176	1.33	234	70.0
<b>INSTALLING A PRODUCTION PLATFORM (&amp; EQUIP)</b>								
All Work by Platform Installation Crews	150	2	2.0	-	600	10.0	6000	89.5
Helicopter Support-Platform Installation	5	1	2.0	2.0	20	10.0	200	47.5
Tugboat Support for Platform Installation	10	1	1.5	4.0	60(e)	1.0	60	58.0
Supply/Anchor Boat Support-Platform Inst.	13	1	1.5	3.0	59(e)	10.0	585	58.0
Longshoring for Platform Installation	20	1	1.5	-	30(e)	10.0	300	35.0
Other Onshore Support for Platform Inst.	25	1	1.5	-	38(e)	10.0	375	89.5
<b>INSTALLING AN OFFSHORE LOADING PLATFORM</b>								
All Work by Platform Installation Crews	50	2	2.0	-	200	2.5	500	89.5
Helicopter Support-Platform Installation	5	1	2.0	2.0	20	2.5	50	47.5
Tugboat Support for Platform Installation	12	1	2.0	1.0	24	1.0	24	58.0
Supply/Anchor Boat Support-Platform Inst.	12	1	2.0	2.0	48	2.5	120	58.0
Longshoring for Platform Installation	6	1	2.0	-	12	2.5	30	35.0
Other Onshore Support for Platform Inst.	8	1	2.0	-	16	2.5	40	89.5
<b>CONSTRUCTING A PRODUCTION SHORE BASE</b>								
DRILLING A PRODUCTION OR SERVICE WELL	50	2	2.0	-	200	12.0	2400	47.5
LAYING OFFSHORE OIL PIPE (100 MILES)	28	2	2.0	-	112	3.0	336	79.0
<b>LAYING OFFSHORE OIL PIPE (100 MILES)</b>								
All Work of Laying Barge Crews	175	2	2.0	1.0	700	3.3	2310	89.5
Helicopter Support for Pipe Laying	5	1	2.0	1.0	10	3.3	33	47.5
Tugboat Support for Pipe Laying	10	1	1.5	2.0	30(e)	3.3	99	58.0
Supply/Anchor Boats for Pipe Laying	13	1	1.5	3.0	59(e)	3.3	193	58.0
Longshoring Support for Pipe Laying	20	1	1.5	-	30(e)	3.3	99	35.0
Other Onshore Support for Pipe Laying	35	1	1.5	-	53(e)	3.3	173	89.5
<b>LAYING ONSHORE OIL PIPE (100 MILES)</b>								
CONSTRUCTING A MARINE OIL TERMINAL	250	2	2.0	-	1000	6.7	6667	79.0
CONSTRUCTING AN ONSHORE PUMP STATION	300	1	2.0	-	600	12.0	7200	47.5
CONSTRUCTING A PRODUCTION ISLAND	100	1	2.0	-	200	8.0	1600	47.5
CONSTRUCTING A PRODUCTION ISLAND	225	2	2.0	-	900	3.0	2700	47.5
<b>OPERATING A PRODUCTION PLATFORM (1 YEAR)</b>								
All Work of Platform Operations Crews	40	2	2.0	-	160	12.0	1920	25.0
Helicopter Support-Platform Operations	5	1	2.0	1.0	10	12.0	120	25.0
Supply/Anchor Boats-Platform Operations	12	2	1.5	1.0	36(e)	12.0	432	25.0
Longshoring for Platform Operations	6	1	1.5	-	9(e)	12.0	108	25.0
Other Onshore Work for Platform Operatns	2	1	1.5	-	3(e)	12.0	36	25.0
<b>MAINTENANCE ON ONE MAJOR PLATFORM</b>								
MAINTENANCE ON ONE PRODUCTION ISLAND	10	1	2.0	-	20	4.0	80	25.0
WELL WORKOVERS FOR ONE OIL PLATFORM	28	2	2.0	-	112	3.0	336	25.0
OPERATING A PRODUCTION SHORE BASE (1 YEAR)	10	1	2.0	-	20	6.0	120	25.0
OPERATING A MARINE OIL TERMINAL (1 YEAR)	40	1	2.0	-	80	12.0	960	25.0
OPERATING A MARINE OIL TERMINAL (1 YEAR)	50	2	2.0	-	200	12.0	2400	25.0

Notes: (a) work-months (180 hours) per shift (b) shifts per rotation  
(c) rotations per month: "2.0"--15 days on/15 off schedule, "1.5"--20 days on/10 off schedule  
(d) total work-months per month (e) 240 hour work-month

Sources: MMS Employment Model, Alaska OCS Region, 1985; Dames and Moore, 1982

Table J-2. Sale 124 Direct Industry Employment Requirements for the Base Case

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010
TOTAL DIRECT OCS MANPOWER REQUIREMENTS .....	0	10	15	20	40	239	412	422	269	289	1521	2069	1395	716	716	735	735	735	745	725
ONSHORE JOBS -- TOTAL .....	0	0	0	0	0	38	65	65	38	38	577	599	553	124	124	124	124	124	124	124
SHORT-TERM																				
Skilled .....	0	0	0	0	0	22	38	38	22	22	449	449	406	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	16	27	27	16	16	128	128	104	0	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	13	26	66	66	66	66	66	66	66
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	9	18	58	58	58	58	58	58	58
OFFSHORE JOBS -- TOTAL .....	0	0	0	0	0	151	287	287	151	151	745	1270	641	392	392	411	411	411	421	421
SHORT-TERM																				
Skilled .....	0	0	0	0	0	151	287	287	151	151	745	1048	249	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	180	360	360	360	379	379	379	389	389
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	16	32	32	32	32	32	32	32	32
EXPLORATION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	189	352	352	189	189	0	0	0	0	0	0	0	0	0	0
DEVELOPMENT PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	1321	1651	892	0	0	0	0	0	0	0
PRODUCTION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	0	218	436	516	516	535	535	535	545	545
TOTAL EMPLOYMENT - EXCEPT HQ	0	0	0	0	0	189	352	352	189	189	1321	1869	1328	516	516	535	535	535	545	545

Source: MMS Employment Model, 1989

Table J-3. Sale 124 Direct Industry Employment Requirements for the Low Case

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010
TOTAL DIRECT OCS MANPOWER REQUIREMENTS .....	0	10	15	20	40	239	249	0	0	0	0	0	0	0	0	0	0	0	0	0
ONSHORE JOBS -- TOTAL .....	0	0	0	0	0	38	38	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORT-TERM																				
Skilled .....	0	0	0	0	0	22	22	0	0	0	0	0	0	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFFSHORE JOBS -- TOTAL .....	0	0	0	0	0	151	151	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORT-TERM																				
Skilled .....	0	0	0	0	0	151	151	0	0	0	0	0	0	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EXPLORATION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	189	189	0	0	0	0	0	0	0	0	0	0	0	0	0
DEVELOPMENT PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRODUCTION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EMPLOYMENT - EXCEPT HQ	0	0	0	0	0	189	189	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: MMS Employment Model, 1989

Table J-4. Sale 124 Direct Industry Employment Requirements for the High Case

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2010
TOTAL DIRECT OCS MANPOWER REQUIREMENTS .....	0	10	15	20	40	402	883	816	749	529	1232	2408	2288	2475	2271	2271	2327	1739	1739	1749
ONSHORE JOBS -- TOTAL .....	0	0	0	0	0	65	128	119	110	74	609	613	575	575	292	292	292	292	292	292
SHORT-TERM																				
Skilled .....	0	0	0	0	0	38	78	72	66	44	475	458	436	436	0	0	0	0	0	0
Unskilled .....	0	0	0	0	0	27	50	47	44	30	135	155	139	139	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	158	158	158	158	158	158
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	134	134	134	134	134	134
OFFSHORE JOBS -- TOTAL .....	0	0	0	0	0	287	695	627	559	355	423	1596	1513	1700	1779	1779	1835	1247	1247	1277
SHORT-TERM																				
Skilled .....	0	0	0	0	0	287	695	627	559	355	423	1569	1513	1700	603	603	603	15	15	15
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0
LONG-TERM																				
Skilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1080	1080	1136	1136	1136	1166
Unskilled .....	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	96	96	96	96	96
EXPLORATION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	352	823	746	669	429	265	189	15	15	15	15	15	15	15	15
DEVELOPMENT PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	767	2020	2207	2260	588	588	588	0	0	0
PRODUCTION PHASE EMPLOYMENT (EXCEPT HQ)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1468	1468	1524	1524	1524	1554
TOTAL EMPLOYMENT - EXCEPT HQ	0	0	0	0	0	352	823	746	669	429	1032	2208	2222	2275	2071	2071	2127	1539	1539	1569

Source: MMS Employment Model, 1989

**APPENDIX K**

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**ENDANGERED SPECIES ACT SECTION 7  
CONSULTATION AND DOCUMENTATION**



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
1335 East-West Highway  
Silver Spring, MD 20910  
OFFICE OF THE DIRECTOR

AUG 7 1990

Mr. Barry Williamson  
Director  
Minerals Management Service  
U.S. Department of the Interior  
Washington, D.C. 20240

Statement Regarding Incidental Taking  
Pursuant to Section 7(b)(4) of the  
Endangered Species Act of 1973

Dear Mr. Williamson:

Enclosed is an amended Incidental Take Statement for endangered whales that should become a part of the Arctic Region biological opinion issued to the Minerals Management Service November 23, 1988.

At that time, the taking of endangered whales incidental to OCS leasing and exploration activities was not authorized by the National Marine Fisheries Service under Section 7 of the Endangered Species Act because this incidental take had not been authorized under Section 101(a)(5) of the Marine Mammal Protection Act. However, NMFS published final regulations on July 18, 1990, under Section 101(a)(5) authorizing a take of marine mammals incidental to oil and gas exploration in the Beaufort and Chukchi Seas for the next five years. These regulations will become effective August 17, 1990, which will also be the effective date of the amended Incidental Take Statement.

If you have any questions regarding the statement, please contact Dr. Nancy Foster, Director, Office of Protected Resources, at (301) 427-2322.

Sincerely,

*William W. Fox, Jr.*  
(for) William W. Fox, Jr.

Enclosure

Section 7(b)(4) of the Endangered Species Act (ESA) requires that when a proposed agency action is consistent with Section 7(a)(2) of the ESA, and the action is also likely to take individuals of some species incidental to the action, the National Marine Fisheries Service (NMFS) will issue a statement that specifies the impact (amount or extent) of the incidental taking, and will provide reasonable and prudent measures that are necessary to minimize the impacts of the taking. Incidental taking by the Federal agency or applicant that complies with the specified terms and conditions of this statement is authorized and exempt from the taking prohibitions of the ESA.

This statement allows a take of bowhead and gray whales (by harassment) incidental to oil and gas exploration in the Beaufort and Chukchi Seas for the next 5 years. No incidental take of other endangered or threatened species is authorized. The impact of taking was discussed in the preamble and final rule allowing an incidental take (55 FR 29207). Consultation must be reinitiated if the take is other than by harassment.

Reasonable and Prudent Measures

Compliance with 50 CFR Part 228 - Subpart D - Taking of Marine Mammals Incidental to Oil and Gas Exploration in Alaska

THE ASSISTANT ADMINISTRATOR  
FOR FISHERIES





UNITED STATES DEPARTMENT OF COMMERCE  
National Marine Fisheries Administration  
NATIONAL MARINE FISHERIES SERVICE  
1225 East-West Highway  
Silver Spring MD 20910  
OFFICE OF THE DIRECTOR

AUG 8 1990



IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99503



NAES/DOS

JUN 11 1990

Mr. Ed Cassidy  
Deputy Director  
Minerals Management Service  
Department of the Interior  
Washington, D.C. 20240

Dear Mr. Cassidy:

Thank you for your letter regarding recent changes to oil resource estimates for Outer Continental Shelf Lease Sale 124.

Since the revised estimates would not appreciably affect the level of activity occurring during the exploration phase of this sale, and since the Minerals Management Service will reinstate consultation for any future development and production phase, the National Marine Fisheries Service concurs with your assessment that the Arctic Region Biological Opinion remains relevant and appropriate. These changes would not result in an impact to endangered species not previously considered. Therefore, we concur that reinstitution of consultation is not necessary at this time.

Sincerely,

*Samuel W. McKean*  
(for) William W. Fox, Jr.

THE ASSISTANT ADMINISTRATOR  
FOR FISHERIES



Memorandum

To: Regional Director  
Minerals Management Service, Alaska

From: Regional Director  
Region 7

Subject: Section 7 Consultation on Proposed Oil and Gas Lease Sale 124

The Minerals Management Service and the Fish and Wildlife Service (Service) recently concluded Section 7 consultation on the proposed Beaufort Sea Oil and Gas Lease Sale 124. The Service concluded that the proposed action would not jeopardize the continued existence of the Arctic peregrine falcon (*Falco peregrinus tundrius*). Minerals Management Service subsequently revised their estimate for potential oil and gas resources in the area of Lease Sale 124. Estimated oil resources in the project area were revised from 530 million barrels to 900 million barrels. The estimated marginal probability that a commercial oil accumulation exists in the area increased from 14 to 16 percent. These changes resulted in Minerals Management Service revising the projected level of development and production activities from two to four production platforms. The projected level of exploration activities remained the same.

As a result of these changes, Minerals Management Service re-evaluated the potential effects of the proposed project on threatened and endangered species. They concluded that these changes would not significantly affect endangered and threatened species in a manner or to an extent not considered in the May 17, 1990, Biological Opinion. The Service concurs with the Minerals Management Service's conclusion that the Biological Opinion continues to remain relevant and appropriate.

Thank you for your continued concern for endangered species. If you have questions, please contact Ronald L. Garrett, Regional Endangered Species Coordinator at (907) 786-3505 or FTS 869-3505.

*Walter O. Stiefitz*

RECEIVED

JUN 13 1990

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

RL/LL



United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240



JUN - 4 1990

RECEIVED  
JUN 8 1990

Dr. William Fox  
Assistant Administrator for Fisheries  
National Marine Fisheries Service  
Department of Commerce  
Washington, D.C. 20235

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

Dear Dr. Fox:

The Minerals Management Service (MMS) recently used updated information and analytical methods to reassess the potential oil and gas resources in numerous planning areas on the U.S. Outer Continental Shelf. One of these was the Beaufort Sea Planning Area offshore northern Alaska, which includes the areas to be offered for leasing in proposed oil and gas Lease Sale 124.

Under section 7(a) of the Endangered Species Act (ESA), MMS requested on December 1, 1989, initiation of formal consultation with the National Marine Fisheries Service (NMFS) for the leasing and exploration phases of proposed Lease Sale 124. On March 9, 1990, NMFS issued its finding that the previously released November 23, 1988, biological opinion for the Arctic Region remained valid and applied also to Sale 124. That opinion concluded "no jeopardy" for the leasing and exploration phases, provided exploration does not occur in the spring lead (ice-free) systems occupied by migrating bowhead whales.

The potential mean oil resources considered in the original Sale 124 consultation were estimated to be 530 million barrels. Our recent reassessment, however, made us revise this figure upward to 900 million barrels. The estimated marginal probability that a commercial oil accumulation exists in the area has risen less dramatically from 14 to 16 percent. These changes forced us to reassess the projected exploration and development/production scenarios and the oil spill risk analysis (OSRA). Overall, the changes increase the projected level of development and production activities from two to four production platforms, but the projected level of exploration activities remains the same.

The MMS completed in February 1990, a draft Environmental Impact Statement (EIS) on proposed Lease Sale 124. The final EIS--scheduled for completion in September 1990--will be updated to include the revisions described above. These changes are also reflected in the enclosed text pages and appendices to the biological evaluation we provided to you with our original December 1, 1989, request for formal consultation. The revisions in the text are highlighted while the material they replace is

Dr. William Fox

2

marked-through to facilitate ready review. (To expedite such a review, we are sending to your Anchorage field office a copy of this letter and the enclosures.)

The marginal probability of commercial oil accumulations existing in the area requires as much consideration as the effects due to the estimated oil resources. Translated to potential levels of impact to endangered species addressed in the Lease Sale 124 consultation, MMS believes that the extremely low likelihood of oil spills during exploration would, in light of the revised low probability of finding oil, remain low. In addition, the OSRA revisions result in an overall low potential of one or more spills occurring during production and contacting endangered species resource areas (see revisions on pages 8, 15, 17, and appendix E). Consequently, all available data indicate that the conclusions in the November 23, 1988, NMFS biological opinion continue to remain relevant and appropriate.

Relative to NMFS's ESA section 7 implementation regulations, we do not believe that reinitiation of consultation is needed or appropriate under 50 CFR 402.16(b)--the only criterion that applies in this case--because the above information would not significantly affect endangered species in a manner or to an extent not considered during the consultation. We ask for your written concurrence with our determination as quickly as practicable. Such written concurrence is consistent with the spirit of 50 CFR 402.13(a) and 402.14(b), although these sections do not technically apply to this situation because we are dealing here with potentially adverse effects that NMFS has already scrutinized through the section 7 process.

If you or your staff have questions about this matter, please contact Jackson E. Lewis of our headquarters office at (703) 787-1742, or Dan Benfield of our Alaska Region office at (907) 261-4672.

Sincerely,

Carolita Kallaur

Ed Cassidy  
Deputy Director

5 Enclosures

PS/KS  
Alaska  
Region



United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240



JUN - 4 1990

Memorandum

To: Director, U.S. Fish and Wildlife Service  
From: Deputy Director /s/ Ed Cassidy  
Subject: Endangered Species Act Section 7 Formal Consultation for Proposed Oil and Gas Lease Sale 124

The Minerals Management Service (MMS) recently used updated information and analytical methods to reassess the potential oil and gas resources in numerous planning areas on the U.S. Outer Continental Shelf. One of these was the Beaufort Sea Planning Area offshore northern Alaska, which includes the areas to be offered for leasing in proposed oil and gas Lease Sale 124.

Under section 7(a) of the Endangered Species Act (ESA), MMS requested on December 11, 1989, initiation of formal consultation with the U.S. Fish and Wildlife Service (FWS) for the leasing and exploration phases of proposed Lease Sale 124. On May 17, 1990, the FWS Alaska Regional Director issued a "no-jeopardy-to-peregrine-falcons" biological opinion for the sale.

The potential mean oil resources considered in the original Sale 124 consultation were estimated to be 530 million barrels. Our recent reassessment, however, made us revise this figure upward to 900 million barrels. The estimated marginal probability that a commercial oil accumulation exists in the area has risen less dramatically from 14 to 16 percent. These changes forced us to reassess the projected exploration and development/production scenarios and the oil spill risk analysis (OSRA). Overall, the changes increase the projected level of development and production activities from two to four production platforms, but the projected level of exploration activities remains the same.

The MMS completed in February 1990 a draft Environmental Impact Statement (EIS) on proposed Lease Sale 124. The final EIS--scheduled for completion in September 1990--will be updated to include the revisions described above. These changes are also reflected in the attached text pages and appendices to the biological evaluation that we provided to you with our original December 11, 1989, request for formal consultation. The revisions in the text are highlighted while the material they replace is marked-through to facilitate ready review. (To expedite such a review, we are sending to your Anchorage regional office and Fairbanks field office copies of this memorandum and the attachments.)

The marginal probability of commercial oil accumulations existing in the area requires as much consideration as the effects due to the estimated oil resources. Translated to potential levels of impact to endangered and threatened species addressed in the Lease Sale 124 consultation, MMS believes that the extremely low likelihood of oil spills during exploration would, in light of the revised low probability of finding oil, remain low. In addition, the OSRA revisions result in an overall low potential of one or more spills occurring and contacting endangered and threatened species resource areas (see revisions on pages 8, 15, 17, and appendix E). Consequently, all available data indicate that the conclusions in the May 17, 1990, FWS biological opinion continue to remain relevant and appropriate.

Relative to FWS's ESA section 7 implementation regulations, we do not believe that reinitiation of consultation is needed or appropriate under 50 CFR 402.16(b)--the only criterion that applies in this case--because the above information would not significantly affect endangered and threatened species in a manner or to an extent not considered during the consultation. Although we have received verbal agreement with our determination from FWS headquarters staff, we ask for written concurrence as quickly as practicable. Such concurrence is consistent with the spirit of 50 CFR 402.13(a) and 402.14(b), although these sections do not technically apply to this situation because we are dealing here with potentially adverse effects that FWS has already scrutinized through the section 7 process.

If you or your staff have questions about this matter, please contact Jackson E. Lewis of our headquarters office at (703) 787-1742 or Dan Benfield of our Alaska Region office at (907) 261-4672.

5 Attachments

bcc: Official File  
AD/OMM  
Deputy Director  
RD, Alaska Region  
RS/LE, Alaska Region  
OEAD RF  
Chief, BEO  
Lewis/Turner  
BEE/BEM/BES  
Offshore Chron (1)/(2)  
BEO RF

IMS:OEAD:MS644:Lewis:lm:5/22/90:9-787-1728:Lewis:124FWS.mem



United States Department of the Interior

FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99503

IN REPLY REFER TO:

NAES/DOS

MAY 17 1990

Memorandum

To: Regional Director  
Minerals Management Service, Alaska

From: ~~Acting~~ Regional Director  
Region 7

Subject: Biological Opinion for Lease Sale 124

This responds to your December 11, 1989, request for formal consultation pursuant to Section 7 of the Endangered Species Act of 1973, as amended, for Beaufort Sea Oil and Gas Lease Sale 124. The only species considered in this opinion is the threatened Arctic peregrine falcon (Falco peregrinus tundrius).

Biological opinions were issued for the Bering Sea Region on August 22, 1980, and the Arctic Region on November 9, 1981. Additional opinions were issued for the Navarin Basin (Lease Sale 83) and the Diapir Field (Lease Sale 87) on July 15, 1983, and for the Beaufort Sea planning area (Lease Sale 97) on July 30, 1985.

This opinion addresses only Lease Sale 124 and those activities associated with leasing and exploration. Since it is impossible to predict with certainty the occurrence or location of commercially significant deposits of oil and gas, this consultation will proceed in increments. Leasing and exploration are considered the first incremental step in the action; development and production are considered the second incremental step. This biological opinion addresses only leasing and exploration. Any development or production proposals will require separate consultation at a later time.

Project Description

Lease Sale 124 is located off the northern coast of Alaska from the Alaska-Yukon Territory border west to approximately Icy Cape, Alaska. The proposed lease sale encompasses about 22.1 million acres extending from 3 to 140 nautical miles offshore in water depths that range from approximately 7 to 3,280 feet.

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REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

The most likely exploration scenarios and facility locations are presented in the "Biological Evaluation for Threatened and Endangered Species with Respect to the Proposed Beaufort Sea Oil and Gas Lease Sale 124" (Minerals Management Service 1989). A total of 560 seismic-line miles of shallow surveys are expected. Ten exploration and four delineation wells are expected to be drilled between 1992 and 1996. Drilled depths of exploration and delineation wells are expected to average 10,000 feet. The most likely choice for drilling vessels would be drill ships with icebreaker support. Ice islands may potentially be used in shallow water. On-shore support would be from existing facilities, such as Prudhoe Bay and Barrow. Approximately 1260 helicopter flights are expected (1 flight per drilling day for each drilling unit). Vessel support would be 140 to 170 supply trips during open-water season, and one standby vessel for each drilling unit. When ice conditions require, two or more ice-breaking vessels for floating units would be used.

Effects on Arctic Peregrine Falcons

The Arctic peregrine falcon is geographically distributed throughout the tundra regions of North America. In Alaska, this includes the area north of the Brooks Range and along the west coast south to and including Norton Sound. The Service estimates that 200 pairs historically occupied Alaska. Beginning in the late 1940's, the use of the pesticide dichloro-diphenyl-trichloroethane (DDT) and its metabolites (hereafter referred to as organochlorine pesticides) greatly affected Arctic peregrine falcons, resulting in thin-shelled eggs which often failed to hatch and consequently lowered reproduction. In Alaska, the population declined to approximately 30 percent of historical levels by 1972, at which time the United States restricted the use of organochlorine pesticides. The population remained stable for the next six years, and in 1978 the population began to increase. In 1984, the Service, prompted by markedly improved population levels, changed the status of the Arctic peregrine falcon from endangered to threatened.

Based on 1989 surveys, the Service estimates the population of Arctic peregrine falcons in Alaska to be between 125 and 150 pairs and increasing. Arctic peregrine falcons are present in Alaska from late April to mid-September. Egg-laying in northern Alaska begins in early May, and young fledge from late July to mid-August. There are no known nest sites along the northern coast of Alaska, although nest sites occur about 25 miles inland. The most frequent sightings of Arctic peregrine falcons in the vicinity of the proposed sale area occur along the north coast of Alaska east of the Colville River where adults and immature birds stage and hunt prior to and during migration.

Oil spills, noise and disturbance associated with exploration activities are sources of potential impacts to Arctic peregrine falcons. If oil is spilled near migration routes or hunting areas, peregrine falcons could be adversely affected by eating contaminated prey or through reduced prey availability. The Minerals Management Service concluded that there is a 0.5 percent probability (defined as "combined probability" in the Biological Evaluation) that one or more oil spills of 1,000 barrels or greater would contact the Colville River Delta and a 1.0 percent probability that the Canning River Delta would be contacted within a

30-day period following a spill. It is not likely that peregrine falcons will be significantly affected by oil spills, given the low probability of oil spills and the relatively small amount of time that peregrine falcons spend along the coast. If oil spills affected peregrine prey populations, then localized reductions in food availability could occur.

Nesting peregrine falcons could be disturbed by aircraft overflights related to the proposed sale. The extent of such disturbance would depend on locations of support facilities. Deadhorse and Barrow are the most likely support facilities and are located on the coast. Aircraft based in Deadhorse or Barrow would not typically fly over nesting areas. Therefore, significant disturbance of nesting peregrine falcons from air traffic associated with the exploration phase, is unlikely.

#### Incidental Take

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the bounds of the Act provided that such taking is in compliance with the incidental take statement.

The Service does not anticipate that the proposed Lease Sale 124 (leasing, exploration and associated activities) will result in the incidental take of Arctic peregrine falcons. Accordingly, no incidental take statement is provided. Should any incidental take occur, Minerals Management Service must reinitiate formal consultation with the Service.

#### Cumulative Effects

Cumulative effects are those effects of future State or private activities on endangered and threatened species or critical habitat that are reasonably certain to occur within the action area of the Federal action subject to consultation. Future Federal actions will be subject to the consultation requirements established in Section 7 and, therefore, are not considered cumulative in the proposed action. State and private activities reasonably certain to occur include oil and gas near-shore and on-shore leasing, exploration, development and production; gravel mining, support facilities and road construction to support these activities; pipelines and related oil and gas transport facilities, including feeder lines, Trans-Alaska Pipeline operation and maintenance, and oil tanker traffic from the Valdez terminal to points in the lower 48 states; and all associated activities in support of these projects. Although the impacts of these activities are impossible to predict, the improving status of the Arctic peregrine falcon leads the Service to conclude that the cumulative effects of these reasonably certain activities are not likely to adversely affect Arctic peregrine falcons.

#### Biological Opinion

It is my biological opinion that leasing and exploration activities associated with Lease Sale 124 are not likely to jeopardize the continued existence of the Arctic peregrine falcon. Although this opinion addresses only leasing and exploration, the Service believes there is a reasonable likelihood that the entire action (leasing, exploration, development and production) will not jeopardize the continued existence of the Arctic peregrine falcon. As described in the Biological Evaluation (MMS 1989), development and production facilities would be tied closely to existing facilities. New pipelines, if required, would likely be routed along the coast away from nesting areas. Consultation will be required prior to development and production phases.

This concludes formal consultation on leasing and exploration activities associated with proposed Lease Sale 124. Reinitiation of formal consultation is required if any incidental take occurs; if new information reveals effects of the action that may impact listed species or critical habitat in a manner or to an extent not considered in this opinion; if the action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in this opinion; or if a new species is listed or critical habitat designated that may be affected by the action.

Thank you for your concern for endangered species.



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
Silver Spring, Maryland 20910

MAR 9 1990

Mr. Barry A. Williamson  
Director  
Minerals Management Service  
U.S. Department of the Interior  
Washington, DC 20240

Dear Mr. Williamson:

This responds to Minerals Management Service's (MMS) request for an Endangered Species Act Section 7 Consultation on proposed oil and gas Lease Sale 124 and associated exploration in the Beaufort Sea planning area offshore northern Alaska. Sale 124 is scheduled for March 1991.

The National Marine Fisheries Service (NMFS) has reviewed the information provided with your letter and concludes that the proposed lease sale is essentially a re-offering of unleased blocks addressed in the Arctic Region Biological Opinion of November 23, 1988, which considered the impact of Lease Sales BF, 71, 87, 97, and 109. The Arctic Region opinion considered all phases of exploration, development, and production activities that have occurred or are proposed in the planning area. In these opinions, NMFS concluded that leasing and exploration activities were not likely to jeopardize the continued existence of endangered species of whales. This finding was dependent upon the MMS conclusion that exploratory activities within the spring lead system were not expected during the bowhead whale migration since the ice at that time of year would be too thick for drilling and supply vessels to operate. However, beyond the incremental step (leasing and exploration) analysis, NMFS found that development and production activities in the spring lead system would likely jeopardize the continued existence of the bowhead whale. The effects of these activities on endangered whales is the subject of several on-going research efforts.

Our review of recently published research, and the interim results of on-going studies, have not indicated any new information that might alter our previous opinion. Because the areas and species impacted by the proposed activity remain unchanged, the conclusions of the November 23, 1988, Arctic Region Biological Opinion are valid and are applicable to proposed Lease Sale 124.



This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be re-initiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified, or critical habitat determined that may be affected by the proposed activity.

Please note that although regulations have been proposed under Section 101(a)(5) of the Marine Mammal Protection Act that would allow a take of certain marine mammals incidental to exploration activities, no marine mammal take is authorized until the final rule is in place and related "Letters of Authorization" are issued.

I look forward to your continued cooperation in future consultations and in developing needed information.

Sincerely,

*William W. Fox, Jr.*  
for William W. Fox, Jr.  
Assistant Administrator  
for Fisheries



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
Washington, D.C. 20235

NOV 23 1988 11:00 AM T-40

Mr. Robert Callman  
Director  
Minerals Management Service  
U.S. Department of the Interior  
Washington, D.C. 20240

Dear Mr. Callman:

Enclosed is the Biological Opinion prepared by the National Marine Fisheries Service (NOAA Fisheries) under Section 7 of the Endangered Species Act (ESA) concerning leasing and exploration activities in the Arctic Region. For the purposes of this opinion the Arctic Region refers to the Beaufort Sea, Chukchi Sea, and Hope Basin Outer Continental Shelf (OCS) Planning Areas.

NOAA Fisheries concludes that leasing and exploration activities in the Arctic Region are not likely to jeopardize the continued existence of any endangered or threatened cetaceans. In formulating this opinion, NOAA Fisheries used the best available information, including material submitted by the Minerals Management Service (MMS) on the probability of an oil blowout from exploratory drilling, recent research on effects of noise associated with drilling activities on bowhead whales, and the results of research available and considered relative to the issuance of the Biological Opinions for the Beaufort Sea (Sale 97 planning area) and Chukchi Sea (Sale 109 planning area).

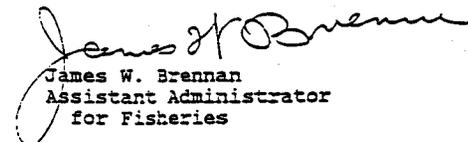
Although we have concluded that foreseeable exploration activities are not likely to jeopardize the bowhead or gray whales, NOAA Fisheries is concerned about the potential additive effects of oil and noise from OCS activities in the Arctic Region, particularly combined with ongoing and future exploration, production, and development activities throughout the range of these two species of endangered whales. We urge MMS to continue studies on the potential effects of OCS activities on endangered species so that the necessary information will be available for future consultations, including those on development and production. Conservation recommendations are provided with the opinion concerning these information needs and concerning actions that MMS can take to minimize potential impacts to whales.

In addition to our opinion on the incremental step (leasing and exploration), NOAA Fisheries is providing its views on the entire action, including development and production. Under 50 CFR

Section 402.14(k) of the Section 7 regulations, there must be a reasonable likelihood that the entire action will not violate Section 7(a)(2) of the ESA for the Federal agency to proceed with the incremental step. Based on currently available information and technology and the absence of effective mitigating measures, we believe that development and production activities in the spring lead systems used by bowhead whales for their migration would be likely to jeopardize the population. This potential for jeopardy should be recognized as early as possible so that the oil companies will be aware of possible future restrictions. We have included reasonable and prudent alternatives to the action to avoid jeopardy. In addition, NOAA Fisheries will reconsider this conclusion when new information, technology, and/or measures become available or are proposed that would effectively eliminate or otherwise mitigate this potential jeopardy situation.

No taking of endangered whales incidental to OCS leasing and exploration activities has been authorized under the Incidental Take Statement. Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for listed marine mammals, authorization is required under Section 101(a)(5) of the Marine Mammal Protection Act. However, NOAA Fisheries is processing a small take request under Section 101(a)(5) and the Incidental Take Statement will be appropriately amended after that process is complete. If you have any questions concerning this opinion or the incidental take provisions, please contact Dr. Nancy Foster, Director, Office of Protected Resources and Habitat Programs (427-2333).

Sincerely,

  
James W. Brennan  
Assistant Administrator  
for Fisheries

Enclosure



ENCLOSURE 2

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

**Agency:** Minerals Management Service

**Activities:** Oil and Gas Leasing and Exploration - Arctic Region (Beaufort Sea, Chukchi Sea, and Hope Basin)

**Consultation Conducted By:** National Marine Fisheries Service (NOAA Fisheries)

**Date Issued:**

**Background:**

The Minerals Management Service (MMS) of the Department of the Interior has, to date, offered or proposed five Federal oil and gas lease sales in the Beaufort Sea, three in the Chukchi Sea, and two in the Hope Basin. Chukchi Sea Lease Sale 85 and Hope Basin Lease Sale 86 were cancelled. Since 1980, NOAA Fisheries has conducted Section 7 consultations for Outer Continental Shelf (OCS) lease sales in the Arctic Region and has issued the following Biological Opinions:

Arctic Region  
April 1, 1982 - Arctic Region in general

Beaufort Sea  
June 24, 1980 - Joint Federal/State Sale BF,  
April 1, 1982 - Revised Opinion for Sale BF,  
May 19, 1982 - OCS Sale No. 71 (Diapir Field),  
December 19, 1983 - OCS Sale No. 87 (Diapir Field),  
May 20, 1987 - OCS Sale No. 97 (Beaufort Sea),

Chukchi Sea  
September 1, 1987 - OCS Sale 109

The original BF Opinion (1980) found there was insufficient information to determine whether bowhead whales were jeopardized by the lease sale. In 1982 these uncertainties were the basis to find that bowhead whales were likely to be jeopardized by activities associated with the lease sale. Activities associated with Lease Sales 71, 87, and the Arctic Region in general were also found to likely jeopardize bowhead whale populations. Jeopardy findings were based mainly on concerns about the effects of oil spills and of oil exploration-associated noise on the

bowhead population. Insufficient data existed to adequately examine these issues, and a conservative approach was taken to protect the population. Subsequent research has been and is being conducted to determine better estimates of population abundance and distribution, investigate the probability of the occurrence and effects of an oil spill when whales are present, and investigate the effects of exploration-associated noise on the whales. After considering results from the most recent research available at that time, NOAA Fisheries issued opinions for Lease Sales 97 and 109 that bowhead whale populations were not likely to be jeopardized by oil exploration activities. Both opinions, however, expressed concerns about oil spill and noise effects and recommended placement of restrictions on drilling associated activities, especially when whales were present in the spring lead systems.

MMS believes the "jeopardy" conclusions in the earlier opinions, based on information then available, are no longer warranted. MMS cites the substantive information investigating oil spill risks and effects to bowhead and other whales of noise from OCS oil- and gas-related operations. On April 9, 1987, MMS requested NOAA Fisheries to re-initiate consultation and amend these opinions where appropriate.

This Opinion is for leasing and exploration activities in the entire Arctic Region (Lease Sales BF, 71, 87, 97, and 109), and replaces the earlier Opinions for Arctic Region sales. Opinions on future lease sales should incorporate by reference this Opinion if it contains the best information currently available.

Proposed Activities:

This is an incremental step consultation covering leasing and exploration activities of OCS lease sales in the Arctic Region (Lease Sales BF, 71, 87, 97, and 109). The activities considered are oil and gas lease sales, and the subsequent exploratory drilling, testing, and surveying. Separate consultations for development and production activities will be conducted if oil is discovered and development plans are proposed. The details for past or potential exploration, development, and production scenarios are contained in each respective Final Environmental Impact Statement for each proposed sale. Details for future lease sales will be provided by MMS.

The expected resource potential for the Arctic Region is 1.74 billion barrels of oil with a marginal probability of discovery of 0.81 (Powers 1987). These estimates apply to all undiscovered economically recoverable resources in the Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas. The activities associated with lease sales in the Region are foreseen to be similar to the activities associated with past and proposed lease sales, with exploration beginning on newly leased tracts the first year

following the sale and continuing for six years. A total of 23 successful exploratory wells are projected for the Beaufort Sea, Chukchi Sea and Hope Basin Planning Areas. Of these, 9 likely will be drilled from artificial islands, 11 from mobile gravity structures and 3 from ice-strengthened drillships.

Drilling from ice-strengthened drill ships or other floating platforms will be conducted in water depths over 25 m, working in the late summer and fall when there is minimal sea ice. For the purposes of this opinion late summer and fall are considered July through mid-November in the southern Chukchi Sea and in the Hope Basin Planning area, August through October in the Beaufort and northern Chukchi Seas. Icebreaker assistance would be necessary to extend the drilling season into freeze-up. In water depths of less than 25 m, gravel and ice islands, single steel drilling caissons, or concrete structures may be used for exploration (MMS 1985). Caisson retained islands may be used in water depths to 30 m. Conical drilling units, or other round drillships or ice-strengthened floating platforms, may be used for exploration in water depths over 30 m. Monocone-type structures (mobile, bottom-founded structures) have been designed but not yet constructed for the 30 to 50 m water depths. Sub-sea well completions are unlikely.

Associated activities include ice-breakers in support of drillships, helicopter flights, supply boat trips, and dredging at some well locations prior to installation of the well-head. In the Chukchi Sea, drillship operations may be supported from barges towed into the area from the west coast. The most practical method of support may be to load all equipment and supplies aboard a large ship and keep it near the drilling site (MMS 1985).

Shallow-hazards seismic surveys are expected to occur on leases in the Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas. The total shallow-hazards seismic activity is estimated to cover 80,000 line kilometers. Low resolution, deep seismic surveys (air guns) are primarily a pre-lease activity and few, if any, are projected to occur as post-lease activities.

Listed Species and Critical Habitats: There are six species of endangered whales that inhabit Arctic Region waters of Alaska. These are:

Bowhead Whale  
Right Whale  
Fin Whale  
Sei Whale  
Humpback Whale  
Gray Whale

Balaena mysticetus  
Eubalaena glacialis  
Balaenoptera physalus  
B. borealis  
Megaptera novaeangliae  
Eschrichtius robustus

No critical habitat has been designated for any endangered whale under Section 4 of the Endangered Species Act (ESA).

The right and sei whales are rare in Arctic waters. They are represented by isolated records in the Chukchi Sea, probably of stray individuals well outside the normal ranges of their populations. The humpback and fin whales are occasional inhabitants of the Chukchi Sea, usually in low numbers. Both are at the northern edge of their summer range when in the Chukchi Sea. The few migrants that reach Arctic waters in the summer are found primarily on the Siberian side of the southern Chukchi Sea and have been only irregularly sighted in the Alaska sector. Only the bowhead and gray whales commonly occur in the Arctic Region with gray whales only occurring infrequently in the Beaufort Sea.

Gray Whale: The northern Bering and Chukchi Seas are the main summer feeding grounds for the gray whale population. Gray whales are regular summer inhabitants of the Chukchi Sea from June through October, although the majority of the population probably summers south of the Bering Strait. The Bering Strait is an important migratory corridor for whales moving north between late May and August and returning to the Bering Sea from September to November on their return to southern waters. From July through mid-October, some gray whales are found regularly as far north as Point Barrow, and a few occasionally travel as far east as the Canadian Beaufort Sea.

Present knowledge of the distribution and abundance of the gray whale is incomplete. Up to one-fourth of the total gray whale population of an estimated 21,113 (IWC In press) may enter the northern Chukchi Sea to feed during the open water season (July-October).

Gray whales have been observed feeding in the Alaskan Chukchi Sea well into October (Ljungblad et al. 1983). However, it is not known if this is a summer resident feeding population of gray whales. Many gray whales have been observed feeding in coastal waters of northwest Alaska during summer and fall aerial surveys (Ljungblad et al. 1985a, 1987). Most recent sightings of gray whales feeding in the Chukchi Sea are in nearshore waters averaging 20.5 m in depth and within 14.5 km of shore (Moore et al. 1986). They normally avoid heavy ice conditions, remain south of the pack ice edge, and leave northern areas before freeze-up, an exception being the Fall of 1988 when 3 gray whales were trapped by ice off Barrow, Alaska. Other reports of whales feeding farther offshore are known, and feeding appears to be widespread.

Bowhead Whales: The bowhead whale is the northernmost ranging of the great whales. The size of the Western Arctic population of this whale has recently been estimated to be 7,800 animals

(95% confidence level of 5700-10,600) (IWC in press). These whales migrate northward in the spring from their wintering areas in the Bering Sea. They pass through the Bering Strait and eastern Chukchi Sea from late March to mid-June through newly opened leads and polynyas in the shear zone between the shorefast ice and offshore pack ice. Recent acoustic survey data indicate that bowhead whales also swim through the area beneath the ice within several kilometers of the leads. The path followed through the leads along the edge of the shorefast ice varies in distance from shore with water depth and the topography of the coast. At coastal promontories such as Pt. Hope, Cape Lisburne, Icy Cape, and Pt. Barrow the leads are within a few kilometers of the coast. At indentations, the shorefast ice zone is wider and the leads farther from shore. The spring migration of bowhead whales past Cape Lisburne seems to follow two or more corridors, depending on the number of leads, 2-10 km offshore (Braham 1984). This migration essentially spans the period mid-April to early June, with a few whales migrating before and after depending on annual variability in ice conditions.

In the Beaufort Sea, the fast-ice zone is broader and the leads are progressively farther offshore as they extend eastward. The lead system at Pt. Barrow is especially narrow and close to shore, and all whales are believed to funnel through the near-shore leads or under the ice adjacent to the leads. The width of the lead system varies with ice movements and is sometimes less than one km. East of Pt. Barrow, the spring lead system begins to branch offshore. East of 151° W (approximately the longitude of the Colville River), the leads dissipate into numerous branches that vary in location and extent from year to year. Here, the migration corridor widens as multiple leads are used by the whales in their movements to the Canadian Arctic (Ljungblad et al. 1982). The spring migration appears to be contained between 71°20' N and 71°45' N to at least as far east as the longitude of Barter Island. Past Barter Island, the path of the eastward migration is less predictable, and complex leads branch north and east towards Banks Island.

In spring, bowhead whales use the Alaskan Beaufort Sea primarily as a migration path. Activities such as calving, socialization, and some opportunistic feeding also occur, but generally the whale movements are purposeful through the area (Braham et al. 1980, Ljungblad et al. 1982, 1985a, 1987). For example, three whales taken by Barrow natives in the spring of 1985 had stomachs full of zooplankton (George and Tarpley 1986), as did 4 of 7 harvested in 1986 (George et al. 1987), indicating that at least in some years feeding does occur along the migration path.

Bowhead whales appear to be scarce in the Alaskan Beaufort Sea during July when the offshore water is usually still heavily ice-bound. Bowhead whales return to the eastern Alaskan Beaufort Sea as early as the beginning of August. Aerial surveys beginning in

August have been conducted in the Beaufort Sea since 1982. During 1982 and 1983, bowhead whales were found in the offshore area east of Barter Island as early as August 2 (Ljungblad et al. 1985a,b). Distributional data for an offshore component does not exist, however, such an offshore component could partially account for the small number of nearshore sightings compared to the estimated size of the population. In addition, they apparently do not commonly occur inside the Beaufort Sea barrier islands. From 1974 to 1988, only one confirmed sighting of a bowhead whale has been made inside the Islands.

In the fall, both feeding and migration activities occur in the Alaskan Beaufort Sea. Certain areas appear to be regularly used for feeding and resting. The best documented feeding area is east of Barter Island including the waters offshore of Demarcation Bay, where bowhead whales repeatedly were observed feeding and resting in the fall (Ljungblad et al. 1982, 1983; McLaren and Richardson 1985, Richardson et al. 1986). Bowhead whales have also been observed feeding north of Flaxman Island (Ljungblad et al. 1982), in outer Harrison Bay north and east of the Colville River plume (Ljungblad et al. 1983), and in the waters offshore of Smith Bay and east of Barrow (Braham et al. 1983, 1984, Ljungblad et al. 1985a).

A two year study (Richardson, 1987) on the importance of the Eastern Alaskan Beaufort Sea to feeding bowhead whales indicates that, for the population as a whole, food resources consumed in the Eastern Alaskan Beaufort Sea do not contribute significantly to the annual energy needs of the Western Arctic bowhead stock. However, it was also noted that in some years those animals that feed in the study area longer than others may acquire a significant fraction of their annual energy needs in the study area.

Bowhead whales tend to congregate at locations with significantly higher concentrations of zooplankton (primarily copepods, mysids, and euphausiids) than are present in surrounding waters (Richardson et al. 1985a). Such feeding in deep water areas has been inferred in the Canadian Beaufort on a regular basis (McLaren and Richardson 1985). Feeding in late summer and autumn may be especially important to bowhead whales as this may be the last major feeding period for several months and the energy content of the zooplankton prey is highest at this time (Lowry and Frost 1984, McLaren and Richardson 1985). In addition, bowhead whales appear to feed while wintering in the Bering Sea (Schell, Saupe and Haubenstock 1987).

Depending on ice conditions and proximity to freeze-up, the bowhead whales appear to alternate feeding and westward migratory activities, probably stopping to feed in areas containing suitable prey. In 1985, there was evidence of feeding while

whales were traveling slowly westward and at times when they remained in specific areas (Thomson 1986, 1987).

#### Assessment of Impacts:

NOAA Fisheries believes that oil spills and noise associated with exploration activities in the Alaska OCS Arctic Region have the potential to adversely affect endangered whales. Because of their relatively low population numbers, their habit of frequenting confined coastal waters, and their apparently low reproductive rate, bowhead whales may be particularly vulnerable to impacts from offshore oil and gas activities throughout their range.

Since the issuance of the Arctic Region Biological Opinion in 1982, several studies have been conducted on the possible effects of OCS activities on bowhead and gray whales. Studies on the effects of oil on marine mammals have continued (Geraci and St. Aubin 1986), however, none has been conducted on living baleen whales but only on the baleen from dead specimens. Noise disturbance of bowhead whales related to industrial activities have been studied during a 5-year program in the Canadian Beaufort Sea (Richardson and Green 1983, Richardson et al. 1985a,b, 1986, 1987). Some studies have investigated noise disturbance of bowhead whales in Alaskan waters (LGL et al. 1987, Miles et al. 1987).

Oil Spill Probabilities: Oil spills from OCS drilling are a major concern. Oil spilled in the spring lead systems might be critical to bowhead whales contacting the oil while migrating through the area. Oil spills in the fall might affect bowhead whales in feeding areas or along migration paths either through open water or among multi-year or newly forming sea ice.

Oil spill risks from gravel islands or other bottom-founded structures are perhaps generally less than from drillships. Operations from these structures are generally spread out over a period that does not have to coincide with the bowhead migration because their operation is not constrained by ice conditions. Because bottom-founded structures are used in the shallower waters, the probability of oil from a blowout contacting bowhead whales is partly dependent on whether or not the structure is located in the spring migration path. Although much of the oil may be contained on the structure, any spilled oil that entered the water may be difficult to contain and clean up.

An oil spill or blowout associated with a drillship, on the other hand, is likely to enter the water. Also, drillships, which are more appropriate for use in deeper water, are more likely to drill in or near the migration path. Drillships operating in the fall may also have to suspend operations temporarily and move off the well because of pack-ice encroachment. The risk of well-

control problems may increase because of suspension of operations and subsequent reentry into the well, however, MMS (J. Lewis, MMS, pers. comm.) believes that the increased risk is minimal. Easley (1987) reported that although circulation of heavy mud was the most common method of well control for blowouts of wells drilled from stationary platforms, this method may not work for drillship blowouts. Due to safety requirements, drillships may have to move off location if a blowout occurs. Therefore, it cannot circulate mud for well control but must rely on other remedial actions. In addition if a relief well is required to halt a blowout, it may not be possible to complete it during the normal drilling season. However, MMS believes that the drilling season can be extended into early winter if necessary through the extensive use of ice-management programs.

MMS (Powers 1987) estimates a mean of four spills of 1,000 barrels or greater in size in the Arctic Region over the projected life of all fields discovered and developed in the region. This assumes full development of the resource estimate of 1.74 billion barrels and transportation of that oil to shore. MMS also estimates that most likely zero spills of at least 100,000 barrels will occur.

MMS has concluded that the probability of an oil spill resulting from a blowout during exploratory drilling is extremely low (Martin 1986). In fact, to date, there has been no oil spilled as a result of a blowout during exploratory drilling on the U.S. OCS. They cite several studies of offshore drilling statistics that indicate the probability of a blowout during offshore exploration on the U.S. OCS is around 0.64 percent or about 1 blowout per 156 wells drilled, however, most of the data is from drilling in the Gulf of Mexico.

MMS believes that such a low probability does not pose a threat to bowhead whales as a result of an oil blowout from exploratory drilling. In fact, based on the U. S. record and technically advanced equipment, procedures, and operational training employed in exploratory drilling in the Arctic, MMS expects a substantially lower probability of an oil blowout during exploratory drilling in the Arctic Region.

Easley (1987) reviewed MMS's oil spill probability statistics and suggested that the factors associated with historic data used by MMS to calculate the statistics may be entirely different from those associated with future blowouts. He also suggested oil probabilities should be computed using more systematic techniques (e.g., Fault-Tree Analyses and/or Failure Mode and Effect Analyses) instead of simply dividing the number of blowouts by the number of wells drilled (including Gulf of Mexico wells) as done by MMS.

An oil spill from a blowout has not occurred to date in the Alaska OCS. For this reason it seems reasonable to examine data from the remaining U.S. OCS to get approximate values that may be applicable for the Alaskan OCS. Because the number of blowouts in other U.S. OCS regions is very small compared to the large number of drilled wells, NOAA Fisheries believes the probability of an oil spill resulting from a blowout during exploratory drilling in the Arctic Region is low. However, we recognize that other techniques may be available to calculate oil spill probabilities and we urge MMS to investigate these possibilities.

Finally, MMS cites legal authorities and operational procedures (Murrell et al. 1987) that are in place to ensure safe drilling practices on OCS leases, providing further assurance that an oil spill from exploratory drilling would be unlikely. Such authorities include operational requirements contained in regulations, OCS Operating Orders, lease stipulations, inspection requirements, and conditions of approval of Exploration Plans, Applications for a Permit to Drill, and Critical Operations and Curtailment Plans.

If, however, an oil spill should occur during exploration activities from either a blowout or an operational discharge, the conditional probabilities (expressed as percent chance) that an oil spill will contact a certain bowhead whale habitat (i.e., spring or fall migration corridors, feeding areas) within 3 to 30 days have been calculated to range from nil (less than 0.5 percent) to nearly 100 percent depending on spill location and season (MMS 1985, 1987a,b).

Effects of Oil: Assuming an oil spill were to occur and contact whales, the worst adverse impacts to whales from contact with spilled oil include death or illness caused by ingestion or inhalation of oil, irritation of skin and eyes, fouling of feeding mechanisms, and reduction of food supplies through contamination or losses of food organisms. Although no data exists on effects of oil on bowhead whales in the open ocean, Albert (1981) speculated that the most likely adverse effects of oil contact to bowhead whales would be 1) conjunctivitis and corneal eye inflammation leading to reduced vision and possibly blindness, 2) development of skin ulcerations from existing eroded areas on the skin surface with subsequent possibility of bacteremia, 3) compromising of tactile hairs as sensory structures, and 4) development of bronchitis or pneumonia as the result of inhaled irritants. In a laboratory study using baleen plates from bowhead whale specimens, plates fouled by oil had decreased filtering efficiency for at least 30 days but 85% of the efficiency was restored within eight hours (Braithwaite et al. 1983). This fouling possibly may result in oil ingestion which, theoretically, could lead to blockage of the narrow channel of the stomach (Albert 1981). However, the extent of

oiling that would be necessary to produce these effects is unknown. Neither is it known, however, if oiling would produce such effects. Experiments by Geraci and St. Aubin (1982, 1985, 1986) demonstrated that effects of actual oiling of certain marine mammals (no bowhead whales were tested) are probably short-term, transient, minor, and reversible.

Although direct evidence is lacking, Geraci and St. Aubin (1986) reasoned that bowhead whales have the visual capability to detect spilled oil which sufficiently alters the optical properties of the surface, and may also be able to detect oil by tactile senses. Cetaceans may be initially attracted to an oil slick but may subsequently become conditioned to avoid them. Such behaviors, as displayed in dolphin studies, may help individuals avoid multiple contacts with oil. Geraci and St. Aubin indicated, however, that in heavy ice conditions, the ability of bowhead whales to avoid oil trapped among ice would be limited.

Ahmaogak (1986) suggested that bowhead whales may not detect oil fouled waters and, even if they could, they may not avoid it. Observations from the Regal Sweri spill off Cape Cod (Goodale et al. 1982) showed that large whales (i.e., fin, humpback, and probably right whales) did not avoid areas of oil spills and apparently performed normal activities, such as feeding, in and among oil slicks. This may indicate that either the whales were unaware of or unable to detect the oil slicks, or were not bothered by them. Gray whales off Coal Oil Point in California showed mixed reactions to the oil seeps there (Geraci and St. Aubin 1982). Some whales apparently avoided the area, and others modified their behavior while passing through the area. Whether this indicates detection and learned avoidance among individuals, or adverse reaction, is unclear. In any case, these examples indicate that whales may not readily avoid oil spills, and may, therefore, be susceptible to the effects of contact with a spill. However, no ill effects to whales have been observed in these areas.

Geraci and St. Aubin (1986) concluded that the skin of toothed whales and dolphins is at least partially resistant to oil, and subtle effects caused by short-term contact with volatile components are reversible. They believe the structure of the skin of bowhead whales should afford at least equal protection. However, the questions of adhesiveness of oil to the skin and the effects of long-term exposure to persistent oil remain unanswered. Albert (1981) and Ahmaogak (1986) suspect that the skin excursions on bowhead whales will facilitate adherence while Geraci and St. Aubin (1986) believe that unless whales are trapped in a lead and remain in continuous contact with newly spilled oil for a period of hours or days, petroleum hydrocarbons would have little effect on the intact epidermis of whales.

Petroleum vapors, particularly the low molecular weight hydrocarbons, inhaled within a few hours of being spilled can be toxic. Evaporation rapidly removes these components from oil and they are the first to disperse into the air. Evaporation would be slowed in the cold Arctic waters, possibly lessening the spread of harmful concentrations of toxic vapors. Inhaled volatile hydrocarbons may aggravate lung diseases or be absorbed into the circulatory system and liver. Bowhead or gray whales encountering a weathered oil spill in open water would not be exposed to harmful vapors (Geraci and St. Aubin 1986). Although bowhead and gray whales may feed on contaminated prey, it appears to be difficult for them to consume enough oil in this manner to be poisoned by absorbed hydrocarbons. As in humans, cetaceans could develop lung damage from aspirating regurgitated hydrocarbons (Geraci and St. Aubin 1986).

Bowhead whales rely primarily on ice leads, cracks and small pools in ice during their spring migration. Cracks and small pools are likely to concentrate spilled oil entering the water. Bowhead whales, in a lead system, may be unable to avoid encounters with oil in cracks and small pools, and, therefore, would be more susceptible to oil contact than would whales in open water.

Hansen (1985) reviewed the literature on the potential effects of oil spills on whales and other marine mammals, and suggested that the level of effects would be related to the degree of exposure of a cetacean to an oil spill. Baleen whales, such as the bowhead, may be less likely to avoid oil slicks than more mobile small cetaceans, and the bowhead whales' association with sea-ice may also provide less ability or opportunity for avoidance than for subarctic species (Geraci and St. Aubin, 1986).

Other effects of oil spills on whales may include reduction in availability of food within localized areas near the spill site and in areas where the oil slick occurred. However, Richardson (1987) suggests that it is unlikely that accidental oil spills would have a significant or lasting effect on zooplankton in the study area, or on the availability of zooplankton to bowheads. Nonetheless, there may be uncertain long-term effects of oil ingestion and hydrocarbon accumulation.

**Noise disturbance:** Many of the sounds produced by industrial activities are at low frequencies (below 1000 Hz), which is also the frequency range of most bowhead vocalizations. Such low frequency noises could travel long distances to waters used by bowhead whales for migration and feeding in spring and fall.

Potential impacts to whales that may result from noise disturbance include disruption of feeding activity, short- or long-term displacement or deviations from migratory paths,

interference with socialization, reproductive behavior and communication, physiological stress, and possibly even abandonment of traditional areas. Geophysical seismic noise, drilling, construction, icebreaker activity, and other vessel noise in areas where whales are present, possibly, could cause such impacts. The level of noise required to produce these effects depends on the distance of the noise from the animals, the ambient noise levels, the source level of noise, and the acoustic propagation properties of the environment.

To date, there has been little opportunity to directly assess the impacts of industrial activities on bowhead whales in Alaska waters. This is because of seasonal drilling restrictions imposed for the first three Beaufort Sea Federal oil and gas lease sales and because most prior OCS activities in Arctic Alaska (all of which are still in the exploration phase) have occurred in the Beaufort Sea during the winter when bowhead whales are not present. During the spring, the ice leads used by the migrating whales are offshore and away from any gravel islands where most Beaufort Sea wells have been drilled to date, and exploratory drilling in the spring lead systems has not occurred.

Exploration at a few drilling locations has recently been permitted during the fall migration. Most of these locations have also been shoreward of the main migration corridor. In 1985, Unocal Exploration was allowed, by waiver of MMS' Stipulation #4 for Lease Sale 87, to conduct drilling during the fall whale migration from a drillship operation in the Alaskan Beaufort Sea. However, the drilling was completed before the onset of the fall migration. Drilling of a second nearby well in 1985 by Shell Western was prevented by heavy pack ice. In 1986, Shell Western conducted exploratory drilling during the beginning of the fall migration, and Unocal subsequently drilled an exploratory well, during the migration. The two wells, which were located in the nearshore migration path of the bowhead whales, were drilled using a drillship, an icebreaker and icebreaking support vessels. Drill-associated noises were monitored to determine their effects on the migrating whales (LGL et al. 1987).

Data from these studies suggested that migrating bowhead whales avoided and could have been displaced by the offshore drilling operation. No whales were sighted closer than 9.5 km from the drillship, and few were sighted closer than 15 km (LGL et al. 1987). Significant numbers of bowhead whales passed south of the rig as well as north of it. One whale was tracked for 6.8 hours while it travelled 32 km. The whale moved in an arc around the drilling operation maintaining a distance of about 23-27 km from the drillship. Bowhead whales observed between 15 and 30 km from the drillship apparently did not exhibit "strong" (i.e., definite

responses which usually involved major changes in respiration, surfacing, and dive cycles) behavioral responses.

There was no evidence that the drilling operation (including the support vessels) acted as a barrier to migration (LGL et al. 1987). However, during the study period ice conditions were very light and animals could pass north or south of the rig. No evidence exists to determine if whales would or would not approach an operating rig to continue their migration during heavy ice conditions and if the rig was located in the migration path. Although recent research indicates whales travel under the ice near leads, it is not known how far whales travel from the leads.

Disturbance responses to industrial activities of bowhead whales summering in the Canadian Beaufort have been the focus of a 5-year study (Richardson 1981, 1982, 1985; Richardson et al. 1985a,b, 1986, 1987). Sound sources, besides ambient noise, included geophysical seismic exploration, drilling and associated machinery noise, dredging, icebreaker activity, boat and aircraft traffic, and construction of gravel islands or other offshore structures. Behavior near actual and simulated activities associated with offshore oil exploration was compared with presumably undisturbed behavior. In general, bowhead whales showed considerable tolerance of ongoing noise from dredging or drilling, but tended to react more strongly to a moving or rapidly changing noise source such as an approaching boat or aircraft or the startup of noise sources (Richardson et al. 1985a,b, 1986, 1987).

In the Canadian Beaufort studies, behavioral responses of bowhead whales were not apparent beyond 4 km from an active drillship. However, playback experiments showed that some whales reacted, although not strongly, to drillship noises at intensities similar to those 12 km from an active drillship (Richardson et al. 1985a,b, 1986, 1987). Why bowhead whales reacted more strongly to playback noises than to actual noises is not clear. Richardson concluded that sightings near drillships and the limited reactions to playbacks show that at least some bowhead whales summering in the Canadian Beaufort tolerate considerable drillship noise. In fact, comparison of behavior of bowhead whales summering in the Canadian Beaufort with that of migrating whales in the Arctic Region (LGL et al. 1987) indicates that summering whales may be considerably more tolerant of drillship noise than migrating whales.

Playback of dredge noise in Canadian waters produced behavioral responses from some bowhead whales, including avoidance and changes in orientation, out to 2.25 km, although some animals did not respond until they were within 800 meters of the sound source. Around active dredges, apparently undisturbed bowhead whales were observed, within 1 to 5 km, and no disturbance was

observed beyond 2.8 km. However, there are differences in reactions of these whales to dredge noise. The whales seen near actual dredges may have been less sensitive animals; those more sensitive may have moved away earlier or may have avoided the area (Richardson et al. 1985 a,b, 1986, 1987).

The effect of noise associated with a drilling operation on bowhead whales has also been investigated using simulation models. In an MMS-contracted, 2-year study of noise characteristics and propagation, the underwater acoustic environments of five specific drill sites in the Alaskan Beaufort Sea were measured during 1985 and 1986. This information was used to simulate preliminary estimates of zones of responsiveness of bowhead whales to these noise sources. The zones of potential responsiveness (where half of the whales would probably respond at a 30db signal to noise ratio) were estimated for continuous noise sources at 6 drill sites through modeling studies. The radii of responsiveness ranged from 1 to 8 km for a tug underway in open water, 1 to 4 km from an active drillship, 0.02 to 0.2 km from man-made gravel island drilling noise, 2 to 12 km from an icebreaker underway in open water, and 1.6 to 12 km from two tugs forcing a barge against an island (Miles et al. 1987). Because the study by Miles et al. involved no direct observations of whale behavior relative to real or playback sound, they relied on Richardson et al.'s earlier reported observations of whales behavioral responses to comparable sounds in the Canadian Beaufort Sea. Therefore, Miles et al. were able to insert Richardson's observations into a broader framework wherein roughly half of the bowhead whales show avoidance responses (probability of avoidance of about 0.5) to industrial sounds which have a 30 dB S:N (signal-to-noise ratio). A smaller proportion of the bowhead whales observed by Richardson, et al. reacted when the S:N is about 20 dB, which would occur at greater ranges than those estimated above by Miles et al. and a few bowhead whales may react with even lower S:N. However, some bowheads observed by Richardson, et al. apparently tolerated S:N ratios of 40 dB without exhibiting an avoidance reaction.

Marine geophysical sounds from seismic surveys are the loudest industrial sounds emitted into the marine environment. Seismic surveys are of two general types: (1) low-resolution, high-energy, deep-penetration and (2) high-resolution, low-energy, shallow-penetration seismic surveys. Low resolution surveys (airguns) are used to study deep geologic formations. They are, generally, authorized under a geological and geophysical permit to occur prior to a lease sale, and usually are not expected to occur during post-lease sale exploration. Companies most often conduct high-resolution seismic surveys during exploration on leases to evaluate potential shallow hazards to drilling. MMS (Powers 1987) estimated that the total high-resolution seismic activity in the Arctic Region will be 80,000 line km.

In three of six experiments, bowhead whales oriented away from a vessel with a single airgun deployed (high-energy, low-resolution system) at a range of 0.2 to 4.5 km from the sound source (Richardson 1985). There was no reaction to the single airgun vessel at a range of 3 to 5 km in the other three experiments. We believe the effects on bowhead whales from high-resolution seismic disturbances are minor because low-resolution seismic effects disappear (i.e., whales' surface-respiration-dive characteristics return to normal) within 30 to 60 minutes (Ljungblad et al. 1985c).

Heavy boat and aircraft traffic could also affect bowhead whales adversely. In the Canadian Beaufort Sea, responses of whales to moving boats is the most consistent and second-most pronounced of all disturbance factors tested (Montague 1985). In most cases, bowhead whales oriented away from a moving vessel up to 4 km away and actively swam away from vessels 2 km or less away. There was no clear relationship between the size of the vessel and the distance of the response (Richardson 1982, Richardson et al. 1985a). The whales ceased their avoidance when the vessel passed out of range, but may have remained scattered for longer periods. Collisions between vessels and bowhead whales are unlikely if the whales are able to detect and avoid the vessels, or if the vessels take appropriate steps to avoid the whales.

The reaction of bowhead whales to aircraft is more variable than to vessel noise. Most reactions to fixed-wing aircraft occur at altitudes of less than 1,500 feet (Richardson et al. 1985a). Reaction to helicopters may have a similar area of influence (M. Dahlheim, NOAA Fisheries, pers. comm.). Disturbance due to aircraft traffic, unless sustained and intense, is likely to cause only temporary disturbance to these whales. With proper altitude observance, most impacts from aircraft can be avoided.

Noise producing activities, such as drilling and vessel traffic, in the spring lead systems used by bowhead whales have a high potential of significantly affecting the whales. If migrating bowhead whales are concentrated within the lead systems in the spring, the noise could seriously disrupt the migration. However, according to MMS, exploratory activities using floating drill ships within the spring lead systems are not expected during the bowhead migration since the ice at this time of year typically would be too thick for drilling ship and supply vessels operations. Although marine exploration activities generally occur for about 90 days, in August, September and October, exploration in the Chukchi Seas and Hope Basin Planning Areas may also occur in July through mid-November.

Additional Impacts: To date, the exposure of bowhead whales to the effects of OCS activities has largely been confined to the Canadian Beaufort Sea. In Alaska waters, limited drilling during the fall migration of the whales has only recently begun. The

additional effects from planned or future sales will be limited to further exploratory drilling, increases in boat and air traffic in relation to support activities, and the small increased risk of an oil spill occurring prior to or during the migration period.

The ability of the bowhead whale to accommodate increasing industrial disturbance is uncertain. Some accommodation undoubtedly can occur, but the level of stress imposed on the species as a result cannot be predicted. A decreased use by bowhead whales of the Canadian Beaufort Sea industrial areas, as evidenced from aerial surveys during the summer, has been noted (Richardson et al. 1985a,b, 1986, 1987). However, changes in bowhead whale abundance has also occurred outside as well as within the main industrial area. One suggested cause for the decreased use is the effect of increased disturbance from industrial activity that began in the early 1970's and significantly increased since 1980. Variation in food availability (zooplankton concentrations) may also have been involved.

Present and proposed OCS exploratory and development activities in the Arctic Region may eventually adversely affect the successful life cycle of bowhead whales. At present, we are unable to predict what these tolerance thresholds might be, but we do not believe the foreseeable additive effects of previous and planned sales should exceed this level of concern. Continued efforts to monitor distribution patterns and indicators of population health, such as reproductive success, recruitment, growth rates and behavior are important to assure the combined effects from all OCS activities are not likely to jeopardize the continued existence of the bowhead whale population.

#### Conclusions:

Based on review of the information provided to us by MMS and from information available on endangered whales, NOAA Fisheries has reached the following conclusions on proposed oil and gas leasing and exploration activities in the Arctic Region.

Right Sei, Fin and Humpback Whales: The proposed activities are not likely to jeopardize the continued existence of the right and sei whales. Right and sei whales rarely occur in Arctic waters, being found there only as isolated, possibly stray, individuals, and are unlikely to be affected adversely by the identified activities. The proposed activities are also not likely to jeopardize the continued existence of humpback and fin whales which inhabit the Chukchi Sea on occasion, but in relatively low numbers.

Gray whales: We conclude that the proposed activities are not likely to jeopardize the gray whale. In Arctic waters gray whales are most likely to be encountered in the southern Chukchi Sea and the Bering Strait region and would be affected most by oil and gas exploration activities in those areas. Perhaps as much as one-fourth of the gray whale population may enter the northern Chukchi Sea through the Bering Strait. Although some individuals may suffer disturbances or other impacts from the proposed activities, due to the good overall condition of the gray whale population and to its widespread distribution in the Bering and Chukchi Seas, such impacts are not likely to jeopardize the existence of the species.

However, additive impacts that could result from past and future OCS activities in the Arctic Region, the Bering Sea, and in other regions outside Alaska, may have the potential to affect the population adversely. Continued monitoring of the health of the gray whale population and the effects of OCS activities in these areas are important to assess whether the combined impacts are affecting the gray whales adversely.

Bowhead Whales: We conclude that the proposed activities are not likely to jeopardize the continued existence of the bowhead whale. However, the primary concerns of NOAA Fisheries in the Arctic Region focus on the bowhead whale. The entire population of this whale is susceptible to impacts in this area during its spring migration through nearshore leads. In the fall, a large portion of the bowhead whale population may again be exposed to oil spills and disturbance from noise when they migrate through the Arctic Region both nearshore and offshore with the pack ice.

Oil Spill Probabilities: Based on information utilized by MMS (Martin 1986), an uncontrolled oil blowout or a major oil spill in the Arctic Region as a result of exploratory drilling is an unlikely event. Therefore, we conclude that exploratory drilling itself does not constitute a significant level of risk of oil spills.

Noise Disturbance: Large or widespread noise disturbance along the spring or fall migration paths or in feeding areas could affect bowhead whales by interfering with successful feeding, migration, or other behavioral activities. The range or level of noise required to produce these effects depends on the location and source of noise, and on the acoustic propagation properties of the environment. Although some impacts to individuals may occur, we do not believe anticipated proposed exploratory activities will produce noise levels expected to reduce appreciably the likelihood of survival and recovery of the bowhead whales by reducing the reproduction, numbers, or distribution of the species.

However, this conclusion is based on the assumption of MMS that exploratory activities will not occur within the spring lead system during the bowhead migration. If new exploratory activities technology, procedures, etc., are developed that would allow activity in spring leads, MMS should reinstate consultation with NOAA Fisheries. Our concerns over other activities in the spring lead systems are discussed further under the subsequent section on "Incremental Step Consultation".

Physical Impacts: Although individual impacts may occur, we believe the foreseeable exploratory activities in the Arctic Region are unlikely to produce a level of physical impacts, such as collisions with vessels or structures, that are likely to jeopardize the species.

Based on jeopardy conclusions in previous consultations, exploratory drilling operations in lease areas have been restricted by lease stipulation to avoid or reduce their coinciding with bowhead whale presence during the fall migration. However, new information indicates the probability of an oil spill during oil exploration is very small (Martin 1986) and other recent research suggests that bowhead whales continue their migration while avoiding noise from drilling operations by detouring around the drill site in open water conditions (LGL et al. 1987). Therefore, limiting OCS exploratory drilling to the times of years and portions of the lease area where whales are not present may not be necessary to prevent jeopardizing the population.

Because few bowhead whales have been sighted inside the Beaufort Sea barrier islands, exploratory drilling operations during the bowhead migration should not be restricted inside the barrier islands. However, monitoring OCS exploratory drilling outside the barrier islands especially during heavy ice conditions, when concurrent ice-breaking activity would be greatest, should be conducted to insure that migrations are not blocked or impeded, resulting in whales being trapped in the Beaufort Sea at freeze up. Additionally, several drill sites operating simultaneously, even in open-water years, could form an acoustic barrier to the whale migration. However, present MMS drilling schedules do not include this possibility.

NOAA Fisheries believes that continued monitoring of bowhead whale migrations at industrial sites is necessary to detect any major disturbance. Results from monitoring studies and other additional information will prove valuable for future consultation on OCS activities, particularly those associated with development and production. Conservation Recommendations addressing research needs and additional actions that MMS and/or the oil companies can take to minimize adverse effects to bowhead whales are provided with this opinion.

### Reinitiation of Consultation

During the post-lease exploration phase, MMS should provide NOAA Fisheries with all exploration plans and any subsequent revisions of these plans. MMS should review these plans to determine if further Section 7 Consultation is necessary during exploration. Consultation must be reinitiated for the development and production phases in the Arctic Region. Consultation must also be reinitiated if (1) new information reveals impacts from the proposed activities that were not previously considered, (2) the activities are modified in a manner that causes effects that were not previously considered, or (3) a new species is listed or critical habitat is designated that may be affected by the proposed activities.

### INCREMENTAL STEP CONSULTATION

The preceding opinion covers the incremental step of leasing and exploration of the Arctic Region. In addition to our opinion on the incremental step (leasing and exploration), NOAA Fisheries is providing its views on the entire action including development and production. For the Federal agency to proceed with the incremental step, there must be a reasonable likelihood that the entire action will not violate Section 7(a)(2) of the ESA (50 CFR 402.14(X)).

Based on currently available information and technology and the absence of effective mitigating measures, NOAA Fisheries believes that development and production activities in the spring lead systems used by bowhead whales have the potential to jeopardize the continued existence of the bowhead whale population. We base this belief on our present knowledge of the confined nature of this pathway and our concerns for the risks of oil spills and noise disturbance. Although recent acoustic studies indicate that bowhead whales swim beneath the ice within several kilometers of the leads, it is not clear how long whales remain under the ice before returning to the leads. In particular, we believe that noise-producing activities in the pathway of the spring migration could block or seriously disrupt the successful movements of the species along the Chukchi Sea coast and into the Beaufort Sea. We believe this potential for jeopardy should be recognized and addressed at the leasing stage. NOAA Fisheries will reconsider this conclusion when new information, technology and/or measures that would effectively eliminate or otherwise mitigate this potential jeopardy situation become available or are proposed.

Therefore, NOAA Fisheries provides the following reasonable and prudent alternatives that MMS can adopt to avoid the likelihood of jeopardy from oil spills and noise. We believe that either (1) the lease blocks within 25 miles of the nearshore lead system should be deferred from the lease sale (for example see the Coastal Deferral Alternative VI (MMS 1987a) for Lease Sale 109 and the Barrow Deferral Area identified by MMS during consultation for Lease Sale 97) or, (2) if these blocks are leased, development and production activities should not be approved unless and until further consultation results in a no jeopardy conclusion or a reasonable and prudent alternative is developed and adopted that would avoid the likelihood of jeopardy. More specific options and alternatives may be developed during further consultation, particularly as new information or technology is developed or specific development plans or specific mitigation measures are proposed. However, we cannot, at this time, identify more specific reasonable and prudent alternatives to avoid this likelihood of jeopardy from production and development activities.

#### INCIDENTAL TAKE STATEMENT

Section 7(b)(4)(C) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under Section 101(a)(5) of the Marine Mammal Protection Act of 1972 (MMPA). Since no incidental take in the Arctic Region has been authorized under Section 101(a)(5) of the MMPA, no statement on incidental take of endangered or threatened marine mammals is provided.

#### CONSERVATION RECOMMENDATIONS

NOAA Fisheries offers MMS the following recommendations to further promote the conservation of endangered whales in the Arctic Region.

1. MMS, with the assistance of NOAA Fisheries, should establish measures to reduce, as far as practicable, possible impacts from noise associated with drilling and other activities. During the spring (April through June) and fall (August through October), drilling, construction, and vessel traffic should not be conducted in a manner that will significantly affect any whales present. Specific measures to reduce impacts of drilling and associated activities at individual well locations cannot be developed until these locations are known and exploration plans are submitted. Case-by-case information on the location, times, and manner of drilling operations, along with planned mitigating measures to protect bowhead whales, should be provided to NOAA Fisheries for review. In addition, MMS should limit the number of active industrial sites to ensure that the potential for adverse effects is low.
2. To minimize potential harassment to bowhead and gray whales from daily activities associated with OCS exploration in the Arctic Region, MMS should advise operators that aircraft should observe a minimum distance of 1,500 feet (approximately 500 m), horizontally or vertically from observed whales, and from areas where whales are believed to be present; and vessels, including seismic geophysical vessels, should avoid concentrations of whales and attempt to keep a distance of at least 1 mile from any observed whales.
3. To avoid adverse effects should a major oil spill occur, MMS should cooperate with appropriate Federal agencies to ensure that areas occupied by either bowhead or gray whales are clear of spilled oil. Special precautions should be taken to ensure that spilled oil does not persist in areas located in or near (a) lead systems used by bowhead whales during their spring migration (April through June), (b) the bowhead whale coastal migratory corridor from the U.S./Canada Border to the Bering Strait in the fall (August through October), and (c) feeding areas used in the fall.
4. Except for exploratory drilling operations inside the Beaufort Sea barrier islands, exploratory operations conducted in the area of and during the fall migration should be monitored using appropriate survey techniques to determine the movement and activity of whales near the drill sites, and whale migration and other habitat use, such as feeding. The behavior of the whales should be monitored by qualified researchers to determine the

behavior of whales present and if they are being affected. Use of feeding areas is particularly important to document. NOAA Fisheries should be involved in monitoring efforts and then kept informed of the status of monitoring efforts and of any potential indications of significant disturbance or displacement of bowhead whales. Each year's research should be conducted so that it is comparable with previous years. At the end of the season all years data should be reviewed and a decision made by MMS in consultation with NOAA Fisheries as to the need and kind of further research.

5. If an unauthorized take of bowhead whales occurs as a result of OCS activities, MMS should halt the activities immediately. It is strongly recommended that NOAA Fisheries conduct or participate in the monitoring efforts to make these determinations.

6. MMS is encouraged to continue to sponsor research needed to improve knowledge of the seasonal movements and habitat utilization of endangered whales in the Arctic Region, and of the effects of oil spills and other OCS activities on these whales. Possible areas of continued research are to (a) identify and characterize feeding areas and habitat use of gray and bowhead whales, and determine their importance to the populations, (b) determine the nature and effects of industrial noise in the Arctic Region on migrating bowhead whales, including geophysical seismic sounds using airguns and drilling noise from both fixed and floating units and their support activities, including icebreakers and dredges, and (c) detect cumulative effects.

7. The location of the spring lead system and distribution of whales in this system should be investigated to determine as precisely as possible the location, extent and yearly variation of this migratory corridor, so that this information can be used in leasing decisions.

8. The results of MMS sponsored research on bowhead and gray whales should be made available to NOAA Fisheries and other parties interested in management of these whales in a timely manner. To provide for greater interdisciplinary coordination among researchers, and between researchers and agencies, the information gained during the research efforts should be made available at meetings such as the Biennial Conference on Marine Mammals, Biennial Bowhead Whale Biology Conference, and MMS Information Transfer Meetings.

9. The Beaufort and Chukchi Biological Task Forces should be utilized by MMS for input for sales in the Arctic Region to ensure that future OCS operations are planned and conducted in a manner consistent with MMS's responsibilities to protect and conserve endangered species and other living marine resources and the habitats upon which these resources depend.

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United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240



DEC 1 1989

Mr. James E. Douglas, Jr.  
Assistant Administrator for Fisheries  
National Marine Fisheries Service  
1335 East-West Highway  
Silver Spring, Maryland 20910

Dear Mr. Douglas:

The Minerals Management Service (MMS) is preparing a draft Environmental Impact Statement (EIS) on proposed oil and gas lease Sale 124 and associated exploration in the Beaufort Sea Planning Area offshore northern Alaska. This is the fifth sale proposed for this planning area and is tentatively scheduled for March 1991. The previous sales were Sale BF (December 11, 1979), Sale 71 (October 13, 1982), Sale 87 (August 22, 1984), and Sale 97 (March 16, 1988).

The enclosed biological evaluation describes the specifics of proposed Sale 124, as well as potential effects of postlease activities on endangered species. (The information in the appendices is from the preliminary draft EIS and may be modified for the final EIS.) These details and effects are almost identical to those previously projected for Sale 97, which the National Marine Fisheries Service (NOAA Fisheries) examined thoroughly before issuing its Endangered Species Act (ESA) section 7 biological opinion for that sale (on May 27, 1987) and its revised opinion for the entire arctic region (on November 23, 1988). Because these data still represent the best scientific and commercial information available, we believe the Sale 97 and revised arcticwide opinions apply equally well to proposed Sale 124. Still, because Sale 124 is a separate action and "may affect" listed species, we hereby request, under ESA section 7 (a)(2), formal consultation on the leasing and any exploration that may occur as a result of this sale. To facilitate timely start of consultation, MMS Alaska regional staff have already provided a copy of the evaluation to their NOAA Fisheries counterparts in Anchorage.

We believe there is no need for lengthy formal consultation for Sale 124 as the Sale 97 data are still current. After reviewing the evaluation, NOAA Fisheries may wish to affirm in writing the applicability of the Sale 97 and revised arcticwide opinions to Sale 124. Such an action would avoid unnecessary paperwork and time delays and is consistent with the statement in the arcticwide opinion that "Opinions on future lease sales should incorporate by reference this opinion if it contains the best information available."

This approach will result in speedy conclusion of consultation. It is similar to confirming an early consultation's preliminary biological opinion as a final opinion (as described in 50 CFR 402.11(f)). We hope that NOAA Fisheries would issue the affirmation within the 45 days noted for confirming a preliminary opinion.

Mr. James E. Douglas, Jr.

2

While we believe the affirmation approach has compelling merit, we recognize that NOAA Fisheries may prefer to conduct a full-scale formal consultation for Sale 124 that might require the entire 135-day period allowed by ESA section 7 for consultation and delivery of a biological opinion. If, during such a prolonged consultation, NOAA Fisheries considers a potential finding of "jeopardy," new conservation recommendations, or new incidental take measures, terms, and conditions, we request that our respective staffs discuss these aspects as early as possible in the consultation. Such discussions would be essential to ensure that the alternatives, recommendations, and/or measures, are within our authority to control or implement and that they would be feasible, appropriate, and effective. Through these discussions, if they should be needed, MMS believes it would be possible to minimize or prevent later problems or misunderstandings and greatly expedite timely and effective conclusion of the formal consultation.

Although recent discussions between MMS and NOAA Fisheries headquarters staff indicate agreement that a lengthy consultation is neither necessary nor appropriate, we would welcome some official word from NOAA Fisheries as soon as possible that this is indeed the case and some notice on when we might expect to receive a biological opinion for proposed Sale 124. This information would greatly facilitate planning for the sale and the EIS's.

It is understood that by extending existing biological opinions to proposed Sale 124, or by providing us with an entirely new opinion for this sale, NOAA Fisheries will not be foreclosing on opportunities to reconsider that opinion as future lease sales are proposed for this area.

If you have any questions regarding this matter, please contact Mr. Jackson E. Lewis, Minerals Management Service, Mail Stop 644, Parkway Atrium Building, 381 Elden Street, Herndon, Virginia 22070-4817 (commercial telephone: 703-787-1729; FTS 787-1729), or Mr. Dan Benfield, Minerals Management Service, Alaska Region, 949 East 36th Avenue, Anchorage, Alaska 99508-4302 (commercial and FTS telephone: 907-261-4672).

Sincerely,

(sgd) William D. Bettenberg

Associate Director for  
Offshore Minerals Management

Enclosure

Mr. James E. Douglas, Jr.

3

bcc: (all copies without enclosure)  
Official File (BEO) (Sale 124; ENV 7-1d)  
AD/OMM  
DAD/Leasing  
DAD/Operations  
RD, Alaska Region  
RS/LE, Alaska Region  
Dan Benfield, Alaska Region  
Chief, OLM  
Chief, ORED  
OEAD RF  
Chief, BEO  
Lewis/Turner/Sun  
BEE/BEM/BES  
Offshore Chron (1)/(2)  
BEO RF

LMS:OEAD:MS644:JELewis:11/28/89:9-787-1729:Lewis:NMFS124.LTR



United States Department of the Interior

MINERALS MANAGEMENT SERVICE  
WASHINGTON, DC 20240

DEC 11 1989

Memorandum

To: Director, U.S. Fish and Wildlife Service

From: Associate Director for Offshore Minerals Management  
(SGD) WILLIAM D. BETTENBERG

Subject: Endangered Species Act Section 7 Formal Consultation for Leasing and Exploration Attendant Proposed Beaufort Sea Oil and Gas Lease Sale 124

The Minerals Management Service (MMS) is preparing a draft Environmental Impact Statement (EIS) on proposed oil and gas Lease Sale 124 and associated exploration in the Beaufort Sea Planning Area offshore northern Alaska. This is the fifth sale proposed for this planning area and is tentatively scheduled for March 1991. The previous sales were Sale BF (December 11, 1979), Sale 71 (October 13, 1982), Sale 87 (August 22, 1984), and Sale 97 (March 16, 1988).

The attached biological evaluation describes the specifics of proposed Sale 124, as well as potential effects of postlease activities on endangered species. (The information in the appendices is from the preliminary draft EIS and may be modified for the final EIS.) These details and effects are almost identical to those previously projected for Sale 97, which the U.S. Fish and Wildlife Service (FWS) examined thoroughly before issuing its July 30, 1985, Endangered Species Act (ESA) section 7 biological opinion for that sale. Because these data still represent the best scientific and commercial information available, we believe the Sale 97 opinion applies equally well to proposed Sale 124. Still, because Sale 124 is a separate action and "may affect" listed species, we hereby request, under ESA section 7(a)(2), formal consultation on the leasing and any exploration that may occur as a result of this sale.

To facilitate the earliest possible start of this consultation, we are sending a copy of this request directly to the FWS Alaska Regional Director. The MMS Alaska Region has already supplied him with a copy of the attachment. In this way, we expect the consultation to officially start on the date he receives his copy of this request.

We believe there is no need for lengthy formal consultation for Sale 124, as the Sale 97 data are still current. After reviewing the evaluation, FWS may wish to affirm in writing the applicability of the Sale 97 opinion to Sale 124. Such an action is consistent with the conclusion in the Sale 97 opinion that FWS opinions for earlier Beaufort Sea sales remained valid. It would also avoid unnecessary paperwork and time delays.

This approach will result in speedy conclusion of consultation. It is similar to confirming an early consultation's preliminary biological opinion as a final opinion (as described in 50 CFR 402.11(f)). We hope that FWS would issue the affirmation within the 45 days noted for confirming a preliminary opinion.

While we believe the affirmation approach has compelling merit, we recognize that FWS may prefer to conduct a full-scale formal consultation for Sale 124 that might require the entire 135-day period allowed by ESA section 7 for consultation and delivery of a biological opinion. (If this happens, the attached evaluation would be the primary source document for the consultation. As for past sales, however, MMS headquarters and Alaska Region staff would still try to provide FWS representatives with any additional information they might require, meet with them as necessary, and answer any questions they might have.)

If, during such a prolonged consultation, FWS considers a potential finding of "jeopardy," new conservation recommendations, or new incidental take measures, terms, and conditions, we request that our respective staffs discuss these aspects as early as possible in the consultation. Such discussions would be essential to ensure that the alternatives, recommendations, and/or measures are within our authority to control or implement and that they would be feasible, appropriate, and effective. Through these discussions, if they should be needed, MMS believes it would be possible to minimize or prevent later problems or misunderstandings and greatly expedite timely and effective conclusion of the formal consultation.

Although recent ("informal consultation") discussions between MMS and FWS Alaska regional and field office staff indicate that lengthy consultation may not be necessary, we would welcome some official word from FWS as soon as possible if this is indeed the case and some notice on when we might expect to receive a biological opinion for proposed Sale 124. This information would greatly facilitate planning for the sale and the attendant EIS's.

It is understood that by extending existing biological opinions to proposed Sale 124, or by providing us with an entirely new opinion for this sale, FWS will not be foreclosing on opportunities to reconsider that opinion as future lease sales are proposed for this area.

If you have any questions regarding this matter, please contact Mr. Jackson E. Lewis, Minerals Management Service, Mail Stop 644, Parkway Atrium Building, 381 Elden Street, Herndon, Virginia 22070-4817 (commercial telephone: 703-787-1729; FTS: 393-1729), or Mr. Dan Benfield, Minerals Management Service, Alaska Region, 949 East 36th Avenue, Anchorage, Alaska 99508-4302 (commercial and FTS telephone: 907-261-4672).

Attachment

cc: (without attachment)  
Regional Director  
U.S. Fish and Wildlife Service  
1011 Tudor Road  
Anchorage, Alaska 99503

bcc: (all copies without attachment)  
Official File (BEO) (Sale 124; ENV 7-1d)  
AD/OMM  
DAD/Leasing  
DAD/Operations  
RD, Alaska Region  
RS/LE, RS/FO, Alaska Region  
Dan Benfield, Alaska Region  
Chief, OLMD  
OEAD RF  
Chief, BEO  
Lewis/Turner/Sun  
BEE/BES/BEM  
Offshore Chron (1)/(2)  
BEO RF

LMS:OEAD:MS644:Lewis:mr:11/29/89:9-787-1727:Lewis:FWS124.LTR



IN REPLY REFER TO:  
DOS

United States Department of the Interior

FISH AND WILDLIFE SERVICE  
1011 E. TUDOR RD.  
ANCHORAGE, ALASKA 99503



MAR 13 1989

Memorandum

To: Regional Director, Minerals Management Service  
Alaska OCS Region

From: ~~Acting~~ Regional Director  
Region 7

Subject: Endangered Species - Proposed Oil and Gas Lease Sale 124  
(Beaufort Sea)

This responds to your subject memorandum of March 3, 1989. We have reviewed your notification of the listed and proposed species and critical habitat that will be included in your biological evaluation. We concur with your conclusion that the threatened Arctic peregrine falcon (Falco peregrinus tundrius) is the sole species requiring evaluation under Section 7 of the Endangered Species Act.

The Fish and Wildlife Service has only limited information regarding the numbers and distribution of this species within or near the proposed lease sale.

If you have any questions please contact Skip Ambrose at (907) 456-0232.

TELEPHONE CONVERSATION RECORD

Time of call: 3:30

Date: 2 Aug 89

Call to: Ron Morris

Call from: Gary Wheeler

Title & Org: NMFS Anch. Field Off.

Title & Org: Wildlife Bio. L&E

Phone No. 271-5006

Phone No. 261-4684

SUBJECT: Confirmation of species list for Sale 124 Bio Evaluation

I called Ron Morris to try to get confirmation of the list of endangered species to be discussed in the endangered species biological evaluation for Sale 124. We had sent NMFS a letter on March 3, 1989 stating that we would discuss effects on the gray whale and bowhead whale, and asked them to confirm this list. We had gotten no reply from NMFS. In our phone conversation this afternoon, Ron stated that discussing the effects on those two species would be adequate for the biological evaluation. Consequently, we now have confirmation of our species list.

cc: Paul Lowry  
John Schindler  
Dick Roberts  
Dan Benfield

RECEIVED

MAR 15 1989

REGIONAL DIRECTOR, ALASKA OCS  
Minerals Management Service  
ANCHORAGE, ALASKA

bcc: Official File (EAS) 102-01a ENV7-1  
(LAU) 1001-04a (Sale 124)

LE Read  
Author  
ED Chron  
Branch of Environmental Operations (MS 644)  
Attention: Jack Lewis  
Dick Roberts, Sale 124 Coordinator

MAR 3 1989

doc:brksam.gpw; disk:fkpdmemos;2/24/89kp

Memorandum

To: Regional Director, U.S. Fish and Wildlife Service  
From: Acting Regional Director, Alaska OCS Region  
Subject: Endangered Species - Proposed Oil and Gas Lease Sale 124 (Beaufort Sea)

The Minerals Management Service has initiated the planning process for the leasing and exploration associated with the proposed Outer Continental Shelf Oil and Gas Lease Sale 124. This lease sale is proposed for February 1991 in the Beaufort Sea planning area (map attached).

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we are providing a notification of the listed and proposed species and critical habitat that will be included in our biological evaluation.

It is our understanding that there are no designated or proposed critical habitats for any listed species in Alaska. Our biological evaluation will evaluate the effects of proposed Sale 124 on the threatened arctic peregrine falcon (Falco peregrinus tundrius) that may be present near the proposed lease area.

Please notify us of your concurrence with or revisions to our species list and any new information concerning the species' occurrence in relation to the proposed project area. To facilitate the review, we have provided a copy of this letter to your Anchorage field office. Upon receipt of your response, we will begin preparation of the biological evaluation that will review the potential effects of the proposed action.

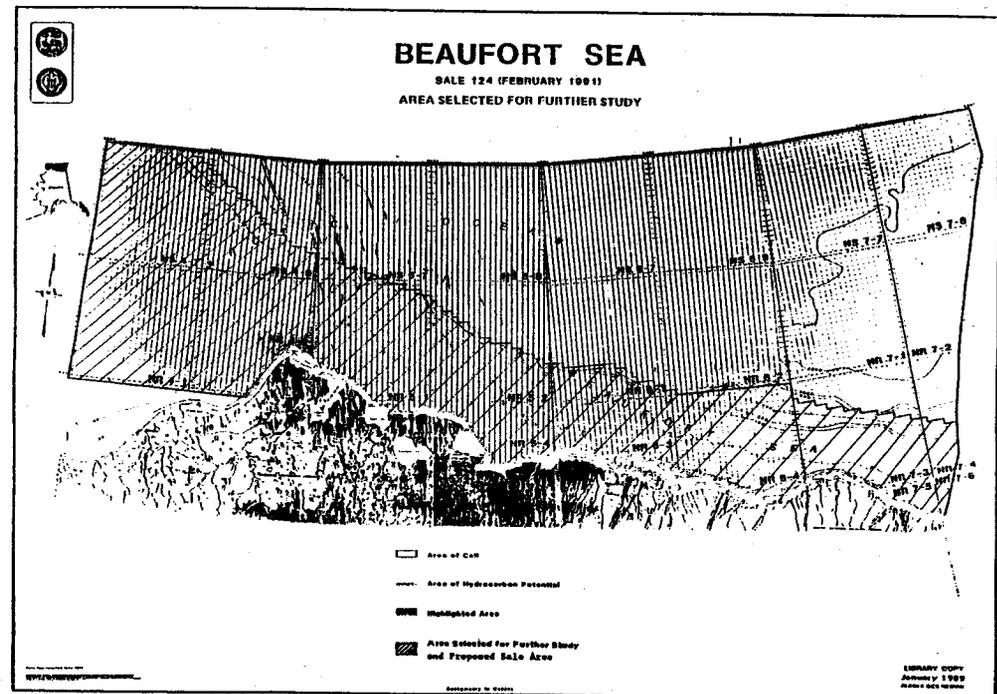
We look forward to working with you and your staff in protecting and conserving endangered and threatened species. If you have any questions concerning this proposed action, please contact Gary Wheeler at (907) 261-4684.

original signed by

*Roger W. Kleginger*

Attachment

cc: Anchorage Field Office, USFWS



MAR 3 1989

bcc: Official File (LAU) 1001-04a (Sale 124)  
X FILE (EAS) 102-01a ENV7-1

Mr. Steve Pennoyer  
Director, Alaska Region  
National Marine Fisheries Service  
P.O. Box 1668  
Juneau, Alaska 99802

LE Read  
Author  
RD Chron  
Branch of Environmental Operations (MS 644)  
Attention: Jack Lewis  
Dick Roberts, Sale 124 Coordinator

doc:brkslet.gpw; disk:fkpdmemos;2/24/89kp  
revised 3/2/89:cp

Dear Mr. Pennoyer:

The Minerals Management Service has initiated the planning process for the leasing and exploration associated with the proposed Outer Continental Shelf Oil and Gas Lease Sale 124. This lease sale is proposed for February 1991 in the Beaufort Sea planning area (map enclosed).

In accordance with the Endangered Species Act Section 7 regulations governing interagency cooperation, we are providing a notification of the listed and proposed species and critical habitat that will be included in our biological evaluation.

It is our understanding that there are no designated or proposed critical habitats for any listed species in Alaska. In our biological evaluation, we will review the following listed species that may be present in the proposed lease area for Sale 124:

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Gray whale	<u>Eschrichtius robustus</u>	Endangered
Bowhead whale	<u>Balaena mysticetus</u>	Endangered

Please review our list, and notify us of your concurrence or revisions and any new information concerning the species occurrence in relation to the proposed project area. To facilitate the review, we have provided a copy of this letter to your Anchorage field office. Upon receipt of your letter, we will begin the preparation of the biological evaluation to review the potential effects of the proposed action.

We look forward to working with you and your staff in protecting and conserving endangered and threatened species. If you have any questions concerning this proposed action, please contact Gary Wheeler at (907) 261-4684.

Sincerely,

original signed by

*Roger W. Kleginger*  
Acting Regional Director

Enclosure

cc: Anchorage Field Office, NMFS, NOAA

**APPENDIX L**

---

**FATE AND EFFECTS OF EXPLORATORY PHASE  
OIL AND GAS DRILLING DISCHARGES  
IN THE  
BEAUFORT SEA PLANNING AREA,  
LEASE SALE 124**

**Rates and Effects of Exploratory  
Phase Oil and Gas Drilling  
Discharges in the Beaufort Sea  
Planning Area, Lease Sale 124**

---

**APPENDIX**

Prepared for:

**U.S. Environmental Protection Agency  
1200 Sixth Avenue, WD-136  
Seattle, WA 98101**

Prepared by:

**Jones & Stokes Associates  
1808 - 136th Place, N.E.  
Bellevue, WA 98005  
(206) 641-3982**

August 29, 1990

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## INTRODUCTION

### PURPOSE OF EVALUATION

The U. S. Environmental Protection Agency (EPA) intends to issue a National Pollutant Discharge Elimination System (NPDES) general permit for effluent discharges associated with oil and gas exploration in the Outer Continental Shelf (OCS) Lease Sale 124 in the Beaufort Sea. Sections 402 and 403 of the Clean Water Act (CWA) require that NPDES permits for such ocean discharges be issued in compliance with EPA's guidelines (Ocean Discharge Criteria authorized by Section 403 of the CWA) for preventing unreasonable degradation of ocean waters.

Section 301(c) of the CWA provides that the discharge of pollutants to ocean waters is unlawful except in the terms of an NPDES permit. Under EPA's regulations (40 CFR 122.28[a][2]), EPA may issue a single general NPDES permit to a category of point sources located within the same geographical area if the regulated point sources:

- involve the same or substantially similar types of operations;
- discharge the same types of wastes;
- require the same effluent limitations or operating conditions;
- require similar monitoring requirements; and
- in the opinion of the EPA Regional Administrator, are more appropriately controlled under a general permit than under individual permits.

EPA Region 10 has decided that general permits are more appropriate for effluent discharges associated with oil and gas exploration than individual permits, and EPA expects to issue a general permit for exploratory drilling operations for Sale 124. However, EPA may issue individual NPDES permits for areas requiring special consideration, such as areas of sensitivity or of biological concern, and may elect to issue individual NPDES permits for future development and production operations in the Sale 124 area.

Before EPA can issue an NPDES permit to a new source, an environmental review must be conducted pursuant to Section 511(c)(1) of the CWA. EPA expects to adopt the Sale 124 Final Environmental Impact Statement (EIS) in order to satisfy this requirement. Ocean discharges must also be evaluated with

respect to the Ocean Discharge Criteria developed in accordance with Section 403(c) of the CWA. EPA therefore agreed to be a cooperating agency in the development of the EIS. The Minerals Management Service (MMS) of the U. S. Department of the Interior (DOI) requested that EPA provide an appendix presenting the fate of exploration-phase deliberate discharges, and the effects of these discharges on receiving water quality and biological populations.

### SCOPE OF EVALUATION

This document evaluates the effects of waste discharges that would be provided for by the general NPDES permit which will be proposed for offshore oil and gas exploration in the Beaufort Sea Planning Basin under federal OCS Lease Sale 124. This evaluation is based only on deliberate wastewater discharges occurring during exploration. It does not include impacts from exploration caused by noise, construction, spills, or other factors and does not include discharges during development and production.

### CURRENT EVALUATION

MMS has presented three development scenarios which assume different numbers of exploration and delineation wells (Table 1) (DOI 1989). The average exploration and delineation well in the Beaufort Planning Area will be about 3,100 meters (10,000 feet) deep, will use 571 tonnes (630 short tons) of dry mud, and will produce 743 tonnes (820 short tons) of dry rock cuttings (DOI 1989).

The first scenario is the low case. Four exploration wells are projected to be drilled during 1992 and 1993 and using a total of 2,283 tonnes (2,520 short tons) of drilling muds and producing a total of 2,972 tonnes (3,280 short tons) of dry rock cuttings.

The second scenario is a base case projection which assumes that exploration will result in the discovery of approximately 900 million barrels of commercially recoverable hydrocarbons. This scenario projects 10 exploratory wells and four delineation wells between 1992 and 1996 with discharges of 5,709 tonnes (6,308 short tons) of drilling muds and 7,430 tonnes (8,200 short tons) of cuttings.

The third scenario is a high case projection which assumes that the exploration phase will result in the discovery of approximately 2,600 million barrels of commercially recoverable hydrocarbons. Activity is assumed to continue through 1998 with 25 exploration wells and 11 delineation wells projected. Approximately 14,271 tonnes (15,750 short tons) of drilling muds and 18,576 tonnes (20,500 short tons) of cuttings are expected to be produced during the six-year period.

**Table 1. Estimated Annual Production of Drilling Muds and Cuttings During Exploration and Delineation Activities in the Beaufort Sea Planning Area, Lease Sale 124<sup>1</sup>**

	Year	Exploration <sup>2</sup>				Delineation <sup>3</sup>		
		Number of Rigs	Number of Wells	Mud (Tonnes)	Cuttings (Tonnes)	Number of Wells	Mud (Tonnes)	Cuttings (Tonnes)
Low Case	1992	2	2	1142	1486	0	0	0
	1993	2	2	1142	1486	0	0	0
	Total		4	2284	2972	--	--	--
Base Case	1992	2	2	1142	1486			
	1993	3	2	1142	1486	2	1142	1142
	1994	3	2	1142	1486	2	1142	1142
	1995	2	2	1142	1486			
	1996	2	2	1142	1486			
	Total		10	5710	7430	4	2284	2284
High Case	1992	4	4	2283	2972			
	1993	6	5	2854	3715	4	2283	2972
	1994	5	5	2854	3715	3	1713	2229
	1995	5	4	2283	2927	3	1713	2229
	1996	3	3	1713	2229	1	571	743
	1997	2	2	1142	1486			
	1998	2	2	1142	1486			
	Total		25	14271	18575	11	6280	8173

Source: DOI 1989

<sup>1</sup> Estimated number of wells and hypothetical drilling schedule.

<sup>2</sup> The average exploration well is assumed to use 571 tonnes (630 short tons) of dry mud and 744 tonnes (820 short tons) of cuttings.

<sup>3</sup> The average delineation well is assumed to use 571 tonnes (630 short tons) of dry mud and 744 tonnes (820 short tons) of cuttings.

### ALTERNATIVE DRILLING SCENARIOS

Three drilling alternatives are under consideration: (1) the proposed action with no deferral (Figure 1); (2) the Barrow Deferral Alternative deleting 201 whole and partial blocks (approximately 412,354 hectares); and (3) Barter Island Deferral Alternative deleting 144 whole and partial blocks (approximately 290,000 hectares).

### DISCHARGE SCENARIOS

Three discharge scenarios are analyzed below: (1) alternative ways of discharging drilling effluents such as shunting and pre-dilution; (2) effect of discharges under open water conditions and in broken ice (during freeze-up and break-up) conditions, and on ice; and (3) no discharge of drilling effluents (land disposal). A fourth scenario, discharge down the well annulus, has been used in the Alaskan OCS. Land disposal must be considered as the alternative to ocean disposal of drilling muds if the NPDES permit conditions are not met or if there is insufficient information to determine that there will be no unreasonable degradation to the marine environment.

### ORGANIZATION OF EVALUATION

The factors evaluated in this document are:

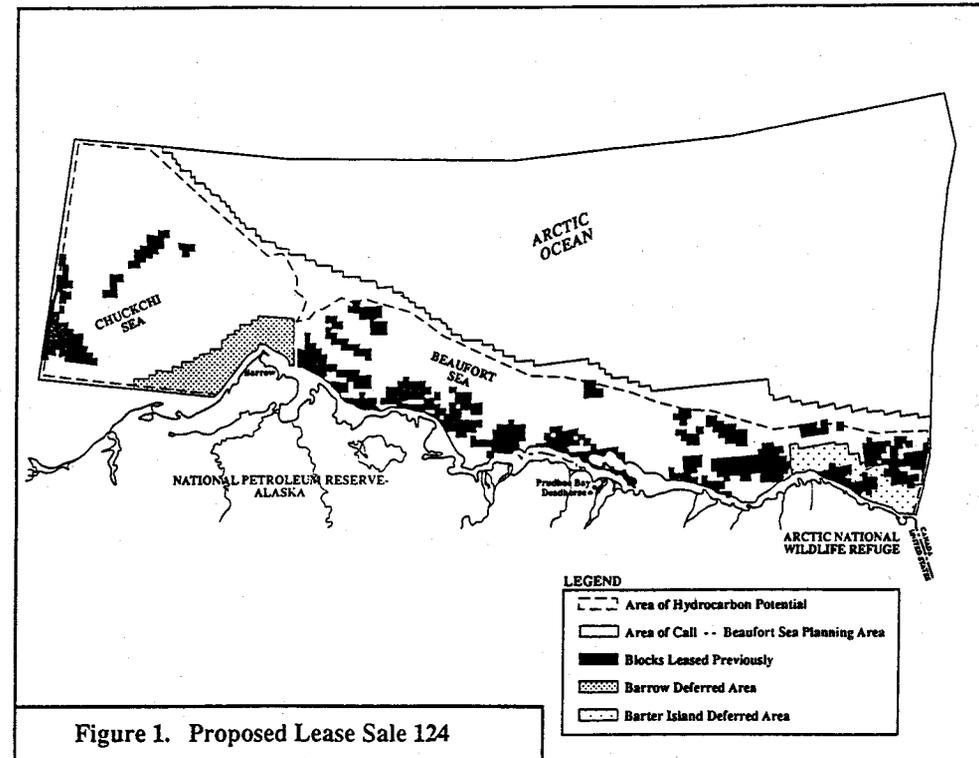
- the composition and quantities of material discharged;
- the fate and transport of materials discharged;
- various methods of disposal of drilling muds and cuttings to the marine environment;
- the effects of discharges with reference to applicable marine water quality criteria;
- the effects of discharges upon the biotic community; and
- the implications of land disposal (no discharge).

### DESCRIPTION OF ALTERNATIVES

This section discusses the alternatives available under the CWA, including the granting of an NPDES permit and technology-based effluent limitations, and briefly reviews alternative development scenarios.

### CLEAN WATER ACT PERMIT REQUIREMENTS

Sections 301(b), 304, 308, 401, 402, and 403 of the CWA provide the basis for NPDES permit conditions. The general requirements of these sections fall into two categories, ocean



discharge criteria and technology-based effluent limitations. These sections are described below.

#### OCEAN DISCHARGE CRITERIA

EPA's Ocean Discharge Criteria (40 CFR Part 125, Subpart M) set forth specific determinations of unreasonable degradation that must be made prior to permit issuance. "Unreasonable degradation of the marine environment" is defined as (40 CFR 125.121[e]):

- (1) Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities,
- (2) Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or
- (3) Loss of aesthetic, recreational, scientific or economic values, which is unreasonable in relation to the benefit derived from the discharge.

The determination of unreasonable degradation must be based on the following factors: quantities, composition, and potential for bioaccumulation or persistence of the pollutants discharged; potential transport of such pollutants; the composition and vulnerability of the biological communities exposed to such pollutants; the importance of the receiving-water area to the surrounding biological community; the existence of special aquatic sites; potential effects on human health; existing or potential effects on recreational and commercial fishing; applicable requirements of approved Coastal Zone Management Plans; marine water quality criteria developed pursuant to section 304(a)(1) of the CWA; and other relevant factors.

If the EPA Regional Administrator determines that the discharge will not cause unreasonable degradation of the marine environment based upon the above criteria, an NPDES permit may be issued. If the Regional Administrator determines that the discharge will cause unreasonable degradation of the marine environment, an NPDES permit cannot be issued.

If the Regional Administrator has insufficient information to determine prior to permit issuance that there will be no unreasonable degradation of the marine environment, an NPDES permit may not be issued unless the Regional Administrator, on the basis of the best available information, determines that: (1) such discharge will not cause irreparable harm (as defined in 40 CFR 125.121[a]) to the marine environment, (2) there are no reasonable alternatives to the on-site disposal of these

materials, and (3) the discharge will be in compliance with certain specified permit conditions (40 CFR 125.123[d]).

#### TECHNOLOGY-BASED EFFLUENT LIMITATIONS

The CWA requires particular classes of industrial discharges, including those associated with oil and gas exploratory drillings, to meet technology-based effluent limitations established by EPA. The CWA provides for implementation of these effluent limitations in three stages.

Best practicable control technology currently available (BPT) was required no later than July 1977. BPT represents the average of the best existing performances of well-known technologies for control of traditional pollutants. EPA set effluent limitation guidelines requiring BPT for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category (40 CFR Part 435, subpart A) on April 13, 1979 (44 FR 22069). BPT for this subcategory limits the discharge of oil and grease in produced water to a daily maximum of 72 milligrams per liter and a 30-day average of 48 milligrams per liter; prohibits the discharge of free oil that would cause a sheen on the water surface in deck drainage, drilling fluids, drill cuttings, and well-treatment fluids; requires a minimum residual chlorine content of 1 milligram per liter in sanitary discharges; and prohibits the discharge of floating solids in sanitary and domestic wastes.

Toxic pollutants are controlled by the best-available technology economically achievable (BAT) (40 CFR 401.15), while conventional pollutants, such as oil and grease, biochemical oxygen demand, pH, suspended solids, and fecal coliforms, are controlled by the best conventional pollutant control technology (BCT). Controls by BAT and BCT are to be achieved as expeditiously as practicable, but in no case later than three years after the date of final promulgation of technology-based guidelines, and in no case later than March 31, 1989. In no case are BAT or BCT to be less stringent than the already existing BPT. Permits must impose effluent limitations which control non-conventional (i.e., neither toxic nor conventional) pollutants by means of BAT no later than March 31, 1989.

Finally, effluent limitations based on the best-demonstrated control technology must be imposed with the development of new-source performance standards (NSPS).

BAT/BCT effluent limitation guidelines and NSPS for the Offshore Subcategory were proposed by EPA in August 1985 (50 FR 34592). The guidelines are slated to be proposed again in June 1990. The reproposal will address all applicable wastestreams (drilling muds and cuttings, produced water, produced sand, deck drainage, well treatment fluids, work overfluids, sanitary wastes, and domestic wastes). Promulgation of these guidelines and standards is not expected until July 1991, although proposed rules have been published (53 FR 41358).

EPA Region 10 BAT requirements in permits (1) prohibit the discharge of all oil-based muds, diesel oil, and cuttings with either an oil content greater than 10 percent by weight, or cuttings which contain diesel oil, or those that cause a sheen; (2) limit the mercury and cadmium content of barite to 1 milligram per kilogram and 3 milligrams per kilogram (dry weight basis), respectively; (3) set limits for the biochemical oxygen demand of sanitary waste and require a residual chlorine content of no less than 1.0 milligram per liter in the wastes; (4) controls drilling mud and cuttings toxicity via the drilling fluid formulation process; and (5) set other limits on miscellaneous discharges. Such requirements were incorporated in the general permits for the Bering and Beaufort Seas (49 FR 23734, June 7, 1984), for Norton Sound (50 FR 23578, June 4, 1985), for Cook Inlet (EPA 1988a), and for the Chukchi Sea and Beaufort Sea (53 FR 37846, September 28, 1988).

#### COMPOSITION AND QUANTITY OF MATERIALS DISCHARGES

This section describes and quantifies the various discharges expected from oil and gas drilling rigs during exploratory and delineation activities. Attention is given to the drilling muds and the specialty additives they contain.

#### TYPES OF DISCHARGES

Exploratory oil and gas well drilling can produce a wide range of waste materials related to the drilling process, maintenance of equipment, and personnel housing. The major discharges to be expected from exploratory drilling are drilling fluids (muds), and drilling cuttings and washwater. Other discharges may include sanitary and domestic wastes, desalination-unit discharge, boiler blowdown, test fluids, deck drainage, non-contact cooling water, blowout-preventer fluid, uncontaminated ballast and bilge water, and excess cement slurry.

#### MISCELLANEOUS DISCHARGES

Sanitary waste discharge is expected to be under 37,850 liters (10,000 gallons) per day per rig (Menzie 1983), which consists of chlorinated, perhaps secondary treated, effluent. Upon discharge, immediate dissolved oxygen demand is exerted, which represents the oxygen demand of organic compounds that are rapidly oxidized. Calculations described in EPA (1984a) indicate that the dissolved oxygen depression resulting from the discharge of treated sewage effluent during offshore exploratory drilling will not be significant when ambient dissolved oxygen concentrations are at least 1 milligram per liter above the dissolved oxygen standard for aquatic life, usually 6 milligrams per liter at the surface, 5 milligrams at depth in Alaskan inshore waters. Since the ambient dissolved oxygen concentration in the receiving water exceeds 8 milligrams per liter, sewage effluent discharge is not expected to significantly impact dissolved oxygen concentrations in the ocean.

Domestic waste (shower and sink drainage) is not expected to produce a significant discharge flow, usually less than 8,000 gallons per day, and is sometimes reused to make drilling mud rather than discharged directly (Jones & Stokes Associates 1984). Average discharge rates from an Alaskan offshore exploration rig are presented in Table 2.

The blowout preventer may be located on the sea floor or on the drilling platform. This device is designed to contain pressures in the well that cannot be contained by the drilling mud. Fluid may be discharged when the blowout preventer is actuated, generally on a weekly basis for testing. Some self-contained blowout preventers are now in use. The primary constituents of blowout preventer fluid are ethylene glycol and water (Jones & Stokes Associates 1984). Some proprietary formulations are also used. The volume of fluid discharged when the device is actuated needs to be monitored. A representative discharge estimate obtained from industry discharge monitoring reports is 200 gallons per day. However, this estimate may be high (Jones & Stokes Associates 1984).

Cement, along with spud mud and cuttings, will be discharged from drillships. It will also be discharged on the ocean floor in the early phases of drilling before the well casing is set, and during well abandonment and plugging. Excess cement slurry will result from equipment washdown after cementing operations. The exact composition of the cement is not documented. Consequently, its composition should be either defined or an aquatic toxicity test conducted to define its hazard potential. It is generally expected to be nontoxic (Jones & Stokes Associates 1984). Discharge volumes are not documented and are relatively site specific, but are not expected to comprise a significant volume.

Desalination-units may discharge on the order of 757,000 liters (200,000 gallons) per day per rig of water having salinity twice that of ambient seawater. Boiler blowdown may be discharged once or twice a year per rig in volumes of around 230 liters (60 gallons). Both of these discharges may contain biocides or chemicals used to combat corrosion and scaling. The volume of boiler blowdown is so small that it is unlikely to be a significant source of pollution. Desalination-unit water could result in significant mass loadings of pollutants into the immediate marine environment if the chemicals are not consumed or detoxified prior to discharge.

Test fluids are discharged from the well upon completion of drilling. These may consist of formation water, oil, natural gas, formation sands, any acids or chemicals added downhole, or any combination thereof. Test fluids are generally stored and treated for oil removal and pH before being discharged or flared. Approximately 1 percent of the total test fluids will have a pH of 2. During a typical 5-day well test, this may involve 8,000 liters (50 barrels) of water. The addition of strong

Table 2. Representative Discharges from Alaskan Offshore Exploration Rig<sup>a</sup>

Discharge, Units	6/10-6/30	7/01-7/31	8/01-8/31	8/31 <sup>b</sup>	9/01-9/30	10/01-10/12
<b>Drilling Mud</b>						
Average BPH	30	10	21.2	ND <sup>c</sup>	39	137
Total Maximum BBL	4,406	2,845	1,679		4,679	2,165
<b>Cuttings</b>						
Average BPH	-----	1	0.3	ND	5	1
Total Maximum BBL	-----	389	109		1,956	75
<b>Washwater</b>						
Average BPH	257 <sup>d</sup>	236 <sup>e</sup>	172 <sup>f</sup>	ND	217 <sup>g</sup>	139 <sup>h</sup>
Total Maximum BBL	35,148 <sup>d</sup>	79,213	58,698		78,950	15,294
<b>Deck Drainage</b>						
Average GPD	13,430	13,006	13,940	21,600	25,080	12,150
Total Maximum GAL	282,000	403,200	418,200	21,600	752,400	145,800
<b>Sanitary Waste</b>						
Average GPD	2,225	2,427	2,075	2,280	2,124	2,068
<b>Domestic Waste</b>						
Average GPD	7,419	8,084	6,917	7,600	7,080	6,892

<sup>a</sup> Compiled from EPA Region 10 discharge monitoring reports for a selected representative Alaskan offshore exploration semi-submersible rig at two wells in the Navarin Basin, 1985 season. BPH = barrels per hour; BBL = barrels; GPD = gallons per day; GAL = gallons.

<sup>b</sup> Rig relocated to new exploration block.

<sup>c</sup> No discharge.

<sup>d</sup> Includes cuttings.

<sup>e</sup> Maximum mud, cuttings and washwater reported as 532 BPH.

<sup>f</sup> Maximum mud, cuttings and washwater reported as 438 BPH.

<sup>g</sup> Maximum mud, cuttings and washwater reported as 575 BPH.

<sup>h</sup> Maximum mud, cuttings and washwater reported as 875 BPH.

acidic fluids downhole could cause significant leaching of heavy metals from the formation and residual drilling muds. The remaining test fluids will have a pH of 5 to 8.5, with about 97 percent of the volume above pH 6.5. The permit will require neutralization (pH 6.5 to 8.5) of all spent acidic fluids before discharge.

Deck drainage, consisting of precipitation and wash-water from the deck and drilling floor, is reported as 53,000 liters (14,000 gallons) per day (Menzie 1983). Gutters normally carry the drainage to a sump tank where oil is separated and removed before the water is discharged. Oil is the primary pollutant in deck drainage, with a reported range of 24 to 450 milligrams per liter, but these discharges may also contain small quantities of detergents used in cleaning procedures and spilled drilling mud or chemicals (Mors et al. 1982).

Generally, except for an elevated temperature, the composition of non-contact cooling water will not significantly differ from ambient seawater (Jones & Stokes Associates 1984). Oil-water separators are used to treat bilge waters for removal of petroleum hydrocarbons prior to discharge. While ballast waters are untreated, the permit prohibits discharges that will produce an oil sheen.

The volume of non-contact cooling water can vary depending on the system used. Closed-system, air-cooled designs require no cooling water, whereas other systems may discharge 0.4 to 3.8 million liters ( $10^5$  to  $10^6$  gallons) per day. Reported temperatures range from 15° to 25°C (62° to 84°F), much higher than ambient seawater. Biocides may be used to control fouling in the heat exchange units (Zimmerman and de Nagy 1984). The volumes of cooling-water discharge could result in significant mass loadings of pollutants into the immediate marine environment if the chemicals are not consumed or significantly detoxified prior to discharge.

Bilge waters are treated for removal of oil prior to discharge. Ballast waters are not treated; however, the permit will prohibit discharges that produce an oil sheen.

In summary, discharges other than drilling mud and cuttings are expected to represent only small pollutant loadings from offshore exploratory drilling operations using properly designed and functioning equipment. Potential pollutant loadings could result from deck drainage, biocides, corrosion inhibitors, and scale preventors and the following precautions appear warranted:

- cooling-water and desalination-unit discharges (and any other high volume discharge) should be monitored for volume of discharge and the chemical composition and concentration of biocides, corrosion inhibitors, or other chemical additives;

- heavy metal concentrations in spent test fluids should be determined;
- oil separators or sump tanks should be used for deck drainage, and the oil disposed of safely; and
- no solid waste should be thrown into the sea.

#### COMPOSITION OF DRILLING MUD

##### GENERAL COMPOSITION

Drilling muds are complex mixtures of clays, barite, and specialty additives used primarily to remove rock particles from the hole created by the drill bit. The composition of drilling mud can vary over a wide range from one hole to the next, as well as during the drilling of a specific hole.

Drilling muds serve several other functions in addition to removing solids. These include creating pressure to counteract pressure encountered in the formation at depth and controlling the flow of fluids between the formation and the hole. As the hole becomes deeper and encounters different formations, the type of mud may need to be changed or the composition altered.

Eight generic water-based mud (WBM) types have been evaluated and approved by the EPA during permit development. Table 3 lists the basic components of each mud and the maximum allowable concentration of each base component (50 FR 23601). Maximum values represent the present authorized maximum concentrations. Each mud differs in its basic components, and a single mud type can vary substantially in composition. Specialty additives may also be incorporated. Oil-based drilling muds may be used but are not allowed to be discharged because they violate the effluent limitation of no discharge of free oil. "Oil-based" means that the mud or fluid contains oil as the continuous phase with water as the dispersed phase. Additionally, the discharge of drilling muds and associated cuttings which have been contaminated by diesel oil is prohibited.

##### METALS

The presence of potentially toxic trace elements in drilling muds and cuttings is a concern. Metals, including lead, zinc, mercury, arsenic, vanadium, and cadmium, can be present as impurities in barite; chromium is present in chrome lignosulfonates and chrome treated lignite (Crippen et al. 1980; Menzie 1982). According to Ayers et al. (1980), drill pipe dope (15 percent copper, 7 percent lead) and drill collar dope (35 percent zinc, 20 percent lead, 7 percent copper) also contribute trace metals to the muds and cuttings discharge.

Trace metal concentrations expected in drilling muds used in oil and gas exploratory drilling are given in Table 4. Two values are given. The metals content of the generic muds prior

Table 3. Authorized Drilling Mud Types

Components	Maximum Allowable Concentration (lb/bbl)	Components	Maximum Allowable Concentration (lb/bbl)
<b>1. Seawater/Freshwater/Potassium/Polymer Mud</b>			
KCl	50	Bentonite	50
Starch	12	Acrylic Polymer	2
Cellulose Polymer	5	Lime	2
Xanthum Gum Polymer	2	Barite	180
Drilled Solids	100	Drilled Solids	70
Caustic	3	Seawater/Freshwater	As Needed
Barite	575		
Seawater/Freshwater	As Needed		
<b>4. Non-Dispersed Mud</b>			
<b>2. Seawater/Lignosulfate Mud</b>			
Bentonite <sup>1/</sup>	50	Lime	2
Lignosulfate, Chrome, or Ferrochrome	15	Bentonite <sup>1/</sup>	50
Lignite, Untreated or Chrome-treated	10	Caustic	2
Caustic	5	Barite	50
Lime	2	Soda Ash/Sodium Bicarbonate	2
Barite	575	Seawater	As Needed
Drilled Solids	100		
Soda Ash/Sodium Bicarbonate		<b>5. Spud Mud</b>	
Cellulose Polymer	5		
Seawater/Freshwater	As Needed		
<b>6. Seawater/Freshwater Gel Mud</b>			
<b>3. Lime Mud</b>			
Lime	20	Lime	2
Bentonite <sup>1/</sup>	50	Bentonite <sup>1/</sup>	50
Lignosulfate, Chrome, or Ferrochrome	15	Caustic	3
Lignite, Untreated or Chrome-treated	10	Barite	50
Caustic	5	Drilled Solids	100
Barite	575	Soda Ash/Sodium Bicarbonate	2
Drilled Solids	100	Cellulose Polymer	2
Soda Ash/Sodium Bicarbonate	2	Seawater/Freshwater	As Needed
Seawater/Freshwater	As Needed		

Source: EPA 1988

<sup>1/</sup> Attapulgite, sepiolite, or montmorillonite may be substituted for bentonite.

to use was analyzed by CENTEC (1984) and these values are reported in Column 1. The metals content of the discharges, which consist of both generic muds and additives, is reported in DMRS, and maximum metal concentration values from the reported data are given in Column 2. The difference in concentrations is substantial for barium, cadmium, chromium, lead, mercury, nickel, and zinc. Arsenic and copper change very little. This difference can be attributed to authorized specialty additives, incidental contamination from pipe dope, and differences in laboratory analyses and sample sources.

Table 4. Selected Trace Metal Concentrations Expected in Generic Drilling Muds and in Muds and Additives Discharged in Alaskan Waters

Metal	Maximum Concentration (mg/kg)	
	Generic Muds <sup>1</sup>	Muds Discharged in Alaskan Waters <sup>2</sup>
Arsenic	17.2	11.8
Barium	1,240	298,800
Cadmium	0.7	5.5
Chromium	908	1,820
Copper	77.3	47.7
Lead	52.2	1,270 <sup>3</sup>
Mercury	0.7	19 <sup>4</sup>
Nickel	9.8	88 <sup>5</sup>
Vanadium	n/a <sup>6</sup>	235 <sup>5</sup>
Zinc	90.4	3,420

<sup>1</sup> CENTEC (1984). The muds were hot-rolled prior to analysis to simulate chemical changes induced by downhold conditions.

<sup>2</sup> EPA (1988a). Reported in mg/kg solids.

<sup>3</sup> Only one operator, using Generic Mud #8, discharged muds with this high concentration of lead. The average of 100 records is 33.1 mg/kg with a standard deviation of 127.8 mg/kg.

<sup>4</sup> Only one operator, using Generic Mud #7, discharged muds with this high concentration of mercury. The average of 100 records is 0.36 mg/kg with a standard deviation of 1.86 mg/kg.

<sup>5</sup> Northern Technical Service, 1981, p. 91. Reported in ppm drilling fluid.

<sup>6</sup> Not available.

The range of metal concentrations in the drilling discharge is compared to average concentrations of the metals observed in the Earth's continental crust and in Alaskan OCS sediments (Table

5). With the exception of nickel and copper, all the listed metals can occur at concentrations greater than average continental crust or Alaskan OCS sediments. Barium in drilling muds is present at two orders of magnitude or greater concentration than any other trace metal.

Table 5. Comparison of the Range of Trace Metal Concentrations in Standard Drilling Muds and Average Earth's Continental Crust

Metal	Drilling Muds <sup>1</sup> (mg/kg dry weight of whole mud)	Continental Crust (mg/kg) <sup>2</sup>	Alaska OCS (mg/kg) <sup>3</sup>
Arsenic	11.8	1.8	-
Barium	298,800	425	-
Cadmium	5.5	0.15	<0.1
Chromium	1,820	120	1.7 - 3.2
Copper	48.7	60	<0.3 - 31
Lead	1,270	14	-
Mercury	19	0.08	0.011 - 0.067
Nickel	88	84	<1.3 - 13
Vanadium	235	120	-
Zinc	3,420	70	0.9 - 39

<sup>1</sup> From Table 3. Maximum metals concentration of muds and additives discharged to Alaskan waters.

<sup>2</sup> Ronov and Yaroshevsky 1972, pp. 252-254.

<sup>3</sup> Burrell 1978, pp. 281-329. Values for extractable concentrations from sediment.

#### CHROME LIGNOSULFONATES

Chrome lignosulfonates are present in two of the six generic muds approved for offshore drilling. When added to drilling fluids, chrome lignosulfonates adsorb to the clay component, inhibiting flocculation and loss of viscosity during use. However, chrome lignosulfonates are readily soluble in water (approximately 500 grams per liter [Knox 1978]), and the extent to which they may be displaced from drilling muds during use, or by seawater ions after discharge, has not been determined. Chrome lignosulfonates resist decomposition and persist in the marine environment for long periods of time. They are a major source of chromium, and their impacts on the biota will be addressed in a later section. The proportion of total chromium in the discharge that is actually combined with used lignosulfonates is unknown (Liss et al. 1980).

Marine sediments are the likely repository for discharged chrome lignosulfonates. The fate of these compounds in marine sediments is unclear. Because they are water soluble, the potential exists for slow release into sedimentary pore waters and/or reintroduction into bottom waters by resuspension or bioturbation, increasing their availability to marine organisms. All evidence points to minimal degradation by either abiotic (strictly chemical) degradation (Sarkanen and Ludwig 1971) or microbial breakdown (Crawford 1981). This evidence is supported by published studies of lignin distributions in marine sediments that indicate minimal *in situ* degradation periods in excess of 10,000 years (Hedges and Van Green 1982). This indicates that chrome lignosulfonates will persist in the sediments for long periods of time.

#### SPECIALTY ADDITIVES

In addition to the substances listed in Table 3 that make up the six generic mud types approved for use by EPA, a group of downhole additives are used for specific problems that may be encountered in the course of drilling. These additives can range from simple inorganic salts to complex organic polymers. Table 6 lists the more common additives in water-based drilling muds. Among the additives used in large enough quantities to result in significant mass loadings to the environment are: spotting materials, lubricants, zinc compounds, biocides, and materials added to prevent loss of circulation.

Spotting materials are used to help free stuck drill strings. Some of these (e.g., vegetable oil or fatty acid glycerol) are easily broken down in the environment. The most effective and consequently most frequently used spotting compounds are oil based. Previous oil and exploration NPDES permits have authorized, with restrictions, the use of mineral oil as a spotting agent (EPA 1988a). The discharge of muds and cuttings contaminated by diesel oil, spots, or oil-based muds is prohibited. In normal situations, 8,000 to 32,000 liters (50 to 200 barrels) of spotting material are sent downhole in a concentrated pill (not diluted throughout the mud system) (EPA 1984b). Concentrations within the pill may approach 100 percent oil. When the drill string is unstuck, the spotting material can sometimes be brought out as a plug to a separate holding tank and residual oil content in the mud will remain at approximately 2 percent. However, if the drill string remains stuck, the pill of spotting material is left downhole with the abandoned drill string. If the oil is left to mix with the drilling muds, average concentrations of up to 10 percent oil can be reached in the drilling muds.

Lubricants are added to the drilling mud when high torque conditions are encountered on the drill string. These lubricants can be vegetable or mineral oil or asphalt-based compounds such as Soltex. When needed, these lubricants are used to treat the entire mud system (roughly 320,000 liters [2,000 barrels]) with

Table 6. Authorized Mud Components/Specialty Additives

Product Name	Generic Description <sup>1/</sup>	Maximum Allowable Concentration (lb/bbl unless otherwise noted) <sup>2/</sup>
Aktflo-S	Aqueous solution of non-ionic modified phenol (equivalent of DMS)	3 <sup>2/</sup>
Aluminum stearate	----	0.2
Ammonium nitrate	----	200 mg/L nitrate or 0.05 lb/bbl
Aqua-Spot	Sulfonated vegetable ester formulation	1% by vol.
Bara Brine Defoam	Dimethyl polysiloxane in an aqueous emulsion	0.1
Ben-Ex	Vinyl acetate/maleic anhydride copolymer	1 <sup>2/</sup>
Bit Lube II	Fatty acid esters and alkyl phenolic sulfides in a solvent base	2
Calcium carbide	----	As needed
Cellophane flakes	----	As needed
Chemtrol-X	Polymer treated humate	5 <sup>2/</sup>
Con Det	Water solution of anionic surfactants	0.4 <sup>2/</sup>
D-D	Blend of surfactants	0.5 <sup>2/</sup>
DMS	Aqueous solution of nonionic modified phenol	3 <sup>2/</sup>
Desco CF	Chrome-free organic mud thinner containing sulfomethylated tannin	0.5
Duovis	Xanthan gum	2
Durenex	Lignite/resin blend	6 <sup>2/</sup>
Flakes of silicate mineral mica	----	45

Product Name	Generic Description <sup>1/</sup>	Maximum Allowable Concentration (lb/bbl unless otherwise noted) <sup>2/</sup>
Gelex	Sodium polyacrylate and polyacrylamide	1 <sup>2/</sup>
Glass beads	----	8
LD-8	Aluminum stearate in propoxylated oleyl alcohol	10 gal/1500 bbl
Lube-106	Oleates in mixed alcohols	2
Lubri-Sal	Vegetable ester formulation	2.0% (by vol)
MD (IMCO)	Fatty acid ester	0.25 <sup>2/</sup>
Milchem MD	Ethoxylated alcohol formulation	0.04 gal/bbl or 0.3 lb/bbl <sup>2/</sup>
Mil-Gard	Basic zinc carbonate	As needed
Nut hulls, crushed granular	----	As needed
Phosphoric acid esters and triethanolamine	----	0.4
Plastic spheres	----	8
Poly RX	Polymer treated humate	4 <sup>2/</sup>
Resinex	Reacted phenol-formaldehyde-urea resin containing no free phenol, urea, or formaldehyde	4 <sup>2/</sup>
Selec-Floc	High molecular weight polyacrylamide polymer packaging in light mineral oil	0.25
Sodium chloride	----	50,000 mg/L chloride
Sodium nitrate	----	200 mg/L nitrate or 0.05 lb/bbl

Product Name	Generic Description <sup>1/</sup>	Maximum Allowable Concentration (lb/bbl unless otherwise noted) <sup>2/</sup>
Sodium polyphosphate	----	0.05
Soltex	Sulfonated asphalt residuum	6
Sulf-X ES	Zinc oxide	As needed
Therma Check	Sulfono-acrylamide copolymer	1
Therma Thin	Polycarboxylic acid salt	4
Torq-Trim II	Liquid triglycerides in vegetable oil	6
Vegetable plus polymer fibers, flakes, and granules	----	50
VG-69	Organophilic clay	12
XC Polymer	Xanthan gum polymer	2
XO <sub>2</sub>	Ammonium bisulfite	0.5
Zinc carbonate and lime	----	As needed

Source: EPA 1988

<sup>1/</sup> Any proprietary formulation that contains a substance which is an intentional component of the formulation, other than those specifically described, must be authorized by the Director.

<sup>2/</sup> If a listed product will be used in combination with other functionally equivalent products, the maximum allowable concentration (MAC) for the sum of all of the products is the lowest MAC for any of the individual products. Four examples of functionally equivalent products are: (1) Aktaflo-S and DMS, MAC = 3 lb/bbl; (2) Ben-Ex and Gelex, MAC = 1 lb/bbl; (3) Chemtrol-X, Durenex, Poly RX, and Resinex, MAC = 4 lb/bbl, and (4) Con Det, D-D, MD (IMCO), and Milchem MD, MAC = 0.25 lb/bbl. For these examples, the MAC for any combination of the products is given in parentheses. For guidance on whether other products are considered to be functional equivalents, contact the regional office of EPA.

concentrations of 5.5 to 140 kilograms per cubic meter (2 to 50 pounds per barrel).

Zinc compounds (e.g., zinc carbonate) are used as sulfide scavengers when formations with hydrogen sulfide are encountered. The entire mud system is treated with zinc compounds as needed. Typically, concentrations of 1.5 to 5.5 kilograms zinc compounds per cubic meter of mud (0.5 to 2 pounds per barrel) are used, resulting in 450 to 1,800 kilograms (1,000 to 4,000 pounds) of zinc carbonate (240 to 940 kilograms [520 to 2,080 pounds] of zinc) in the drilling mud. The zinc sulfide and unreacted zinc compounds are discharged with the drilling mud into the environment.

In cases of lost circulation to the mud system, combinations of cellophane, mica, and walnut hulls are added to the mud in one of two methods. The entire system can be treated with typically 0.2 to 2.0 kilograms (0.5 to 5 pounds) per barrel, which results in 220 to 2,200 kilograms (1,000 to 10,000 pounds) of the additives to the system. Alternately, a pill of 100 to 200 barrels with a concentration of 9 to 27 kilograms (20 to 60 pounds) per barrel can be sent downhole (EPA 1984b). When drilling is resumed, the additives are separated out from the drilling mud and discharged with the cuttings into the environment; the muds are reused.

#### COMPOSITION OF CUTTINGS

The trace metal concentrations listed for the earth's continental crust are an indicator of the concentrations to be expected in the cuttings. It should be noted, however, that the trace metal concentrations in mud and the natural rock could vary well beyond the range noted in Table 5. Most of the trace metals in the cuttings are likely to be located in the mineral structure of the rock formation. Cuttings typically occur as granular material similar to coarse sand.

#### QUANTITY OF DRILLING MUDS AND CUTTINGS

The estimated quantities of drilling muds and cuttings to be disposed of under each scenario are described on page 2 of this appendix and are given in Table 1. A total of 14,271 tonnes (15,727 short tons) of drilling mud and 18,575 tonnes (20,470 short tons) of cuttings are projected under the high case scenario.

The rate of discharge during a well drilling operation is quite variable. There are periods of no discharge when drill bits are changed or casing is placed. During the actual drilling and circulation of the drilling mud, cuttings are brought up from the hole, removed by solids control equipment (approximately 90 to 95 percent efficient), and discharged relatively continuously. Drilling mud is discharged in bulk when mud type is changed, during cementing operations, or at the end of drilling. Bulk discharge rates have been reported to range from 4,800 to 190,000

liters per hour (30 to 1,200 barrels per hour) with the total volumes discharged each time ranging from 15,900 to over 320,000 liters (100 to 2,000 barrels).

#### FATE AND TRANSPORT OF MUDS AND CUTTINGS

This assessment relies extensively on the results of computer simulation modeling of dispersion and dilution of drilling muds. Oceanographic conditions are briefly described, then the model and verification studies are presented, and the results of the modeling runs are discussed.

Factors influencing the transport and persistence of discharged drilling muds and cuttings include oceanographic characteristics of the receiving water, depth of discharge, discharge rate, and method of disposal. Because ice covers the lease sale area during most of the year, three disposal methods are discussed in this section: on-ice disposal, open-water disposal, and below-ice discharge. Oceanographic influences include tide, wind, freshwater overflow, ice movement, stratification, and current regime.

#### THE BEAUFORT SEA PLANNING AREA ENVIRONMENTAL CONDITIONS

The lease area encompasses continental shelf and ocean basin waters. Water depths range from 2 to 3,900 meters (7 to 12,800 feet). Distances from the Alaskan coastline range from 5 to 180 kilometers (3 to 240 miles).

The proposed Sale 124 comprises approximately 4,079 blocks encompassing about 9 million hectares (22 million acres) located offshore along the Alaskan north coast from the U. S./Canadian boundary westward to Icy Cape and including both the American Beaufort Sea and a portion of the Chukchi Sea. The majority (75 percent) of Sale 124 lies in water depths greater than 40 meters (132 feet). In the Chukchi Sea portion of the lease sale area (45 percent of the area), all depths are greater than 40 meters.

#### METEOROLOGY

The lease sale area is in the Arctic climate zone. The mean annual temperature is  $-12^{\circ}\text{C}$ . Low levels of solar energy during the winter (roughly October to May) produce low temperatures and a harsh environment. The sun remains below the horizon for 49 consecutive days during midwinter. Mean temperatures at Oliktok for January through March are around  $-30^{\circ}\text{C}$  (U. S. Department of the Interior 1977). With the Arctic Ocean to the north and level tundra to the south, there are no natural barriers to still the wind. The Brooks Range to the south of the tundra is a formidable barrier to north-to-south air mass movements.

Summer (roughly June to September) temperatures at the coast remain within a few degrees of freezing. The ice covered Beaufort Sea to the north depresses temperatures near the coast,

while the Brooks Range limits the flow of warm air from the south. The severity of ice conditions during the summer is correlated with sea level pressure over the Arctic Ocean. The pressure gradient associated with higher than normal sea level pressure northeast of Alaska produces surface winds which push the ice away from the coast. Light-ice summers create mild autumnal temperatures.

#### SEA ICE

The lease sale area is essentially ice covered for all but two months of the year. Breakup typically begins as early as June and coincides (within a few weeks) with the initiation of spring river discharge. As nearshore melting continues, a coastal lead (open water) forms between Point Barrow and Demarcation Bay, which varies in offshore extent from several kilometers to several hundred kilometers, depending on the particular year. Open water conditions typically persist through September, when the refreezing process begins. The timing of breakup and freezeup is variable from year to year.

In an "average year," the edge of the summer Arctic pack ice is approximately 48 to 64 kilometers (30 to 40 miles) offshore (Selkregg 1975); however, this boundary may occur anywhere within a region that is about 260 kilometers (160 miles) wide. During the summer, winds from the east and northeast are the most common along the Alaskan Beaufort Sea coast. Because of the Coriolis effect, these winds drive most of the ice offshore; westerly winds move the ice on-shore. The timing of the open-water season, the amount of residual ice, and the threat of ice incursion varies from year to year and from place to place.

Sea ice in the nearshore region is more mobile during the breakup and freezeup periods than it is during winter. The ice is primarily driven by winds and by ocean current forces. Displacement of the ice may be up to several miles per day during these periods. As a first approximation, wind-driven sea ice moves at a rate of about 2.5 percent of the velocity of the wind (Pritchard and Stringer 1981). During the spring the sea ice is relatively weaker than it is in the winter, and in the fall it is relatively thinner. Large-scale movement of ice sheets in the fall and early winter can create pileups and possible override beaches.

Based on observation of the dynamic behavior and the location of the structural types of sea ice, the winter ice regime of the southern Beaufort Sea may be divided into the landfast ice zone, shear or stamukhi zone, and the pack ice zone (Figure 2). The location of these zones varies spatially and temporally and is strongly influenced by bathymetry and the position of offshore island sand shoals. The boundaries between these zones are, for the most part, gradational.

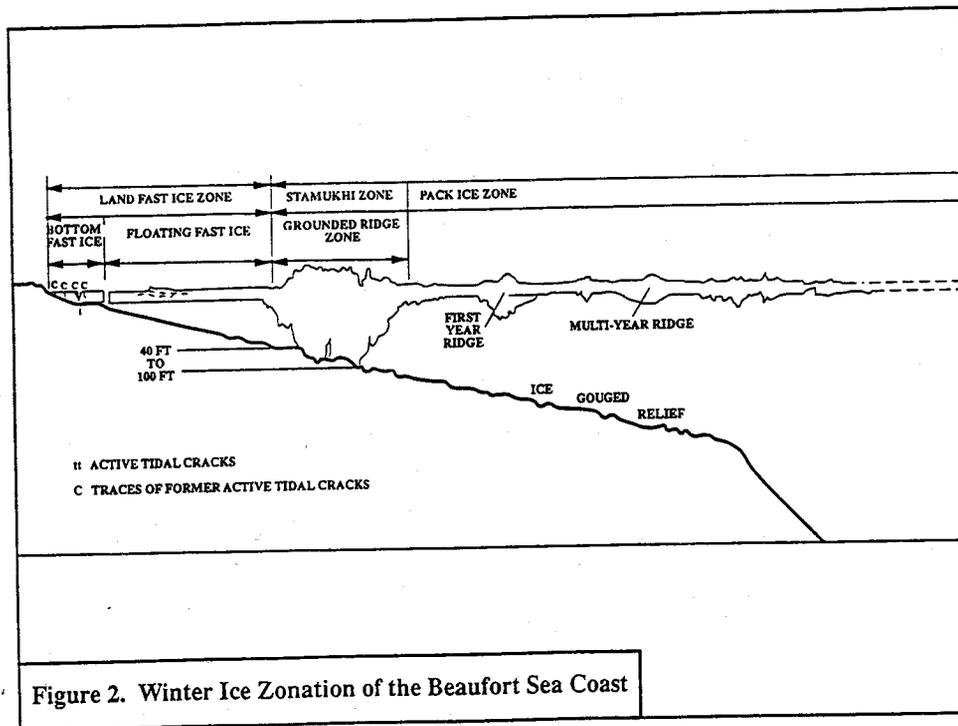


Figure 2. Winter Ice Zonation of the Beaufort Sea Coast

## CIRCULATION

The circulation in the Beaufort Sea can be divided into four regimes: nearshore, inner shelf, outer shelf, and Beaufort Gyre. The circulation patterns characteristic of each region are described in the Sale 97 ODCE.

In addition to the circulation patterns described in the Sale 97 ODCE, the portion of Sale 124 lying to the north and west of Point Barrow may be strongly influenced by the Alaskan coastal current. The Alaskan coastal current is an easterly flowing countercurrent whose flow generally opposes wind-driven coastal flow and the offshore Beaufort Gyre. It enters the Beaufort Sea along Barrow Canyon to the west of Point Barrow. This current is a continuation of flow which begins as far south as the Bering Sea and Chukchi Sea, where it turns toward the east near Point Barrow. At Point Barrow, the current moves offshore and lies at depths between 50 to 200 meters (160 to 660 feet). This current has been identified as far east as Kaktovik.

## CURRENTS

Currents measured in the Beaufort Sea during the summer months range from less than two to greater than 95 centimeters per second, the latter being measured at the onset of a storm in mid-August. Details of these measurements for the lease sale area are given in the Sale 87 ODCE and Sale 97 ODCE (EPA 1984b, 1988c).

## TIDES

Tides in the lease sale area are semi-diurnal and of low amplitude, with a range between 10 to 30 centimeters (4 to 12 inches). Meteorological tides (storm surges) are much more important than astronomical tides. Variations in water level of +3 meters to -0.9 meters (+10 feet to -3 feet) may result from a storm surge. Storm surges are important oceanographic processes in the Beaufort Sea, as currents generated by storm surges are several orders of magnitude greater than tidal currents (EPA 1984b, 1988c). Further details of tides in the lease sale area may be found in the Sale 87 ODCE and the Sale 97 ODCE.

## STRATIFICATION, SALINITY, AND TEMPERATURE

Nearshore salinity measurements have identified a two-layer system. The upper layer, consisting of fresher water from riverine input, rests on top of a layer containing more saline oceanic water. The surface layer shows a marked decrease in salinity in proximity to major rivers such as the Sagavanirktok, Kuparuk, and Colville Rivers. Freshwater input also causes a marked division between nearshore and offshore waters, often occurring near the 6 meter (19 foot) isobath. Details of the relevant studies may be found in Section 3 of the Sale 87 ODCE and the Sale 97 ODCE.

In general, the summer surface salinity over the shelf ranges from less than 5 to 30 part per thousand. At 10 meters (33 feet) salinities range from 25 to 30 part per thousand and at 30 meters (100 feet) salinities vary from 31 to 32.5 part per thousand (EPA 1984b). Surface and 10 meter (33 foot) temperatures range from -1 to 6°C. At 30 meters (100 feet), they vary from -1 to 7°C (EPA 1984b). In the winter, the lack of freshwater supply to the coast and salt leaching from sea ice both contribute to result in a weak winter stratification.

At these cold temperatures, water densities are determined by salinities and not temperatures.

#### SEDIMENT TRANSPORT

Several factors influence the rate and quantity of sediment transport in the Beaufort Sea, including ice gouging, entrainment in sea ice, wave action, currents, and bioturbation. Sediments on the inner shelf landward of the 20 meter (66 foot) isobath are influenced strongly by waves and currents. The bulk of sediment on the Alaskan shelf is transported westward on the inner shelf (Barnes and Reimnitz 1974).

The Sale 87 ODCE and the Sale 97 ODCE (EPA 1984b, 1988c) also noted that sediments experience intensive reworking by currents in areas landward of the 15 meter (50 foot) isobath. Bedload transport rates of up to 43,500 cubic meters per year, landward of the 6 meter (20 foot) isobath have been estimated (EPA 1984b) (about 1/5th to 1/10th of average littoral drifts along the southern California Coast [Ippen 1966]). Catastrophic transport associated with severe storms is an important transport mode and is particularly effective in the fall months when such storms are associated with fresh ice which enhances the erosion and often entraps sediments in new ice. In the spring the breakup of this dirty ice may result in sediment being deposited large distances from the point of entrapment

#### SUMMARY

The Lease Sale 124 oceanographic conditions can be summarized as follows:

- The Sale Area water depth varies from 2 meters (7 feet) to 3,900 meters (12,800 feet). Much of the drilling is expected to occur between 5 meters (9 feet) and 200 meters (660 feet).
- The area is ice covered much of the year, except for open water during a few months in summer.
- Current speeds are between 2 to 4 centimeters per second (0.04 to 0.08 knots) with speeds of 10 to 15 centimeters per second (0.2 to 0.3 knots) over the continental shelf and in some eddies. Current speed and water exchange are increased with wind stress.

- The water column is stratified in summer and relatively homogeneous in winter.
- Sediment transport occurs primarily during the summer and transition seasons.
- Sediment is transported by intense storms and ice; otherwise, natural sediment transport rates are low.

#### THE OFFSHORE OPERATORS COMMITTEE MODEL

The prediction of the fate of discharged muds and tailings relies on a computer model developed by a consortium effort of offshore operators. The Offshore Operators Committee (OOC) model was developed to describe the fate of offshore drilling mud discharges and has been used in all Ocean Discharge Criteria Evaluations prepared for Alaskan waters. The model simulates the amount of material settling on the bottom. It is discussed in detail in Brandsma et al. (1983), Tetra Tech (1984), and EPA (1984b, 1988c).

Field and laboratory experiments provide a qualified understanding of discharge plume behavior. The studies indicate that discharge of drilling mud and cuttings separate into an upper and lower plume (EPA 1984b, 1988c). The upper plume is subject to physical transport processes very different from those influencing the lower plume. The lower plume contains the bulk of the solids (over 90 percent) and descends rapidly (faster than the rate predicted by Stokes' law for individual particles). The lower plume usually has not been studied.

The lower plume initially forms a circular jet with negative buoyancy and momentum. As the jet descends, ambient fluids are entrained and the plume grows larger and less dense. The jet remains in a convective descent phase until it reaches the level of neutral buoyancy or hits the seafloor where it spreads radially outward. At the level of neutral buoyancy, the material in the jet travels at mean velocity similar to the ambient fluid (EPA 1984b, 1988c).

Most field experiments indicate that discharged drilling materials settle mainly near the discharge point. Advection of discharged solids strongly influences solids accumulation patterns, especially in shallow water. Increased currents can resuspend or laterally transport effluent flows away from the discharge point (EPA 1984b, 1988c).

Several studies have been conducted to determine the magnitude of initial dilution of drilling discharges, including several studies from the Beaufort Sea area. Details of these studies may be found in the Sale 87 ODCE and the Sale 97 ODCE. Due to difficulty of obtaining measurements for the lower plume, dilution data refer only to the upper plume. Overall, solids dilutions from 1,000:1 to greater than 10,000:1 have been measured in the upper plume at the edge of the mixing zone (100

meters [330 feet]) during OCS studies. Due to the presence of sea ice, which is a dominant feature of the lease sale area, dilution may be much less than observed elsewhere because under-ice currents are weaker. Dilutions on the order of 200:1 -- several orders of magnitude lower than dilutions typical of open water -- were observed by Northern Technical Services (1983) from a discharge from Tern Island, a gravel island in the nearshore Beaufort Sea.

Virtually all solids and some soluble components present in drilling mud discharges are eventually deposited in seafloor sediments downcurrent from the discharge point. Deposition characteristics and patterns are extremely variable and are strongly influenced by several factors, including type and quality of mud discharged, hydrographic conditions at the time of discharge, and height above the bottom at which discharges are made (EPA 1984b, 1988c).

According to the Sale 87 ODCE and the Sale 97 ODCE (EPA 1984b, 1988c), studies have shown that accumulation of drilling materials on the seafloor is inversely related to the energy dynamics of the ambient environment. A low energy environment does not possess currents capable of removing or vertically mixing deposited material.

Metals associated with the drilling muds have been shown to accumulate in surficial bottom sediments, but the distribution is extremely uneven. Of the drilling mud components, barium is present in the highest concentrations in sediments downcurrent of the discharge point. This is due to its high concentration in the drilling mud, insolubility, and high density. Generally, there is a gradient of decreasing concentration of deposited materials with distance from the discharge point. The greatest deposition usually occurs directly under or a short distance away from the discharge point. Major deposition usually occurs within 100 meters (330 feet) of the discharge point, and background level concentrations of heavy metals are usually achieved within 1,000 meters (3,300 feet) downcurrent (EPA 1984b, 1988c).

The OOC model uses LaGrangian calculations to track material settling out of a fixed pipe. A Gaussian formulation is used to sum the three components and to track the distribution of solids to the bottom. Although there are limitations to this model (it does not account for mud flocculation, and it does not simulate produced water), it is considered one of the best available for modeling discharge plume behavior in water depths greater than 5 meters (16 feet) and when surface waves induce variations in water depth of less than 10 percent (Tarnay, undated).

The model simulates the effluent plume through three phases: the jet-phase (convective) descent; the dynamic collapse of the plume; and a later passive diffusion phase. In addition, the model simulates an upper cloud of material which appears as particles of mud separate from the main plume during its convective descent phase. The spread of muds and cuttings on the

bottom increases with water depth; in-water dilutions also are greater with increasing depths.

Inputs to the model include data from three parametric categories; drilling mud characteristics, discharge conditions, and ambient conditions (Table 7). Drilling mud characteristics consist of bulk density discrete particle classes, and concentration, density, and settling velocity for each particle class. Discharge conditions include rate, duration, orientation, and position of discharge, and rig type. Ambient conditions include water depth, density profile, current velocity, and wave conditions.

Table 7. Summary of OOC Model Inputs

Category	Variable	Typical Value <sup>1</sup>
Discharge Conditions	Rate	100-1,000 bbl/h
	Duration	30-60 min
	Angle (from horizontal)	90°
	Depth Below Surface	0.3 m (1.0 ft)
	Nozzle Radius	0.1 m (0.33 ft)
	Rig Length	70.1 m (230 ft)
	Rig Width	61.0 m (200 ft)
	Forced Separation of Fine Particles	yes
Drilling Mud Characteristics	Bulk Density	2.09 g/cm <sup>3</sup> (17.4 lb/gal)
	Initial Solids Concentration	1,441,000 mg/l
	Tracer Concentration	100 mg/l
Receiving Water Characteristics	Current Velocity	2-30 cm/sec
	Wave Height	0.61 m (2 ft)
	Wave Period	12 sec
	Density Gradient	<0.10

Source: Tetra Tech 1984b

<sup>1</sup> Typical values used for all model runs unless otherwise specified.

For the model simulations, it was assumed that 10 percent of the mud separated in a linear fashion during the convective descent phase of the main plume. Initial concentrations of suspended solids in the discharge of 70 meters (230 feet) are assumed to be 1,441,000 milligrams per liter. Ocean currents are assigned a constant magnitude and direction for each model run, although in reality they vary with depth and time. A consequence of this assumption is overestimation of solids accumulations on the bottom and underestimation of dilutions. Typical drilling rig and discharge characteristics are assumed for a rig of 60 by 70 meters (200 by 230 feet), a discharge nozzle radius of 4 centimeters (1.2 inches), and a vertical angle of discharge. The model assumes the discharge occurs 0.3 meters (1 foot) below the sea surface, although in reality the depths are greater than this

to ensure the discharge is below the wave action at the surface. It is assumed that 1,000 barrels per hour are discharged, which is at the upper limit of discharge rates (Tarnay, undated). Model assumptions are summarized in Table 8.

Table 8. Summary of OOC Model Inputs for Test Cases<sup>1</sup>

Case	Depth		Surface Currents <sup>2</sup>	
	(m)	(ft)	(cm/sec)	(knots)
1	40	130	2	0.40
5	5	17	10	0.2
10	15	50	2	0.04
15	70	230	10	0.2
16	120	400	10	0.2

Source: Tetra Tech 1984b

<sup>1</sup> All cases use a 2.09 g/cm<sup>3</sup> (17.4 lb/gal) mud, initial solids concentration 1,441,000 mg/l, discharged at a rate of 1,000 barrels per hour.

<sup>2</sup> Uniform velocity distribution with depth was assumed.

The model has been calibrated using field measurements taken at several continental shelf drilling sites including the Gulf of Alaska. The field studies and modeling effort suggest the following conclusions:

- Drilling muds tend to be rapidly diluted over space and time. Concentrations can be reduced three to four orders of magnitude within 100 meters (330 feet) of the discharge, and five to six orders of magnitude within 800 meters (2,600 feet).
- Greatest deposition occurs beneath or slightly downcurrent of the discharge point. In shallower waters, a majority of sedimentation occurs within 100 meters (330 feet) of the discharge point, and background concentrations of trace metals and suspended solids are reached within 1,000 meters (3,300 feet). Deeper waters result in greater dilution, wider dispersion, and lower depth of accumulation.
- Metal distribution in bottom sediments is uneven, generally with a gradient of decreasing concentration associated with distance from the outfall.

#### DRILLING FLUID FATE FROM OPEN WATER DISPOSAL

Dilution of muds and cuttings discharge during the open water season should be aided by dynamic oceanographic processes. Other OCS studies indicate that dilutions on the order of 2,000 to 1 can occur 100 meters (330 feet) from the discharge point (EPA 1984b). These dilutions occurred in areas with currents ranging from 10 to 80 centimeters per sec, which are comparable to those occurring during the open water period in the Beaufort Sea (average of less than 3 to 14 centimeters per second and maximum of 95 centimeters per second, depending on location). It should be noted, however, that current speeds are highly variable and depend on the time and location of measurements.

The only field studies of drilling effluent disposal in the Sale 124 area are from man-made gravel island located in depths of less than 15 meters (48 feet) (Northern Technical Services 1981, 1983, 1984, 1985). Of these studies, only one considered discharges during the open water period.

Northern Technical Services (1983) conducted a drilling effluent disposal study at Tern Island, located in the Beaufort Sea. Case 1 conditions included a mud discharge rate of 84 barrels per hour, a predilution with seawater of 30:1, and an average current velocity of 12 centimeters per second (0.4 feet per second) at 3.4 meters (11.1 feet) above the sea floor. Case 2 conditions included a mud discharge rate of 34 barrels per hour, predilution with seawater of 75:1, and an average current of 11 centimeters per second (0.4 feet per second). The minimum dilution (due to ambient water solely) measured for test plot 1 was 167:1 at 100 meters (330 feet) and 320:1 at 160 meters (530 feet) from the discharge for test plot 2. During this study, effluents remained within 0.5 meters (1.6 feet) of the seafloor in the nearfield (within 10 meters of the discharge point), and most solids were deposited within 240 meters (800 feet) of the discharge point, in shallow water, approximately 5.5 meters (18 feet) in depth.

#### DILUTION PREDICTED BY THE OOC MODEL

A computer model was developed to describe the initial dilution of drilling mud discharges to the marine environment and has been adopted by the Offshore Operators Committee (OOC). A description of the OOC Model parameters, assumptions, limitations, and model results for Sale 87 may be found in the Sale 87 ODCE and Sale 97 ODCE (EPA 1984b, 1988c). These model results may be applied to the shallower areas of Sale 124.

Model results do not include cuttings. These are expected to be of coarser grain size than muds and will, therefore, settle more quickly. Cuttings will affect a smaller area than muds, but will accumulate to greater depths.

The OOC model was used to predict initial dilution and solids deposition of drilling mud discharges representing shallow areas of the Sale 124 area, during the open water season. Conditions of the model simulations and minimum dilutions are shown below (Table 9) (EPA 1984b).

**Table 9. Initial Dilution and Solids Deposition in Shallow Areas of Sale 124**

	Case 1	Case 2	Case 3
Discharge rate, bbl/hr	1,000	250	1,000
Water depth, m	15	15	5
Unidirectional current speed, cm/sec	10	10	10
Minimum solids dilution at 100 m	1,750	2,560	4,810
Minimum dissolved dilution at 100 m	530	2,540	200

Case 1 and 2 simulations are considered most representative of the Sale 124 area during open water. Minimum dilutions approaching 2000:1 are expected at a distance of 100 meters from the outfall.

Based upon the OOC modeling performed for preparation of the Sale 87 ODCE, the following generalization may be made for the Sale 124 area: virtually all solids present in drilling fluid discharges are eventually deposited in seafloor sediments downcurrent from the discharge point. Deposition characteristics and patterns are extremely variable and are strongly influenced by several factors, including type and quantity of mud discharged, hydrographic conditions at the time of discharge, and height above the bottom at which discharges are made.

Model results indicate that a smaller area is affected at the 1,000 barrels per hour discharge rate, but sediment accumulation depths are greater. For a discharge rate in the range of 250 to 1,000 barrels per hour and water depth of 15 meters, the area of seafloor receiving muds deposition of greater than 1 millimeter at each drilling site is expected to range from 1.2 to 2.2 hectares (3.0 to 5.4 acres), depending on the discharge rate (EPA 1984b). The total area within Sale 124 that would receive deposition greater than 1 millimeter during open water is estimated to be 43 to 79 hectares (106 to 174 acres) for the estimated 36 exploration wells planned in the Sale 124 area. In tracts deeper than 15 meters, the solids deposition area is expected to increase, while the deposition thickness decreases (EPA 1984b). Depth estimates for Sale 87, therefore, are

overestimated for the deeper Sale 124 tracts, but areal coverage may be underestimated.

For a drilling mud discharge of 1,000 barrels per hour, the maximum depth of drilling mud deposition is 50 centimeters, predicted to occur 30 meters downcurrent of the discharge. At 250 barrels per hour, the maximum depth of deposition is 29 centimeters 30 meters from the point of discharge. In both cases, cuttings (not included in the above estimates) are expected to settle more rapidly than muds and to accumulate to greater depths, but in a more restricted area. Quantities of cuttings are approximately twice that projected for drilling muds. Cuttings discharged from artificial gravel islands will likely be deposited on the submerged toe of the island.

Solids accumulation and persistence are related to the hydrologic energy of the system. Accumulation of drilling materials on the seafloor is inversely related to the energy dynamics of the ambient environment. A low energy environment does not contain currents capable of removing or vertically mixing deposited material.

Surface waves have been shown to resuspend sediment to a depth of approximately 70 meters (230 feet), and bottom currents greater than approximately 20 centimeters per second can resuspend deposited materials (Sharma 1979). In shallow portions of the Sale 124 area (less than 70 meters), sediment resuspension may occur during the open water season and where the fetch (open water over which the wind blows) is larger. The frequency of resuspension is largely a function of meteorological events (storms, etc.) which occur frequently during the summer. Data are unavailable for deeper offshore areas, but it is likely that the slow currents and greater depths of these areas will preclude resuspension.

#### DILUTION, DISPERSION, AND SOLIDS ACCUMULATION FOR DEEPER TRACTS

Over 80 percent of the Sale 124 area lies in depths of 15 meters (49 feet) or greater. Due to the greater depth of the mixing zone, effluent dilution is expected to be greater than in shallower, depth-limited areas.

The OOC model has previously been used to predict initial dilution and solids deposition of drilling mud discharges for other Alaskan OCS areas. The results of representative model runs for depths between 20 and 120 meters (66 and 396 feet) are shown in Table 10.

Dilution rates derived from the OOC model for deeper tracts are similar to predicted dilutions for shallower areas. Predicted minimum dilutions at 100 meters (330 feet) for solids ranged from 731 at a depth of 40 meters to 1,803 at 70 meters.

Minimum dissolved dilutions ranged from 1,082 at 20 meters to 2,702 at 70 meters.

Table 10. Minimum Solids and Dissolved Fraction Dilutions Predicted by the OOC Model for a Point 100 Meters (330 Feet) From Discharge for Deeper Tracts

Water Depth		Minimum Dilution	
(m)	(ft)	Particulate	Dissolved
20	66	1,092	1,082
40	132	731	1,186
70	231	1,803	2,702
120	396	1,437	2,503

Model Conditions: Total discharge rate = 1,000 barrels per hour  
Current speed = 10 centimeters per second

Normal operating procedure requires several discharges of drilling mud in the course of drilling one well. It is unlikely that there will be repeated deposition in one area except directly beneath the outlet, given the changing currents and a narrow deposition footprint. Thus, examples modeled by Tetra Tech (1984a) assume the total solids discharged were 114,634 kilograms (52,000 pounds).

For the purposes of our analysis, it was conservatively assumed that all discharges from the drilling of one well are deposited at once. The projected quantity of muds used in drilling one exploratory well in the sale area is 572,727.2 kilograms (571 tonnes [1,260,000 pounds]), or 4.99 times the modeled quantity. The maximum thickness of deposited mud projected by the model was multiplied by 4.99 to accommodate the difference in quantities discharged.

The deposition pattern along the axis of the current is given for 70 meters (Figure 3) and for 120 meters (Figure 4). (Peaks in the histogram are artifacts of the model corresponding to different settling patterns for different particle size classes.) The total amount of discharge is accounted for if it is assumed that the material settles to a uniform depth over an 8 degree arc of a circle.

Approximately 86 percent of discharged solids will be deposited on the seafloor within 914 meters (3,000 feet) down-current of the discharge point for depths of 70 meters. In the

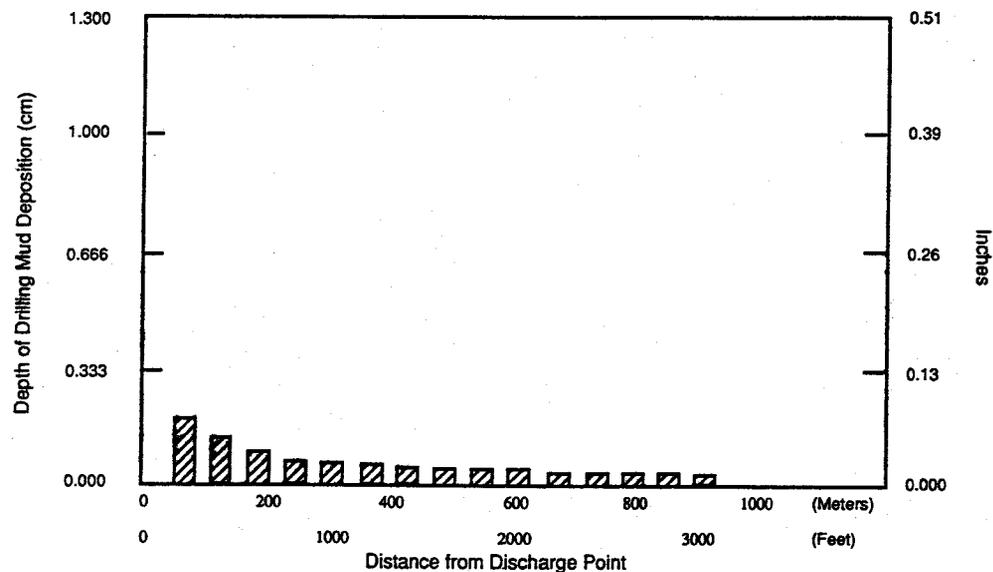


Figure 3. Solids Deposition Pattern Modeled by OOC for a Drilling Mud Discharge into Water 70 meters Deep with a Current Speed 10 cm/second

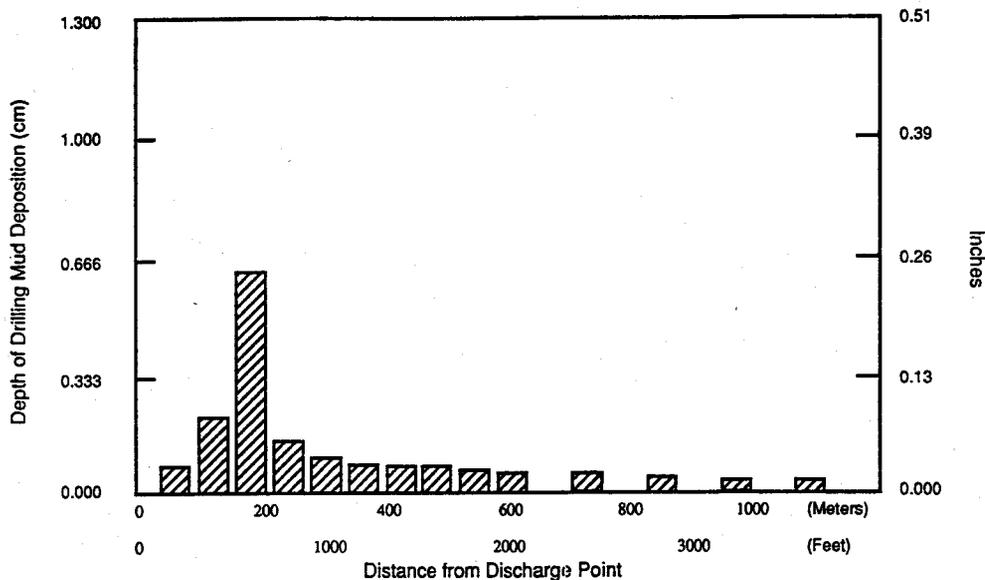


Figure 4. Solids Deposition Pattern Modeled by OOC for a Drilling Mud Discharge into Water 120 meters Deep with a Current Speed 10 cm/second

deeper water (120 meters), approximately 99 percent of the discharged solids will be deposited on the seafloor within 975 meters (3,200 feet) down-current of the discharge point. The maximum depths are 0.18 centimeter (0.07 inch) at 61 meters (200 feet) and 0.61 centimeter (0.24 inch) at 183 meters (600 feet), respectively (Figures 3 and 4).

#### DRILLING FLUID FATE FROM ABOVE-ICE DISPOSAL

The nearshore Beaufort Sea is generally ice covered from October through May and the majority of the Sale 124 area lies far enough offshore that pack ice may persist throughout the year. In these offshore areas, during stable ice conditions, disposal above the ice may be the only available method. Above-ice discharges should avoid, to the maximum extent possible, areas which show signs of sea ice cracking or major stress fracturing.

#### DILUTION AND DISPERSION OF DRILLING DISCHARGES

Disposal above ice is usually accomplished by deposition on the ice in large frozen chunks with no layering attempted. It may also be spread in thin layers on the ice within berms to keep the disposal site intact as long as possible. Dilution and dispersion of the effluent occur at ice breakup, when greater wind and water movement are present. Mud discarded as large chunks may not be dispersed to the same extent as the layered discharges.

A detailed discussion of dilution and dispersion of drilling effluent using above-ice disposal techniques is presented in the Sale 87 ODCE. This discussion applies equally well to the Sale 124 area.

#### DRILLING FLUID FATE FROM UNDER-ICE DISPOSAL

The nearshore Beaufort Sea is covered by ice for approximately eight months of the year, from early October through late May. Oceanographic conditions during ice cover are very different from those of open water season. This in turn affects effluent dispersion. In an NPDES permit issued for the Lease Sale 124 area, under-ice disposal would likely require special authorization from the Regional Administrator.

**CURRENTS.** Current velocities are much lower under the ice pack than during the open water season. Under-ice currents are typically 5 centimeters per second, which is fast enough to enhance dilution, but significantly lower than the approximately 20 centimeters per second required to resuspend bottom sediments (EPA 1984b; Houghton et al. 1980). A more detailed discussion of under-ice currents may be found in the Sale 87 ODCE and Sale 97 ODCE (EPA 1984b, 1988c).

Winter under-ice currents from the Beaufort Sea (Sale 97) area possess mean speeds up to 5 centimeters per second (EPA

1984). Higher velocities have been recorded in some areas. Current measurements taken at 100 meters (330 feet) at depths of 225 meters (740 feet) showed higher mean speeds of 13 centimeters per second, with episodic speeds reaching more than 50 centimeters per second (EPA 1984b, 1988c).

Under-ice drifter releases near Prudhoe Bay showed a net shoreward movement of water some 10 kilometers (6.2 miles) offshore (EPA 1984b, 1988c). Nearshore movements tend to be slow (a few centimeters per second). However, the Sale 87 ODCE and Sale 97 ODCE (EPA 1984b, 1988c) reported tidal currents as high as 25 centimeters per second where the flow was restricted by ice.

**STRATIFICATION, SALINITY, AND TEMPERATURE.** The degree to which mixing and dispersion of drilling discharges will occur is influenced by the degree to which the water column is stratified. Greater vertical differences in temperature and salinity increases the degree of density stratification, which reduces dilution and dispersion of discharges (National Research Council 1983).

Marked seasonal fluctuations in salinity and temperature distribution occur in the lease sale area. Nearshore temperatures and salinity characteristics are strongly affected by seasonal ice formation. During freezing, only 15 to 20 percent of the solutes are incorporated into the ice, and waters below tend to have increased salinities and densities. This tendency is most pronounced in shallow or semi-enclosed bays where under-ice salinities typically exceed 35 parts per thousand and can reach 50 parts per thousand (EPA 1984b, 1988c). During ice cover, water temperatures generally range from -2 to 0°C.

A detailed discussion of stratification, salinity, and temperature conditions in the Sale 124 area may be found in the Sale 87 ODCE and Sale 97 ODCE.

**SEDIMENT TRANSPORT.** Of the factors influencing sediment transport, ice gouging and sediment entrainment in sea ice predominate during the winter months. The effect of ice in intensifying currents in shallow water and mitigating wind stress on the water are also significant factors. A detailed discussion of these factors appears in the Sale 87 ODCE and Sale 97 ODCE.

**DILUTION, DISPERSION, AND SOLIDS ACCUMULATION.** Of all the disposal methods described, below-ice discharge introduces the largest peak concentration of muds to the environment. A stratified, low energy environment exists throughout the winter months, restricting dilution and increasing solids accumulation. Current velocities are generally less than 5 centimeters per second during ice cover, depending on location. Water depth can directly influence dilution by restricting the available entrainment area, and the total depth of the available water column is reduced by ice cover. Shoreward of the 15 meter (49

foot) isobath, the floating fast ice may reach thicknesses of up to 2 meters (6.6 feet).

The combination of shallow water and low current velocities during periods of ice cover will lead to minimal dilution and dispersion. Existing studies are inconclusive as to the magnitude of expected dilution in waters less than 10 meters (33 feet) deep. Actual dilution values in low energy environments such as the ice-covered Beaufort Sea are presently unknown (EPA 1984b, 1988c). However, a low energy environment having current velocities generally less than approximately 20 centimeters per second (except for infrequent periods of time during storms) is not capable of resuspending and transporting deposited muds. Figures 5 and 6 show deposition patterns for shallow discharges in low energy environments.

Several studies of under-ice effluent disposal have been conducted in the Sale 124 area (Northern Technical Services 1981, 1984, 1985). All of the studies monitored discharges from man-made gravel islands in depths of 12 meters (40 feet) or less.

Northern Technical Services (1981) conducted two shallow water effluent disposal studies at 8.4 meters (27.6 feet) and 5.5 meters (18.0 feet) off Reindeer Island in the Beaufort Sea. These studies revealed minimum dilution of 112:1 at a distance of 61 meters (200 feet) from the point of discharge, showing a dilution rate significantly lower than measured from typical open-water disposal studies. Details of this study are discussed in Sale 87 ODCE.

Northern Technical Services (1984) conducted a study to determine the areal extent and distribution of drilling solids discharged from Seal Island, an artificial gravel island located at a depth of 12 meters (40 feet) in the Beaufort Sea. The area of cuttings deposited was limited mainly to the submerged portion of the island. Cuttings 8 to 15 centimeters (3.6 inches) thick extended less than 61 meters (200 feet) beyond the toe of the island.

A recent study was conducted by Northern Technical Services (1985) to identify the distribution of drilling muds discharged under the ice from Mukluk Island, an artificial gravel island located approximately 45 kilometers (25 nautical miles) offshore at a depth of 15 meters (48 feet).

In general, trace metal analysis of bottom sediments from the vicinity of Mukluk Island suggest that effects of drilling muds disposal were observed at locations up to 200 meters (656 feet) away from the water's edge (or 155 meters from the toe of the island, NORTEC 1985). Although metals levels are elevated from the ambient levels for the area, they are still within the range of values found elsewhere in the Beaufort Sea.

Previously completed investigations suggest that effects on trace metal levels should be considerably less than actually

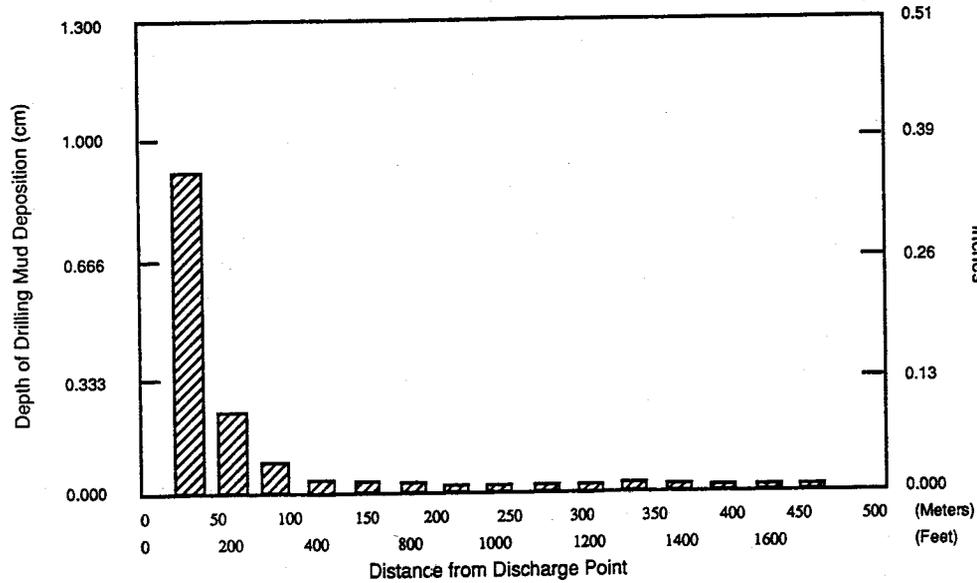


Figure 5. Solids Deposition Pattern Modeled by OOC for a Drilling Mud Discharge into Water 40 meters Deep with a Current Speed 2 cm/second

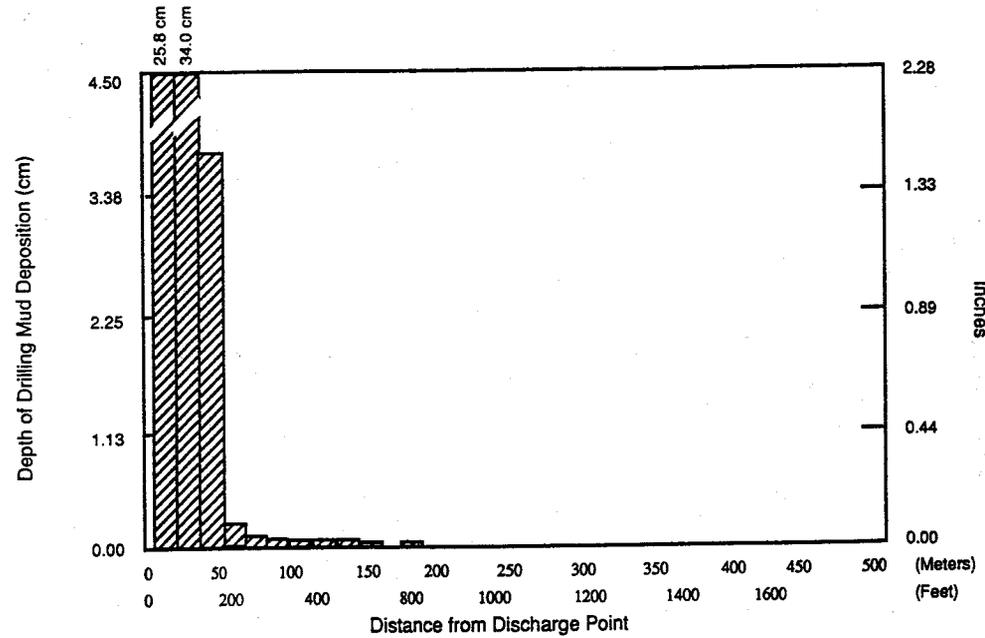


Figure 6. Solids Deposition Pattern Modeled by OOC for a Drilling Mud Discharge into Water 15 meters Deep with a Current Speed 2 cm/second

measured at Mukluk Island. The higher metal levels observed at Mukluk Island are likely directly attributable to the fact that effluents were discharged near the seafloor where wave-induced turbulence -- hence resuspension -- is minimal. Given the water depths, NORTEC (1985) calculated that a 4.5 second wave (or longer period) would be required to resuspend and transport drilling effluents. Waves of this size typically do not occur until late August or September. As such, it is likely that bottom effects from drilling effluent disposal may persist a longer time in deeper waters such as found in the vicinity of Mukluk Island. All previous investigations in the Alaskan Beaufort Sea have been conducted in much shallower waters where nearly any wave action (periods much less than 4.5 seconds) could result in resuspension of material deposited on the seafloor.

The OOC model was used to predict initial dilution and solids deposition of below-ice discharges in Beaufort Sea (Sale 97 ODCE) (Table 11), which represent conditions comparable to those found in the Sale 124 area. Initial conditions of the model simulation area and minimum dilutions follow.

Table 11. Initial Dilution and Solids Deposition of Below-Ice Discharges in Beaufort Sea (Sale 97)

	Case 4	Case 5
Discharge rate, bbl/hr	250	1,000
Water depth, m	15	40
Current speed, cm/sec	2	2
Predilution	0	9
Minimum particulate dilution at 100 m	8,870	2,000
Minimum dissolved dilution at 100 m	2,240	2,200

Model predictions for these test cases are shown in Tables 3-10 through 3-13 of the Sale 87 ODCE, along with a discussion and summary of results, which includes predicted depth of deposition and area affected.

Based on information provided in the Sale 87 ODCE, for a discharge of 1,000 barrels per hour at a depth of 40 meters, the area of seafloor receiving deposition greater than 1 millimeter thick for each well site is predicted to be approximately 5 hectares (12 acres). Total area receiving deposition from 36 wells (high resource case) would be 180 hectares (445 acres). Maximum mud deposition of 9 centimeters (3.5 inches) is predicted to occur approximately 30 meters (100 feet) downstream of the discharge; cuttings will accumulate to a greater depth but will be more restricted in distribution.

#### DISCHARGE WITH SHUNTING

Shunting increases the depth at which the discharge enters the water, i.e., reduces the functional water depth. For example, a 30 meter (100 foot) shunt pipe discharging in water depth of 70 meters (230 feet) is equivalent to a surface discharge with 40 meters (130 feet) water depth.

The most conservative case of discharge to 15 meters (50 feet) of water was used to estimate the deposition pattern of shunted discharges (current speed of 10 centimeters per second). The deposition pattern along the axis of the current is given in Figure 7. Approximately 100 percent of discharged solids will be deposited on the seafloor within 107 meters (350 feet) down-current of the discharge point. The maximum depths are approximately 88 centimeters (34.6 inches) at 15 meters (50 feet) from the discharge point (Figure 7). The deposition assumes all drilling muds are deposited at once, whereas normal operating procedure is highly unlikely that this depth of deposits would occur given changing tides and currents in the area. However, there is no advantage to increased dispersion with shunting, and this course of action is unlikely to be adopted.

#### SUMMARY

The Sale 87 ODCE and the Sale 97 ODCE both summarize the results presented in this section which may be applied to Sale 124.

The results of field studies and computer modeling of discharges in the nearshore Beaufort Sea and other OCS areas support the following conclusions for Sale 124:

- Drilling muds tend to be diluted rapidly over both space and time. Dilutions of 1,000 to 2,000:1 are generally achieved within 100 meters (330 feet) of the discharge.
- In shallow areas of less than 15 meters (48 feet), where the depth of the mixing zone is limited, dilutions may be much lower. Dilutions as low as 167:1 have been observed at the edge of the mixing zone (Northern Technical Services 1983).
- A minimum dilution of 200:1 at the edge of the mixing zone for any given well may be considered as a conservative estimate for the Sale 124 area.
- Of the three disposal methods available -- open-water, above-ice, and below-ice disposal -- below-ice disposal is the least desirable due to the lesser dilution and dispersion of discharges.
- Exploratory drilling solids deposition and accumulation is limited to the immediate discharge area. Studies of

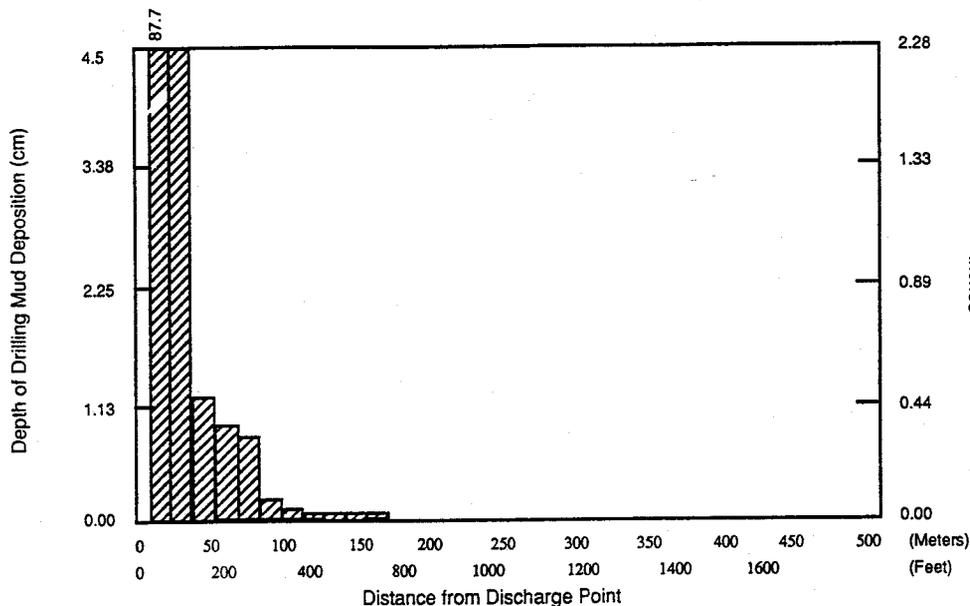


Figure 7. Solids Deposition Pattern Modeled by OOC for a Drilling Mud Discharge into Water 5 meters Deep with a Current Speed 10 cm/second

actual discharges from gravel islands in the lease sale area (Northern Technical Services 1984, 1985) have shown that the area of significant deposition is generally limited to an area within 500 meters (1,650 feet) of the discharge site.

Based on OOC model results, the total area within Sale 124 receiving drilling mud and cuttings to a depth greater than 1 millimeter during the open water season is estimated to be 12 to 22 hectares (30 to 55 acres) for the ten drill sites expected. In tracts deeper than 15 meters (48 feet), the solids deposition area is expected to increase while deposition thickness decreases (EPA 1984b). Depths estimated for Sale 87 are therefore conservative for the deeper Sale 124 tracts, but areal coverage may be underestimated.

WATER QUALITY

WATER-QUALITY CRITERIA

The 403(c) regulations allow a 100-meter (330-foot) radius mixing zone for initial dilution of drilling effluent. At the edge of the mixing zone, EPA marine water-quality criteria must be met. Compliance with water-quality criteria is assessed in this section.

Marine water-quality criteria (45 FR 79318, 50 FR 30784, 51 FR 43665, and 52 FR 6213) are stated as acute (or one-hour average concentration) and chronic (or four-day average) values. The chronic criteria are applicable to a relatively constant flux of pollutants. Acute criteria values are applicable to instantaneous releases or short-term discharges of pollutants. As drilling mud discharges are periodic with durations of only a few hours, the acute criteria are applicable to drilling-mud discharges (Petrazzuolo 1981).

The water quality criteria have been developed using several different operationally defined concentrations for the metals, including "dissolved," "active" (a term no longer in use), "total recoverable," and "total" concentrations. These classifications refer to the types of filtration and degree of acid-digestion a sample receives and are a first-estimate of the form of the metal in the sample (e.g., bound, unbound). In the past EPA has considered the estimated dissolved metal concentrations to be sufficiently similar to the operationally defined "active" and "total recoverable" concentrations to permit comparison with the criteria. The discharges from exploratory phase oil and gas drilling are to open waters and occur intermittently for a few hours at a time. Dissolved metals concentrations are of most concern under these conditions since these are immediately available and are bioavailable (O'Donnel et al. 1985).

Due to a lack of total recoverable metals data, estimated dissolved metals concentrations are also utilized here. However, the Region will consider requiring permittees under future oil and gas general permits to report total recoverable metals data instead of total metals. Hence in the future it will be possible to conduct direct comparisons with the water quality criteria using total recoverable metals data.

The dilution achieved within 100 meters (330 feet) of the discharge has been predicted in the section entitled "Fate and Transport of Muds and Cuttings." The worst case predicted by the computer model was a discharge of 1,000 barrels per hour into 5 meters (16 feet) of water and a current speed of 10 centimeters per second. The dilution achieved at the edge of the mixing zone was approximately 200:1. This dilution value can be applied to the expected concentration of dissolved metals in the drilling mud to determine metal concentrations at the edge of the mixing zone. Dissolved metals concentrations are considered closer to "active" or "total recoverable" concentrations than "total" values. Concentrations of metals in the whole mud will be used to estimate dissolved metals concentrations (Table 12). Table 12 also presents the maximum allowable water quality criteria for the metals considered. A comparison of these values shows that all dissolved metal concentrations at the edge of the mixing zone are well below the acute criteria. Concentrations of one metal, mercury (.0001 ppm), exceed maximum chronic exposure levels (0.000025 ppm), but are well within criteria for acute exposure (0.0021 ppm).

Over a period of months or years, leaching or diffusion of dissolved metals from deposited muds is also expected to be insignificant. Only a small fraction (about 0.1 percent) of the metal concentrations in whole mud is expected to be in the dissolved state; the remaining metals are bound to the solid phase. The dissolved portion is probably lost to the water column during plume descent. After deposition on the seabed, some additional metals can be expected to dissolve into the interstitial water under certain sediment conditions. However, after equilibrium is established, the concentrations of metals in the interstitial water will not be any higher than the estimated dissolved concentrations. These dissolved metals would be dispersed throughout the water column during a sediment resuspension event or slowly diffused upward from an undisturbed mud deposit. Metals released to the water column will likely readily adsorb onto naturally occurring suspended sediments. The dissolved phase of metals and other chemicals tends to be more bioavailable than the particulate phase (Lockhart et. al. 1982, O'Donnel et. al. 1985). Particulate-bound chemicals have variable bioavailability that depends on the chemical and biological species and environmental conditions considered (Anderson et al. 1987).

Table 12. Comparison of Expected Dissolved Metals Concentrations at the Edge of the Mixing Zone in Sale 97 to Marine Water Quality Criteria

Metal	Dissolved Concentrations <sup>1</sup> ppm		Marine Criteria <sup>4</sup> ppm	
	In Discharge <sup>2</sup>	100 m from Discharge <sup>3</sup>	1-hr. Ave.	96-hr. Ave.
Arsenic	0.024	0.00012	0.069	0.036
Barium	399	2.0	No Criterion	No Criterion
Cadmium	0.004	0.00002	0.043	0.0093
Chromium	1.3	0.006	1.1 (hexavalent)	0.05 (hexavalent)
Copper	0.088	0.0004	0.0029	No Criterion
Lead	0.820	0.004	0.14	0.0056
Mercury	0.002	0.0001	0.0021	0.000025
Nickel	0.088	0.0004	0.071 <sup>5</sup>	0.0079 <sup>5</sup>
Vanadium	0.235	0.0012	No Criterion	No Criterion
Zinc	1.350	0.007	0.095 <sup>6</sup>	0.086 <sup>6</sup>

<sup>1</sup> Based on whole mud concentrations as reported in EPA 1988c.

<sup>2</sup> Dissolved concentrations in ppb (ug/l), representing 0.1 percent of total concentration in muds.

<sup>3</sup> Assumed dilution 200:1. Corresponding to discharge of 1,000 bbl/m into water depth of 5 m and current speed of 10 cm/sec.

<sup>4</sup> From 50 FR 30784. One hour average concentration (ppm) not to be exceeded more than once every three years on the average (acute exposure levels) and 96 hour average concentration not to be exceeded more than once every three years on the average (chronic exposure levels). Both are based on the total recoverable method which is operationally defined as the concentration of metal in an unfiltered sample following treatment with hot diluted mineral acid (EPA 1979).

<sup>5</sup> From 51 FR 8363, (EPA 1986). Proposed criteria, based on total recoverable method. Existing criteria are 0.140 and 0.0071 ppm, respectively (EPA 1980).

<sup>6</sup> From 52 FR 6213. Criteria based on total recoverable method.

## EFFECTS ON MARINE BIOTA

Petroleum exploration will take place in three depth zones: shallower than 20 meters, 20 to 40 meters and deeper than 40 meters. Oceanic features having a great influence on the biological community in these areas include seasonal ice fronts, and ice associated phenomena (e.g., ice gouging and breakup, layered water stratification caused by seasonal river flow, and reduced dissolved oxygen during periods of ice cover). A primary effect of ice is a lowering of overall primary productivity due to drastically reduced light penetration.

Currents and tides in the area are of low magnitude. During seasons of ice cover, wind and wave action on the water column (and bottom, in shallower areas) is precluded, water depth is decreased and freshwater input generally ceases altogether. These changes are of greatest import in the shallow nearshore areas. Ecology and community structure in the western portion of Lease Sale 124 are also influenced by plankton carried along with the intrusion of warmer Bering Sea water and its high organic content.

In general, the Beaufort Sea marine ecosystem can be portrayed as two interrelated natural systems. The nearshore environment (which will not be within the lease area) extends from the shoreline to a depth of approximately 20 meters, and the offshore habitat which extends from the 20-meter contour seaward. There is a major transport of marine carbon and nutrients from the offshore to the inshore (Truett 1984).

As expected, marine zooplankton and phytoplankton are common to both systems as major food sources for higher trophic levels. Primary food sources for nearshore vertebrate species include epibenthic crustaceans (principally amphipods and mysids) and to a much lesser extent, zooplankton (Griffiths and Dillinger 1980). With the exception of the benthic feeding bearded seal, the primary food of offshore vertebrate assemblages appears to be zooplankton and other vertebrates (USCOE 1984).

Due largely to the short-term nature of the physical impacts of discharges from exploratory and delineation drilling, the trophic relationships most affected will probably include benthic infaunal and epifaunal communities in waters deeper than 5 meters, and benthic feeders. However, the nearshore biota appear to be resilient, due to large-scale periodic physical and food web changes resulting from natural processes (Truett 1984). Most of Lease Sale 124 exploration activities are expected to be conducted in the offshore areas (i.e., in depths over 20 meters). Thus, offshore biota are of primary concern for activities associated with Lease Sale 124.

## IMPORTANT PLANKTONIC SPECIES

Detailed information concerning planktonic resources of the area is available in the Sale 87 ODCE and the Sale 97 ODCE. These note that phytoplankton and zooplankton are key components of any pelagic community inasmuch as they constitute a major portion of the food base for the pelagic food web and exert control over nutrient dynamics. The larval forms of important non-planktonic trophic and harvest species may also be planktonic.

### PHYTOPLANKTON

As discussed in greater detail in the Sale 87 ODCE and the Sale 97 ODCE, diatoms are the most important phytoplankters at high latitudes, although other free-floating phytoplankters such as dinoflagellates are also important. Diatoms comprise the majority of the epontic or attached under-ice algae, constituting the major source of early spring primary productivity and serving as an inoculum for recruitment of open-water communities. Phytoplankton spatial distribution is variable and patchy, although distribution for most species is widespread.

### ZOOPLANKTON

While zooplankton sampling in the Beaufort Sea has been limited, copepods appear to be the major components of zooplankton, although mysids, euphausiids, chaetognaths, amphipods, and other groups are also expected. Zooplankton standing stock appears to decrease from nearshore to offshore waters.

### EFFECT ON PHYTOPLANKTON

No geographic areas of specific importance for benthos potentially affected by the discharges have been identified. The possible impacts of drilling mud discharges on marine phytoplankton include:

- decreased primary production due to light reduction from increased turbidity;
- decreased primary production and or increased mortality due to direct acute or sublethal toxic effects of trace metals; and
- stimulation of primary production by trace nutrients in the discharge (Jones & Stokes Associates 1984).

### EFFECT ON ZOOPLANKTON

Possible impacts to zooplankton include:

- decreased growth, altered behavior, and/or increased mortality due to the direct acute or chronic effects of toxic materials in drilling muds;
- interference with feeding or respiratory activity due to increased suspended solids concentrations; and
- indirect enhancement or inhibition of zooplankton populations resulting from impacts on phytoplankton (Jones & Stokes Associates 1984).

Both cadmium and mercury affect plankton. Exposure to 100 micrograms cadmium per liter seawater for 10 days reduced dinoflagellate population growth by 20 percent (Prevot and Soyergobillard 1986). Five micrograms cadmium per liter seawater for 10 days reduced diatom spore formation by 35 percent and 15 micrograms cadmium reduced spore formation by 81 percent (Sanders and Cibik 1985). Low levels of cadmium (2.0  $\mu\text{M}$ ) and mercury (0.2  $\mu\text{M}$ ) reduced fatty acid content and therefore the nutritional quality of marine diatoms (Jones et al., 1987). However, these concentrations of metals are not expected to be reached.

The suspended particulate phase of a reference drilling mud and a used production mud significantly increased hydranth shedding in the coelenterate Tubularia crocea after 48 hours exposure to 100,000 parts per million (Michel et al. 1986). The liquid phase was more toxic, with concentrations of 10,000 parts per million increasing coelenterate shedding.

The effects of drilling muds on the marine algae Skeletonema costatum were investigated (EG&G Bionomics 1976a; EG&G Bionomics 1976a). The EC50 (concentrations at which a designated effect is displayed by 50 percent of the test organisms) with barite was 385 ppm and with freshwater lignosulfonate was 430 ppm without agitation. With agitation, the EC50s increased to 1,650 ppm and 16,000 ppm respectively. Various lignosulfonate formulations were tested in agitated mixes (EG&G Bionomics 1976); the lowest EC50 was 1,325 ppm with IMCO RD-123+spot.

The effects of two drilling muds and eight mud additives on the primary production of natural assemblages of Californian marine phytoplankton were assessed by Alldredge et al. (1986). Short-term (4-hour) exposure to barium sulfate, lignosulfonate, and a reference drilling mud concentrations over seven orders of magnitude did not affect primary production, and the used drilling mud significantly enhanced production. Long-term exposure (120 hours) to 10 micrograms of X-Pel-G or Soltex or to 100 milligrams iron lignosulfonate per liter significantly reduced production. In no case was the species composition altered. Plankton are unlikely to be exposed to drilling mud discharges for this length of time.

## CONCLUSIONS

Dilution of solids and dissolved materials are predicted for discharges at 40 meters (120 feet) and 120 meters (390 feet) of water with currents of 10 centimeters per second. A minimum particulate dilution of at least 1,437:1 is expected in the water column 100 meters (330 feet) from the discharge for discharges of 1,000 barrels per hour in 120 meters (396 feet) of water. (It should be noted that this minimum dilution applies to the area of greatest solids concentration within the plume.

Several factors suggest that the discharge of drilling muds will have a limited effect on plankton:

- Most toxic metals will be bound to muds and ligands and will not be available in the water column.
- Expected concentrations of metals in the drilling-mud discharges at the edge of the mixing zone are within the EPA water quality criteria, which were established to protect marine life.
- The dilution of muds is rapid. At the edge of the mixing zone, dilutions of 200- to 9,127-fold are expected for particulates (Table 13). Concentrations of over 1,000 ppm will probably be present for only 100 meters (330 feet) down-current of the discharge.
- The residence time of the drilling muds will be much shorter than the 96-hour time period of bioassay tests.
- The area affected by detectable discharge plumes is very small relative to the area of the total lease sale area (Jones & Stokes Associates 1989).

## BENTHIC INVERTEBRATE RESOURCES

No commercially important benthic species are found in the Lease Area. A detailed discussion of benthic species, including species composition and distribution, may be found in the Sale 87 ODCE and the Sale 97 ODCE.

## IMPORTANT SPECIES

Benthic organisms are generally sensitive to deposition of solids such as drilling muds, and can be considered indicators of the intensity or extent of pollution. In their role as consumers of organic material derived from zooplankton and phytoplankton, benthic infauna are important mediators of nutrient recycling from the substrate to the water column, providing nutrients for primary productivity. With emphasis on the epibenthic community, benthic organisms also serve as prey for higher organisms. The far western portion of the Lease Sale area is a transition area for Pacific fauna of the Bering Sea and high Arctic fauna of the Beaufort Sea.

**Table 13. Dilution Factors for Particulates and Dissolved Fractions**

Case	Particulate	Dissolved
a) At the edge of the mixing zone, 100 meters (330 feet) from the discharge point <sup>1</sup>		
5	1:4,810	1:200
6	1:1,785	1:536
3	1:905	1:1,285
16	1:1,437	1:2,503
12	1:752	1:903
17	1:5,793	1:9,127
b) 30 meters (100 feet) from the discharge point <sup>1</sup>		
5	1:215	1:141
6 <sup>2</sup>	1:273	1:129
3 <sup>2</sup>	1:115	1:239
16	-----	-----
12	1:268	1:147
17	1:2,002	1:2,859

Source: Tetra Tech 1984a, pp. A-3, A-5, A-6, A-12, A-16, A-17

<sup>1</sup> The minimum dilution (discharge:seawater) through the water column is given.

<sup>2</sup> Figures are extrapolated.

Benthic infauna species are dominated by polychaetes and bivalves. Sale 124 infauna are not utilized to the extent of these in lower latitudes and are of minor prey importance, with the exception of one polychaete and one bivalve (EPA 1988c).

Common epifauna are predominantly crustaceans and include amphipods, mysids, isopods, shrimp, and crabs. Together with copepods, euphausiids, and planktonic amphipods, they constitute a substantial portion of the invertebrate biomass, especially in inshore areas. While Broad (1979) concludes that there are no differences between populations of nearshore and inshore motile epifauna in the Beaufort and northeastern Chukchi Seas, in offshore areas echinoderms are important contributors to the total biomass. The primary prey organisms for fish, mammals, and birds are the motile organisms of the water column and motile epifauna.

#### IMPORTANT HABITATS OR AREAS

The "Boulder Patch" located near the Sagavanirtok River is recognized as an important habitat (primarily due to habitat provided by hard substrates and associated algal beds); to date no other similar sites have been determined within Lease Sale 124. If such habitats are found, they would constitute habitats which are unique or are of limited distribution, and exploratory activities should accordingly be precluded in the vicinity. Other than general onshore/offshore patterns of distribution discussed in the Sale 87 ODCE and the Sale 97 ODCE, no specific critical habitats or areas have been identified which are subject to this evaluation (EPA 1984b, 1988c).

#### EFFECTS ON BENTHIC COMMUNITIES

NRC (1983), Ferbrache (1983) and Jones & Stokes Associates (1984) have summarized the work of Petrazzuolo (1981), Neff (1981), and the Offshore Operators Committee, identifying the potential detrimental benthic impacts of discharged drilling fluids and cuttings in low energy environments as:

- Physical smothering of benthic epifauna and infauna.
- Introduction of substances which may have negative effects upon metabolism, health, behavior, or reproductive capability of benthic species.
- Alteration of sediment chemistry and texture, making it unsuitable for certain species, e.g., interference with burrow construction and feeding or interference with settlement of benthic larvae.

**SMOTHERING.** Research and data collection efforts indicate that if a depositional mound or cuttings pile remains on the seabed following discharge, population depressions and/or changes in the benthic community will occur. The suspended solids content of these discharged fluids consists mainly of barite and

bentonite. Cuttings are generally sand grain sized and settle out at relatively short distances from the point of discharge.

A localized reduction of individuals and numbers of species due to smothering effects will be most likely in areas where deposition of cuttings on the benthos exceeds 1 centimeter and persists for more than a few days (Jones & Stokes Associates 1984). More subtle community changes may result from alteration of substrate characteristics. Species will be favored which are more tolerant of the deposition of increased silt/clay components derived from drilling fluids. Increased requirements for feeding, respiration and reproductive energy may cause adverse impacts, and decreased larval recruitment may occur (Menzie et al. 1980). Menzie noted reduced abundances in polychaetes, molluscs, and crustaceans up to 370 meters from a well site in low energy mid-Atlantic OCS drill site in 120 meters of water. However, hake (*Urophycis* spp.) and crabs (primarily *Cancer borealis*) were apparently attracted to the drill site. Abundance of sand stars (*Astropectin americanus*) appeared unaffected.

Species attracted to the harder substrates of intact mounds may colonize this newly formed area in response to a "reef effect" (Shinn 1974 and George 1975 in Northern Technical Services 1981, and Menzie et al. 1980). Increased predation resulting from the attraction of predator species may result in net reduction of prey species as an indirect impact (Menzie et al. 1980). Such an indirect impact could reduce localized nearshore reproductive success and recruitment of important motile epifaunal species (i.e., gammarid amphipods), with attendant impacts to higher trophic levels.

**TOXICITY.** Houghton et al. (1980) identified ligno-sulfonates and caustic soda (sodium hydroxide), through an effect on pH, as the most acutely toxic components of water-based drilling fluids. The NRC (1983) identified diesel fuel (No. 2 fuel oil) and biocides as two of the most toxic constituents which may be present in some drilling muds. In light of this, EPA Region 10 permits for offshore drilling operations have prohibited the discharge of diesel oil and limited the toxicity of drilling muds. The toxicity of new drilling-mud additives must pass a toxicity-based criterion prior to their discharge.

Generally, the animals tested in laboratory bioassay studies have a remarkably high tolerance to whole drilling muds (EPA 1984b). Dock shrimp larvae had the lowest LC50 (lethal concentration for 50 percent of the test organisms) of any Alaskan organisms tested in an unmixed whole mud (LC50 of 600 ppm) (Carls and Rice 1984). However, it is possible the mud used was formulated with a component containing hexavalent chromium, which is highly toxic to marine life and is not be permitted by EPA Region 10. Other low EC50s for a high molecular weight polymer are 10,000 ppm for *Mya arenaria* and 14,000 ppm for the amphipod *Orchestia traskiana* (KCL-XC-polymer) (EPA 1984b).

The toxicity of drilling muds and barite to the primitive vertebrate lancelets (*Branchiostoma carbaeum*) was tested in flow-through aquaria (Clark and Patrick 1987). Lancelets were kept in 1:1 clean sand:test sediment, with additional treatments of daily additions of barite or lime to the depth of 0.15-0.23 centimeter (0.06-0.09 inch). Although burrowing was reduced, making the animals more susceptible to predation, neither barite sediment nor barite additions were toxic to lancelets. Seawater/lignosulfate mud (Mud #2, Table 3) and lime mud (Mud Type #3, Table 3) were toxic to buried animals after 7 days, and to animals on the surface within 24 hours. Lightly treated lignosulfate was toxic to both buried and surface lancelets within 24 hours. Drilling muds are one to two orders of magnitude more toxic to mysids (*Mysidopsis bahia*) than they are to lancelets (Gaetz et al. 1986).

Although few studies have been conducted, it is possible that other benthic organisms emerge from drilling mud deposits. This would not only make the animals more susceptible to predation, but would attract predators to selectively feed in the area of drilling mud deposits, increasing the chance of heavy metal accumulation through the food web.

**BIOACCUMULATION.** Heavy metals can be highly persistent in the environment and have the potential to bioaccumulate in marine organisms and to biomagnify through food webs, possibly leading to man. Benthic organisms are particularly susceptible since they live on and in drilling-mud deposits. Mercury, cadmium, and barium are of most concern due either to toxicity and propensity to bioaccumulate or to the possibility of exposure to high concentrations. Anderson et al. (1987) report that marine species have demonstrated little bioaccumulation from exposure to sediments contaminated with heavy metals, with the exception of mercury, cadmium, and copper.

Mercury, one of the few metals to biomagnify (increase in concentration up trophic levels) may be in excess of 10 parts per million in some drilling muds. Concentrations of mercury in ocean sediments range from <10 to 2,000 parts per billion with a mean of 100 parts per billion (D'Itri 1972). Although mercury discharged in drilling muds is largely inorganic and not bioavailable, virtually any mercury compound may become a bioaccumulation hazard for organisms since bacteria common to most natural waters are capable of biomethylating the metal (Callahan et al. 1979). Several studies have reported sediment and organism mercury concentrations to be correlated, with bioconcentration factors of 0.01 to 0.57 (O'Conner and Rachlin 1982), although some organisms, such as polychaetes, probably absorb mercury from the water through their epidermis (Jensen and Baatrup 1988). The polychaete *Nereis virens* exposed to 9 parts per billion mercury as mercuric chloride in aquaria water had a bioconcentration factor of 930 with a constant rate of uptake. Constant rates of mercury uptake have been observed for over 72 days in marine polychaetes (Kendall 1978).

Cadmium can accumulate to high levels in marine organisms without causing apparent ill-effects, due perhaps to proteins such as metallothionein that detoxify non-essential metals (Hamer 1986; Langston and Zhou 1987). Several studies have reported sediment and organism cadmium concentrations to be correlated. Cadmium bioconcentration factors for oysters range from 0.008 (Atwood et al. 1979) to 40 (Neff et al. 1978) times that of sediment. The soft shell clam, *Macoma* accumulates cadmium primarily from water (Langston and Zhou 1987). *Macoma* exposed to 100 micrograms cadmium per liter of seawater had a linear uptake of cadmium. The elimination rate from the soft tissue was very slow (1 percent of the accumulated cadmium was eliminated daily) while the elimination rate was faster from the shell (46 percent in 7 days).

Barium is considered a chemical of concern due to its high concentration in drilling muds and propensity to settle on the substrate, although it has low toxicity. Bioaccumulation has been described in non-Alaskan species. Mariani et al. (1980) found barium in benthic organisms to be about 10 times that of sediment concentrations. Expected barium concentrations in the drilling muds are 298,800 parts per million (Table 4).

**ALTERATION OF SEDIMENT CHEMISTRY AND TEXTURE.** Alteration of sediment characteristics is expected to affect the benthos more subtly than smothering and over larger areas. Menzie et al. (1980) noted reduced abundances of polychaetes, echinoderms, molluscs, and crustaceans up to 370 meters (1,200 feet) from a well site in a low-energy mid-Atlantic OCS site in 120 meters (390 feet) of water. The authors could not attribute the population depressions to any one factor, but instead suggested four possible mechanisms: fish and large epibenthic invertebrates attracted to the drilling area reduced benthic populations through predation; mobile crustaceans emigrated from the discharge area; altered sediment composition adversely affected feeding and survival of some benthic species; and altered sediment composition inhibited larval recruitment. The initial impact zone was recolonized and commenced recovery within a year of cessation of drilling-mud discharge.

It has been suggested that low levels of metals in seawater significantly reduce larval settlement. The settling of larvae have been tested in known heavy metal constituents of all drilling muds, in proprietary drilling mud additives, and in samples of drilling mud standards (Morse, 1984). Of the heavy metals, larvae were most sensitive to mercury which significantly interfered with settling at minimum concentrations of 2 parts per billion. The additives (Soltex, lignosulfonate, and Drispac) reduced settling at dilutions of 1:100, and drilling mud reduced settling at dilutions of 0.1 milligram mud in 1 liter of water (1:10,000).

An 8-week recolonization study conducted by Tagatz et al. (1985) consisted of boxes containing clean sand (control), 1:10 or 1:3 barite:sand mix, and 1:10 or 1:3 drilling-mud:sand mix

placed in 3 meters (10 feet) of water in Santa Rosa Sound, Florida. A total of 1,081 individuals representing 63 species recolonized the boxes. There were 43 species in the control substrate compared with 38 species in the barite:sand mixes, 32 in the 1:10 mud:sand, and 24 species in the 1:3 mud:sand mix. The apparent toxicity of the lime drilling mud was attributed to diesel oil, a component banned from use in EPA Region 10. Although there were significantly fewer individuals in the 1:3 barite:sand mix compared with the control (220 vs 296), species diversity, species dominance, and dissimilarity indices were not markedly affected.

**RECOVERY.** After cessation of drilling activity, benthic communities will recolonize the area although pioneer species may not be the same as those lost. With time, the pre-existing community will probably recover. Menzie et al. (1980) suggest that benthic communities within the initial impact zone are recolonized and commence recovery within a year following cessation of discharge. The potential for bioaccumulation of metals remains (Crippen et al. 1980), although the discharge of toxic pollutants can be regulated through the NPDES permit.

Crippen et al. (1980) analyzed sediment and benthos for mercury, arsenic, cadmium, lead, and zinc near a drilling site in the Beaufort Sea one year after discharge had ceased. There were suggestions of elevated mercury levels in benthic organisms very near the original discharge site, but no indications of significant bioaccumulation for any of the other metals. The mud discharged had mercury levels far in excess of those which EPA Region 10 would approve for discharge under current NPDES permits.

A field survey was conducted at the Murchison oil-field in the North Sea 16 months after the major cuttings discharges had ceased (Mair et al. 1987). The benthic community was sampled to 2,000 meters (6,600 feet) from the discharge point. Species abundance, diversity, and evenness were significantly lower at the 100-meter (330-foot) station as compared to the reference station, although these community parameters were not significantly different from the reference point 1,000 meters (3,300 feet) from the discharge point. The community recovery was strongly affected by the oil residues from the oil-based drilling muds. Oil-based drilling muds are not permitted under EPA Region 10 permits.

**CONCLUSIONS.** No geographic areas in the lease sale area of specific importance for benthos potentially affected by the discharges have been identified. Simpson Lagoon near the Sagavanirktok River could be affected by activities in the lease sale area. The following factors should result in limited benthic community effects from drilling fluids discharges:

- the potential for resuspension and further dispersion and dilution of contaminated sediments by periodic high current velocities and storm events;

- the relatively low numbers and diversity of infaunal organisms in areas of intensive ice-gouging;
- the mobility of many of the trophically important epibenthic organisms (mysids and amphipods); and
- the control of toxic pollutants effected through the BAT and NSPS effluent limitations.

Therefore, it is anticipated that transitory and localized impacts from exploratory drilling may occur on the benthos of the sale area. Due to the limited quantity of materials which would be discharged and the small area affected by those discharges, the impacts would be insignificant.

#### FISH RESOURCES

Detailed discussion of species anticipated to be present in Sale 124, population dynamics and community characteristics for fishes may be found in the Sale 87 ODCE and the Sale 97 ODCE.

#### IMPORTANT SPECIES

As discussed in the Sale 87 ODCE and the Sale 97 ODCE, fish resources in the Beaufort Sea are limited relative to more temperate habitats, largely due to the reduced productivity, lack of winter habitat (due to ice formation), and lower temperatures. Little sampling has been accomplished west of Harrison Bay, and fish overwintering areas are poorly defined. While investigative activities have focused upon the nearshore (shallower than 2 meters) areas of the Beaufort Sea (an area primarily outside Sale 124) and relatively extensive data are available for anadromous and demersal fishes in the nearshore, data for the inshore (2 to 20 meters) habitat are particularly scarce. Data are scarce as well for the offshore demersal species in depths less than 40 meters (130 feet) and greater than 150 meters, and virtually all data on pelagic species come from incidental catch during demersal sampling.

Potential impacts on anadromous fishes and other species principally associated with nearshore shallows had been an issue in the Sale 87 ODCE and the Sale 97 ODCE effort due to the inclusion of the State Lease areas which are located within the nearshore and contain the predominant critical life stage habitats for these species. A major difference between Sale 124 and the previous sale is the exclusion of the area within the 3-mile Alaskan state waters boundary. Based on previous studies, permitted discharges in Sale 124 are expected to have short-term and localized impacts which will be limited to the vicinity of operation.

Accordingly, nearshore enclosed lagoons and coastal waters less than 2 meters deep are outside the scope of this evaluation. It is important to note, however, that 91 to 98 percent of all

fishes counted in Alaskan Beaufort Sea studies (as discussed in the Sale 87 ODCE and the Sale 97 ODCE) were represented by 5 of the 34 species recorded in the nearshore zone.

For the inshore area the Sale 87 ODCE and the Sale 97 ODCE states that the small amounts of information available on inshore fishes indicates densities are low compared to nearshore areas, and that marine rather than anadromous species predominate. Demersal fish species include Arctic cod, fourhorn sculpin, spotted sailfish, and wattled eelpout. In addition to Arctic cod, pelagic sampling data added liparids, cottids, and gaddids to the list of more common species.

As discussed in the Sale 87 ODCE and the Sale 97 ODCE, only one survey of offshore (20 to 100 meters) demersal fishes has been made, and little is known of the pelagic species. The limited data suggest the offshore assemblage is quite distinct from that of the nearshore area. Only 3 of the 19 species collected were reported from coastal areas, and offshore fish comprised a very small portion (generally less than 3 percent) of the total biomass.

Many investigators have identified Arctic cod as a key trophic link in the vertebrate food web (with emphasis on the pelagic ecosystem) (EPA 1984b, 1988c). There are temporal shifts in prey importance in the diet of Arctic cod, food includes amphipods, mysids, copepods and zooplankton (in waters deeper than 40 meters) (Truett 1984). U. S. Army Corps of Engineers (1984) suggests that Arctic cod is the key consumer of secondary production in the Beaufort Sea and presence or absence may affect patterns of movement and distribution of Arctic Ocean marine mammals and seabirds. Except for Arctic cod and the leatherfin lumpsucker (which feeds mainly on zooplankton), the Sale 87 ODCE and the Sale 97 ODCE suggest that all other offshore fish species rely heavily on benthic invertebrates, particularly amphipods and polychaetes.

#### IMPORTANT HABITATS OR AREAS

Nearshore and inshore overwintering areas are currently poorly defined, but the potential disruption of overwintering habitat is an important consideration in any evaluation of Beaufort Sea discharges from petroleum exploration. If important overwintering areas are found to be located such that they could be adversely impacted by effects from Sale 124 exploratory activity, a monitoring program should be developed to determine the extent of such effects and a mitigation plan proposed.

Offshore species appear to have patchy distribution, suggesting discrete centers of abundance for different species. Factors influencing this patchy distribution are not well known.

Additional information regarding critical habitat or critical areas may be found in the Sale 87 ODCE and the Sale 97 ODCE.

## EFFECTS ON FISH RESOURCES

Fish and most motile pelagic species should be able to avoid discharge plumes and areas of high turbidity resulting from exploratory drilling operations. Jones & Stokes Associates (1984) suggest that although some studies have indicated that fish may be attracted to a discharge plume, it is likely that stresses induced by particulates in the main body of the plume would restrict fish to the plume edges. These factors also mean that fish are unlikely to experience significant exposures to toxic concentrations of pollutants in the discharge. Following cessation of discharge, fish will return to a discharge area, particularly if the settlement of discharged cuttings and drilling fluid provides significant micro-relief (i.e., creation of new habitats).

While little is known regarding threshold effects for smothering or effects of toxics on demersal fish eggs, wider dispersion of discharged drilling fluids in deeper areas could result in a large area being covered with more than 1 millimeter of muds and cuttings. This could result in the smothering of eggs of cottids (Arctic cod) and other demersal fish (Jones & Stokes Associates 1984). However, under actual field conditions, the area affected should be relatively small.

The toxicity of whole mud to fish species has been tested. Of the eight Alaskan fish species tested with a total of 24 whole mud samples, all of the 96-hour LC50 values exceeded 1,000 ppm, 95 percent exceeded 10,000 ppm, and 43 percent exceeded 100,000 ppm (EPA 1984b). Of the Alaskan species tested with approved drilling mud, pink salmon (an important commercial species) fry had the lowest LC50 value (3,000 ppm) based on a volume:volume dilution of continuously suspended drilling mud. The concentration of suspended solids at this LC50 was 1,100 milligrams per liter, suggesting that relatively low concentrations of suspended solids, along with toxicological effects, may affect juvenile salmon survival.

For distances from Sale 124 exploration wells, dilution of solids and dissolved materials were predicted for discharges at 40 meters (120 feet) and 120 meters (390 feet) of water with currents of 10 centimeters per second. A minimum particulate dilution of at least 1,437:1 is expected in the water column 100 meters (330 feet) from the discharge for discharges of 1,000 barrels per hour in 40 meters (120 feet) of water (Table 13a). (It should be noted that this minimum dilution applies to the area of greatest solids concentration within the plume. Other areas within the plume will experience greater dilutions).

The most susceptible life-stage tested, pink salmon fry, leave their natal streams and enter the ocean immediately upon hatching but remain near shore to feed and grow. The predicted concentrations of drilling mud could adversely affect the fry if they were within 200 meters (660 feet) of the discharge point and if they remained in the plume for the entire duration of

discharge. All other species of Alaskan fish that have been tested with drilling muds have much higher LC50s (EPA 1984b).

Expected concentrations of heavy metals from drilling mud at the edge of the mixing zone (100 meters [330 feet] from the discharge) were compared to EPA water-quality acute (1-hour) criteria (Jones & Stokes Associates 1989). All metals are within the criteria which were established to protect marine life. Fish populations are not considered to be at risk from toxicity effects of metals in discharged drilling muds and cuttings.

**BIOACCUMULATION.** Heavy metals are the primary constituents of mud and cuttings having potential for bioaccumulation. Fish can bioaccumulate metals either through their gills with direct absorption from the water (Fair and Sick 1984) or by ingestion of contaminated food. Because of the small area of water column affected, the intermittent and short duration of the discharge, and the mobility of fish, it is likely that any metals accumulated by fish would be obtained through their diet. Once metals are ingested, elimination is slow (Ballatori and Boyer 1986). It is not possible to predict the degree to which an individual fish will accumulate metals from its prey, although it is thought that this is a relatively minor concern given the wide foraging range of fish. However, incrementally small additions of heavy metals from diverse sources do increase the potential for bioaccumulation through the food chain.

**EFFECTS ON FOOD SUPPLY.** Disposal of muds and cuttings could indirectly affect fish by temporarily reducing or increasing their food supplies in the vicinity of drilling rigs. Field work indicates little change in benthic species composition and only a slight reduction in population levels (Tagatz et al. 1985; Gray 1988). Benthic species emerge from drilling muds, making them more susceptible to predation (Clark and Patrick 1987) and possibly attracting predators to selectively feed on drilling mud deposits.

## MARINE MAMMALS

### IMPORTANT SPECIES

At least eight marine mammal species have been observed in the Beaufort Sea, and a number of species normally present in the Chukchi Sea may also be found in the Sale 124 Lease Area, particularly in the westernmost portion. Many species are seasonal and many are associated with ice. Year-round residents include ringed and bearded seals and polar bears, all of which are ice associated. Seasonal species include beluga and bowhead whales and the spotted seal. The gray whale and walrus may also occur, most often in areas nearest to the western end of the Sale 124 area, north of Icy Cape and Peard Bay.

All of the marine mammals and their habitat are protected by the Marine Mammal Protection Act, and several whale species, including bowhead, gray, fin and humpback whales are protected by

the Endangered Species Act. The polar bear is also protected by an international treaty.

Endangered species regularly occurring in the Sale 124 area include bowhead and gray whales. Utilization of the area by bowhead and gray whales is discussed in the Sale 87 ODCE and the Sale 97 ODCE. Bowhead whales feed in the Beaufort during summer and fall and in the Chukchi sea during the fall (Braham et al. 1980).

Gray whales migrate into the Chukchi and Beaufort Seas during spring to feed through the late spring, summer, and early fall. Their distribution is illustrated in Sale 87 ODCE and the Sale 97 ODCE, where migration and foraging behavior are also discussed.

Species of major importance to subsistence harvests include the bowhead whale, bearded seal, and ringed seal. The Beluga whale, spotted seal, walrus, and polar bear are also taken. Subsistence harvests are discussed below.

#### IMPORTANT HABITATS OR AREAS

The ice distribution determines timing and route of migration for shallow habitat species as well as location of seals, polar bear, and walrus. Years of heavy ice will delay migration, depending on circumstances, and may redistribute seal and bear populations. Because marine mammal species are often quite mobile, it is difficult to predict the exact location of animal concentrations or predict populations at any given time or location. Variations between the summer/fall distribution and the winter/spring distribution of mammals, as related to the ice formation and ice zones, are shown in the Sale 87 ODCE and the Sale 97 ODCE. In summer/fall, the area from the ice edge to the nearshore area supports the greatest number of mammal species and the highest densities of animals. In winter/spring, the flaw zone between the fast ice and the pack ice supports the greatest numbers of species and individuals. Additional information on marine mammal habitats is found in the Sale 87 ODCE and the Sale 97 ODCE.

A number of different areas constitute important habitat of marine mammals because of the variety of species, their mobility, and the timing of their occurrence in the Sale 124 vicinity. Most marine mammal activity in the Sale 124 area occurs outside the 3-mile limit. Important polar bear habitat, which exists in the state lease sale areas shoreward of the Sale 124 area, is discussed in the Sale 87 ODCE and the Sale 97 ODCE.

The flaw zone is important during winter and spring for the bowhead, beluga, polar bear, bearded seal, and non-breeding ringed seals, which either migrate through or live and forage within it. Peard Bay, which is shoreward and outside of the Sale 124 area in the Chukchi Sea, is a known summering area for both the Beluga whale and spotted seal.

#### EFFECTS ON MARINE MAMMALS (ENDANGERED AND NON-ENDANGERED)

**EXPOSURE TO DISCHARGES.** Marine mammals are large and mobile, and in many cases are only migrants though the lease sale area. Because many species are sensitive to noise and human activity, the drilling process should keep most mammal species at a distance, and therefore away from direct contact with the discharge plume.

Discharge of muds and cuttings is expected to be intermittent and relatively brief, and exposure of mammals to the plume, especially to the most concentrated portions, is unlikely. Exposure to settled muds on the bottom would be possible, at least in shallower portions of the lease sale area. Above-ice disposal would allow mammals such as seals and bears to have contact with muds, primarily in frozen form, but it is not likely to be ingested (Jones & Stokes Associates 1984).

**ACUTE AND CHRONIC TOXICITY.** Acute and chronic toxicity levels for drilling muds and cuttings have not been determined for marine mammals. However, it is unlikely that they would remain in contact with the discharge for sufficient periods to receive exposure to acutely or chronically toxic levels of metals in either the water column or the bottom sediments. Because of the limited number of wells and intermittent discharge of materials, and dispersion/dilution expected, any acute or chronic effects are judged to be unlikely (Jones & Stokes Associates 1984).

**BIOACCUMULATION.** Little is known concerning metal concentration in Alaskan marine mammals, although mercury concentrations in beluga whale and other species has been observed to exceed the criteria for human consumption in some areas (EPA 1984b). Any bioaccumulation of metals is most likely to occur through ingestion of contaminated food sources rather than through absorption of metals from the water column.

Benthic feeders are most likely to bioaccumulate metals from feeding on contaminated prey and incidental ingestion of drilling-mud sediment. Gray whales are most at risk, since they feed on pioneer species of amphipod (Nelson and Johnson 1987) that would probably rapidly settle on drilling-mud discharges. Their feeding behavior would resuspend anaerobic muds with a high content of dissolved metals such as the highly toxic methyl mercury.

Mammals feeding on plankton are less likely to accumulate metals than those feeding on benthic species because animals in the water column are less likely to be exposed to elevated metals concentrations. However, mammals feeding on higher levels of the trophic level are at risk to bioaccumulation of mercury and cadmium, particularly since fish prey only slowly eliminate metals.

Detectable levels of mercury and cadmium have been found in many mammals, including gray and fur seal from Canada (Olafson and Thompson 1974), Dall's porpoise from the North Pacific (Fujise et al. 1988), harp seal off Newfoundland (Botta et al. 1983), and in seals from the unexploited Antarctic (Steinagen-Schneider 1986). It is not possible to attribute metal body burdens in marine mammals to any one source such as exploratory oil and gas drilling, as increasing emissions of pollutants is a general and world-wide phenomena, and animals in remote areas have detectable levels of metals. However, incrementally small additions of heavy metals from diverse sources do increase the potential for bioaccumulation through the food chain.

Some benthic feeders selectively feed on pioneer species of recently disturbed muds and these species, which includes the gray whale, are most susceptible to heavy metal bioaccumulation. Feeding grounds of benthic feeders should be identified and monitored for trace metals. Otherwise, bioaccumulation of heavy metals in mammals specifically from drilling-mud and cuttings discharges during exploratory drilling is judged not to be a significant concern based on:

- the relatively limited volume of the wastes discharged;
- the limited number of exploratory wells;
- the limited areal extent of elevated heavy metal concentrations in the water-column and sediments; and
- the mobility of mammals which allows selection of food from a variety of uncontaminated as well as contaminated locations.

**EFFECTS ON FOOD SUPPLY.** Disposal of mud and cuttings could indirectly affect marine mammals by reducing benthic populations serving as food, although field work indicates little change in benthic species composition and only a slight reduction in population levels (Tagatz et al., 1985; Gray, 1988). Benthic species emerge from drilling muds, making them more susceptible to predation (Clark and Patrick, 1987) and possibly attracting predators to selectively feed on drilling mud deposits.

#### **MARINE BIRDS**

##### **IMPORTANT SPECIES**

Data on the ecology and distribution of marine birds in the Beaufort and Chukchi Seas are incomplete, but some recent studies have been completed in coastal and nearshore areas. Up to 150 species of birds use the Sale 124 vicinity, although those using open water are necessarily migrants present primarily during summer.

Significant portions of the total North American populations of several species are present, including oldsquaw; black brant;

common and king eiders; glaucous, Sabine's and Ross' gulls; and red and red-necked phalaropes. Some appear only during migration; others nest, molt, feed, and accumulate critical fat reserves needed for migration in the lease sale vicinity.

Offshore, the highest pelagic bird density is located between Barrow and Cape Halkett. This is probably due to the infusion of Bering Sea water in this area, which contains high amounts of plankton that provide a food source for birds as well as other organisms. The effect is greatest on surface-feeding zooplankton consumers such as phalaropes, terns, and kittiwakes.

The only endangered bird species in the area is the peregrine falcon, which may occur at times near the shoreline, but should not be encountered beyond 3 miles from shore in the shoreward extent of the Sale 124 area. The eskimo curlew, although historically present, is not considered to inhabit the Sale 124 area. Additional information on marine birds is found in the Sale 87 ODCE and the Sale 97 ODCE.

##### **IMPORTANT HABITATS OR AREAS**

Most of the important bird habitats are located in nearshore areas less than 5 kilometers (3 miles) from shore. These areas all lie within the geographic 3-mile limit and are excluded from the Sale 124 area. The offshore areas from Point Barrow to Cape Halkett support the highest pelagic bird densities in the Alaskan Beaufort Sea.

Five types of habitat particularly capable of supporting a variety of marine coastal avifauna include the barrier islands, coastal lagoons, coastal salt marshes, river deltas, and offshore areas. Of these habitat types, all but the offshore areas are excluded from the Sale 124 area. The importance of these nearshore habitats is discussed in the Sale 87 ODCE and the Sale 97 ODCE. The offshore areas from Point Barrow to Cape Halkett support the highest pelagic bird densities in the Alaskan Beaufort Sea.

##### **EFFECTS ON MARINE BIRDS**

**EXPOSURE TO DISCHARGE.** Discharges are expected to be intermittent and relatively brief. Since discharge activity is distant from land, nesting sites are not expected to be affected. It is not expected that marine birds will be directly affected by exposure to the discharges, since, due to their mobility, they are able to avoid stressful regions of the plume during discharge.

**TOXICITY.** No data exist concerning the acute toxicity of drilling mud to birds. Toxicity could only result if birds are exposed directly to discharges or indirectly through contaminated food. Because discharge is intermittent, dilution occurs rapidly during discharge, and much of the material settles quickly following cessation of discharge, direct contact between marine

birds and the concentrated plume is not expected to be extensive. In areas where highly turbid waters occur naturally, little seabird foraging occurs, apparently due to the inability of birds to visually locate prey (EPA 1984b). Feeding that has been recorded in highly turbid water is limited to situations in which prey organisms are concentrated at the surface, such as during gray whale feeding activity, and does not include diving birds (EPA 1984b). Drilling mud discharges are not expected to concentrate prey organisms near the surface. Toxic effects from direct contact with discharged material are, therefore, expected to be minimal.

Ingestion of contaminated food organisms is possible; however, due to the limited areal coverage of a discharge plume, the intermittent nature of the discharge, and the mobility of birds it is highly unlikely that a significant portion of a bird's diet would be contaminated. Toxicity from ingestion of contaminated food organisms are, therefore, also highly unlikely.

**BIOACCUMULATION.** No data exist concerning heavy metal bioaccumulation in marine birds from drilling mud and cuttings discharges. Pelagic birds foraging offshore (e.g., non-breeding gulls, murre) may obtain some heavy metals via contaminated prey particularly since fish eliminate accumulated metals very slowly. Birds are likely to forage on uncontaminated areas as well as contaminated areas, but individuals will forage in either location. Metal accumulation is judged to be a minor concern because of the limited benthic or pelagic prey species, and the mobility of birds and most prey species. Measurable impacts would be likely only if the drilling was to affect large portions of major feeding areas for extended periods of time. However, incrementally small additions of heavy metals from diverse sources do increase the potential for bioaccumulation through the food chain.

**EFFECTS ON FOOD SUPPLY.** A number of bird species feed on fish and invertebrates. Bird populations could be reduced if their prey were significantly reduced in quantity. Field studies show no change in planktonic species composition and little reduction in population numbers (Tagatz et al. 1985; Gray 1988). An insignificant proportion of the food supply may have a reduced nutritional quality from some drilling mud discharges. Because discharges are intermittent, of short duration, and dilution and dispersion occur rapidly, these effects are not expected to be significant. Significant effects on bird populations are, therefore, highly unlikely.

#### COMMUNITY EFFECTS

Overall, larvae and planktonic organisms are most sensitive to constituents in the water column, and effects on the biota will primarily be a function of dilution and dispersion of the discharge plume and duration of discharge. Since dilution is rapid and metals concentrations are within EPA water quality criteria (set to protect marine life) within 100 meters (330

feet), effects to the plankton biomass are expected to be transient and localized.

The benthic community is the most likely to be affected physically and toxicologically because of potential exposure to large amounts of drilling mud solids. Effects on the benthos will be primarily a function of the depth and areal extent of solids deposition. Since the area affected is small, population depressions in the benthic community are not expected to have serious impacts on marine species higher up on the trophic web.

Benthic community structure is changed in the immediate vicinity of the discharges due to smothering, in particular by cutting piles which may be a few meters high and 100 to 200 meters (300 to 600 feet) in diameter in a non-dispersive environment (Battelle Ocean Sciences 1987). However, the fresh habitat is rapidly recolonized, and field studies show little change in benthic communities one year following cessation of drilling activity, providing oil-based drilling muds are not used.

Mercury and cadmium bioaccumulation through the trophic links is of some concern. Plankton in the discharge plume are exposed to these metals and have the potential to ingest them. The benthic polychaete, *Capitella capitella*, feeding on phytoplankton-zooplankton debris contaminated with mercury and cadmium show a significant metal accumulation (Windom et al. 1982). It is also possible that pioneer species reinvading the areas smothered during mud deposition are selected prey for fish and mammals. Although minimal bioaccumulation of metals during exploratory drilling is expected because of the limited volumes of drilling muds and cuttings discharged, tissue analyses of benthic species pioneering the mud deposits should be conducted.

Based on an assessment of the sensitivities and susceptibilities of Alaskan marine organisms to drilling mud and drilling mud components, the biological communities in Sale 124 do not appear to be at unreasonable risk from toxicity caused by limited offshore exploratory phase discharges of drilling mud. However, the potential for significant effects on all communities increases when large-scale production is considered.

#### COMMERCIAL, SUBSISTENCE, AND RECREATIONAL HARVESTS

#### INTRODUCTION

In light of information presented in the Sale 87 ODCE and the Sale 97 ODCE, it appears that the potential for commercial fisheries in Arctic waters is probably limited to nearshore, localized, small-scale efforts. By virtue of the nearshore locations of principal fishery use areas, such fisheries can be generally considered to be outside the exploratory activity context of this evaluation. On the other hand, production

impacts could affect fisheries inside the 3-mile state limit. Consideration of such potential impacts becomes a critical component of evaluation of subsequent phase activities.

Various authors have speculated that the specifics of population dynamics of Arctic fisheries are poorly understood and that significant gaps in the data base exist. Although Arctic zooplankton and fishes support large populations of marine mammals and birds feeding inshore, an important data gathering effort centered on the Beaufort Sea inshore suggests that fish numbers and biomass values are relatively low.

The abundance and biomass values for offshore demersal fishes and epibenthic invertebrates appear to be low as well, based on limited-scale bottom trawl survey efforts in the Beaufort Sea. Low fish harvest values from this survey appear to preclude the feasibility of a Beaufort Sea offshore commercial fishery.

Small commercial harvests could be established in the future at coastal locations outside the context of this evaluation, such as the commercial fishery operated by Jim Helmericks on the lower Colville River.

Data are likewise limited for the portion of the Sale 124 area which lies within the extreme northeastern Chukchi Sea. The presence of ice close to shore, even in summer, and limitation of habitual species harvested results in the predominance of fishing effort being associated with the beaches and riverine habitats. Furthermore, trawl data strongly suggest that the offshore fish communities potentially associated with the Sale 124 Area are depauperate.

Marine mammals are protected under the Marine Mammal Protection Act of 1972 and may not be taken for commercial or sport purposes. They are, however, taken for subsistence purposes and form a substantial subsistence fishery in the Chukchi Sea.

#### COMMERCIAL HARVESTS

Only one continuous commercial fishing operation, on the lower Colville River, exists on the Alaskan North Slope (EPA 1984b), and it is outside of the limits of the Sale 124 area.

#### SALMON

In 1978, king (chinook), sockeye, chum, and pink salmon were taken incidentally to the catch of miscellaneous species (EPA 1984b).

#### HERRING

Herring are not a significant portion of the fishery in the Sale 124 area.

#### MISCELLANEOUS FINFISH SPECIES

As noted above, the fishery which exists does not extend beyond the 3-mile state limit. Arctic cisco is the single most important cash product and is sold for human consumption. Other species uses and importances are discussed in the Sale 87 ODCE.

#### SUBSISTENCE HARVESTS

Subsistence harvest of fishes by North Slope Inupiat Eskimos does not generally occur outside the 3-mile state limit or in the Sale 124 area. However, marine mammals are a significant component of the subsistence harvest and this fishery is conducted in areas which are included in the Sale 124 area.

Importance of the total subsistence harvest is summarized in the Sale 87 ODCE. A discussion of the subsistence fishery appears in the Sale 87 ODCE.

Mammal species of major importance to subsistence harvests are the bowhead whale, bearded seal, and ringed seal. Beluga whale, other seals, walrus, and polar bear are also taken (EPA 1984b). The number of marine mammals harvested each year depends on the availability of the resource; i.e., the native population are opportunistic hunters. If one marine mammal species is particularly available, then subsistence harvests of that species may continue rather than switching to another species. This leads to variability in the number of individuals taken each year. Residents from Barrow and Kaktovik (on Barter Island), are the main harvesters of marine mammals, whereas Nuiqsut residents take proportionately less. The majority of the marine mammals harvested occur in the Chukchi Sea. Bowhead whales are also harvested east of Barrow during the fall (Marquette 1978; Burns 1978). Most of the subsistence hunting takes place within approximately 3 to 5 miles of the shore with the exception of bowhead whale hunting which occurs up to 20 miles offshore (MMS 1989).

Subsistence hunting for bowhead whales is discussed in the Sale 87 ODCE. The number of various marine mammal species taken is shown in Table 6-2 of that document.

The Sale 87 ODCE and the Sale 97 ODCE summarize availability of various biological resources to coastal Alaskan native villages of the northeastern Chukchi and Beaufort Seas and illustrates the relative seasonal use of resources at Wainwright, just south of the western portion of the Sale 124 area. Specific times of importance may be slightly different at other Beaufort Sea locations, especially those further to the east.

Waterfowl are considered to be a primary subsistence because they are important food in spring and summer and the hunting trips have sociocultural significance. However, the quantity taken and hunting season are limited (EPA 1984b). The majority of the subsistence harvest of waterfowl occurs in the onshore area shoreward of the Sale 124 boundary.

#### RECREATIONAL FISHERY

Limited sport fishing occurs beyond the Sale 124 area, associated with villages, DEW-line stations, and oil camps and Arctic char is the main species taken. Recreational fishing is also discussed in the Sale 87 ODCE.

#### EFFECTS OF WASTE DISCHARGE IN OCS SALE 124

##### EFFECTS OF HARVEST QUANTITY

Disposal of drilling muds in the inshore and offshore portions of the Sale 124 area, via any discharge technique, is not expected to directly interfere with commercial harvests in the Colville River delta, or with the minor recreational harvest that occurs within the 3-mile limit.

Similarly, open water disposal in Sale 124 is not likely to directly affect inshore subsistence fish harvests. Further discussion appears in the Sale 87 ODCE.

Impacts of exploratory drilling operations in the Sale 124 Area are anticipated to have insignificant impacts on the quality of fish harvested, based on the relatively limited volume of wastes discharged, the limited number of exploratory wells to be drilled, the limited areal extent of toxic concentrations in the water column and sediments, and the mobility of harvested species. Additional discussion appears in the Sale 87 ODCE.

#### SUMMARY

Nearshore locations utilized for commercial, subsistence and recreational fisheries are predominantly outside areas which could conceivably be impacted by activities conducted during Sale 124 area exploratory drilling.

Mammal subsistence harvesting may be affected to the extent that discharge sites may alter distribution of the animals. However, effects should be insignificant if discharge locations are not in close proximity to each other. The likelihood of significant metal uptake or transference to humans is small due to the limited number of expected discharges, their limited areal extent, and the mobility of potentially exposed species.

Residues of pollutants accumulated in the marine biota are not expected to pose a significant hazard to people.

#### HUMAN HEALTH IMPACTS

Adverse human health effects from drilling muds are unlikely to result from the limited exploratory phase discharges as direct human exposure is low. Human health effects are most likely to result from chronic ingestion of marine organisms that have accumulated high levels of metals. Three metals are of concern: mercury and cadmium because they biomagnify in food webs, and barium, which is present in large concentrations in drilling muds. Barium could be accumulated in marine organisms but human ingestion of enough contaminated seafood in a short enough period of time to pose a human health threat is unlikely. Petrazzuolo (1981) assessed human health risk based on reported barium concentrations in biota and concluded that a human would have to eat 5 to 15 kilograms (11 to 13 pounds) of contaminated seafood in a short period of time (biological half-life of barium is less than 24 hours) in order to be at risk. This event is highly unlikely to occur.

Organic mercury is readily taken up by marine biota and accumulates in the liver and kidney (Hamer 1986). Mercury accumulation by pilot whales can be high enough to pose a health risk to human inhabitants of the Faroe Islands (Andersen et al. 1987), and seal meat has been found to contain high levels of mercury (Botta et al. 1983). The potential for chromosome mutagenicity was high in Greenlandic Eskimos having a high proportion of seal meat in their diet, and seal meat consumption was positively correlated with human blood concentrations of mercury and cadmium (Wulf et al. 1986).

The body burden of metals in birds and animals from areas remote from major human activity (the Antarctic and the Canadian Arctic) are relatively high (Steinhagan-Schneider 1986; Eaton and Farant 1982). The increases in metal body burdens of animals consumed by humans attributable to drilling mud discharges are expected to be minor, since drilling mud discharges are periodic and of small volume. However, incrementally small additions of heavy metals from diverse sources do increase the potential for bioaccumulation of metals through the food chain. Metal content of drilling muds should therefore be minimized.

#### COASTAL ZONE MANAGEMENT ACT

The Coastal Zone Management Act requires that states make consistency determinations for any federally licensed or permitted activity affecting the coastal zone of a state with an approved Coastal Zone Management Program (CZMP) (16 USC 1456[c] [A] Subpart D). Under the Act, applicants for federal licenses and permits must submit a certification that the proposed activity both complies with and will be conducted in a manner consistent with the State's approved CZMP. For NPDES general permits for OCS exploration, EPA is considered an applicant submitting the general permit to the state for a consistency determination.

Waste discharges associated with oil and gas exploration in Lease Sale 124 will be consistent with relevant ACMP policies. The consistency assessment is based on ACMP policies and district policies approved by local, state, and federal governments. Relevant policies with which the waste discharges will be consistent are related to subsistence uses of the coastal zone, management of all coastal habitats, management of specific habitat types (offshore areas, estuaries, wetlands and tideflats, and high energy coasts) and state water quality regulations. The consistency certification made by EPA will be submitted to the State of Alaska for formal state review pursuant to 15 CFR 930.60-15 CFR 930.64.

#### EFFECTS OF LAND DISPOSAL

Land disposal of drilling muds and cuttings is generally unattractive as sites fill and new disposal locations must be found. Although land disposal has been considered for operations off the Canadian coast (Lamm 1982) and in the Beaufort (Dranjnich 1983; Cooper Consultants, Inc. 1986a) and Chukchi (Cooper Consultants, Inc. 1986b) Seas. However, if the drilling mud composition is such that ocean disposal would violate the conditions of the NPDES permit, or if there is insufficient information to determine that there will be no unreasonable environmental degradation to the discharge site, on-land disposal is the only option.

On-shore disposal options include placing the mud in existing quarries, building pits or sumps, or direct land disposal. For each of these options, shipping traffic, docking facilities, and haul roads are required.

The construction of pits or sumps removes land from other uses. The magnitude of land loss is dependent on the volume of waste to be disposed and the amount of time that would be required to reclaim the lands with vegetative cover. Snow can accumulate in the pits over winter, and flooding is a danger during spring break-up. Furthermore, drilling muds and fluids that could not be safely disposed of at sea probably contain toxic materials such as oil and grease, heavy metals, synthetic and natural organic compounds, high concentrations of salt, and have a high biochemical oxygen demand.

Accumulated pit water must be disposed of to avoid a lagoon forming which may attract waterfowl and other wildlife and pose potential hazards to them. Land disposal of pit water can stress the vegetation; for example, willows are particularly sensitive to salt concentrations over 4,000 milligrams per liter (Cooper Consultants, Inc. 1986a).

French and Rossiter (1985) monitored the impacts of placing waste drilling fluids upon tundra. It was found that (a) no significant deleterious changes in water quality occurred in

adjacent Hoodoo River as a result of overland seepage of waste effluent, (b) leaching of heavy metals appeared to be slow and soluble components were quickly diluted to background levels, and (c) terrain disturbance was considerably less than that which might have occurred if a sump had been constructed. These short-term results suggest that direct surface disposal of waste fluids may be an acceptable procedure in those polar semi-desert environments where the potential for permafrost terrain disturbance is high.

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**APPENDIX M**

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**ASPECTS  
OF  
SPILLED OIL**

## ASPECTS OF SPILLED OIL

**I. Fate and Behavior of Spilled Oil:** The description of the behavior and fate of spilled oil in general and in specific regard to surface spills, subsurface spills, summer broken-ice spills, and winter broken-ice or under-ice spills as contained in Section IV.A.1.a of the Sale 100 FEIS (USDOJ, MMS, 1985), is incorporated by reference; a summary of this description, as augmented by additional material, as cited, follows. This section in particular addresses additional concerns for proposed Sale 124 related to oil spills in the ice conditions of the Beaufort Sea Planning Area. Many of the rate estimates for the oil-weathering discussion in this section have been calculated from the weathering model described in Payne et al. (1984b) and Kirstein and Redding (1988).

Note that in this discussion of spill behavior, cleanup of oil spills is not considered or assumed. It is likely that cleanup would be attempted but, historically, at-sea cleanup has not been very effective. Success depends too greatly on local ice, oceanographic, and weather conditions; type and quantity of oil; logistics; and shoreline character. Readers are referred to Section III of this Appendix for a discussion of oil-spill-cleanup technology and its effectiveness.

Spills from pipelines and platforms pose the greatest spill risk to the study area. In the Beaufort Sea, 53 percent of spill risk is derived from pipelines and 47 percent from platforms.

A pipeline spill would almost always be a subsurface spill. Most platform spills—because platform spills are much more likely to occur during production than during exploration—would occur as surface spills. Spills from the two sources—pipelines and platforms—are more likely to be of crude oil but also could be of fuel oils. In the OCS, 7 of 12 platform spills of 1,000 bbl or greater were of stored oil, either stored crude or fuel oil. Stored-oil spills could be as large as blowout spills. For example, preliminary plans for the Endicott Reservoir development called for storage of 50,000 bbl of diesel for potential placement in the pipeline in case of shutdown (crude oil could congeal in the pipeline).

A winter spill that resulted from the proposed action most likely would be into moving pack ice. Most of the proposed sale area contains pack ice, the previously unoffered Chukchi Sea portion of the proposed sale area has little landfast ice, and most undiscovered resources are thought to be in deeper waters.

**A. Surface Spills:** Oil spills spread less in colder waters than in temperate waters because of the increased viscosity of the oil. Offshore of northern Alaska, an oil spill would spread less than in temperate waters, remaining 100-fold thicker than a slick in a more temperate climate. A spill of 22,000 bbl (average size of pipeline or platform spill of 1,000 bbl or greater) in open water in the Beaufort Sea physically might cover 2 to 5 km<sup>2</sup> of surface, and a spill of 100,000 bbl might cover 5 to 14 km<sup>2</sup> of surface (Table M-1).

The oil spill, however, would not long remain as one contiguous slick over such a small area. Winds in excess of 4.4 m per second will cause a slick to break into windrows. Waves, movement of the slick, and changes in winds and ocean currents all tend to spread the slick discontinuously over the ocean surface. In open water in the Beaufort Sea, within 30 days, the slick could spread discontinuously over an area 200-fold greater than the area of actual oiled surface. As weathering and spreading forces continued, the oil would separate further into individual tarballs or pancakes.

The composition of the oil affects just how an oil slick would weather. Composition and resulting characteristics of known North Slope and Beaufort Sea crudes vary considerably, but generalizations can be made. Evaporation of volatile components accounts for the largest percentage of loss from most

crude-oil spills, on the order of 25 percent within the first 24 hours. Over the life of an oil slick, evaporation accounts for about one-sixth to two-thirds of slick mass. For an oil such as Prudhoe Bay crude, with a high resid content, only about 9 percent of a spill would evaporate in 1 day at 1 °C and a 6-m-per-second (11-kn) wind (calculated from Payne et al., 1984b). Higher wind speeds or warmer temperatures would increase the initial rate of evaporation but would not appreciably increase the percentage of slick mass that eventually escapes into the atmosphere. Volatile components total only 18 percent of Prudhoe Bay crude.

A spill of diesel fuel would behave similarly, but diesel is missing both the most volatile and least volatile components found in crude oil. Under the conditions assumed above for a Prudhoe Bay crude, a light diesel would initially evaporate more slowly than the crude, on the order of 3.2 percent over the first day, but a larger, overall percentage of diesel eventually would evaporate.

Competing with evaporation is dissolution, which chiefly involves the aromatic fraction of spill volatiles. Dissolution, however, is very slow compared to evaporation; usually most volatiles evaporate rather than dissolve. Dissolved hydrocarbon concentrations underneath a slick, therefore, tend to remain low (see Sec. IV.B.1 of this EIS). Over time, about 5 percent of a slick can be expected to dissolve.

Winds, waves, and currents break off oil droplets from a slick and mix them into the underlying water. The greater the turbulence, such as in a storm, the more rapidly oil is lost from the slick. Dispersion of oil droplets into the water, not dissolution, is the major mechanism for getting oil into the water column. Mousse formation (water-in-oil emulsion) slows but does not stop dispersion from a slick.

For an oil with a relatively small volatile component, such as Prudhoe Bay crude, dispersion can be as important as evaporation in removing oil from a slick. Initial dispersion of Prudhoe Bay crude in the 22,000-bbl spill of Table M-1 would be 9.7 grams per square meter per hour. Dispersion would initially remove about 2.4 percent of the oil slick per day, about 13 percent over 10 days, and about 18 percent over 30 days. Storm winds and waves could greatly increase dispersion rates.

At the same time that oil is being lost from the slick, the character of the slick changes. Many crudes, including Prudhoe Bay crude, form mousse. Most Canadian Beaufort Sea crudes, however, do not (Bobra and Fingas, 1986). For Prudhoe Bay crude, roughly 40 percent of the spilled oil could be expected to remain after initial weathering in the form of tarballs, pancakes, or mats. For arctic open waters, tarballs can form within days to within many months, depending on weather, mixing energy, oil type, and availability of nucleation sites to initiate tarball formation (Payne, 1982, 1984b; MacGregor and McLean, 1977).

**B. Subsurface Spills:** Subsurface spills could occur from leaks through the seafloor pipelines or from subsea blowouts of wells. Blowouts or gathering-pipeline spills would disperse small oil droplets and entrained gas into the water column. A trunk pipeline—with gas removed—would emit only oil droplets. Most of the oil would rise rapidly to the water surface to form a slick. Droplets less than 50 microns in size, a category including about 1 percent of total spill volume, could be carried several kilometers down-current before reaching the water surface. Buist, Pistruzak, and Dickins (1981) found that 90 percent of the oil reached the surface within 50 m of the discharge point in a simulated subsurface gas-and-oil blowout at a 20-m water depth in the Canadian Beaufort Sea.

The release of oil droplets would allow some increase in the dissolution of oil, but the rapid rise of most oil to the surface

Table M-1  
Spill-Size Examples for Spills in the Open-Water Season  
in the Beaufort Sea Planning Area

Spill-Size Examples	Time After Spill					
	Summer Spill			Meltout Spill		
	3 Days	10 Days	30 Days	3 Days	10 Days	30 Days
<b>22,000-Barrel Spill</b>						
Oil Remaining (%)	83	72	57	73	56	44
Thickness (mm)	1.5	0.8	0.4	2.1	1.0	0.5
Area of Slick (km <sup>2/3/</sup> )	1.8	3.1	4.8	1.2	2.0	3.0
Discontinuous Area (km <sup>2/4/</sup> )	57	260	1100	1400	1600	2200
<b>100,000-Barrel Spill</b>						
Oil Remaining (%)	85	76	62	77	61	48
Thickness (mm)	2.6	1.3	0.7	3.5	1.7	0.9
Area of Slick (km <sup>2/3/</sup> )	5.1	8.8	14	3.4	5.6	8.5
Discontinuous Area (km <sup>2/4/</sup> )	120	570	2300	3000	3500	4800

Source: Calculations are based on the oil-weathering model of Kirstein, Redding, and Payne (1987). These examples are of a Prudhoe Bay-type crude, which is considered the best analog for undiscovered crude in the Beaufort Sea Planning Area.

- 1/ August spill, 11-knot wind speed, 1 °C, 0.4-meter waves; average weather based on Brower, Baldwin, and Williams (1988).
- 2/ Time after meltout. Spill assumed to occur in May into first-year pack ice, pools 2-cm thick on ice surface for 10 days at 0 °C prior to meltout into 50-percent ice cover, 1 °C, 11-knot wind speed, negligible waves.
- 3/ This is the area of oiled surface.
- 4/ Calculated from Equation 6 of Table 2 in Ford (1985) and is the discontinuous area of a continuing spill or the area swept by an instantaneous spill of the given volume. Note that ice dispersion occurs for about 60 days prior to Meltout Day 0.

suggests that this increase in dissolution must be fairly small. Oil that reached the surface would weather and behave similarly to a surface spill.

C. Summer Broken-Ice Spills: Most of the acreage of proposed Sale 124 is covered by pack ice in summer. Therefore, a summer spill would most likely be into first-year or multiyear broken ice.

An oil spill in broken ice would spread between ice floes into any gaps greater than about 8 to 15 cm (Free, Cox, and Schultz, 1982). A large, instantaneous spill would push loosely packed ice floes away from the spill, creating a larger gap at the spill site. In more closely packed ice—because fresh crude oil is less dense than sea ice—crude oil would have a tendency to overflow rather than underflow ice (Thomas, 1983). Any waves within the ice pack also would tend to pump oil onto the ice. Approximately 25 percent of the oil spilled in pancake ice would be present on top of the pancakes because of this pumping (Stringer and Weller, 1980). More viscous and/or weathered crudes may adhere to porous ice floes, essentially concentrating oil within the floe field and limiting the spread of oil. Such concentration was observed in the Ethe! H. (Deslauriers, 1979) and Kurdistan (Reimer, 1981) spills.

Initial spillage could entrain some oil on the underside of the ice floes; however, because of its buoyancy, most oil would remain in the water between floes. Differences in velocities of ice and underlying water would have to be on the order of 15 to 25 cm per second to move oil along the underside of first-year ice (Cox and Schultz, 1981). Velocities would have to be greater than 20 cm per second to move oil underneath the rougher relief of multiyear ice. Strong surface currents are found at times in the Beaufort Sea Planning Area, and differential velocities of such magnitude are possible.

In broken, first-year ice, brine channels would allow relatively rapid movement of oil from underneath the ice to the ice surface. A maximum flow rate of about 0.4 mm of oil per hour through decaying first-year ice has been calculated by Thomas (1983). Any oscillation of the ice—wave action, slight uplifting of floes in collisions, overturning, or tilting that results from uneven melting—also tends to remove oil from underneath the ice. Multiyear ice does not contain continuous brine channels. Release of entrapped oil from multiyear ice would be slower than from first-year ice but would still occur.

Oil between or on ice floes is subject to normal evaporation. Some additional dispersion of oil occurs in dense, broken ice through the grinding action of floes (Reimer, 1980). This grinding action, however, also greatly promotes mousse formation. Prudhoe Bay crude, for example, forms a mousse within a few hours in such circumstances, an order of magnitude more rapidly than in open water (Payne, 1984).

D. Winter Under-Ice Spills: A winter spill under unbroken, landfast ice or pack ice would most likely have to be a pipeline spill. The oil would rise to the underside of the ice in a manner similar to that described earlier for a summer pipeline spill rising to the water surface.

The spread of oil along the underside of the ice is controlled by several factors. Separate oil droplets or small pools on the order of 0.2-mm thickness will not coalesce or flow into hollows underneath the ice (see Buist, Pistruzak, and Dickins, 1981). About 2 mm of oil could be accommodated in the skeleton layer of ice crystals beneath the solid-ice layer. Thicker layers of oil tend to coalesce or spread under the ice until an equilibrium thickness of 0.8 cm is reached (Rosenneger, 1975). If a sufficient volume of oil were instantaneously spilled, oil would spread into hollows underneath thinner areas of ice. Such hollows in first-year ice of late winter could store 150,000 to 300,000 bbl of oil per square kilometer (Stringer and Weller, 1980). Multiyear ice, which is rougher, could store 1.8 MMbbl per square kilometer in under-ice relief (Kovacs, 1977).

More than 90 percent of the proposed sale area lies in the pack-ice rather than the landfast-ice zone (Roberts, 1987). A spill into winter ice would, therefore, more likely be into multiyear pack ice than landfast ice. The greater storage capacity of multiyear ice would not be well-used in a real spill situation because of the movement of the ice over the spill.

A pipeline spill of 1,000 to 25,000 bbl per day might be spread as a ribbon, approximately 100 m wide and 0.3 to 8 mm thick, on the underside of the moving pack ice. Spills of greater size would pool within the ribbon into hollows on the underside of the ice. Only a spill rate greater than 900,000 bbl per day would fill the underside storage capacity of the ice and result in a somewhat wider ribbon. The length of the ribbon would depend on the duration of the spill; and the ribbon would grow at the speed of ice movement, usually about 5 km per day in the Beaufort Sea Planning Area (see Sec. III.A.3.a of this EIS). Faster movement of the ice, as may occur in a storm, would result in a longer, but thinner, ribbon of oiled ice.

Differential velocities between ice and underlying water need to be greater than 20 to 25 cm per second to move oil out of hollows on the underside of winter pack ice. Such velocities are possible in the Beaufort Sea Planning Area. Even in the presence of such differential velocities, oil likely would not move more than a few kilometers from its original location on the underside of the ice. New ice would form beneath the under-ice oil within 5 to 10 days, isolating it from currents and further weathering. Grease ice and also slush ice beneath the ice cover should retain spilled oil and limit its spread and movement (Martin, 1981; Truett, 1985).

Because of these and other factors, a winter spill (or whatever part of a winter spill that is not cleaned up) will become a fresh, unweathered spill when the ice melts.

To get into the water of a lead or a polynya earlier than breakup, oil would have to be spilled in a polynya or a polynya would have to form through the ice-entrapped spill; that is, it would have to break the ice in the middle of the frozen spill. If such breakage occurred in the latter case, appreciable quantities of oil could not be released unless breakage occurred through a relatively rare, thicker pool of oil. Such pools would be isolated and small; therefore, only minimal quantities of oil would be released into the forming polynya.

Oil released into the polynya would be blown to its downwind edge, where it would accumulate in a band. The oil would then be either frozen into the ice or contained behind accumulating brash ice (floating ice made up of fragments not more than 2 m across). It is possible that the cold, saline water formed as the polynya freezes could incorporate relatively high concentrations of dissolved hydrocarbons into a sinking plume of denser water. This plume would then spread out at some equilibrium depth in deeper water as a relatively stable and distinct layer (see Sec. IV.C.1 of this EIS).

In the Beaufort Sea Planning Area, oil would start melting out of first-year ice in June; oil spilled earlier in winter would melt out earlier. Oil in multiyear ice would be released more slowly, perhaps 1 to 3 months later, with 10 percent of the oil taking more than 1 year for release.

E. Winter Broken-Ice Spills: The most likely winter spills from platforms in the proposed Sale 124 area would be spills into broken pack ice. Spills from platform-stored oil would collect in open water or broken ice in the lee of bottom-founded production platforms.

Blowouts provide a mixed mode of spillage. A subsea blowout would place oil into the broken ice in lee of the platform. The subsequent winter fate of the spilled oil would be similar to that of a subsea-pipeline leak under ice. A surface blowout would place oil into broken ice and on top of rather than underneath the ice. Such surface release would likely result in appreciable, but incomplete, evaporation of volatile hydrocar-

bons prior to breakup. Thus, a surface blowout—or any other spill on top of the ice—would be partially weathered during winter.

The bulk of oil spilled into winter broken ice would be rapidly frozen into the pack ice. Because the oil would be frozen into new ice, brine channels would be present and would allow most oil to be released during breakup.

**II. Extent and Persistence of Oiled Shoreline:** If an oil spill occurs and contacts shore, two important but nonbiological questions arise: (1) how much shoreline will be contaminated and (2) how long will the contamination persist? In winter, landfast ice along the shorelines of the Beaufort and Chukchi Seas would keep spills offshore, away from the shoreline, and any oil that did reach shore would not penetrate into the frozen beach. For these shorelines, the relevance of these questions is much greater for the spills during the open-water season than for spills during the winter.

**A. Extent of a Shoreline Spill:** An offshore spill that reaches shore is not likely to reach the shoreline in its entirety; contact could occur with the shoreline in several locations, or the spill could be "smeared" along a single location, depending on the nature of winds and longshore current. How long a stretch of coastline could be coated by an oil spill is difficult to quantify but can be estimated on the basis of study by Ford (1985).

Ford used multiple regression and case histories of 39 spills in which coastline was oiled to develop empirical equations predicting how much coastline would be oiled if oiling occurred. (Note that not all spills reach shore.) Ford found that an equation estimating oiling as a function of only the volume spilled accounted for 59 percent of the variance in the historical record. An equation estimating shoreline oiling as a function of volume and latitude was a slightly more precise estimator, accounting for an additional 6 percent of the variance. Wind speed, water temperature, and wave height did not significantly correlate with the amount of shoreline oiling.

The Equation 13 (Table 4 in Ford, 1985) relating shoreline oiling to volume alone is a more appropriate predictor than the equation relating oiling to both spill volume and latitude. Obviously, increasing latitude would not directly cause a spill to spread over more shoreline. The correlation with latitude must be an artifact caused by a secondary relationship such as an increase in shoreline complexity as latitude increases. However, the historical spill record used by Ford encompassed only a relatively narrow range of latitude; and the unidentified, indirect relationship should not be assumed to continue outside of that range.

Based on Equation 13, if a spill of 22,000 bbl occurred and contacted land, about 50 km of coastline could be expected to be oiled. For a spill of 100,000 bbl, expected oiling would be on the order of 90 km. However, it would be possible for a spill to contact severalfold longer or shorter stretches of coastline than these averages or, alternatively, not contact any shoreline at all.

Spills greater than 10,000 bbl and, in particular, long-duration spills are depicted less precisely in the oil-spill-risk analysis than are instantaneous spills. The oil-spill-risk analysis can still be used to represent the risk from such spills.

For these spills, the center of mass of the spill is still depicted accurately. However, the spreading of the oil over different trajectories through time and space results in more frequent contacts of oil with land but with each contact involving only a fraction of the total spill. For such spills, the conditional probabilities of contact from an individual hypothetical spill site represent the fraction of the total spill that would contact that environmental-resource area or land segment, disregarding weathering and cleanup. Such spill/model-trajectory behavior was demonstrated by both the Santa Barbara spill of 1969

(Amstutz and Samuels, 1984) and the Exxon Valdez spill of 1989 (Jayko and Spaulding, 1989). (The conditional probability would normally represent the likelihood that the environmental resource area or land segment was contacted by the entire spill.)

Note, however, that there are additional constraints on the degree of oiling of any specific stretch of shoreline. These constraints are discussed in Section IV.A.1.d of the Sale 87 Final EIS (USDOL, MMS, 1984). This discussion is incorporated by reference; a summary follows. The tidal range for this region is quite low (10-30-cm average), and habitats such as marshes or delta tidal flats would have to be inundated by seawater during a storm surge to allow appreciable inland stranding of oil. These dual restraints on stranding of oil reduce the likelihood and degree of oiling to such habitats to less than that implied by probabilities from the oil-spill-risk analysis.

**B. Persistence of Stranded Oil:** The oil-retention characteristics of shoreline along the U.S. Beaufort Sea coast are described in Section IV.A.1.d of the Sale 87 Final EIS (USDOL, MMS, 1984). This description is incorporated by reference; a summary follows. A discussion of persistence necessarily relates to that oil remaining after cleanup or to situations where cleanup could cause more damage than would the original spill if it were left in place. Marshes; low tundra shores; and low, vegetated barriers, which together form most of the Beaufort Sea coast, may be areas where most cleanup operations—removal of contaminated soil and vegetation or even heavy foot traffic—could cause permanent scars in the landscape and ecosystem. Newer techniques, such as low-pressure hosing coupled with clipping of oiled vegetation, provide both ecologically and technologically sound means of cleaning some of these areas. Thus, cleanup is a viable option to mitigate problems caused by shoreline oiling and oil persistence.

Persistence of oil on various types of shorelines has been investigated both experimentally through small, deliberate spills on test plots and by monitoring oil persistence following accidental spills of various compositions and magnitudes. In these studies, the persistence of oil is always highly correlated with shoreline type, largely because of the importance of physical processes in both weathering and natural removal of oil.

Based on these empirical data, several studies have rated the oil-retention potential of the coastline bordering the Beaufort Sea Planning Area. Most of the Beaufort Sea coast is considered to have moderate to high retention potential, with less than half of the coast in the high category. Stranded oil, if not cleaned up and if in a zone of high oil-retention capacity, could persist for decades along at least part of the oiled shoreline. In many locations, persistence would be less because of the rapid rate of retreat of much of the Beaufort Sea coast; stranded oil would be eroded along with the shoreline.

**III. Oil-Spill-Contingency Measures:** The description of the Federal framework for oil-spill response as contained in Allen, Hale, and Prentki (1984) is incorporated by reference; a summary of this description, as augmented by additional material, as cited, follows. The bottom line for OCS oil-spill response is that cleanup is the responsibility of the spiller. The Federal Government will step in as a last resort only if the Government considers the spiller's response to be inadequate. The basic philosophy of both the Government and the oil and gas industry is to prevent spills before they happen. Considerable attention is given to preventive measures such as better technology and better training. However (as with many systems)—because there is a chance of human error or unforeseen incidents—secondary measures that would be taken if an oil spill occurred must be considered.

**A. Contingency Plans:** The Alaska Beaufort Sea Oilspill Response Body (ABSORB) is expected to expand its coverage to include any leases from the proposed sale area prior to

exploration, as has been the case elsewhere along the Beaufort Sea coast of Alaska. The ABSORB area of interest currently includes beaches, subtidal lands, harbors, inland waterways, offshore islands, and the OCS plus inshore waters along the coast of the State of Alaska, within the area bounded on the east by the Canadian border, on the west by 156° W. longitude, and on the south by the mainland shoreline of the State of Alaska.

The ABSORB is part of the umbrella organization, Alaska Clean Seas (ACS), which is a Statewide cooperative. The ACS is in the process of converting from an equipment cooperative to an equipment and spill-response cooperative. The ACS is divided into cost-participation areas (CPA's); ABSORB makes up one CPA. Each CPA is established on the basis of physical conditions that favor the use of similar oil-spill-recovery techniques and equipment in addition to proximity to a staging area for oil-spill-recovery techniques. Spill-response equipment, personnel, training, and research of ACS are available to all CPA-member companies. The ACS also has agreements in place with other industry cooperatives for the loan of equipment during a spill situation.

A second ACS CPA, the North Slope CPA, covers onshore North Slope producing lands, north of 68° N.

The ACS has compiled an oil-spill-contingency-planning manual, an oil-spill-response-considerations manual, and a biological-resources atlas for the ABSORB CPA (ACS, 1984, 1983a, 1983b). Lessees are required to develop oil-spill-contingency plans as part of their exploration plans prior to drilling. More than a dozen oil-spill-contingency plans have been submitted and approved to date for exploration of existing leases in the Beaufort Sea Planning Area. By having onhand prior knowledge of the nature of the spilled material, slick dynamics, and the characteristics of the threatened environment, plus available equipment and manpower, the responsible party can order and evaluate selected actions. These evaluations include consideration of the habitats that are most vulnerable to damage from oil spillage or from the cleanup operation itself.

Responses to spills from OCS activities are approached by arranging and ranking lines of defense to prevent spilled oil from affecting identified vulnerable environment. The first line of defense is always offshore containment. Open-water collection of spilled oil (without containment) is usually not successful (see Sec. III.E below). Containment is useful in stopping the spreading of the oil and in providing extra time for deployment of more equipment and manpower. In the presence of sea ice—which can act as a natural containment barrier—in situ burning may be an effective treatment. For a blowout, well ignition is a drastic but potentially effective contingency measure. If conventional cleanup equipment cannot recover the oil before spill contact with important resources is likely to occur, it may be appropriate to use chemical agents to disperse the slick, if permission for their use can be obtained. The Regional Response Team in Alaska, chaired by the U.S. Coast Guard and the Environmental Protection Agency (EPA), is trying to streamline guidelines and gain partial preapproval for using dispersants in some Alaskan waters. This preapproval procedure was not effective in the Exxon Valdez spill and has become the focus of an Exxon lawsuit against the State of Alaska.

A second line of defense entails the booming of major inlets and the closure of washover channels and small inlets. Next, the defense uses booms to concentrate on preventing oil from entering enclosed waters of bays and lagoons where sensitive resources may occur. Finally, small channels that feed marshes and tidal-flat systems are boomed or closed, entranceways to small bays and coves are boomed, and deflection booming is used to protect fringing marshes and other sensitive environments.

**B. Locally Available Spill-Cleanup Equipment:** The MMS, Alaska OCS Region, requires a lessee who wishes to drill to have an initial spill-response capability of 1,000 bbl per day. To date, during drilling of exploration wells in the Beaufort Sea, this requirement has been met with equipment warehoused at Deadhorse by Alaska Clean Seas and with equipment positioned onsite by individual lessees. Table M-2 lists the detection and recovery equipment of Alaska Clean Seas at Deadhorse. Additional equipment is maintained by individual U.S. companies on the North Slope, in the Chukchi Sea (in summer), and by Canadian companies and the Canadian Beaufort Sea Oil Spill Cooperative at Tuktoyaktuk, NWT (Tables M-3 and M-4). If commercial quantities of oil are discovered in the Sale 124 area, it is likely that additional spill equipment will be stockpiled, either by Alaska Clean Seas or by the field owners.

Table M-5 provides an example of onsite capabilities, listing equipment provided onsite (in this case on the drillbarge) by Amoco Production Company during the drilling of a Sale 87 lease in the summer of 1989. "Onsite" means stored either on the drilling platform, drilling-rig supply vessel, and/or the standby workboat. Amoco Production Company also had a dedicated oil-spill/ icebreaking vessel, MV Kaloic onsite. Onsite equipment is typically capable of handling small operational spills of 50 bbl or less (Hooks, McCloskey, and Associates, Inc., 1984b). Larger spills would require mobilization of additional equipment.

**C. Mobilization Time:** The MMS, Alaska OCS Region, requires initial mobilization and deployment of response equipment within 6 to 12 hours of a spill, geography permitting. However, the spiller must be prepared to respond before the spill reaches shore (in less than 6 hours, if necessary). This initial timeframe is for relatively small spills, although MMS has not specifically defined size. Only onsite equipment and that which could be transported from Deadhorse by helicopter could meet this guideline for deployment for most of the sale area. The limited geographic and temporal presence of open water and slow vessel speeds in broken ice (see Fig. M-1) would preclude timely transport of spill equipment by sea. For larger spills—those that could exceed the local cleanup-response capability—MMS, Alaska OCS Region, requires that additional equipment be made available onsite within 48 hours.

Additional response equipment to handle a large spill would be available from a multitude of sources. Many of these sources and their equipment lists have been inventoried for potential use in the Beaufort Sea, in Alaska Clean Seas (1984), and in the individual oil-spill-contingency plans of lessees. Estimated response times for mobilization and transport of equipment to Prudhoe Bay from these additional sources are given in Table M-6 for air transport and in Table M-7 for sea transport. Equipment stored in Anchorage also could be trucked to Prudhoe Bay within 32 to 40 hours, not including mobilization and loading/unloading times. Mobilization and air-transport times needed to airlift spill-cleanup equipment to Deadhorse would range from 3.3 to 13 hours from sources in Alaska and on the Pacific Coast, assuming available C-130 transport and good weather. Sea transport from Alaskan and other U.S. ports to Prudhoe Bay would not be possible without icebreaker support except during a brief period of relatively open water in late summer (see Fig. M-1). Equipment could reach a summer spill site by vessel in the Sale 124 area within 1.3 to 3 days from Canadian Beaufort Sea and Chukchi Sea equipment sites. The estimate for the Chukchi Sea assumes an airlift between Kotzebue and Deadhorse.

Thus, additional equipment would be most rapidly and readily available from the Canadian Beaufort Sea area. Flight time for a C-130 between Deadhorse and Tuktoyaktuk would be about 1 hour. Equipment could be shipped from the Canadian Beaufort Sea over a period of 2 to 3 months. U.S. Customs regulations would not interfere. Spill equipment to be used in the proposed sale area would require only a courtesy call to U.S. Customs, who should be notified before equipment is

Table M-2  
Response Equipment Maintained by Alaska Clean Seas  
in Deadhorse (July 1989)<sup>1/</sup>

ITEM	QUANTITY
<u>DETECTION</u>	
Gas/Oxygen Detector	1
Gas Analyzer	1
Current Meters	2
Ice Auger	8
Orion Tracking System	2
Marker Stake	1,000
<u>CONTAINMENT</u>	
Goodyear Sea Sentry Heavy Duty Boom	2,035 ft
Kepner Compactible 11x15	5,400 ft
EPI Mini Boom	2,000 ft
American Marine Simplex Boom	3,000 ft
Kepner Reel Pak Boom	4,000 ft
Expandi Boom	4,500 ft
Fire Containment Boom	2,500 ft
<u>RECOVERY</u>	
ARCAT II with 12-man liferaft	1
3M Sorbent Boom Type 280	250 bales
3M Sorbent Roll 100	507 rolls
3M Sorbent Pad Type 151	290 bales
3M Sorbent Pad Type 157	400 bales
3M Sorbent Type 356C	85 boxes
MI-30 Disc Skimmer	1
Weir Skimmer	10
214-E Rope Mop Skimmer	10
Barracuda Rope Mop Skimmer	1
MW 62 Rope Mop Skimmer	1
Trans-Vac with Manta Ray Skimmer	2
Destroll Skimming System (pump and float)	1
Arctic Skimmer System (for <u>North Star</u> vessel)	1
Shallow Water Access Mop System ( <u>Swamp</u> )	1
<u>DISPERSANTS</u>	
EXXON Corexit 9527	10 drums
ARCO Chem D-609	10 drums
Ship Spray Unit	1
	(for <u>ARCAT II</u> )
<u>DISPOSAL</u>	
Ignitors	1,700
Helitorch Aerial Ignition System	1
<u>STORAGE</u>	
Firestone Fabritank (2,250 gal)	20
Firestone Fabritank (4,400 gal)	4
Trellecon Bladder	1
Dracone Barge (2,400 gal)	4
Kepner Towable Bladder (1,200 gal)	3
ERI Air Berm (1,000 gal)	1
ERI Air Berm (2,000 gal)	2
ERI Air Berm (3,000 gal)	2
Fast Tank (rapide, 400 gal with liner)	1
Fast Tank (1,500 gal with liner)	2
Fast Tank (2,000 gal with liner)	2
<u>LOGISTICS - VESSELS</u>	
32-ft <u>North Star</u> Workboat	1
21-ft Munson Workboat	2
16-ft Grumman (with trailer and 25-hp outboard)	1
15-ft Gregor (with trailer and 15-hp outboard)	6

Source: The McCloskey Group (1989).

<sup>1/</sup> This is not a complete inventory.

Table M-3  
Chukchi Sea-Based Equipment for Oil-Spill  
Response, Summer 1989<sup>1/</sup>

ITEM	QUANTITY
34- x 12-ft tow boats with diesel inboard engines	2
26- x 8-ft aluminum workboats with two 140-hp outboard engines	4
18-ft Avon Searider rigid-hull inflatable boats	2
Kepner Reel Paks, 1,000 ft each with compactible 18- x 23-in boom	2
Kepner Reel Paks, 500 ft each with compactible 8- x 12-in boom	5
3M Fire Boom, 12- to 18-in diameters with 18- to 24-in skirts	3,600 ft
Rope mop skimmers	4
Halliburton Skimming Barrier with boom, pump floats, reels, separators, etc.	1
SOCK (over the side skimmer with power pack, storage tanks, etc.)	1
Transrec Skimmer System (Framo/NOFO Type 250) with reel and power pack, 1,000 ft of NOAS (800 series) Ocean Boom on reel, and an Oil Trawl Collection System (over the side V-shaped barrier with net).	1
10-in Hyde-Vac Suction System (August 1989 delivery)	1
Walosep (WI Model) centripetal/weir skimmer with power pack	1
Komara Disc Skimmers with power pack	2
SLURP Skimmer (portable weir skimmer)	2
Hoses, various	4,150 ft
Pumps, various	4
200-bbl oil/water separators	2
100-bbl oil/water separators	2
Firestone Fabritanks (25,000 gal each)	2
Dracone Barges (2,500 gal each)	2
Bladders (2,500 gal each)	6
Bladders (10,000 gal each)	3
Simplex Helitorches	2
Dispersant spray bucket	30
Drums of Corexit 9527 dispersant	20 rolls
3M sorbent rolls	40 rolls
3M Type 100 sorbent sheets	10 bales
3M sorbent boom	120 bales
3M sorbent pads	100 bales
Bird scare-away cannons	10

Source: Spiltec, 1989.

<sup>1/</sup> Below-deck storage tanks nine on oil-spill-response barge will hold up to 67,000 bbl of recovered oil/water. Equipment listed either on icebreaker Robert Lemeur or on oil-spill-response barge. This list is not a complete inventory.

Table M-4  
Response Equipment Maintained by the Canadian  
Beaufort Sea Oil Spill Cooperative at  
Tuktoyaktuk, NWT, July 1989<sup>1/</sup>

ITEM	QUANTITY
<b><u>DETECTION</u></b>	
Orion Tracker Buoys	16
Orion Receiver	2
Orion Antenna	1
Argos Buoys	4
Scott Comb. Gas/Oxy Tester	3
<b><u>CONTAINMENT</u></b>	
Fireproof Boom c/w ISO Container	250 ft
Arctic Boom Mod/	772,200 ft
36-in Containment Boom	5,100 ft
Bennett Inshore Boom	2,000 ft
<b><u>RECOVERY</u></b>	
Morris M130 Skimmer	4
6-in Oil Mop Skimmer	1
Rope Mop Skimmer	1
Slurp Skimmer	1
Lockheed Skimmer	1
<b><u>DISPOSAL</u></b>	
100-bbl/day Saacke Burners	2
Dispersant spray system	1
Air-deployable ignitors	2,000
Simplex Heli-Torch	1
<b><u>TRANSFER</u></b>	
Oil Separator	1
Pumps, various	9
<b><u>STORAGE</u></b>	
Porta Tanks (1,200 U.S. gal)	8
10,000-gal Uniroyal Bladders	3
1,000-gal Canflex Bladders	15
1,000-gal Open-top Canflex Bladder	1
<b><u>LOGISTICS--VESSELS</u></b>	
Carrier II Sea Truck (Twin 70 Merc)	1
90-hp Outboard	2
Zodiac with 20-hp outboard	1
39-ft Deployment outboard vessel (Carrier 5)	1
Hiab Model Crane on Carrier 5	1
14-ft Deployment vessel	1
16-ft Deployment vessel	1
27-ft Jet boat	1
<b><u>LOGISTICS--COMMUNICATIONS</u></b>	
Marconi DT 39 Radios	3
Raytheon FM Radios	6
Marconi Radios	8
Chargers for above radios	5
Lorad VHF Portable Radios	5
SMR VHF 78 CB Radio	3
<b><u>LOGISTICS--ANTI-POLLUTION BARGE II</u></b>	
Barge, 216 ft x 49.5 ft x 9.6 ft, complete with but not limited to the following equipment:	
Free-water knockout system	1
VEP Skimmer	1
Watson Heater Treater/Upgrading	1
5000-bbl/day burner with boom	2
1000-gal fuel tanks	2
Oil and water pumping system	1

Source: The McCloskey Group (1989).

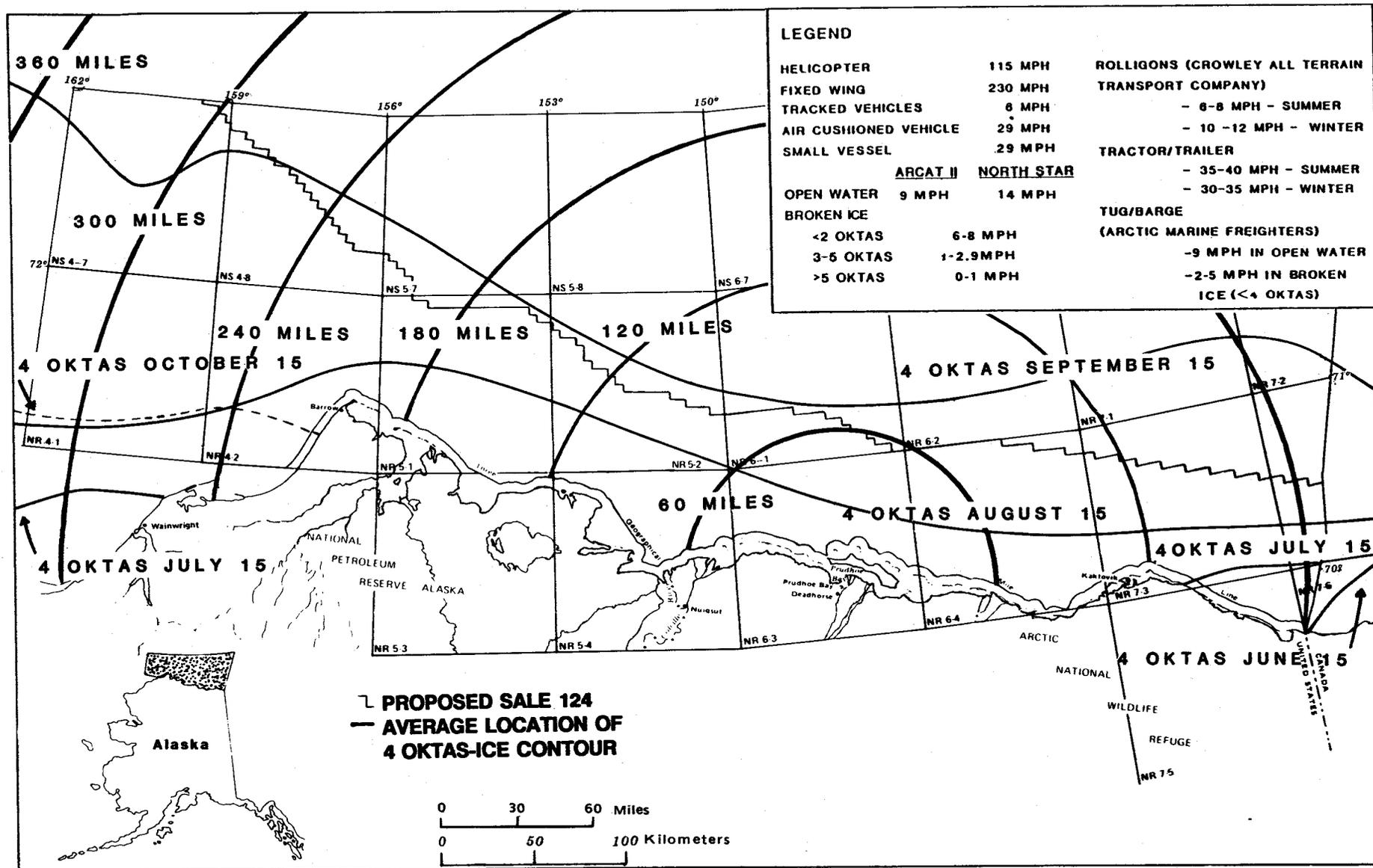
<sup>1/</sup> This is not a complete inventory.

Table M-5  
 Spill-Response Equipment Onboard the Drilling Barge  
 Kulluk During 1989 Drilling of the Belcher  
 Prospect in the Beaufort Sea<sup>1/</sup>

ITEM	QUANTITY
Kepner 48-in Inflatable Offshore Boom mounted on two Kepner Boom Reels	1,000 ft
Zoom 30-in Boom	600 ft
3M Fire-Resistant Boom	1,500 ft
Morris MI-30 Skimmer	2
Storage Bladder (12,000 U.S. gal)	1
Porta-Tanks Water Separator Box (1,200 gal)	2
Pumps	2
8 ft - 10 ft Sorbent boom	25 bales
18 in x 18 in x 3/8 in Sorbent pads	15 bales
36 in x 150 ft x 3/8 in Absorbent	12 rolls
Corexit 9527 dispersant	1 drum
Back pack dispersant spray unit	1
Hose	75 ft
Air-deployable ignitors	20
30-in Sea anchors	2
Orion Tracking Buoys	4

Source: The McCloskey Group (1989).

<sup>1/</sup> This is not a complete inventory.



Source: Alaska Clean Seas, 1984; LaBelle et al., 1983; and Alaska OCS Region.

Figure M-1. Distances from Prudhoe Bay, Response Speeds for Various Craft Vehicles, and Location of the 4-OKTA-Ice Contour

Table M-6  
Estimated Response Times for Mobilizing and  
Transporting Equipment to Deadhorse by Air-Cargo Transport

Equipment Owner	Storage Location	Estimated Mobilization Time <sup>1/</sup> (Hours)		Transportation Time to Deadhorse <sup>2/</sup> (Hours)	Total Response Time to Deadhorse <sup>3/</sup> (Hours)	
		(Min.)	(Max.)		(Min.)	(Max.)
Alaska Clean Seas	Chukchi Sea <sup>4/</sup> Anchorage	--	--	7	7	--
		2	5	1.9	3.9	6.9
Beaufort Sea Oil Spill	Tuktoyaktuk	2	4	1.0	3.0	5.0
Alyeska Pipeline Service Company	Valdez	2	5	2.4	4.4	7.4
Cook Inlet Response Organization	Kenai Anchorage	2	5	2.0	4.0	7.0
		2	5	1.9	3.9	6.9
U.S. Coast Guard	Kodiak Anchorage	2	5	2.6	4.6	7.6
		2	5	1.9	3.9	6.9
VRCA Environmental Service	Prudhoe Bay	2	5	0	2.0	5.0
	Fairbanks	2	5	1.3	3.3	6.3
	Anchorage	2	5	1.9	3.9	6.9
	Kenai	2	5	2.0	4.0	7.0
Clean Sound	Seattle	2	5	6.1	8.1	11.1
Clean Bay	Concord	2	5	7.1	9.1	12.1
Clean Seas	Santa Barbara	2	5	7.9	9.9	12.9
Clean Coastal Waters	Long Beach	2	5	7.9	9.9	12.9
U.S. Navy	Stockton	2	5	7.1	9.1	12.1

Source: The McCloskey Group, 1989; Spiltec, 1989.

- 1/ Estimated mobilization times were supplied by equipment owners and are overall ranges that are nonspecific to the type or quantity of equipment required.
- 2/ Estimated transportation times based on C-130 flight characteristics (300-kn flight speed).
- 3/ Total response times are the sum of estimated mobilization time and travel times by C-130. They do not include the amount of time required to load the equipment or variations in travel time arising from adverse climatic factors that might be encountered enroute.
- 4/ Also, equipment owned by Shell Western Exploration and Production Company.

Table M-7  
Estimated Response Times for Mobilizing and  
Transporting Equipment to the ABSORB Area by Surface Vessel<sup>1/</sup>

Equipment Owner	Storage Location	Estimated Mobilization Time <sup>2/</sup> (Hours)	Estimated Travel Time to Prudhoe Bay (10 Knots) <sup>3/</sup>		Total Response Time <sup>4/</sup>			
			(Days)	(Hours)	Minimum		Maximum	
					(Days)	(Hours)	(Days)	(Hours)
Alaska Clean Seas	Chukchi Sea <sup>5/</sup> Anchorage	--	3	--	3	--	--	--
		2-5	8	19	8	21	9	0
Cook Inlet Response Organization	Kenai	2-5	8	1	8	3	8	6
U.S. Coast Guard	Kodiak Anchorage	2-5	8	1	8	3	8	6
		2-5	8	19	8	21	9	0
Beaufort Sea Oil Spill Cooperative	Tuktoyaktuk	2-4	1	6	1	8	1	10

Source: The McCloskey Group, 1989; Spiltec, 1989.

- 1/ Surface-vessel transportation is available only during the open-water season around Point Barrow. This season is of limited duration--typically 6 to 8 weeks per year.
- 2/ Estimated mobilization times were supplied by the equipment owners and are overall ranges that are nonspecific to the type or quantity required; vessel availability is assumed.
- 3/ Travel times to site are from ports near the storage sites to a hypothetical spill site in the ABSORB CPA. These estimates do not include the amount of time required to unload the equipment at the site or variations in travel time arising from adverse climatic factors.
- 4/ Total response times indicated are the sum of estimated mobilization times and travel times to the spill site.
- 5/ Also, equipment owned by Shell Western Exploration and Production Company. Vessel times from Chukchi Sea assume air transit to Deadhorse from Kotzebue (vessel travel only from Chukchi drill site to Kotzebue).

brought within the 3-mi limit, unless true emergency conditions exist. In the latter case, U.S. Customs will accept after-the-fact notification (Union Oil Company of California, 1985).

Equipment stored at Deadhorse or airlifted to Deadhorse would be capable of meeting the criteria of the 48-hour-response time set by MMS. Additional, slower-arriving equipment would still be useful in case of a major spill; but MMS would not consider such equipment in judging whether oil-spill-contingency plans met the MMS 48-hour-response criteria.

Once spill-cleanup equipment reaches Deadhorse or Prudhoe Bay, it could be transported relatively quickly to the spill site only if it could be carried by helicopter and then only if weather permitted. A helicopter could reach any point in the sale area within 3 hours. Pack ice would prohibit ship transport other than by icebreaker over most of the proposed sale area for most of the year, including summer. Land-vehicle transport of spill equipment would not be safe across appreciable distances on pack ice.

**D. Effectiveness of Oil-Spill Cleanup At Sea:** The 6-to-12-hour and 48-hour response times required of drilling lessees by MMS, Alaska OCS Region, are mobilization and deployment requirements. Cleanup would continue as long as necessary, without any timeframe or deadline. For example, a winter spill in pack ice might require initial onsite response followed by further cleanup of oil melting out and pooling on top of the ice in late spring or summer. For the purposes of environmental assessment of offshore oil and gas lease sales, MMS usually considers mitigation of major oil spills through cleanup to be possible through the tenth day of a spill, after which the oil would be too dispersed for effective recovery. Analyses in EIS's for MMS oil and gas lease sales usually concentrate on this timeframe, as does the analysis of summer spills in this EIS. A winter spill, however, would freeze into the ice and remain relatively intact until it melted out. Such a spill would behave as a fresh, early summer spill.

Mechanical cleanup at sea usually is much more effective on low- or medium-viscosity oils than on high-viscosity oils (Fig. M-2). A low-viscosity oil could be a diesel or fresh, light crude. A medium-viscosity oil could be a lubricating oil or a light, flowing emulsion. A high-viscosity oil would be a weathered crude, bunker oil, or thick emulsion. An oil such as Prudhoe Bay crude initially would have low viscosity but would quickly weather and form an emulsion. In the presence of broken sea ice, this transformation may take as little as 4 hours (Payne, 1984); in the absence of sea ice, it may take perhaps 2 days (Payne et al., 1984a). For the summer, 22,000-bbl example in Table M-1, based on the weathering model of Kirstein and Redding (1988), Prudhoe Bay crude would weather into a high-viscosity oil within 4 hours of spillage. The effectiveness of most forms of mechanical recovery of the crude would decrease twofold over this 4-hour period.

Oleophilic-rope recovery systems are a relevant exception to this twofold decrease in oil-recovery rate with increasing oil viscosity. The Alaska Clean Seas has emphasized such devices in its arctic contingency strategy, including development and deployment of the oleophilic-rope skimmer, the ARCAT II. Oleophilic-rope systems at medium international sea states, between Sea State 1 and Sea State 3, can recover high-viscosity oil more readily than lesser viscosity oils. At a lower sea state (Sea State 0), highly viscous oils can be recovered at 69 percent of the rate for low-viscosity oils (S.L. Ross Environmental Research Ltd., 1983a).

Chemical dispersion—the use of dispersants to mix the oil into the water rather than attempt to recover the spilled oil—is an alternative technique to mitigate spill damage. Dispersants lose effectiveness even more rapidly than mechanical recovery as oil weathers and becomes more viscous (see Fig. M-2). Oils with in situ viscosities greater than 2,000 centistokes usually cannot be dispersed (The International Tanker Owners Pollution Federation, Ltd., 1982a,b). Based on the weathering model of

Kirstein and Redding (1988), under the conditions in Table M-1 for a summer spill of 22,000 bbl, such viscosities would be reached by Prudhoe Bay crude about 8 hours after spillage. In the presence of sea ice, the rapid formation of mousse could preclude effective use of dispersants in even a shorter period of time. Best use of dispersants obviously occurs when they can be applied immediately after the spill has occurred (or near the point of spillage for a continuing spill).

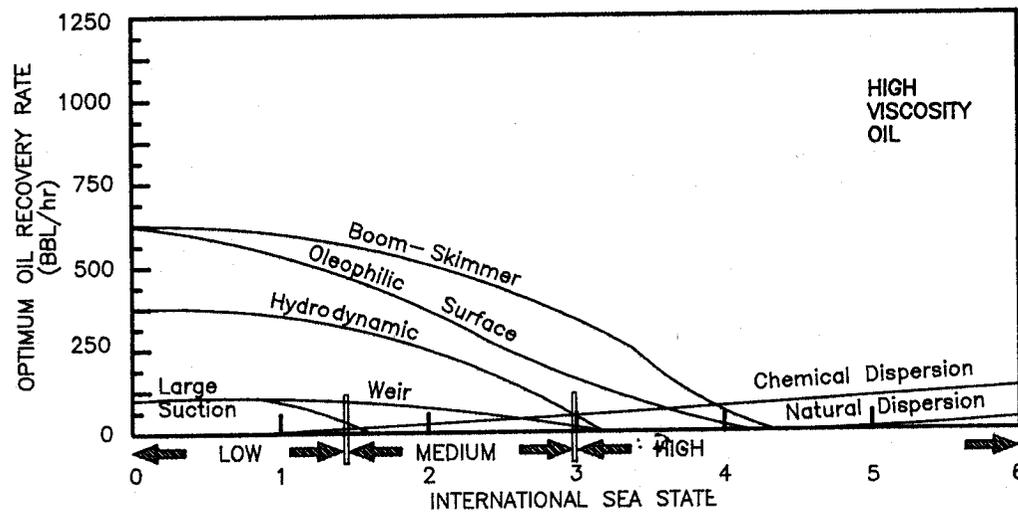
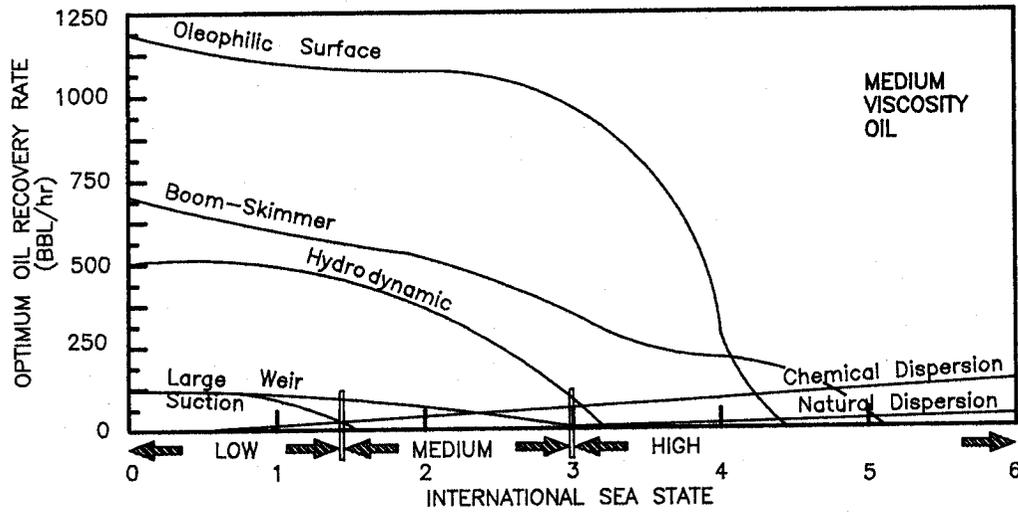
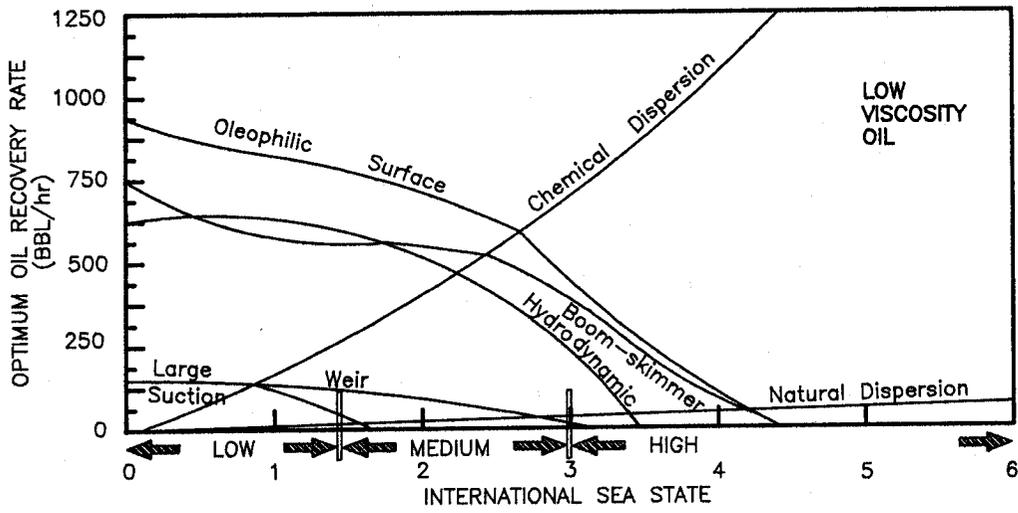
Use of dispersants to treat an oil spill, however, requires the On-Scene Coordinator to have the concurrence of the EPA representative to the Government Regional Response Team (RRT) and also the concurrence of the State's representatives. Historically, such permission has been difficult if not impossible to obtain. The reason for this difficulty lies in the perceived toxicity of oil-dispersant mixtures, in questions as to the effectiveness of the dispersant, and in the fact that dispersants remove oil only from the surface of the water and not from the water environment. Detailed information on the effectiveness of a specific dispersant on a specific spilled oil as a function of air and water temperature, dispersant concentration, and age or weathered state of the slick—as well as detailed information on the proposed dispersant-application system—are necessary for an informed RRT decision on dispersant use. Such parameters would be known when any spill-contingency plans were written for production, and approval for dispersant use would be more likely during production than has been the case during exploration. The RRT, for example, has released guidelines for dispersant use in Cook Inlet and Prince William Sound. Inability to demonstrate effectiveness of dispersants on the Exxon Valdez spill in a timely fashion and slowness in mobilizing both dispersants and delivery systems, however, negated potential effectiveness. No significant proportion of oil was chemically dispersed from this spill.

The post-Exxon Valdez report to the Secretary of the Interior by MMS (USDO, MMS, OCS Oil Spill Task Force, 1989) concluded that "Dispersants have been found to be routinely ineffective in open-ocean application."

Because of natural dispersion, oil slicks of less than 10,000 bbl in the open ocean are seldom tracked for more than about 10 days before the oil becomes too dispersed to locate or identify as a slick. Out of necessity or otherwise, natural dispersion has frequently been the chosen response technique in Alaskan waters. The F/V Ryuyo Maru No. 2 grounded off St. Paul Island in 1979. Fuel oil on board could not be safely removed, and the vessel was deliberately blown up at a time when weather would maximize natural dispersion (Reiter, 1981). In Kuskokwim Bay in the summer of 1982, the Cornell Barge No. 8 sunk, spilling some but not all of its load of fuel oil. The remaining fuel oil was deliberately released and allowed to disperse by the Coast Guard. Accidental and deliberate release totaled 2,190 bbl over 3 weeks (Oil Spill Intelligence Report, 1982). The observed slick extended no more than 1 km from the barge, indicating a slick life of no more than a few hours. The tanker Cepheus grounded in Anchorage Harbor and spilled 5,000 bbl of fuel in January 1984. Because of the presence of broken ice in surrounding waters, the spill could not be tracked and no cleanup occurred away from the tanker, but no slick was ever found.

Oil spills do not always disperse this rapidly or completely. Generally, the more asphaltic the oil, the larger the spill, the calmer the water, and the more restricted the water body, the longer a spill will persist. Oil on the water from the Exxon Valdez closed several State salmon fisheries 5 months after the 260,000-bbl spill.

Uncontained burning also is a possible spill remedy. Experiments suggest that burn efficiencies on the order of 50 to 60 percent may be possible if the spill can be immediately set on fire (Laperriere, 1984). However, any delay in ignition would decrease combustion efficiency. In the Exxon Valdez spill, spilled oil was still burnable on day 3, but not after the storm that occurred at the end of day 3.



Source: S.L. Ross Environmental Research Limited, 1983a.

Figure M-2. Optimum Oil Recovery Rate for Generic Classifications of Skimmers Versus Natural Dispersion

Thus, the effectiveness of both mechanical recovery and in situ burning of spilled oil at sea decreases rapidly with increasing sea state (roughness of the sea). However, in such worsening sea state, the effectiveness of dispersants and natural dispersion increases. According to S.L. Ross Environmental Research Ltd. (1983a), mechanical cleanup becomes nonfunctional between International Sea States 3 and 4. However, a recent reevaluation of the effectiveness of response equipment by USDOJ (USDOJ, MMS, OCS Oil Spill Task Force, 1989) following the Exxon Valdez spill was more pessimistic, concluding that most response equipment available in the U.S. is limited to conditions of Sea State 2 or less (waves less than 2-4 ft and winds less than 10-15 kn).

Based on this MMS evaluation, sea states would exceed the capabilities of response equipment from 9 to 24 percent of the time in summer months (the range in occurrences of Sea States of 3 or greater) in the Beaufort Sea Planning Area (Fig. M-3). Ice cover the remainder of the year would eliminate both high sea states and standard uses of most mechanical-response equipment.

This relatively poor rating of response equipment by the MMS task force was attributed in part by the task force to lack of MMS standard protocols for evaluating and comparing equipment performance. That is, MMS has no formal protocol or quantitative procedures for evaluating whether response equipment proposed by lessees is "state-of-the-art" as required by MMS guidelines for oil-spill-contingency plans or something less. Based on the MMS task force analysis, offshore-response equipment in U.S. waters does not meet the level of performance required by MMS Alaska OCS Region Planning Guidelines for Approval of Oilspill Contingency Plans, "state-of-the-art" equipment capable of operating in 8- to 10-ft seas and 20-kn winds, which are sea conditions equivalent to International Sea State 5. The MMS task force has recommended that MMS establish a standard test protocol for offshore booms and adopt an existing protocol for oil skimmers to define "state-of-the-art" and minimum performance requirements. These recommendations have been presented to the Secretary of the Interior.

In real spill situations, optimum efficiency of cleanup equipment, expressed in Figure M-2, is seldom reached. To some extent, bad weather, equipment failures, and personnel problems can be factored into estimates of cleanup efficiency in oil-spill-contingency plans. In practice, such estimates are usually found to be overly optimistic. Spill cleanup generally requires unexpected modification of procedures and equipment. Equipment or people often do not work as well as hypothesized. This was demonstrated in both the 1987 Glacier Bay and 1989 Exxon Valdez spills of TAP crude in Alaskan coastal waters.

The MMS, Gulf of Mexico OCS Region (USDOJ, MMS, GOM, 1983), reviewed the historical record of oil-spill cleanup at sea and concluded that such cleanup is usually not very efficient:

Offshore containment/cleanup operations are generally a major task requiring significant coordination and cooperation, transportation of large equipment, vessel support, aircraft support, set-up and maintenance of a command/coordination post in the field, and properly staged and available equipment. Often, the weather/sea conditions and crew fatigue become the critical factors during offshore operations. The effectiveness of containment/cleanup operations offshore are, in general, marginally effective. It is possible to contain a platform spill if environmental and logistical conditions are right; however, it has been found through experience that conditions are rarely ideal and full containment of a platform spill is not likely. The effectiveness of this type of containment and cleanup operation is estimated to be approximately 5 percent to 15 percent recovery.

Inshore containment/cleanup operations can be either large-scale or moderately sized operations depending on any particular spill situation. Again, if the task becomes large it requires the same level of coordination and support as an offshore operation. The effectiveness of a containment/cleanup operation in an inshore area largely depends on the unique physical characteristics of the environment and the area of the operation. Beach cleanup is normally effective utilizing hand labor, organic sorbents, and a wide variety of tools from rakes to bulldozers. Utilizing booms and skimmers, containment of a spill moving into an inlet is marginally successful depending almost entirely on the physical characteristics of the inlet. Containment and cleanup in marshes is very controversial. Modern opinions often lean towards the "NO ACTION" strategy for fear of cleanup operations causing even more damage. The effectiveness of inshore containment cleanup operations can often be much greater than offshore operations. Effectiveness is estimated to be 20 percent to 50 percent containment and cleanup of material moving into the area.

**E. Effectiveness of Oil-Spill Cleanup in Ice:** When a spill is dispersed far from its source or when ice is moving, containment and cleanup are more difficult. Planning an effective surface response with mechanical equipment to spills in pack ice would require that an icebreaker (or icebreaking-supply ship) be locally stationed in both winter and summer as a dedicated oil-recovery vessel (Tebeau, 1987). Icebreakers are expected to be present in the proposed sale area during both exploration and production. An appropriate example of such operations would be the exploration drilling conducted by a drillship on Sale 87 leases in the summer of 1985. The drillship was accompanied by an icebreaker and two ice-capable supply ships that "managed" the ice at the drill site.

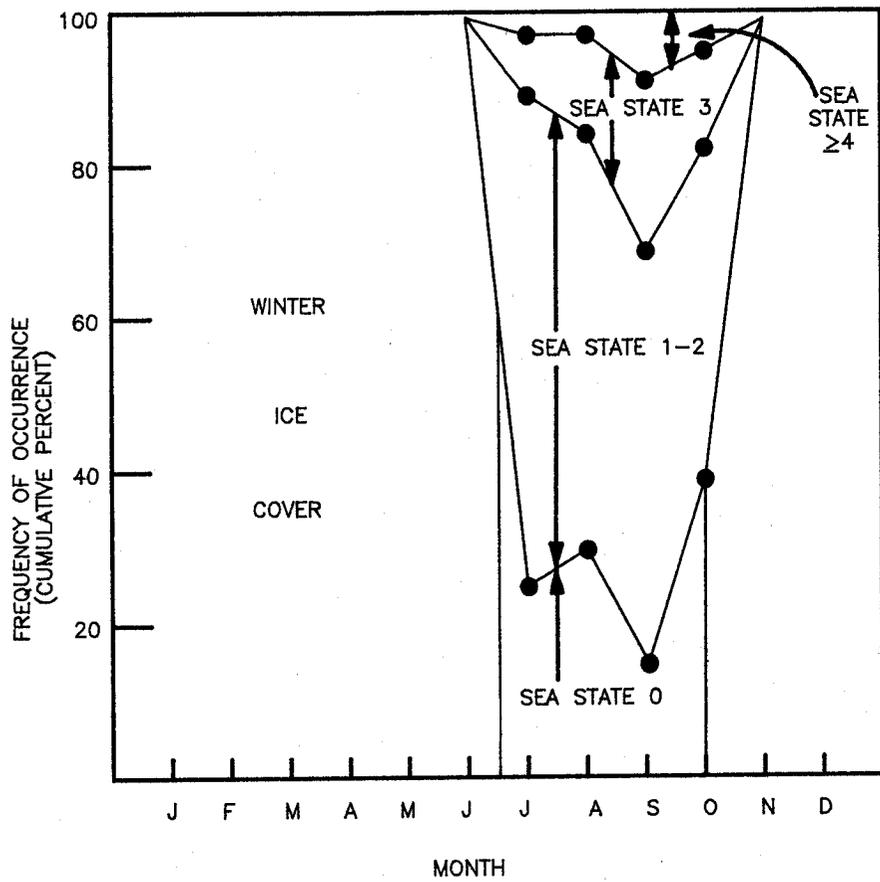
In situ burning of spilled oil during heavy ice periods may be a more promising approach. Buoys or other markers would be placed on the ice to track under-ice spills. Exposed oil would be ignited whenever possible.

Existing response capabilities are more effective on landfast ice than on broken or pack ice. Spills on top of landfast ice can be cleaned up fairly easily as long as oil is not pooled to sufficient depth (on the order of several centimeters) to crack the ice and allow some of the oil to flow underneath the ice (Shell Western E&P, Inc. et al., 1984). About 5 cm of Prudhoe Bay crude, or about 300,000 bbl per square kilometer, could be supported by mature, first-year ice without seepage of oil underneath the ice.

Cleanup effectiveness for oil under landfast ice has been measured by Buist, Pistruzak, and Dickins (1981), who conducted three simulated undersea blowouts totaling 119 bbl under landfast ice in the Canadian Beaufort Sea. The following spring, as the oil rose to the surface and pooled on the ice, as much oil as possible was burned or manually recovered. Cleanup efforts ceased only when breakup occurred and the remaining oil naturally dispersed. A total of 125 burns were conducted, more than one burn for each barrel of oil spilled. Overall burn efficiency averaged 51 percent, with average burn efficiencies ranging from 18 to 77 percent in the three spill experiments. An additional 28 percent of the oil (range of 14-51%) was manually recovered. The manual cleanup was labor-intensive, requiring 0.7 man-days per barrel or 350 man-days per square kilometer. Overall, 79 percent (range of 67-88%) of the weathered oil was burned or manually recovered.

Spills in broken or moving ice would be more difficult to handle. The greatest success would be expected when the spill is contained within a small area close to the source of the spill. The ice itself may be useful in restricting the spreading of the oil, keeping the oil thicker and more amenable to burning.

Oil melting out of pack ice would be much more difficult to burn than oil in the Buist, Pistruzak, and Dickins (1981) study. Oil would melt out of pack ice much more slowly than from



Source: Derived from wave data in Brower, Baldwin and Williams, 1988.

Figure M-3. Cumulative Frequency of Occurrence of Different International Sea States in Open Water By Month in the Beaufort Sea Planning Area

landfast, first-year ice; some oil would even take a second summer to reach the top of the ice (see Sec. I of this appendix). In addition, a stationary but continuing spill could spread a ribbon of oil underneath many or even hundreds of kilometers of pack ice (see Sec IV.N). The manufacture, shipment, temporary storage, and deployment of igniters, helitorches, or gelled gasoline necessary to ignite thousands of oiled melt pools from a major spill is a logistical nightmare.

Burning experiments in broken ice have given promising results with fresh oil, but results have been variable and less promising with weathered oil and emulsions. Field tests in a mud pit at Prudhoe Bay were able to burn 55 to 85 percent of fresh Prudhoe Bay crude, but sparged crude with a flash point of over 30 °F could not be ignited (Shell Oil Company et al., 1983). Tests at OHMSETT for fresh or sparged crude had burn efficiencies of 85 to 95 percent at 22- to 34-percent ice cover and burn efficiencies of 58 to 79 percent at 78- to 85-percent ice cover. Burn efficiencies of two tests for oil-in-water emulsions were only 10 to 52 percent at 78- to 84-percent ice cover (Smith, unpublished). Some oil burned against retaining barriers in both the field and OHMSETT tests; and the efficiencies are somewhat higher than could be expected for a true, uncontained burn in broken ice. Payne (1984) found that emulsification is accelerated in broken ice (occurring within 4 hours), indicating that a slick would have to be set on fire very soon after spillage in order to obtain a high burn efficiency.

It may be more difficult to burn spilled oil during freezeup than at any other time of year. Martin (1981) has shown that wave action mixes the oil downward into the grease ice. Oil and ice would have to be recovered and the oil separated from ice before burning; there would be only a limited capability for in situ burning.

Partly because of oil-spill risks during broken ice, the State of Alaska has applied two sets of seasonal drilling restrictions in State waters of the Beaufort Sea. Tier-I regulations prohibit drilling during periods of broken ice, during some periods of open water for locations outside the barrier islands, and during the fall bowhead whale migration or freezeup for locations outside the barrier islands. Tier-II regulations allow unrestricted drilling in State waters, with the exception of locations outside the barrier islands during the fall bowhead migration and freezeup. The Tier-II level applies only to "lessees who demonstrate compliance with applicable laws and regulations, including the theoretical and physical capability to

detect, contain, and clean up and dispose of spilled oil in broken ice conditions" (see Shell Oil Company et al., 1983).

In 1983, several oil companies participated in a review of applicability of current cleanup techniques to broken-ice conditions (Industry Task Group, 1983) and field demonstrations of capabilities during breakup of landfast ice (Shell Oil Company et al., 1983). A third report (Shell Western E&P, Inc. et al., 1984) provided additional technical documentation of review and demonstrations and constitutes a state-of-the-art manual for cleanup during breakup of landfast ice in the Beaufort Sea.

The cooperative review, the field demonstrations, and the resulting reports considered only breakup conditions. Freezeup conditions were deemphasized because of the existence of a seasonal drilling restriction in State waters during the fall bowhead migration.

The State of Alaska had an independent consultant evaluate this demonstration of industry's capabilities (S.L. Ross Environmental Research Ltd., 1983b) and, based on that and its own analysis, granted Tier-II status to the participating oil companies. The conclusion of S.L. Ross Environmental Research Limited provides a concise summary of oil-spill-countermeasure capabilities of industry in broken-ice conditions:

The industry's technological capability is judged to be very good for removing oil discharged from a large oil well blowout occurring on a gravel island in the Alaskan Beaufort Sea during broken ice conditions (as well as during periods of landfast ice and open water); this is only the case if the blowout is ignited and/or combustion and skimming techniques take place in close proximity to the island. . . . Although industry's overall response capability for gravel-island oil well blowouts is very good (by virtue of oil burning procedures at or near the well-head) the fact remains that the capability to clean up large oil spills floating amongst moving ice is generally not good, particularly if the oil is thin and weathered.

In other words, industry can effectively clean up an oil spill in moving ice only if the spill is a platform blowout that can be set on fire without endangering platform integrity. If this is the case, the platform could still be used as a base for cleanup and well-control operations.

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See Lower-trophic-level organisms

# ACRONYM GLOSSARY

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## ACRONYM GLOSSARY (Includes Common Abbreviations and Symbols)

AAC	Alaska Administrative Code	cf	cubic feet
AADT	Annual Average Daily Vehicle Traffic	cm	centimeter
ABSORB	Alaska Beaufort Sea Oilspill Response Body	cm <sup>2</sup>	square centimeter
ACI	Alaska Consultants, Inc.	cm <sup>3</sup>	cubic centimeter
ACMA	Alaska Coastal Management Act	cm/sec	centimeters per second
ACMP	Alaska Coastal Management Program	CMP	Coastal Management Program
ACS	Alaska Clean Seas	CO	carbon monoxide
ADF&G	Alaska Department of Fish and Game	CPA	cost participation area
AEIDC	Arctic Environmental Information and Data Center	COE	Corps of Engineers (U.S. Army)
AEWC	Alaska Eskimo Whaling Commission	CPC	Coastal Policy Council (State of Alaska)
AMSA	areas meriting special attention	CPUE	catch per unit effort
ANCSA	Alaska Native Claims Settlement Act	CRSA	Coastal Resource Service Area
ANHB	Alaska Native Health Board	CWA	Clean Water Act
ANILCA	Alaska National Interest Lands Conservation Act	CZM	coastal zone management
ANWR	Arctic National Wildlife Refuge	CZMA	Coastal Zone Management Act
AOGA	Alaska Oil and Gas Association	dB	decibels
AOGCC	Alaska Oil and Gas Conservation Commission	DEC	Department of Environmental Conservation (State of Alaska)
APD	Application for Permit to Drill	DEIS	draft environmental impact statement
ARBO	Arctic Region Biological Opinion	DNR	Department of Natural Resources (State of Alaska)
ARRT	Alaska Regional Response Team	DOTPF	Department of Transportation and Public Facilities (State of Alaska)
AS	Alaska Statute	DPDP	Division of Policy Development and Planning (State of Alaska)
ASRC	Arctic Slope Regional Corporation	DST	deep-stratigraphic test
BACT	Best Available Control Technology	DWT	deadweight tonnage
bbl	barrel, barrels	E&D	Exploration and Development (Report)
Bbbl	billion barrels	EIS	environmental impact statement
Bcf	billion cubic feet	EO	Executive Order
BEM	Branch of Environmental Modeling	EPA	Environmental Protection Agency
BF	Beaufort/Joint Federal/State Beaufort Sea Oil and Gas Lease Sale	ESA	Endangered Species Act
BIA	Bureau of Indian Affairs	ESP	Environmental Studies Program
BIOS	Baffin Island Oil Spill Project	EWC	Eskimo Whaling Commission
BLM	Bureau of Land Management	°F	degrees Fahrenheit
BOP	blowout preventor	FAA	Federal Aviation Administration
bpd	barrels per day	FEIS	final environmental impact statement
BTF	Biological Task Force	FR	<u>Federal Register</u>
Btu	British thermal unit	ft	foot, feet
C	carbon	FWS	Fish and Wildlife Service (U.S.)
°C	degrees Centigrade or Celsius	FY	fiscal year
CAH	Central Arctic herd	g	grams
Call	Call for Information and Nominations	gal	gallon
CDU	Conical Drilling Unit	GIS	Geographic Information System
CEQ	Council on Environmental Quality	GOM	Gulf of Mexico (OCS Region)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	ha	hectare
CFR	Code of Federal Regulations	HUD	Department of Housing and Urban Development
CIDS	Concrete Island Drilling System		
CIP	Capital Improvements Program (NSB)		

ICAS	Inupiat Community of the Arctic Slope	NO <sub>x</sub>	nitro-oxide
ICT	Incident Command Team	NOAA	National Oceanic and Atmospheric Administration
in	inch	NODC	National Oceanographic Data Center
IPP	Intergovernmental Planning Program	NOI	Notice of Intent
IRA	Indian Reorganization Act	NOS	Notice of Sale
ISER	Institute of Social and Economic Research	NPDES	National Pollution Discharge Elimination System
ITL	Information to Lessees	NPFMC	North Pacific Fisheries Management Council
ITM	Information Transfer Meeting	NPR-A	National Petroleum Reserve-Alaska
ITU	Integrated Terrain Units	NPS	National Park Service
IUM	Information Update Meeting	NRC	National Research Council or Nuclear Regulatory Commission
IWC	International Whaling Commission	NSB	North Slope Borough
JRT	Joint Response Team	NSBC	North Slope Borough Code of Ordinances
kg	kilogram	NSBMC	North Slope Borough Municipal Code
KIC	Kaktovik Inupiat Corporation	NTL	Notice to Lessees
km	kilometer	O <sub>3</sub>	ozone
km <sup>2</sup>	square kilometer	OAS	Office of Aircraft Services
km <sup>3</sup>	cubic kilometer	OCD	Offshore and Coastal Dispersion (Model)
kn	knot	OCRM	Ocean and Coastal Resource Management
LMR	Land Management Regulation	OCS	outer continental shelf
LC <sub>50</sub>	lethal concentrations at which half the organisms die	OCSEAP	Outer Continental Shelf Environmental Assessment Program
LNG	liquefied natural gas	OCSLA	Outer Continental Shelf Lands Act of 1953
m	meter	OGJ	Oil and Gas Journal
m <sup>2</sup>	square meter	OPD	Official Protraction Diagram
m <sup>3</sup>	cubic meter	OSCP	Oil-Spill-Contingency Plan
M	thousand	OSC	on-scene coordinator
Mbbl	thousand barrels	OSRA	oil-spill-risk analysis
MCF	million cubic feet	PAH	polycyclic-aromatic hydrocarbons
mi	mile, miles	PBU	Prudhoe Bay Unit
mi <sup>2</sup>	square mile	PCH	Porcupine caribou herd
ml	milliliter	PFMC	Pacific Fisheries Management Council
mm	millimeter	PM <sub>10</sub>	particulate matter less than 10 microns
MM	million	ppb	parts per billion
MMbbl	million barrels	ppm	parts per million
MMbpd	million barrels per day	PSD	Prevention of Significant Deterioration
MMcf	million cubic feet	RD	Regional Director
MMcfd	million cubic feet per day	REA	Regional Environmental Assistant
MMPA	Marine Mammal Protection Act	REO	Regional Environmental Officer
MMS	Minerals Management Service	RRT	Regional Response Team
NAAQS	National Ambient Air Quality Standards	RS	Regional Supervisor
NANA	Northwest Alaska Native Association		
NAS	National Academy of Sciences		
NEPA	National Environmental Policy Act		
NHL	National Historic Landmark		
NMFS	National Marine Fisheries Service		
nmi	nautical mile		
nmi <sup>2</sup>	square nautical mile		
NO <sub>2</sub>	nitrogen dioxide		

RSFO	Regional Supervisor, Field Operations
RTWG	Regional Technical Working Group
RU	Research Unit
SBA	Seabird Feeding Area
SDR	Seasonal Drilling Restriction
SID	Secretarial Issue Document
SMA	spring migration area
SO <sub>2</sub>	sulfur dioxide
SOA	State of Alaska
SRA	Subsistence Resource Area
SSDC	Single Steel Drilling Caisson
TAGS	Trans-Alaska Gas System
TAH	total aromatic hydrocarbons
TAP	Trans-Alaska Pipeline
TAPS	Trans-Alaska Pipeline System
Tcf	trillion cubic feet
TLH	Teshkepuk Lake herd
TSP	total suspended particulates
ug/m <sup>3</sup>	micrograms per cubic meter
USCG	United States Coast Guard
USDOC	U.S. Department of Commerce
USDOD	U.S. Department of Defense
USDOE	U.S. Department of Energy
USDOI	U.S. Department of the Interior
USGS	United States Geological Survey
VOC	volatile organic compound
WAH	Western Arctic herd
WES	Waterways Experiment Station
WSF	water-soluble fraction
yd	yard
yr	year
<u>Symbols</u>	
°	degrees (latitude and longitude; Centigrade or Fahrenheit)
‰	parts per thousand (salinity)

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.



MINERALS MANAGEMENT SERVICE  
ALASKA OCS REGION

PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 1

MARINE AND COASTAL BIRDS

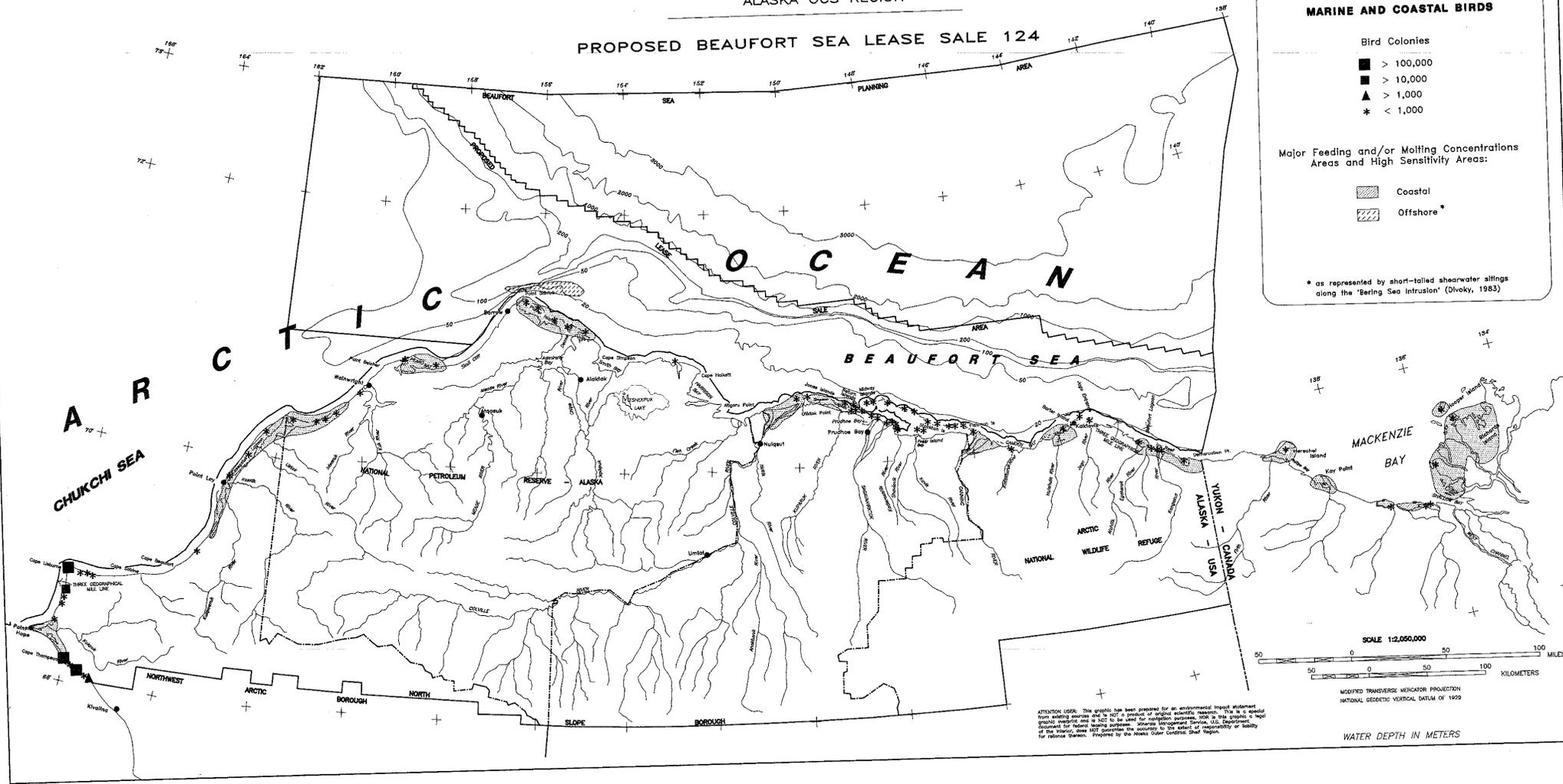
Bird Colonies

- > 100,000
- ▲ > 10,000
- ▲ > 1,000
- \* < 1,000

Major Feeding and/or Molting Concentrations  
Areas and High Sensitivity Areas:

- ▨ Coastal
- ▧ Offshore\*

\* as represented by short-tailed shearwater sightings  
along the "Berling Sea Intrusion" (Dlvokey, 1983)



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SCALE 1:2,050,000  
0 50 100 MILES  
0 50 100 KILOMETERS

MODIFIED TRANSVERSE MERCATOR PROJECTION  
NAD 83 GEODETIC VERTICAL DATUM OF 1929

WATER DEPTH IN METERS



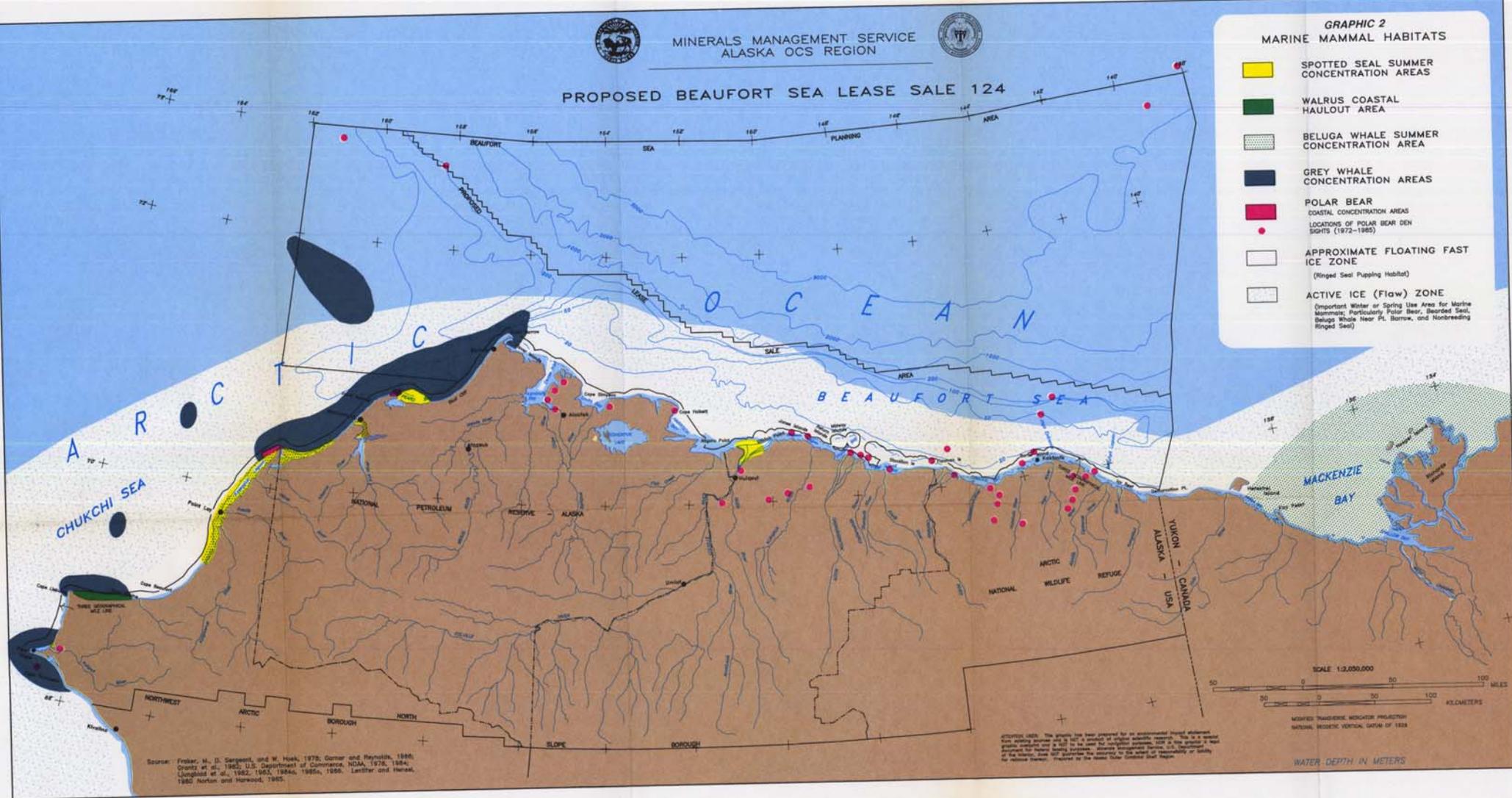
MINERALS MANAGEMENT SERVICE  
ALASKA OCS REGION



PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 2  
MARINE MAMMAL HABITATS

-  SPOTTED SEAL SUMMER CONCENTRATION AREAS
-  WALRUS COASTAL HAULOUT AREA
-  BELUGA WHALE SUMMER CONCENTRATION AREA
-  GREY WHALE CONCENTRATION AREAS
-  POLAR BEAR COASTAL CONCENTRATION AREAS
-  LOCATIONS OF POLAR BEAR DEN SIGHTS (1972-1985)
-  APPROXIMATE FLOATING FAST ICE ZONE (Winged Seal Pupping Habitat)
-  ACTIVE ICE (Flow) ZONE (Important Winter or Spring Use Area for Marine Mammals; Particularly Polar Bear, Bearded Seal, Beluga Whale, Harp Pt. Seal, and Humpbacked Ringed Seal)



Source: Proker, H., D. Sergeant, and W. Hoek, 1978; Gorman and Reynolds, 1980; Counts et al., 1982; U.S. Department of Commerce, NOAA, 1978, 1984; Ljungblad et al., 1982, 1983, 1984a, 1985a, 1985b; Lavtch and Haines, 1980; Norton and Harwood, 1985.

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SCALE 1:1,000,000  
0 50 100 150 200 MILES  
0 50 100 150 200 KILOMETERS

MODIFIED TRANSVERSE MERCATOR PROJECTION  
NATIONAL MEGNETIC VERTICAL DATUM OF 1983

WATER DEPTH IN METERS

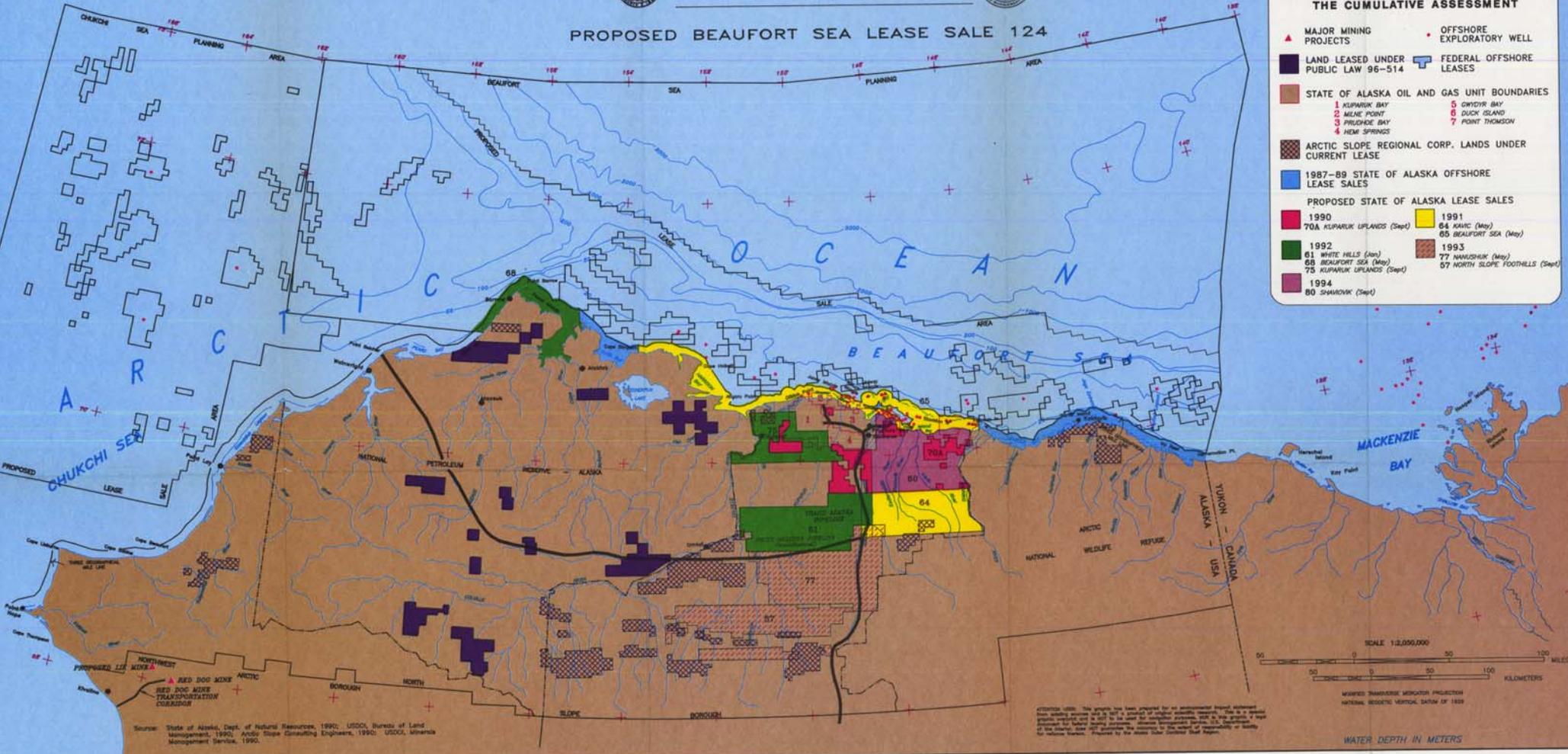


PROPOSED BEAUFORT SEA LEASE SALE 124

GRAPHIC 3

MAJOR PROJECTS INCLUDED IN THE CUMULATIVE ASSESSMENT

- ▲ MAJOR MINING PROJECTS
- OFFSHORE EXPLORATORY WELL
- LAND LEASED UNDER PUBLIC LAW 96-514
- FEDERAL OFFSHORE LEASES
- STATE OF ALASKA OIL AND GAS UNIT BOUNDARIES
  - 1 KUPARUK BAY
  - 2 MILNE POINT
  - 3 PRUDHOE BAY
  - 4 HEM SPRINGS
  - 5 COWDOR BAY
  - 6 DUCK ISLAND
  - 7 POINT THOMSON
- ▨ ARCTIC SLOPE REGIONAL CORP. LANDS UNDER CURRENT LEASE
- 1987-89 STATE OF ALASKA OFFSHORE LEASE SALES
- PROPOSED STATE OF ALASKA LEASE SALES
  - 1990
    - 70A KUPARUK UPLANDS (Sept)
    - 1991
      - 64 KAVIC (May)
      - 65 BEAUFORT SEA (May)
    - 1992
      - 61 WHITE HILLS (Jan)
      - 66 BEAUFORT SEA (May)
      - 75 KUPARUK UPLANDS (Sept)
    - 1993
      - 77 NANKUSHUK (May)
      - 57 NORTH SLOPE FOOTHILLS (Sept)
    - 1994
      - 60 SHARONAK (Sept)



Source: State of Alaska, Dept. of Natural Resources, 1990; USDO, Bureau of Land Management, 1990; Arctic Slope Consulting Engineers, 1990; USDO, Minerals Management Service, 1990.

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WATER DEPTH IN METERS