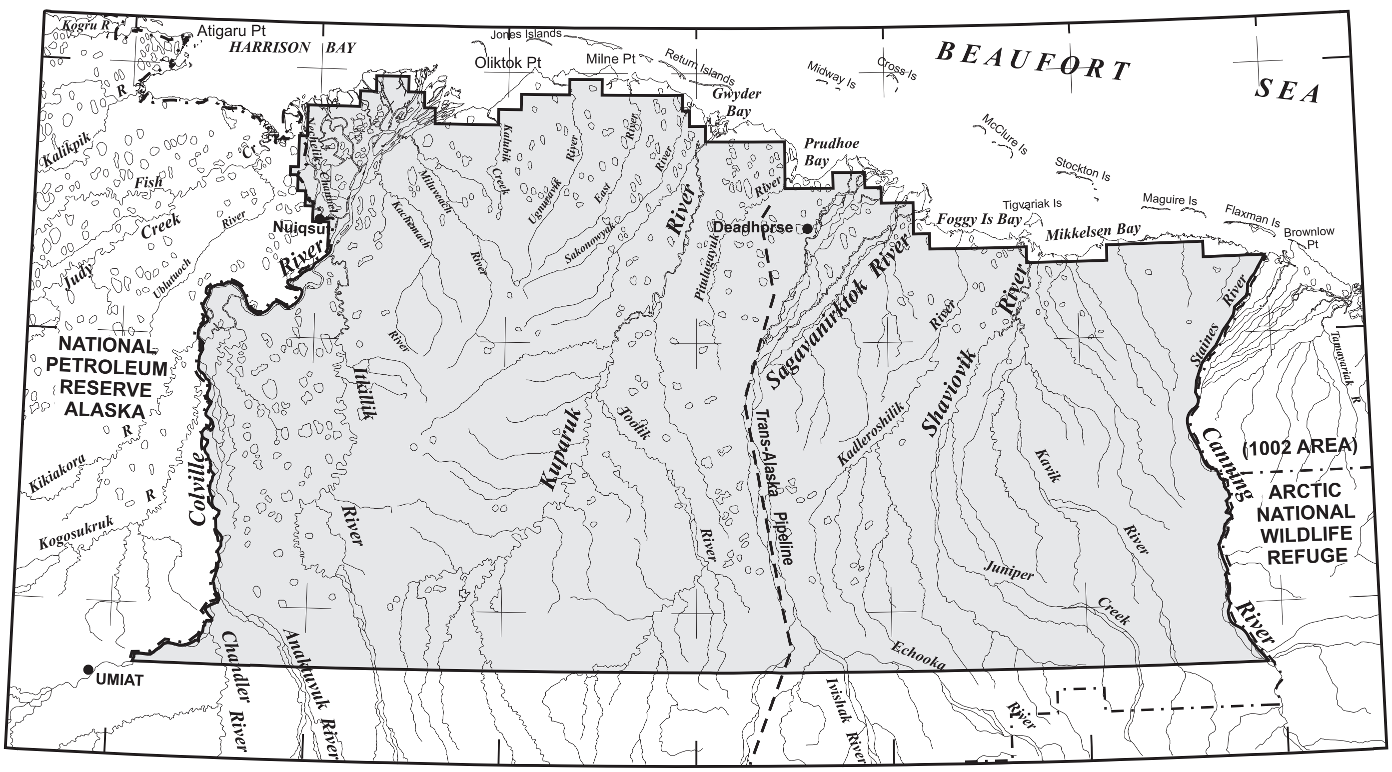
North Slope Areawide
Oil and Gas Lease Sale

Final Finding of the Director

July 15, 2008



Alaska Department of
NATURAL RESOURCES
Division of Oil and Gas

North Slope Areawide
Oil and Gas Lease Sale

Final Best Interest Finding

Prepared by

Alaska Department of Natural Resources
Division of Oil and Gas

Anchorage Alaska
July 15, 2008

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List of Abbreviations

AAC	Alaska Administrative Code
ACMP	Alaska Coastal Management Plan
ADCED	Alaska Department of Community and Economic Development
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOR	Alaska Department of Revenue
AEIDC	Arctic Environmental Information and Data Center
AOGCC	Alaska Oil and Gas Conservation Commission
AS	Alaska Statute
Bbl	Barrel (42 gallons)
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
Bpd	Barrels per day
DF	Division of Forestry
DMLW	Division of Mining Land and Water
DO&G	Division of Oil and Gas
DPOR	Division of Parks and Outdoor Recreation
EIS	Environmental Impact Statement
gal	Gallon(s)
MESA	Most Environmentally Sensitive Area
m	Meter
MMS	Minerals Management Service
NPR-A	National Petroleum Reserve-Alaska
OHMP	Office of Habitat Management and Permitting
OPMP	Office of Project Management & Permitting
RCRA	Resource Conservation and Recovery Act
SPCC	Spill Prevention Control and Countermeasure
SHPO	State Historic Preservation Officer
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDOI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service

Metric and Standard Conversion Tables

To Metric		From Metric	
Feet	Meters	Meters	Feet
1	0.3	1	3.2
2	0.6	2	6.6
3	0.9	3	9.8
4	1.2	4	13.1
5	1.5	5	16.4
6	1.8	6	19.6
7	2.1	7	23
8	2.4	8	26.2
9	2.7	9	29.5
10	3	10	32.8
20	6	20	66
30	9	30	98
40	12	40	131
50	15	50	164
60	18	60	197
70	21	70	230
80	24	80	262
90	27	90	295
100	30	100	328
200	61	200	656
300	91	300	984
400	122	400	1312
500	152	500	1640
1000	305	1000	3281
1500	457	1500	4921

To Metric		From Metric	
Miles	Kilometers	Kilometers	Miles
1	1.6	1	0.6
2	3.2	2	1.2
3	4.8	3	1.9
4	6.4	4	2.5
5	8	5	3.1
6	9.7	6	3.7
7	11.3	7	4.3
8	12.9	8	5
9	14.5	9	5.6
10	16	10	6.2
20	32	20	12
30	48	30	19
40	64	40	25
50	80	50	31
60	97	60	37
70	113	70	43
80	129	80	50
90	145	90	56
100	161	100	62

Chapter One: Introduction

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Chapter One: Introduction

The Alaska Department of Natural Resources (ADNR) is offering for lease all available state-owned acreage in the North Slope Areawide Oil and Gas Lease Sale area. The lease sale area consists of all state-owned lands lying between the National Petroleum Reserve-Alaska (NPR-A) on the west and the Arctic National Wildlife Refuge (ANWR) on the east, and from the Beaufort Sea in the north to the Umiat Meridian Baseline in the south (Figure 1.1). The lease sale area contains approximately 5,100,000 acres. Only areas for which the state owns or has selected the oil and gas estate will be leased. Some acreage not owned or selected by the state may be included within identified sale tracts, but only state-owned oil and gas rights within those tracts can be leased.

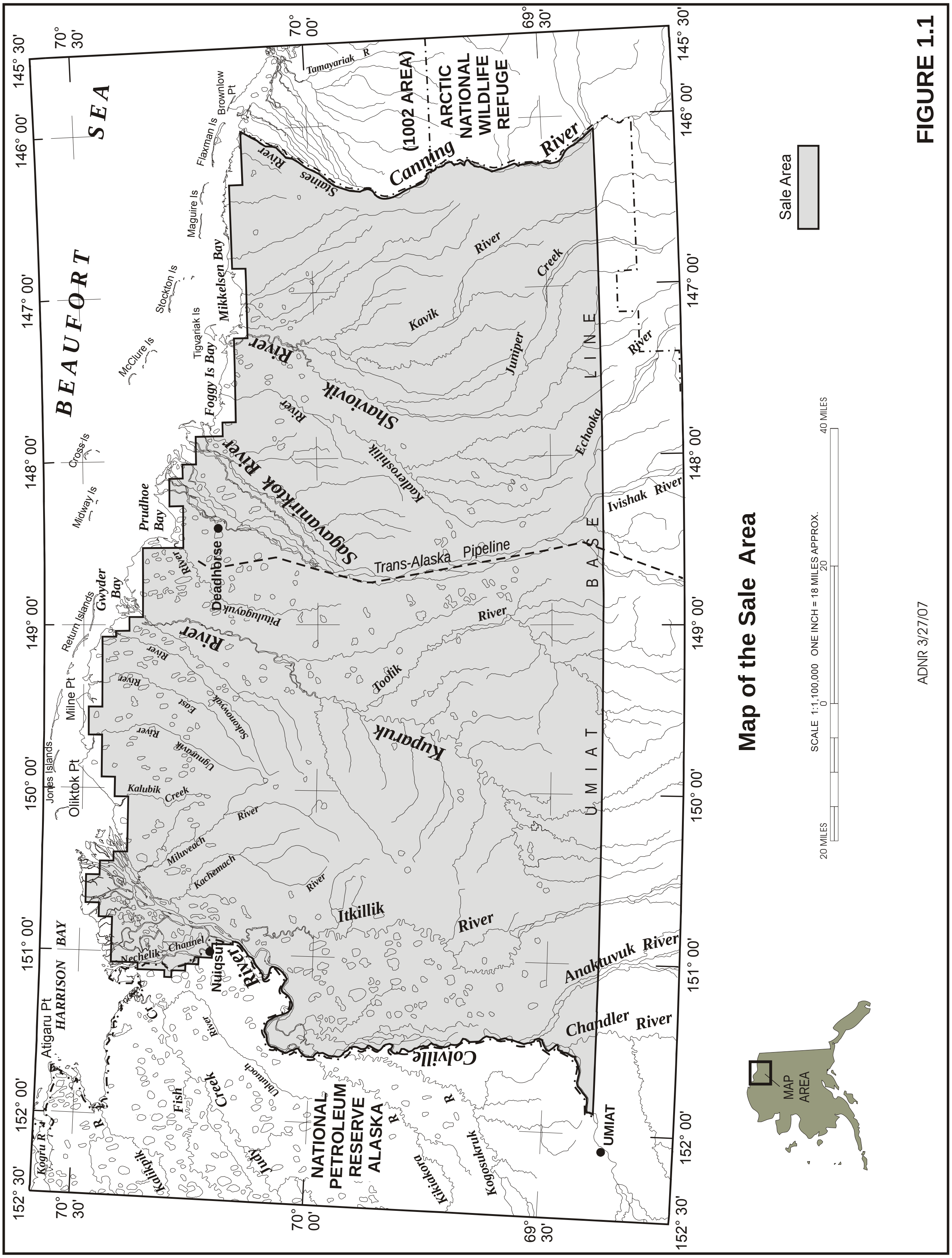
Areawide leasing provides an established time each year that ADNR will offer for lease all available acreage within five geographical regions of the state: the North Slope, Beaufort Sea, Alaska Peninsula, North Slope Foothills, and Cook Inlet. By conducting lease sales at a set time each year, ADNR provides industry with a stable, predictable leasing program, which allows companies to plan and develop their exploration strategies and budgets years in advance. The result is a more efficient exploration and earlier development, which, in turn, benefits the State of Alaska and its residents. Areawide sales are also more efficient for the public and ADNR.

A. Areawide Leasing

1. Authorities

The Alaska Constitution provides that the state's policy is "to encourage ... the development of its resources by making them available for maximum use consistent with the public interest" and that the "legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State ... for the maximum benefit of its people" (Alaska Constitution, article VIII, §1 and 2). To comply with this provision, the Alaska State Legislature enacted Title 38 of the Alaska Statutes (AS 38) and directed ADNR to implement the statutes.

Alaska statutes govern the disposal of state-owned mineral interests. AS 38.05.035(e) says that upon a written finding that the interests of the state will be best served, the director may, with the consent of the ADNR commissioner (commissioner) approve contracts for the sale, lease or disposal of available land, resources, property, or interests in them. The written finding is known as a best interest finding and describes the lease sale area, analyzes the potential effects of the lease sale, describes measures to mitigate those effects, and constitutes the director's determination that the interests of the state will be best served by the disposal. ADNR, Division of Oil and Gas (DO&G) makes available both a preliminary and a final written finding and provides opportunity for public comments. The final written finding also discusses material issues that were raised during the period allowed for receipt of public comment.



Map of the Sale Area

FIGURE 1.1

AS 38.05.035(e) prescribes what, at minimum, must be in these findings. AS 38.05.035(g)(1)(B) lists the following matters that DO&G must consider and discuss in its written finding:

- i. property descriptions and locations;
- ii. the petroleum potential of the sale area, in general terms;
- iii. fish and wildlife species and their habitats in the area;
- iv. the current and projected uses in the area, including uses and value of fish and wildlife;
- v. the governmental powers to regulate the exploration, development, production, and transportation of oil and gas or of gas only;
- vi. the reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas or for gas only on the sale area, including effects on subsistence uses, fish and wildlife habitat populations and their uses, and historic and cultural resources;
- vii. lease stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the leases, and a discussion of the protections offered by these measures;
- viii. the method or methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each;
- ix. the reasonably foreseeable fiscal effects of the lease sale and the subsequent activity on the state and affected municipalities and communities, including the explicit and implicit subsidies associated with the lease sale, if any;
- x. the reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas or gas only on the municipalities and communities within or adjacent to the lease sale area; and
- xi. the bidding method or methods adopted by the commissioner under AS 38.05.180.

A compilation of other laws and regulations applicable to oil and gas activities in Alaska can be found in Appendix B. If the proposed activity occurs in a coastal area, AS 46.40 requires that the activity be consistent with the ACMP, which includes approved local district coastal zone management plans.

2. Public Participation

The public notice statute, AS 38.05.945, includes specific requirements for notice given by ADNR for a written finding under AS 38.05.035(e). These include: publication of both a legal notice and a notice in display advertising in newspapers of statewide circulation and in newspapers of general circulation in the vicinity of the proposed action; public service announcements on the electronic media serving the area to be affected by the proposed action; and one or more of the following methods: posting in a conspicuous location in the vicinity of the proposed action; notification of parties known or likely to be affected by the action; or another method calculated to reach affected parties. Notice must also be given to a municipality if the land is within the boundaries of the municipality; to a coordinating body or a community council if requested in writing; to a regional corporation if the boundaries of the corporation established by the Alaska Native Claims Settlement Act (ANCSA) encompass the land and the land is outside a municipality; to a village corporation organized under ANCSA if the land is within 25 miles of the village for which the corporation was established and the land is located outside a municipality; to the postmaster of a permanent settlement of more than 25 persons located within 25 miles of the land if the land is located outside a municipality, with a request that the notice be posted in a conspicuous location; to a nonprofit community organization or a governing body that has requested notification in writing and provided a map of its boundaries, if the land is within the boundaries.

In addition, AS 38.05.946 provides that a municipality, an ANCSA corporation, or a nonprofit community organization may hold a hearing within 30 days after receipt of the notice. The commissioner also has discretion to hold a public hearing.

The director of DO&G is delegated the authority to make available a preliminary and final written finding and provide opportunity for public comment for a scheduled oil and gas or gas only lease sale (AS 38.05.180). The director signs the best interest finding and the commissioner consents to the director's decision by co-signing the final written finding. A person who is eligible to file a request for the commissioner's reconsideration and who is aggrieved by the final written finding of the director may, within 20 calendar days after issuance of the final written finding, request reconsideration of the decision by the commissioner. A person is eligible to file a request for reconsideration if the person meaningfully participated in the process set out for receipt of public comment by either submitting written comments during the comment period or by presenting oral testimony at a public hearing, if a public hearing was held, and is affected by the final written finding (AS 38.05.035(i)).

A person may appeal a final written finding to the superior court, but only if the person was eligible to request, and did request, reconsideration of that finding at the agency level. In addition, the points on appeal are limited to those presented to the commissioner in the request for reconsideration (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the superior court, the agency is given full opportunity to review, analyze, and respond to the party's points on appeal before litigation. For the purposes of appeal, the burden is on the party seeking review to establish the invalidity of the finding (AS 38.05.035(m).

3. Best Interest Finding Scope of Review

The director's determination is based upon a review of all facts and issues known, or made known, to the director, which enables him to arrive at a determination whether this disposal serves the best interests of the state. The review and finding address only reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)). A reasonably foreseeable effect must also be "significant." Significant means a known and noticeable impact on or within a reasonable proximity to the area involved in the disposal.

Public input assists in providing a body of information for the best interest finding review and analysis that is as complete as possible. Information provided by agencies and the public assist the director in:

- reviewing all of the facts and issues;
- determining which facts and issues are material to the decision;
- determining the reasonably foreseeable significant effects of the proposed lease sale.

Therefore, the scope of review and finding for the disposal is limited to applicable statutes and regulations and the material facts and issues known to the director that pertain to the reasonably foreseeable, significant effects of leasing. In preparing the written finding, the director is not required to speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined. The effects of future exploration, development, or production will be considered at each subsequent phase, when various government agencies and the public review permit applications for the specific activities proposed at specific locations in the lease sale area. However, this final finding does discuss, in general terms, the potential effects that may occur from the lease sale.

4. Phased Review

Phased review recognizes that leasing of state land may result in future projects that cannot be predicted or planned with any certainty or specificity at the initial lease sale phase and that will require future detailed review for authorizations needed before commencement. The state cannot determine with any specificity or definition at the leasing phase if, when, where, how, or what kind of production might ultimately occur as the result of leasing. Although advances in technology, unpredictable market change, and specific infrastructure requirements for possible production cannot be foreseen, new developments or improvements in any or all of these areas may yield answers to some of these questions.

Phasing allows the analysis of leasing to focus only on the issues pertaining to the leasing phase and reasonably foreseeable, significant effects of leasing. Additional authorizations are required for exploration, development, and production phases. When a project is multiphased, review of issues that would require speculation about future factors may be deferred until permit authorization is sought at the exploration, development, and production phases. A discussion of governmental and public involvement at these later phases follows in the section on "Governmental Powers."

Under AS 38.05.035(e)(1)(C), ADNR may, if the project for which the proposed disposal is sought is a multiphased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes and regulations, facts, and issues that pertain solely to the disposal phase of the project when:

- (i) the only uses to be authorized by the disposal are part of that phase;
- (ii) the disposal is of oil and gas or gas only, and, before the next phase of the project may proceed, public notice and opportunity to comment are provided unless the project is subject to a consistency review under AS 46.40 and public notice and the opportunity to comment are provided under AS 46.40.096(c);
- (iii) the department's approval is required before the next phase may proceed; and
- (iv) the department describes its reasons for a decision to phase.

B. North Slope Areawide Oil and Gas Lease Sale Process

1. Scope of Review

The conditions under which phasing may occur, as described in the previous section, have been met in the North Slope Areawide Oil and Gas Lease Sale. Accordingly, the review of activities in the lease sale area is of a multiphased development. The director, in making this final finding, has limited the scope of the finding to the applicable statutes and regulations, facts, and issues that pertain solely to the lease phase of oil and gas activities and the reasonably foreseeable significant effects of issuing a lease.

Condition (i) is met because the only uses authorized by the lease sale are part of the leasing phase. The lease gives the lessee, subject to the provisions of the lease, the right to conduct geological and geophysical exploration for oil, gas, and associated substances within the leased area and the right to drill for, extract, remove, clean, process, and dispose of any oil, gas, or associated substances that may underlie the lands described by the lease. While the lease gives the lessee the right to conduct these activities, the lease sale itself does not authorize any exploration or development activities by the lessee on leased tracts.

Condition (ii) is met because the lease sale is of oil and gas or gas only, and before the next phase of the project may proceed, ADNR will provide public notice and the opportunity to comment for any proposed plan of operations in the lease sale area. Additionally, any plan of operations in the lease sale area is subject to consistency with the Alaska Coastal Management Program standards, including public notice and opportunity to comment under AS 46.40.

Condition (iii) is met because ADNR's approval is required before the next phase (in this case exploration) may proceed. See Chapter Five on the post leasing phases. Before exploration activities can occur on leased lands, the lessee must secure all applicable permits. Additional authorizations and permits must also be prepared and approved by the state for any subsequent development or production on the lease.

The plans of operations must identify the specific measures, design criteria, construction methods, and standards that will be employed to meet the provisions of the lease. A plan of operations is subject to extensive technical review by a number of local, state, and federal agencies. Oil and gas exploration, development, or production-related activities will be permitted only if the proposed operations comply with all local, state, and federal laws and the provisions of the lease.

Condition (iv) is met because ADNR describes its reasons for the decision to phase in subsection A.4. above.

Therefore, the scope of review in this final finding is limited to the applicable statutes and regulations, the material facts and issues known to the director that pertain to the issuance phase, and the reasonably foreseeable, significant effects of leasing. This includes items required by AS 38.05.035(g)(i)-(x) and all material facts and issues raised by the public during the public comment period. A discussion of the possible specific effects of unknown future exploration, development, and production activities is not within the scope of this finding. The effects of future exploration, development, and production will be considered at each subsequent phase, when various government agencies and the public review permit applications for specific activities proposed at specific locations. However, this finding does discuss, in general terms, the potential effects that may occur with oil and gas exploration, development, production, and transportation within the lease area as well as the mitigation measures to be imposed as terms of the lease and as terms of any subsequent permit to mitigate any possible adverse effects.

2. Best Interest Finding Process

As a result of 1996 amendments, AS 38.05.180(d) allows the commissioner to annually offer leases for oil and gas or leases for gas only of the acreage described in AS 38.05.035(e)(6)(F). Further, a written finding under AS 38.05.035(e)(6)(F) that the interests of the state will be best served is not required before the approval of an exempt oil and gas lease sale or gas only lease sale under AS 38.05.180(d) of acreage subject to a best interest finding issued within the previous 10 years or a reoffered oil and gas lease sale or gas only lease sale under AS 38.05.180(w) of acreage subject to a best interest finding issued within the previous 10 years, unless the commissioner determines that substantial new information has become available that justifies a supplement to the most recent best interest finding. This process is discussed in more detail below (Figure 1.2).

a. Request for Agency Information and Preliminary Best Interest Finding

On July 3, 2006, DO&G issued a *Request for Agency Information* to begin the process of gathering information on the proposed lease sale area. ADNR, Office of Habitat Management and Permitting (OHMP) [1] provided a list of publications and websites to obtain updated information on fish and mammals. The Department of Transportation and Public Facilities said that it was involved in numerous access projects in the proposed lease sale area and was interested in any information or data received from other agencies. The commissioner's office of the Alaska Department of Environmental Conservation (ADEC) proposed a lessee advisory regarding air pollution and emissions and ADEC's Industrial Wastewater Program suggested a change to the mitigation measures. The U.S. Forest Service stated that it did not have ownership interests in the proposed lease sale area and that it did not have any information to provide. ADNR, Office of History and

[1] The Office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Division of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.

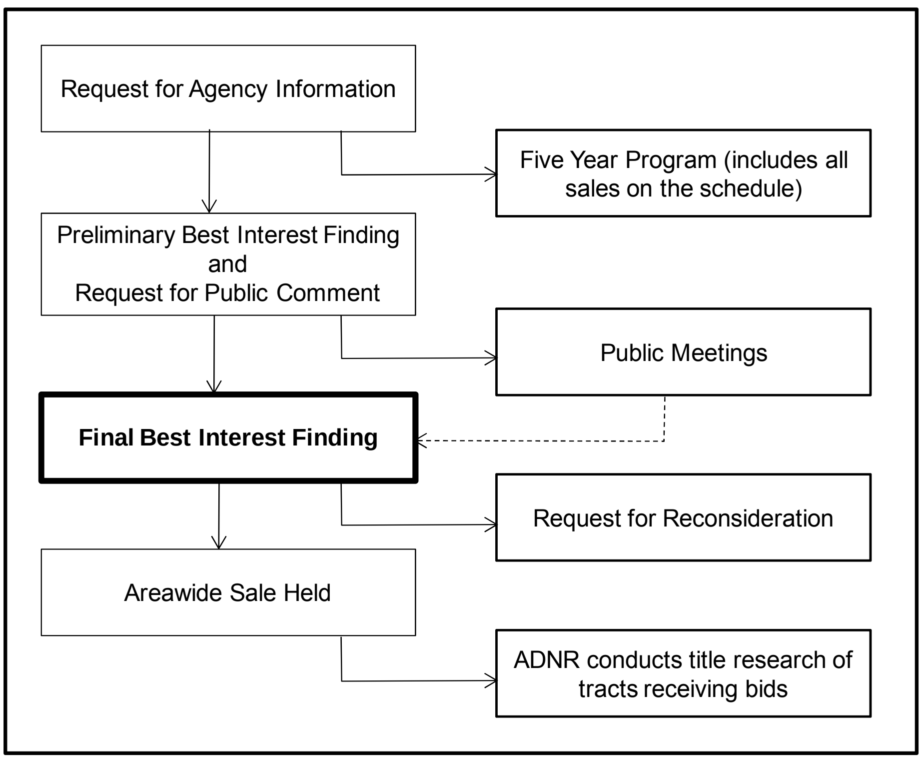
Archaeology stated that the proposed lease sale area was extensive and requested that the final sale boundary area be reviewed under the Alaska Historic Preservation Act. Information provided by these agencies was incorporated into the text of the preliminary best interest finding.

Upon issuance of the preliminary best interest finding, ADNR solicited comments from the public. Appendix A is a summary of those comments and DO&G's responses.

b. Final Best Interest Finding

The proposed finding was revised based in part on comments received during the comment period. Following review of comments on the preliminary best interest finding and any additional available information, the director determined that the lease sale was in the state's best interest and issued this final finding and decision. In accordance with AS 38.05.035, a person who is eligible to file an administrative appeal or request for reconsideration and who is aggrieved by the finding may, within 20 days after issuance of the finding, file an administrative appeal or request for reconsideration of the decision. A person is eligible to file an administrative appear or request for reconsideration if the person meaningfully participated in the process set out for receipt of public comment by submitting written comment during the period for receipt of public comment, or presenting oral testimony at a public hearing and is affected by the final written finding (AS 38.05.035).

Figure 1.2 North Slope Areawide Public Process



3. Future North Slope Areawide Sales 2008-2017

The last best interest finding for the North Slope Areawide Oil and Gas Lease Sale was issued March 17, 1998 and supplements to the finding were issued on August 15, 2000 and July 24, 2002. The 1998 finding was valid for lease sales held through 2007. This final best interest finding addresses North Slope Areawide Oil and Gas Lease Sales from 2008-2017.

As mentioned above, once a finding has been written for an areawide sale, ADNR can conduct a lease sale in that same area each year for up to 10 years without repeating the entire finding process. However, annually, before holding a sale, DO&G must determine whether a supplement to the finding is required through the following process:

- Approximately nine months before a sale, ADNR will issue a call for comments requesting substantial new information that has become available since the most recent best interest finding for that sale area. This call for comments is sent to agencies and individuals on the division's mailing list and posted on the DO&G Web site. The call for comments must provide opportunity for public comment for a period of not less than 30 days.
- Based on information received, ADNR will determine whether a supplement to the most recent best interest finding is required.
- Based on this determination, ADNR will issue either a supplement to the best interest finding or a “Decision of No New Substantial Information” not later than 90 days before the sale.

4. Post-Sale Title Search

The North Slope region has been divided into tracts that will remain fixed for future sales. The extent of the state’s ownership interest in these lands will not be determined prior to the sale; rather, following the sale, ADNR will verify title only for tracts receiving bids. Therefore, should a potential bidder require title or land status information for a particular tract prior to the sale, it will be the bidder’s responsibility to obtain that information from ADNR public records. It is possible that a tract included in the sale may contain land that the state cannot legally lease (due to existing lease, federal, Native or private land, etc.). Following the sale, ADNR will complete the title work and issue all of the leases. The actual number of months between the sale date and issuance of lessees will depend on the number of tracts leased and the complexity of the land holdings involved.

C. Governmental Powers to Regulate Oil and Gas Exploration, Development, Production, and Transportation

All oil and gas activities (exploration, development, production, and transportation) are subject to numerous federal, state, and local laws, regulations, policies, and ordinances, with which the lessee is obligated to comply. This section does not provide a comprehensive description of the multitude of laws and regulations that may be applicable to such activities, but it does illustrate the broad spectrum of authorities various government agencies have to prohibit, regulate, and condition activities related to oil and gas activities. Important laws and regulations applicable to oil and gas activities are included in Appendix B. Each of the regulatory agencies (state, federal, and local) has a different role in the oversight and regulation of oil and gas activities, although some agencies may have overlapping authorities.

An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. However, as discussed in the previous section, except for activities that would not require a land use permit or operations undertaken under an approved unit plan of operations, a plan of operations must be approved before any operations may be undertaken on or in the leased area.

Each agency requires various permits and approvals, which are discussed below along with additional information on the review process (see Table 1.1). However, there is no “typical” project. Actual processes, terms, and conditions will vary with time-certain, site-specific operations. Therefore, each agency has field monitors assigned to ensure that operations are conducted as approved.

The appropriate statutes and regulations should be consulted when specifics are required.

1. Alaska Department of Natural Resources

ADNR, through the Division of Oil & Gas (DO&G), Division of Mining, Land and Water (DMLW), the and the Division of Coastal and Ocean Management (DCOM), reviews, coordinates, conditions, and approves plans of operation or development and other permits as required before on-site activities can take place. The department monitors activities through field inspection once they have begun. Each plan of operation is site-specific and must be tailored to the activity requiring the permit. A plan of operation is required to identify the specific measures, design criteria, and construction methods and standards to be employed so as to comply with the terms of the lease. Applications for other state or federal agency authorizations or permits must be submitted with the plan of operation.

a. Fish Habitat Management

Pursuant to Title 41, ADF&G's Division of Habitat administers the permitting process for activities that may affect anadromous fish streams. Under this program, a Fish Habitat Permit is required prior to using, diverting, obstructing, polluting, or changing the natural flow or bed of an anadromous fish waterbody as required in AS 41.14.870(b). In addition, ADF&G also administers the permitting process for activities that may affect the efficient passage of resident fish as per AS 41.14.840.

Under the Alaska Coastal Management Program (ACMP), wetlands and tidelands must be managed to assure adequate water flow, avoid adverse effects on natural drainage patterns, and the destruction of important habitat as per 11 AAC 112.300. Rivers, streams, and lakes must be managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow (11 AAC 112.300). To further protect fish and wildlife habitat, 11 AAC 112.230 requires that facilities be consolidated to the extent practicable.

b. Alaska Coastal Management Plan (ACMP) Review

The North Slope Areawide Oil and Gas Lease Sale is within the North Slope Borough. Lease related activities are subject to review under the Alaska Coastal Management Plan (ACMP) and the local coastal district plan. An ACMP consistency analysis was issued on May 2, 2007, followed by a proposed consistency determination on January 17, 2008, and a final consistency determination on February 8, 2008.

Permit applications for activities under the lease must be as detailed as necessary for a comprehensive agency review. If a project affects or occurs within the coastal zone, a review of the permit application will be conducted to determine whether the proposed activity is consistent with the standards of the ACMP. Following the review, each agency will approve or disapprove the permit and determine whether any alternative measures (changes in the project description) or permit terms are required prior to approval.

The public is provided the opportunity to participate in ACMP reviews. For example, most permits needed for exploration well drilling require public notice. The ACMP permitting process goes through a 30- or 50-day review and, if other agencies or offices within ADNR require approval, the review is coordinated by the OPMP. This process provides for coordinated agency reviews, public input, and ensures that proposed activities are consistent with the ACMP and local coastal plans.

The 50-day ACMP review process is initiated when the lessee, designated operator, or OPMP distributes an application package to affected coastal resource districts and permitting agencies. The individual agencies initiate their internal consistency reviews and, if necessary, must send a request for additional information to the coordinating agency within 25 days. Public and agency review comments are due on or before Day 34, and a proposed consistency finding is issued on or before Day 44. A request for additional time to complete the review must be received on or before Day 49, and the final consistency determination is issued on Day 50. However, if a reviewing agency objects to the proposed determination they may elevate the decision to the director. If the determination is elevated, a director's determination is issued by Day 65. The 30-day review process has shorter time periods between action points. 11 AAC 110.230.

The consistency determination process has been streamlined through the development of A, B, and C list activities.

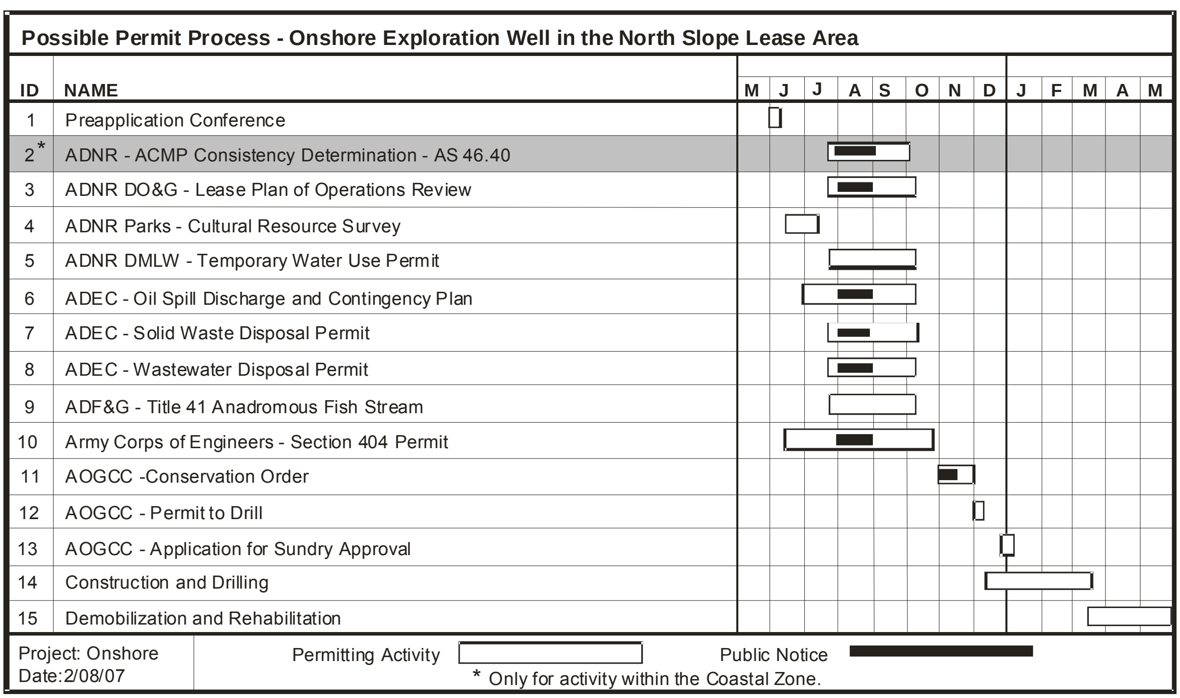
"A list" activities are considered "categorically consistent" and do not result in significant impacts to coastal resources, and therefore do not require a consistency review. On-pad placement of light poles, railings, electrical towers/poles, modules, and associated oil and gas buildings are examples of A list activities. A Coastal Project Questionnaire (CPQ) application is required for projects on the A list unless the A list says a CPQ is not required.

"B list" reviews are classified as General Concurrences, and the activities are considered routine with standard alternative measures. B list activities adopting the alternative measures are consistent with the ACMP. Individual ACMP consistency reviews are not necessary for activities on the B list. However, a Coastal Project Questionnaire (CPQ) application is required for all projects on the B list.

The resource agency(s) will check the CPQ and plan of operations to ensure that the project qualifies for the A or B list. The coordinating agency will also review the standard alternative measures and any applicable procedures against the plan of operations submitted.

"C list" activities are not covered by the A or B lists, and reviews are classified as Individual Project Reviews. C list activities are subject to the 50- or 30-day review process described in this section.

Table 1.1 Possible Permit Process



c. Plan of Operations Approval

Land use activities within oil and gas leases are regulated under 11 AAC 83.158 and paragraph 10 of the lease. These require the lessee to prepare plans of operation and development that must be approved by DO&G and by any other interest holder, if ownership is shared, before the lessee may commence any activities within the leased area. Except for equipment uses exempted under 11 AAC 96.020, the lessee must prepare a plan of operations and obtain all required approvals and permits for each phase of exploration, development, or production prior to implementation of that activity. All permit applications and plans are available for public review and public notice will be given for all development plans of operations.

An application for approval of a plan of operations must contain sufficient information, based on data reasonably available at the time the plan is submitted, in order for the commissioner to determine the surface use requirements and effects directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

- The sequence and schedule of the operations to be conducted in the leased area, including the date operations are proposed to begin and their proposed duration.
- Projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations.
- Plans for rehabilitation of the affected leased area after completion of operations or phases of those operations.
- A description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas cited in 11 AAC 83.158(d)(4).

When it considers a plan of operation, ADNR often requires stipulations, in addition to the mitigation measures developed through the best interest finding. These additional stipulations address site-specific concerns directly associated with the proposed project. The lease stipulations and the terms and conditions of the lease are attached to the plan of operation approval and are binding on the lessee. The lease also requires that the lessee keep the lease area open for inspection by authorized state officials. Activities are field-monitored by ADNR, ADEC, ADF&G, and AOGCC to ensure compliance with each agency's respective permit terms. In addition, each permittee must post a $500,000 statewide bond to cover a drill site. Lease operation approvals are generally granted for three years.

d. Geophysical Exploration Permit

The geophysical exploration permit is a specific type of land use permit issued by DO&G under 11 AAC 96.010. Seismic surveys are the most common activity authorized by this permit. The purpose of the permit is to minimize adverse effects on the land and its resources while making important geological information available to the state (11 AAC 96.005). Under AS 38.05.035(a)(8)(C), the geological and geophysical data that are made available to the state are held confidential at the request of the permittee. If the seismic survey is part of an exploration well program, the permit will be reviewed as part of the exploration well permit package. The application must contain sufficient detail to allow evaluation of the planned activities' effects on the land per 11 AAC 96.030(a). In addition, the application must contain a map showing the general location of all activities and routes of travel of all equipment for which a permit is required. It must also contain a description of the proposed activity, any associated structures, and the type of equipment that will be used. Maps showing the precise location of the survey lines must also be provided, though this information is usually held confidential. A $100,000 bond is required to conduct seismic work. The bond amount for other geophysical surveys is determined when the activity is proposed.

A geophysical exploration permit contains measures to protect the land and resources of the area. The permit is usually issued for one year or less, but may be extended. If the permit is extended, the director may modify existing terms or add new ones. The permit is also revocable for cause under 11 AAC 96.040.

e. Pipeline Rights-of-Way

Most transportation facilities within the lease area or beyond the boundaries of the lease area must be authorized by ADNR under the Right-of-Way Leasing Act, AS 38.35. This act gives the commissioner broad authority to oversee and regulate the transportation of oil and gas by pipelines that are located in whole or in part on state land, to ensure the state's interests are protected. The Right-of-Way Leasing Act process is administered by the State Pipeline Coordinator's Office.

f. Temporary Water Use

A person must receive authorization from DMLW under 11 AAC 93.220 before temporary use of a significant amount of water as described in 11 AAC 93.035(b). Procedures to authorize the temporary use of water as provided in 11 AAC 93.220 will apply if the use continues for less than five consecutive years and the water applied for is not otherwise appropriated. Authorized temporary water use is subject to amendment, modification, or revocation by DMLW if it determines that amendment, modification, or revocation is necessary to supply water to lawful appropriators of record or to protect the public interest. Upon receipt of a written request from the permittee, DMLW may extend an authorization for temporary use of water one time for good cause for a period not to exceed five years (11 AAC 93.210).

g. Permit to Appropriate and Certificate of Appropriation of Water

Industrial or commercial use of water requires a permit to appropriate water under 11 AAC 93.120. The permit is issued for a period of time, not to exceed five years, consistent with the public interest and adequate to finish construction and establish full use of water. Under 11 AAC 93.120(e), DMLW may issue a permit subject to conditions considered necessary to protect the right of prior appropriators of record and the public interest, including: the conditions that no certificate will be issued until evidence is presented to DMLW of acquisition of adequate easements or other means necessary for completion of the appropriation and conditions that require the permittee to measure the water use in a manner to be approved by DMLW and periodically report water use information to DMLW. Permits may also include conditions to maintain, or restrictions from withdrawal, a specific quantity of water to achieve any of the following purposes: protection of fish or wildlife habitat; recreational purposes; navigation; sanitation or water quality; protection of prior appropriators; and any other purpose DMLW determines is in the public interest and should be taken into account under AS 46.15.

Under 11 AAC 93.130, a certificate of appropriation is issued to the permit holder if (1) the permit holder submits a statement of beneficial use stating that the means necessary for the taking of the water have been developed and the permit holder is beneficially using the quantity of water to be certified; and (2) the permit holder has substantially complied with all permit conditions. The certificate may be issued subject to conditions considered necessary to protect the public interest. For example, the permit holder may be required to maintain a specific quantity of water at a given point on a stream or waterbody, or in a specified stretch of stream, throughout the year or for specified times of the year, to achieve protection of fish and wildlife habitat, recreation, navigation, sanitation and water quality, prior appropriators, or any other purpose the commissioner determines is in the public interest. (11 AAC 93.130(c)(1)).

h. Uses Requiring a Land Use Permit

On state land, a permit or other written authorization from DMLW is required for activities involving uses listed in 11 AAC 96.010. Generally allowed uses, uses and activities for which a permit or other written authorization in not required, appear on the list in 11 AAC 96.020. In accordance with 11 AAC 96.025, a generally allowed use is subject to the following conditions:

(1) activities employing wheeled or tracked vehicles must be conducted in a manner that minimizes surface damage;

(2) vehicles must use existing roads and trails whenever possible;

(3) activities must be conducted in a manner that minimizes

(A) disturbance of vegetation, soil stability, or drainage systems;

(B) changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes; and

(C) disturbance of fish and wildlife resources;

(4) cuts, fills, and other activities causing a disturbance listed in (3)(A) – (C) of this section must be repaired immediately, and corrective action must be undertaken as may be required by the department;

(5) trails and campsites must be kept clean; garbage and foreign debris must be removed; combustibles may be burned on site unless the department has closed the area to fires during the fire season;

(6) survey monuments, witness corners, reference monuments, mining location posts, homestead entry corner posts, and bearing trees must be protected against destruction, obliteration, and damage; any damaged or obliterated markers must be reestablished as required by the department under AS 34.65.020 and AS 34.65.040;

(7) every reasonable effort must be made to prevent, control, and suppress any fire in the operating area; uncontrolled fires must be immediately reported;

(8) holes, pits, and excavations must be repaired as soon as possible; holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, or mining leasehold locations may be left open but must be maintained in a manner that protects public safety;

(9) on lands subject to a mineral or land estate property interest, entry by a person other than the holder of a property interest, or the holder's authorized representative, must be made in a manner that prevents unnecessary or unreasonable interference with the rights of the holder of the property interest.

i. Material Sale Contract

If the operator proposes to use state-owned gravel or other substrate materials for construction of pads and roads, a DMLW material sale contract must include, if applicable: (1) a description of the sale area; (2) the volume of material to be removed; (3) the method of payment; (4) the method of removal of the material; (5) the bonds and deposits required of the purchaser; (6) the purchaser's liability under the contract; (7) the improvements to and occupancy of the sale area required of the purchaser; (8) and the reservation of material within the sale area to the division; and (9) the purchasers site-specific operation requirements, including erosion control and protection of water; fire prevention and control; roads; sale area supervision; protection of fish, wildlife, and recreational values; sale area access; and public safety. A contract must state the date upon which the severance or extraction of material is to be completed. DMLW may grant an extension not to exceed one year. When determined by DMLW that a delay in completing the contract is due to causes beyond the purchaser's control, the contract will be extended for a time period equal to the delay.

DMLW may require a purchaser to provide a performance bond based on the total value of the sale. The performance bond must remain in effect for the duration of the contract unless released in writing by the director.

2. Alaska Department of Environmental Conservation

ADEC has statutory responsibility for preventing air, land, and water pollution. ADEC regulates oil and gas activities, such as the disposal of drilling mud and cuttings, the flaring of hydrocarbon gases, and the discharge of wastewater. AOGCC also has regulatory authority over these actions if the activity involves a class II injection well. Several separate written permits are required before an activity can begin. For instance, before solid waste disposal, wastewater or air quality permits are issued, two public notices and an opportunity for public comment (and a public hearing, if requested) are required.

a. Oil Discharge Prevention and Contingency Plan

Lessees must comply with the requirements of AS 46.04.010 - .900, Oil and Hazardous Substance Pollution Control. This requirement includes the preparation and approval by ADEC of an Oil Discharge Prevention and Contingency Plan (C-Plan) (AS 46.04.030; 18 AAC 75.445). Details on the contents of the plan are in Chapter Six.

Prior to receiving a permit to drill, the lessee must demonstrate in each plan of operation the ability to promptly detect, contain, and clean up any hydrocarbon spill before the spill affects fish and wildlife populations or their habitats. ADEC has authority under AS 46.04 for the purpose of preventing and cleaning up oil spills.

If transportation by water is planned, AS 46.04.030 requires that the lessee obtain the approval of ADEC for detailed oil spill contingency plans prior to the commencement of each aspect of the operation, including individual wells, drilling pads or platforms, pipelines, storage facilities, loading facilities, and individual tankers or barges.

b. Wastewater Disposal

Domestic graywater must be disposed of properly at the surface and requires a Wastewater Disposal Permit per 18 AAC 72. Typically, waste is processed through an on-site plant and disinfected before discharge. ADEC sets fluid volume limitations and threshold concentrations for biochemical oxygen demand (BOD), suspended solids, pH, oil and grease, fecal coli form, and chlorine residual. Monitoring records must be available for inspection, and a written report may be required upon completion of operations.

c. Solid Waste Disposal Permit

Recent industry practice is to use methods other than surface reserve pits for disposal of drilling muds, such as injection wells, where possible. In addition, the majority of muds utilized today are water-based. When a well is drilled, muds and cuttings are initially either temporarily stored on a gravel pad or collected in a reserve pit pending final disposal by injection. Drilling muds and cuttings discharged into a reserve pit require pre-approval and a written permit. The permit addresses design, operation, and closure concerns to ensure that unacceptable environmental effects are avoided.

Solid waste storage, treatment, transportation, and disposal are regulated under 18 AAC 60. For all solid waste disposal facilities, a comprehensive disposal plan is required, which must include engineering design criteria and drawings, specifications, calculations, and a discussion demonstrating how the various design features (liners, berms, dikes) will ensure compliance with regulations.

Before approval, solid waste disposal permit applications are reviewed for compliance with air and water quality standards, wastewater disposal, and drinking water standards, as well as for their consistency with the Alaska Historic Preservation Act. The application for a waste disposal permit must include a map or aerial photograph (indicating relevant topographical, geological, hydrological, biological, and archeological features) with a cover letter describing type, estimated quantity, and source of the waste, as well as the type of facility proposed. Roads, drinking water systems, and airports within a two-mile radius of the site must be identified, along with all residential drinking water wells within one-half mile. There must also be a site plan with cross-sectional drawings that indicate the location of existing and proposed containment structures, material storage areas, monitoring devices, area improvements, and on-site equipment. An evaluation of the potential for generating leachate must be presented as well. For above-grade disposal options, baseline water-quality data may be needed to establish the physical and chemical characteristics of the site before installing a containment cell.

Non-drilling related solid waste must be disposed of in an approved municipal solid waste landfill (MSWLF). MSWLFs are regulated under 18 AAC 60.300-.397. All other solid waste (except for hazardous materials) must be disposed of in an approved monofill (18 AAC 60.400-.495). A monofill is a landfill or drilling waste disposal facility that receives primarily one type of solid waste and is not an inactive reserve pit as defined in 18 AAC 60.990(80). An inactive reserve pit is a drilling waste disposal area, containment structure, or group of containment structures where drilling waste has been disposed of which the owner or operator does not plan to continue disposing of drilling waste per 18 AAC 60.990(62). Closure of inactive reserve pits is regulated under 18 AAC 60.440.

Drilling waste disposal is specifically regulated under 18 AAC 60.430. Design and monitoring requirements for drilling waste disposal facilities are identified in 18 AAC 60.430(c) and (d), respectively. Under 18 AAC 60.430(c)(1), “the design must take into account the location of the seasonal high groundwater table, surface water, and continuous permafrost, as well as proximity to human population and to public water systems, with the goal of avoiding any adverse effect on these resources.” The facility must be designed to prevent the escape of drilling waste and leachate, prevent contamination of groundwater, and be of sufficient volume and integrity to prevent leakage due to erosion, precipitation, wind and wave action, and changing permafrost conditions. The plans for the proposed design and construction of the drilling waste disposal facility and the fluid management plan must be approved, signed, and sealed by a registered engineer per 18 AAC 60.430(c)(5).

Presently, the preferred practice is to dispose of drilling fluids by reinjection deep into the ground; however, EPA and ADEC may authorize limited discharge of waste streams under the NPDES permit system. All produced waters must be re-injected or treated to meet Alaska Water Quality Standards prior to discharge. Before a well may be permitted under 20 AAC 25.005, a proper and appropriate reserve pit, also known as a solid waste disposal cell, must be constructed or appropriate tankage installed for the reception and confinement of drilling fluids and cuttings, to facilitate the safety of the drilling operation, and to prevent contamination of groundwater and damage to the surface environment (20 AAC 25.047).

Typically, a reserve pit is a containment cell lined with an impermeable barrier compatible with both hydrocarbons and drilling mud. Average dimensions are approximately 130 feet wide by 150 feet long by 12 feet deep, although specific configurations vary by site. The cell may receive only drilling and production wastes associated with the exploration, development, or production of crude oil, natural gas or hydrocarbon-contaminated solids. The disposal of hazardous or other waste in a containment cell is prohibited. After the well is deepened, the residue in the reserve pit is often dewatered and the fluids are injected into the well annulus. An inventory of injection operations including volume, date, type and source of material injected is maintained by requirement. Following completion of well activities, the material remaining in the pit is permanently encapsulated in the impermeable liner. Fill and organic soil is placed over it and proper drainage is re-established. Surface impoundments within 1,500 feet are sampled on a periodic basis and analyzed. In addition, groundwater-monitoring wells are drilled and sampled on a regular basis. If there are uncontained releases during operations, or if water samples indicate an increase in the compounds being monitored, additional observation may be required.

Substances proposed for disposal that are classified as “hazardous” undergo a more rigorous and thorough permitting and review process by both ADEC, per 18 AAC 62 and 63, and the EPA.

d. Air Quality Control Permit to Operate

The federal Prevention of Significant Deterioration (PSD) program, which is administered by ADEC, establishes threshold amounts for the release of byproducts into the atmosphere. Oil and gas exploration and production operations with emissions below predetermined threshold amounts must still comply with state regulations designed to control emissions at these lower levels (18 AAC 50). Activities that exceed pre-determined PSD threshold amounts, such as the operation of turbines and gas flares, are subject to a more rigorous application and review process.

For oil and gas activities, these regulations require a permit to flare gas during well testing (a safety measure) or when operating smoke-generating equipment, such as diesel-powered generators. Permit conditions will induce additional scrutiny if a black smoke incident exceeds 20 percent opacity for more than three minutes in any one-hour period.

The burning of produced fluids is prohibited unless failures or seasonal constraints preclude storage in tanks, backhauling, or reinjection. Liquids must be burned in smokeless flares when incinerated. The open burning of produced liquids is prohibited, except under emergency conditions.

Gas produced as a by-product of oil production is usually re-injected into the producing formation to maintain pressure and support further oil production. Flaring is not an approved method of disposal. However, as a safety measure and backup for standard gas handling systems, production facilities which separate oil, gas and water are capable of flaring large volumes of gas. Flaring occurs when the oil and gas separation process is interrupted, or when an unplanned event requires an immediate release of pressure. Pilot flares are an operational necessity and are subject to permit requirements as well.

e. Clean Water Act 401 Certification

Under 18 AAC 15.120, a person who conducts an operation that results in the disposal of wastewater into the waters of the state need not apply for a permit from ADEC if the disposal is permitted under an NPDES permit and ADEC has certified the permit. When an NPDES permit is issued under Section 401 (33 U.S.C. § 1341) of the Clean Water Act, ADEC participates by certifying that the discharge meets state and federal water quality standards. The ADEC certificate is termed a Certificate of Reasonable Assurance.

When an application is made to EPA, a duplicate must be filed with ADEC and public notice of the certification application is published jointly by EPA (40 C.F.R. 125.32) and ADEC (18 AAC 15.140). As a result, the state and federal reviews run concurrently. Public comment is sought and a hearing can be requested.

Following an EPA determination, but within 30 days, ADEC must provide the applicant, EPA, and all persons who submitted timely comments with a copy of the certification. The decision may impose stipulations and conditions (such as monitoring and/or mixing zone requirements), and any person disagreeing with the decision may request an adjudicatory hearing (18 AAC 15.200 - .920). Once the activity begins, both EPA and ADEC have the responsibility to monitor the project for compliance with the terms of the permit.

The Corps of Engineers' Clean Water Act 404 permit program (see Corps of Engineers, Section 6 below) also requires certification under section 401 of the Clean Water Act and it is processed in a similar manner.

f. Review Process

Following receipt of an application for a solid waste disposal, wastewater, or air quality permit, ADEC must publish two consecutive notices in a newspaper of general circulation in the area affected by the proposed operation, as well as through other appropriate media. Comments must be submitted in writing within 30 days after the second publication and a public hearing may be requested. A hearing will be scheduled if good cause exists. Notice of a public hearing is handled in a manner similar to that of the initial application.

A decision on an application includes (1) the permit, (2) a summary of the basis for the decision and (3) provisions for an opportunity for an adjudicatory hearing (18 AAC 15.200). The decision, as conditioned, is sent to the applicant as well as each person or entity that submitted timely comments or testified at a public hearing. Permits may be valid for up to five years. Renewals are treated the same as the original application, but they do not receive public notice.

3. Alaska Department of Fish and Game

ADF&G evaluates the potential effect of any activity on fish and wildlife, their habitat, and the users of those resources. ADF&G requires permits for any oil and gas related activity in state game refuges, sanctuaries and critical habitat areas. Special Area management plans provide guidelines for certain activities within many legislatively designated areas. By statute, these areas are jointly managed with ADNR. Permits are conditioned to mitigate impacts. For example, timing restrictions may be used to limit the impact on wildlife during sensitive life-cycle periods. There are currently no state game sanctuaries or critical habitat areas on the North Slope.

Decisions are based upon recommendations provided by area staff, the commenting agencies and coastal districts. For permits issued for activities in anadromous streams, an applicant may appeal a rejection or stipulation through procedures described in the Administrative Procedures Act.

4. Alaska Oil and Gas Conservation Commission

AOGCC administers the Alaska Oil and Gas Conservation Act, AS Title 31. The AOGCC may investigate to determine whether waste of oil and gas resources exists or is imminent. It is also responsible for ensuring that accurate metering and measuring of oil and gas production takes place.

The commission maintains programs to ensure that the drilling, casing, and plugging of a well occurs in a manner that prevents: (1) escapement from one stratum into another; (2) the intrusion of water into an oil or gas horizon; (3) the pollution of fresh water supplies; and (4) blowouts, cavings, seepage and fires. For conservation purposes, the commission regulates certain aspects of the drilling, production, and plugging of wells in addition to well spacing, the disposal of salt water and oil field waste and the contamination of underground water.

Reports, well logs, drilling logs and other information must be filed with the commission for each well drilled. The information is confidential until the land from which the data was acquired is no longer subject to a lease, two years after receipt by the state or until the lease expires, whichever is first.

a. Permit to Drill

Before drilling, a Permit to Drill, valid for 24 months, must be obtained from AOGCC (AS 31.05 and 20 AAC 25). The permit application informs the commission of a proposed operator's engineering and safety plans designed to ensure the structural and mechanical ability of the well to contain fluids and gases that could be encountered at various depths and under varying pressure. A diagram of the proposed blow-out prevention (BOP) equipment (used for secondary well control) and an analysis of expected down-hole pressures must be included with the application. A BOP, along with related well-control equipment, must be installed, used, maintained and tested as necessary to assure control over the well and must conform to the latest technology and accepted industry practice.

Casing, cementing, and drilling fluid programs are also designed to ensure primary well control. A drilling fluid monitoring program must be in place to detect gases entrained in the drilling fluid and hydrogen sulfide, a poisonous gas.

Before beginning to drill, an operator must post a bond of $100,000 in favor of the state for a single well, or $200,000 for a blanket bond covering more than one well. The purpose of the bond is to ensure that a well is properly completed or abandoned.

For exploration wells, a well-site survey is conducted using seismic techniques. The data from the seismic survey is analyzed to detect shallow gas in near-surface strata to a depth of 2,000 feet, and the depths of suspected overpressured strata are predicted. For offshore wells, an analysis of seafloor conditions is required.

If climatic conditions and operational or environmental concerns become apparent, or if unanticipated circumstances prevent the continuation of an approved program, an operator can secure a well and apply for an operational shut down. When a well is abandoned, plans for setting plugs, mudding, cementing, shooting, testing, and removing the casing must be submitted to AOGCC for approval. Wells may remain abandoned or suspended for long periods of time. Until final plans are made, the commission seeks to prevent the movement of fluids into or between freshwater and/or hydrocarbon sources.

After abandonment, a location clearance is required. For onshore locations, materials, supplies, structures, and installations must be removed, debris properly disposed of, and the reserve pit filled and graded. The location must be left uncontaminated, in a clean condition acceptable to state inspectors.

b. Disposal of Wastes

AOGCC must also review and approve proposals for the underground disposal of water and oil field waste (20 AAC 25.252). Before receiving an approval, an operator must demonstrate that the movement of fluids into freshwater sources will not occur. Disposal must be into a well with equipment designed to ensure a controlled release. A plat is required showing the location of other wells within one-quarter mile that penetrate the same disposal zone, and surface owners located within one-quarter mile must be provided with a copy of the application.

Along with a description of the fluid to be injected (composition, source, daily amount and disposal pressures), the application must contain the name, description, depth, thickness, lithologic description and geological data of the disposal formation and adjacent confining zones. Evidence must be presented that demonstrates the disposal well or storage operation will not initiate or propagate fractures through the confining zones that allow fluids to migrate. In addition, a laboratory analysis is required. Under certain circumstances, however, a fresh water aquifer exemption may be granted (20 AAC 25.440).

Following approval, liquid waste from drilling operations may be pumped into a well drill pipe, casing or annulus. The pumping of drilling mud from reserve pits (not runoff) into exploration or stratigraphic test wells or into the annuli of a well approved in accordance with 20 AAC 25.080 is an operation incidental to drilling of the well, and is not a disposal operation subject to regulation as a Class II well under EPA regulations.

c. Annular Injection

An AOGCC permit is required if fluid is to be injected into a well annulus. The material must be incidental to the drilling of a well (muds and cuttings). AOGCC may take all actions necessary to allow the state to acquire the primary enforcement responsibility for the control of underground disposal related to the recovery and production of oil and natural gas. ADEC considers the volume, depth and other physical and chemical characteristics of the formation designated to receive the waste. Annular disposal is not permitted into water-bearing zones where dissolved solids or salinity concentrations fall below predetermined threshold limits. Waste not generated from a hydrocarbon reservoir cannot be injected into a reservoir.

d. Review Process

AOGCC actions that have statewide application, such as adopting regulations, are conducted in accordance with the Administrative Procedures Act. Major actions that result in conservation orders that apply to a single well or field receive public notice by publication in a newspaper (20 AAC 25.540). In addition, a mailing list is maintained for the purpose of sending notices, orders or publications to those who request them.

5. U.S. Environmental Protection Agency

a. NPDES Permit

The federal Clean Water Act requires a NPDES permit to release pollutants into the waters and wetlands of the United States. The permitting system is designed to ensure that discharges do not violate state and federal water quality standards by identifying control technologies, setting effluent limitations, and gathering information through reporting and inspection.

Typically, approved discharges are covered by a general permit developed through a public review process after the EPA has identified the specific location of a proposed discharge in an Authorization to Discharge. When a general permit for a specific geographical area does not exist, proposed discharges are subject to an individual approval process and NPDES permit.

A NPDES permit covers the discharge of drilling muds, cuttings and wash water, as well as deck drainage, sanitary and domestic wastes, desalination unit waste, blow-out preventer fluids, boiler blowdown, fire control system test water, non-contact cooling water, uncontaminated ballast and bilge waters, excess cement slurry, water flooding discharges, produced waters, well treatment fluids and produced solids. In Alaska, ADEC issues certifications of EPA NPDES permits relative to state water quality standards.

b. Typical Permit Requirements

Only pre-approved discharges may be released and each must be emitted in accordance with an effluent limitation designed for that particular emission at that point of discharge. The permit may be modified or revoked after it is issued if new information justifies different conditions, or if new standards are promulgated that are more stringent than those in the original approval. For example, existing permits prohibit discharges within 1,000 meters of river mouths, and specially designed monitoring programs are required within 1,500 meters of areas considered sensitive.

In all cases, mixing zones are established at the discharge point and produced waters are passed through at least one oil separator before discharge. Under certain conditions verification studies may be required of the mixing zone; discharge limitations are then applied as the emission passes through the mixing zone.

Only pre-approved drilling muds, specialty additives and mineral oil pills may be discharged and maximum concentrations are specified. For each mud system, a precise chemical inventory of its constituents is maintained. Free oil or oil-based muds (those containing oil as the continuous phase, with water as the dispersed phase) may not be discharged at any time. The oil content of a discharge must be analyzed: (1) at the time the fluid or additive is used; (2) when a drilling fluid could become contaminated with hydrocarbons from an underground formation; and (3) immediately when the static sheen test of a discharge indicates violation. Water-based drilling fluids that have contained diesel oil or cuttings associated with muds that contain diesel oil may not be discharged. In state waters, the discharge of cuttings with an oil volume greater than 5 percent by weight, or the discharge of free oil as a result of discharging drilling muds or cuttings is prohibited as well. A static sheen test is performed daily on emission samples as well as prior to any bulk discharge. Generally, the discharge of floating solids or visible foam is not allowed. Surfactant, dispersant and detergent discharges are minimized, but may be allowed to comply with occupational health and safety requirements. In all cases, deck drainage and wash water must go through an oil/water separator; the effluent is tested and any discharge that would cause sheen on the receiving waters is prohibited.

c. Spill Response Plan (C-Plan)

Owners or operators of non-transportation-related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing or consuming oil and oil products must prepare a spill prevention control and countermeasures plan (C-Plan) in accordance with 40 C.F.R. § 112. Drilling rigs are included in this facility definition. The purpose of the C-Plan is to prevent discharges of oil into navigable waters of the U.S. and the adjoining shorelines. The plan must address three areas:

- operating procedures installed by the facility to prevent oil spills;
- control measures installed to prevent a spill from entering navigable waters; and
- countermeasures to contain, cleanup and mitigate the effects of an oil spill that impacts navigable waters.

The C-Plan is facility-specific and is part of the required documentation that must be present at the facility for inspection. The owner or operator must have the plan certified by a registered engineer but does not submit it to EPA for approval prior to the beginning of operations. If the facility discharges more than 1,000 gallons or harmful quantities of oil in one event or experiences more than two discharges in a twelve-month period, the operator must submit the C-Plan to the EPA and ADEC for review. The C-Plan differs from the facility response plans (FRP) required by OPA 90 in that the C-Plan focuses on prevention and the FRP focuses on response. See also Section 2.a. above.

d. Review Process

Discharges needing authorization before a general permit is issued require individual permits (40 C.F.R. § 122). Once EPA receives an application for a proposed discharge, a draft permit and fact sheet is prepared to address the proposal. Public notice solicits comments and provides notification of state certification under section 401 of the Clean Water Act.

The review process requires a minimum period of 30 days for public comment and all comments received must be in writing. Public hearings, if scheduled in the original notice, will be canceled if there is no interest in holding them; however, anyone can request a hearing.

An individual permit will not take effect for 30 days, during which time an aggrieved party who earlier submitted written comments may request an evidentiary hearing. EPA will respond by issuing a finding identifying the qualifying issues to be decided before an adjudicatory law judge. For general permits, notice must be published in the Federal Register and issuance may be challenged for 120 days (40 C.F.R. § 124).

A permit will not be issued unless ADEC certifies that the discharge will comply with the applicable provisions of the Clean Water Act and Alaska water quality standards. The certification process is addressed in an agreement between EPA and ADEC. Persons wishing to comment on a state consistency determination or 401certification must submit written comments within the 30-day comment period.

6. U.S. Army Corps of Engineers

a. Section 10 of Rivers and Harbors Act of 1899 (33 U.S.C. § 403)

A Corps permit is required when work is anticipated on, in, or affects navigable waters. A Section 10 Permit addresses activities that could obstruct navigation. Oil and gas activities requiring this type of permit include exploration drilling from a jackup drill rig, installation of a production platform, or construction of a causeway. The process and concerns are similar to those required for Section 404 approval and, at times, both may be required.

b. Clean Water Act Section 404 Permits

Section 404 of the Clean Water Act established a program to regulate the discharge of dredged and fill material into waters and wetlands of the United States. Activities in waters within the United States that are regulated under this program include fills for development, water resources projects such as dams and levees, infrastructure development such as highways and airports, and conversion of wetlands to uplands for farming, forestry, or other purposes. This program mandates that no dredged or fill material may be discharged in a water body or wetland if a practical alternative disposal method can be utilized. A Section 404 Permit applicant must demonstrate that: (1) steps will be taken to avoid wetland impacts where practicable; (2) steps will be taken to minimize potential impacts to wetlands; and (3) the applicant will provide compensation for any remaining unavoidable impacts through activities to restore or create wetlands. In exercising its permitting authority, the USCOE invites review and comment from state and federal agencies. In Alaska, the ADEC issues CWA Section 401 Certifications of USCOE 404 Permits.

c. General Permits

Some oil and gas activities undergo individual project reviews. Under this process, the USCOE evaluates projects on a case-by-case basis and conducts a public interest determination (33 C.F.R. § 320). The Corps also issues general permits that carry a standard set of stipulations that cover frequent, repetitive and similar activities when, individually and cumulatively, there will be a minimal environmental effect. A general permit describes the activity covered and includes appropriate proposed stipulations and mitigation measures. This type of permit generally has a geographical limitation. There are 36 nationwide general permits, and the Alaska District has an additional 21.

d. Letters of Permission (LOP)

LOPs are a type of permit that, once approved for issuance after a public review process, undergo individual, but abbreviated, reviews. These activities are routine and have been determined to have no significant environmental effect. In Alaska, LOPs are used only for activities that might have an effect on navigable waters under section 10.

e. Review Process

Upon receipt of an application, the Corps solicits comments from the public, federal, state and local agencies as well as other interested parties to assess the impact of the proposed activity on aquatic resources, endangered species, historic properties, water quality, environmental effects and other public interest factors. Most public comment periods last 30 days and a public hearing can be requested.

The U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), ADNR, ADF&G submit comments to the Corps in accordance with the Fish and Wildlife Coordination Act. These comments address compliance with section 404(b)(1) of the Clean Water Act as well as the measures the agencies consider necessary for the protection of wildlife resources. Under the Endangered Species Act of 1973, endangered species that frequent the area are identified and the effect the proposed activity might have on them or their habitat is considered. In some cases, an environmental assessment or environmental impact statement may be required by the National Environmental Policy Act.

An application to the Corps serves as an application to ADEC for state water quality certification as required under section 401 of the Clean Water Act of 1977 (P.L. 95-217) and must be reviewed by EPA. The application is reviewed in light of the Act, the Alaska Water Quality Standard, and other applicable state laws. For placing fill in wetlands, water quality stipulations included in the 401 Certification become part of the Corps permit (ADEC 401 Certification in 18 AAC 15.130-180).

The public interest review (33 C.F.R. § 320.4) considers guidelines set forth under section 404(b) of the Clean Waters Act. The guidelines outline a mitigation sequence applicable to all waters, including wetlands, which must be followed in the decision-making process. A permit will be denied if the contemplated discharge does not meet the required standards. For placement of fill, the mitigation sequence requires avoiding wetlands where practicable, minimizing impact where avoidance is not practicable, and compensating for impact to the extent appropriate and practicable.

In addition, a review of cultural resources is coordinated with the state's Historic Preservation Office. Archeological or historical data that could be lost or destroyed by the proposed activity is considered and presented in the Corp's final assessment of the described project.

A decision to issue a permit, with mitigation measures included, is based upon an evaluation of the probable impacts (including cumulative impacts) of a proposed activity. Benefits that can reasonably be expected to accrue are balanced against reasonably foreseeable costs. Factors relevant to the decision are resource conservation, economics, aesthetics, general environmental concerns, wetlands, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation water, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, property ownership, and the needs and welfare of the people in general.

7. North Slope Borough

The North Slope Borough has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes (AS 29.40.020-040). These regulations are Title 19 of the NSB Municipal Code and require borough approval for certain activities necessary for exploration and development of lease contracts. The borough can assert its land management powers to the fullest extent permissible under law to address any outstanding concerns regarding impacts to the area's fish and wildlife species, and habitat and subsistence activities.

The North Slope Borough Coastal Management Plan (NSBCMP) has been incorporated into the ACMP. The program presents policies to regulate activities in the borough's coastal zone. Consistency with the ACMP standards and the policies of the NSBCMP is discussed in the Alaska Coastal Management Consistency Analysis and the final consistency determination.

8. Other Requirements

a. Native Allotments

Lessees must comply with applicable federal law concerning Native allotments. Activities proposed in a plan of operations must not unreasonably diminish the use and enjoyment of lands within a Native allotment. Before entering onto lands subject to a pending or approved Native allotment, lessees must contact the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) and obtain approval to enter.

b. U.S. Coast Guard

The U.S. Coast Guard has authority to regulate offshore oil pollution under 33 C.F.R. §§ 153-157.

c. Rehabilitation Following Lease Expiration

Upon expiration or termination of the lease, paragraph 21 of the lease contract requires the lessee to rehabilitate the lease area to the satisfaction of the state and ASRC. The lessee is granted one year from the date of expiration or termination to remove all equipment from the lease area and deliver up the lease area in good condition.

d. Applicable Laws and Regulations

In addition to existing laws and regulations applicable to oil and gas activities, DO&G requires, under paragraph 26 of the state's standard lease contract, that leases be subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases will also be subject to all future laws and regulations placed in effect after the effective date of the leases to the full extent constitutionally permissible and will be affected by any changes to the responsibilities of oversight agencies.

Chapter Two: Property Description and Petroleum Potential

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Chapter Two: Property Description and Petroleum Potential

A. Property Description

The sale area consists of uplands located just south of the Beaufort Sea coast, between the National Petroleum Reserve-Alaska (NPRA) and the Arctic National Wildlife Refuge (ANWR), with the Umiat baseline as its southern boundary (see Figure 1.1 and Chapter One). The entire sale area is onshore.

The sale area includes the Arctic coastal plain, between the Staines and Canning Rivers on the east and the Colville River on the west. This region is slightly smaller than the state of Massachusetts, encompassing more than 5 million acres of coastal lowlands, north-flowing braided rivers, and streams, lakes, and gently rolling hills and valleys. The southern boundary forms the east-west Umiat baseline located at about 69 degrees, 23 minutes north latitude where ground elevation varies between 500 and 1,200 feet above sea level. Elevation throughout the sale area is a key factor in the distribution of plants and animals as described in Chapter Three (AEIDC, 1975).

Prominent geographic features include the White Hills and Franklin Bluffs. Following the Sagavanirktok River to the south, the first 60 miles of the trans-Alaska oil pipeline bisects the sale area. The area also includes portions of numerous rivers, including the Colville, Miluveach, Kachemach, Itkillik, Anaktuvuk, Chandler, Ugnuravik, Sakonowyak, Kuparuk, Toolik, Putuligayuk, Sagavanirktok, Kadleroshilik, Ivishak, Shaviovik, Kavik, Staines, and Canning.

The entire sale area is within the North Slope Borough. This home rule borough, incorporated in 1972, extends from the Chukchi Sea to the Canadian border. The borough has the powers of taxation, land management and zoning, and is responsible for providing borough communities with public works, utilities, education, health, and other public services. The sale area includes lands in the vicinity of Nuiqsut on the Nechelik Channel of the Colville River, and the industrial community of Deadhorse at Prudhoe Bay. Nuiqsut residents rely heavily on the sale area for subsistence resources. Other borough residents from Kaktovik, Barrow, and Anaktuvuk Pass may travel to the sale area for subsistence (see Chapter Four).

B. Surface and Subsurface Ownership

The state of Alaska owns the surface of most of the sale area. Other surface estate owners within the general sale area boundary include Arctic Slope Regional Corporation (ASRC), the City of Nuiqsut, the North Slope Borough, the federal government, and many Native allottees. The state of Alaska owns most of the subsurface estate beneath the sale area; ASRC and the Kuukpik Village Corporation (Nuiqsut Village) also hold some mineral interests in the area.

The Alaska Statehood Act allowed the state of Alaska to select from the federal public domain 102.5 million acres of land as an economic base for the new state. The act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying interests in the surface estate. The Alaska Native Claims Settlement Act (ANCSA), passed by Congress in 1971, allowed newly created regional Native corporations to select and obtain from the federal domain lands including the surface and subsurface estates within Native corporation boundaries as an economic base. It also allowed for Native village corporations and individual Native Alaskans to receive surface estate interests in land for their economic benefit.

1. Surface Estate

The surface estate of the uplands in the sale area fall into one of three ownership categories: land owned by the state of Alaska, land owned by ASRC or the Kuukpik Village Corporation (Nuiqsut), and land owned by Native allottees. With the exception of the bed of the Colville River, which is owned by the state, the surface estate of the uplands within the Colville River delta portion of the sale area falls into one of two ownership categories: land owned by the Kuukpik Village Corporation (Nuiqsut), and land owned by Native allottees. Kuukpik village land includes lands within and outside of NPRA.

Village-Owned Lands Outside of NPRA: ANCSA allowed the Village of Nuiqsut (Kuukpik Corporation) to select and acquire lands in the Colville River delta. Of Kuukpik's total entitlement of 115,000 acres (five townships), approximately 70,000 acres (three townships) could be selected outside of NPRA on lands that had been tentatively approved for conveyance to the state of Alaska. Under provisions of ANSCA, ASRC was allowed to acquire the subsurface estate beneath these lands. The 1974 agreement between Kuukpik, ASRC, and the state of Alaska, and the 1992 settlement agreement between ASRC and Kuukpik provided for the right of access to Kuukpik's surface. ASRC and the state of Alaska, their successors, assigns, and lessees were allowed to conduct oil and gas activities on Kuukpik's lands east of NPRA under the provisions of the 1992 settlement agreement, the lease, and, to the extent applicable, the requirements of AS 38.05.130.

Village-Owned Lands Inside of NPRA: In order to fully satisfy its land entitlement under ANCSA, Congress allowed Kuukpik to select certain lands within NPRA. Section 1431(o) of Alaska National Interest Lands Conservation Act (ANILCA) allowed ASRC an option to acquire the subsurface estate beneath these village lands, provided that the village corporation concurred. In 1987, Kuukpik conditionally concurred to ASRC's acquisition of these subsurface interests. ASRC subsequently conveyed an undivided ownership interest to certain sections of these lands, located along the Nechelik Channel of the Colville River, to the state of Alaska under the 1991 settlement agreement between the state of Alaska and ASRC (see above). In January 1996, ASRC initiated a lawsuit in federal court seeking a declaratory judgment that Kuukpik's consent rights under Section 1431(o) of ANILCA, the 1987 consent agreement and Section 14(f) of ANCSA do not constitute an absolute veto over exploration and development of ASRC's subsurface in NPRA, and that Kuukpik's consent may not be unreasonably withheld. The federal court ruled that the lawsuit lacked federal jurisdiction and dismissed the case. No other litigation has been initiated and the dispute remains unsettled.

Should these jointly-owned lands within NPRA be offered and leased, the lessee may not exercise its access rights to the Kuukpik-owned surface until the lessee makes provisions to compensate the landowner for all damages sustained by reason of entering upon the land as required by the lease and, to the extent applicable, the requirements of AS 38.05.130 as required in the terms of the lease.

Native Allotments: The surface estates to certain lands within the sale area are owned by Native allottees. Should these jointly-owned lands be offered and leased, rights to exploration and development of the oil and gas resources may not be exercised until the lessees make provisions to compensate the landowner for all damages sustained by reason of entering upon the land as required by the lease, and, to the extent applicable, the requirements of AS 38.05.130.

2. Subsurface Estate

a. Agreement between State of Alaska and Arctic Slope Regional Corporation

The subsurface estate within the portion of sale area located within the Colville River delta is jointly owned by the state and ASRC. The joint ownership is the result of an agreement between the state and ASRC that was signed December 17, 1991, approved by the legislature and became effective on May 27, 1992. The agreement settled a long-running legal dispute concerning North Slope mineral ownership near Nuiqsut and Point Lay resulting from a 1974 agreement in which ASRC and the state agreed to exchange lands near Nuiqsut and Point Lay. Under the 1991 settlement, the state and ASRC agree to jointly own undivided interests in certain minerals (including oil and gas) in the mineral estate of disputed lands. The settlement also grants the state the executive right to hold oil and gas lease sales jointly for itself and ASRC.

If and when such lands are leased, the state and ASRC separately administer the lease with respect to its own undivided interest in the subsurface (the lessee must obtain a permit or approval from both the state and ASRC). The two parties have what is essentially an identical but separate relationship with the lessee with respect to the same mineral estate. Although such mineral cotenancies (possession of a unit of property by two or more persons) are unusual in Alaska, this is a frequent occurrence in other states, like Texas, where land ownership is more complicated. The agreement involves only the mineral estate; it does not change the surface ownership. The surface of the uplands within the agreement area near Nuiqsut is owned by the Kuukpik Corporation and by individual Native allotment holders. The subsurface estate beneath the tide and submerged lands, and bed of the Colville River within the sale area, are also jointly owned by the state and ASRC.

Under the settlement agreement, the state does not give up any of its duties to the public imposed by law. The state still must determine whether a sale would be in the best interests of the state, and must follow relevant substantive and procedural requirements for leasing and for permitting subsequent exploration, development and production. The state retains all rights under state law to ensure that development activity on leased tracts complies with laws governing natural resource management and protection.

b. Agreement between Arctic Slope Regional Corporation Agreement and the Kuukpik Corporation

Portions of the sale area are located within NPRA, and may also be subject to a 1987 land selection consent agreement between ASRC and the Kuukpik Corporation (Nuiqsut village). In that agreement these parties consented and agreed as follows:

(1) Kuukpik hereby gives its concurrence for ASRC to exercise its option under 1431(o) of ANILCA to acquire the ASRC Subsurface, but Kuukpik expressly conditions its concurrence in such acquisition of the ASRC Subsurface by reserving the right to consent to any Exploration and Development Activities that ASRC, its successors and assigns, may engage in from time to time with respect to the ASRC Subsurface.

(2) ASRC agrees that it will not engage in any Exploration and Development Activities with respect to the ASRC Subsurface without first obtaining the consent referred to in paragraph 1 of this agreement.

ASRC received title to these lands subject to this agreement. The state of Alaska received its undivided interest to the subsurface estate beneath these lands from ASRC in 1992, 1993, and 1994. The state’s title and leases issued on these lands are, therefore, also subject to the 1987 ASRC-Kuukpik Agreement.

Copies of the 1974 agreement, the 1991 settlement agreement between the state of Alaska and ASRC (which includes the 1987 ASRC-Kuukpik Agreement), and the 1992 settlement agreement between Kuukpik and ASRC will accompany the lease for any of the tracts to which the agreement applies. Copies of all agreements are available for review in the ADNR’s Public Information Center and are also available from DO&G on request.

C. Physical Characteristics

1. Geology

Northern Alaska is made up of three distinct geologic regions: the Brooks Range, the Arctic Foothills, and the Arctic coastal plain (Moore, et al., 1994). The sale area is located in the center of the Arctic coastal plain, and rock sequences with known petroleum potential underlie the entire region. The rocks under the sale area are exposed at the surface in the Brooks Range. Rock sequences are formed by geologic events and are often described in terms of the time period during which they were formed (see Table 2.2).

Table 2.1 Geologic Time and Formations

Eras	Periods	Epochs	Began Approximate Number of Years Ago
Cenozoic	Quaternary	Holocene (Recent)	10,000
		Pleistocene (Glacial)	1 million
	Tertiary	Pliocene	7 million
		Miocene	25 million
		Oligocene	40 million
		Eocene	60 million
		Paleocene	68-70 million
Mesozoic	Cretaceous	Upper and Lower	135 million
	Jurassic		180 million
	Triassic		225 million
Paleozoic	Permian		270 million
	Pennsylvanian		325 million
	Mississippian		350 million
	Devonian		400 million
	Silurian		440 million
	Ordovician		500 million
	Cambrian		600 million

Source: Webster's Ninth New Collegiate Dictionary, 1991:512; AEIDC, 1975:37

The Brooks Range consists of east-west trending mountain groups that reach heights in excess of 6,000 feet. Rocks of pre-Mississippian age (350 million-plus years) to Tertiary age (7 million-plus years) are exposed due to extensive uplift, folding, and faulting. There is little to no oil and gas potential in the Brooks Range because of this extensive deformation and uplift, however these pre-Mississippian to Tertiary-age rocks are studied by petroleum geologists, because they do contain petroleum where they occur beneath the sale area.

The Arctic Foothills is a narrow province between the Brooks Range and the Arctic coastal plain, consisting of a series of rolling hills, mesas, and east-trending ridges that descend from 1,500- to 900-foot elevations. The rocks in this area are less deformed and younger than those to the south.

The Arctic coastal plain contains surface sediments which were formed by fluvial (moving water) and deltaic deposition. These sediments are relatively uniform sandy silts (Craig, et al., 1985). The coastal plain is underlain by the Colville basin; a large east-west trending foreland basin of Cretaceous (135 million-plus years) to Tertiary age (7 million-plus years). The subsurface geology of this area and the history of previous petroleum production and exploration make it the most prospective area for hydrocarbons in northern Alaska.

The history of rocks beneath the sale area is marked by periods of continental rifting, mountain building, and sedimentary deposition. This history is marked by four distinct geologic sequences of rocks with each having a unique sediment source area, depositional environment, and structural character. As these major rock sequences were being formed, relatively smaller-scale events, such as changes in sea level, altered the depositional environment and created additional internal complexities. The four major rock sequences from oldest to youngest (the oldest rocks are the deepest) are: the Franklinian, Ellesmerian, Rift, and the Brookian. The order of events in the evolution of the area geology was (see Figure 2.3):

1. A stable early Arctic Continental Platform before Devonian time,
2. onset of continental rifting with uplift to the north of this stable Arctic platform and deposition of sediments southward; and
3. continued rifting, uplift, and termination of deposition from the north, along with uplift of the Brooks Range and deposition of sediments from the south onto the Arctic coastal plain.

The oldest rock sequence, the Franklinian, may have once been a stable Arctic continental platform before middle Devonian time (about 400 million years ago). This sequence is also referred to as the pre-Mississippian sequence, because of a lack of continuous geologic information. The Franklinian sequence contains a wide range of rock types that include volcanics, granites, carbonates, and metamorphosed argillites. Due to its geology and tectonic history, the Franklinian sequence is considered to have low petroleum potential (Richter, 1997).

During middle to late Devonian time, a mountain-building and rifting event uplifted the Franklinian sequence, deforming and metamorphosing the rocks in the process. Sediments from the uplifted Franklinian sequence spread southward into the large arctic basin (epicontinental shelf). This process continued through to late Cretaceous time. These northerly-sourced sediments formed the Ellesmerian sequence (Moore, et al., 1994).

The Ellesmerian sequence is the most important geologically in terms of petroleum production. Formations within the Ellesmerian sequence form the primary petroleum reservoirs at Prudhoe Bay and Endicott. The Ellesmerian sequence contains marine carbonates and quartz- and chert-rich clastic rocks, representing about 150 million years of deposition (Mississippian through Triassic). From the center of the Colville basin, the Ellesmerian thins to the south due to depositional distance from its source and thins to the north due to subsequent uplift and erosion (Moore, et al., 1994).

Rifting of the continental mass dominated the geology by the end of the late Jurassic to late Cretaceous periods. The northern continental source for the Ellesmerian sediments supplied less and less sediment to the Arctic basin as time passed. Uplift and faulting of the Franklinian and Ellesmerian sequence formed fault blocks and grabens (low areas between fault blocks). These grabens were filled by sediments from the locally uplifted or upfaulted Ellesmerian and Franklinian sequences, forming the Rift sequence (Craig, et al., 1985). It is also at this time that the Barrow Arch formed along the present-day Beaufort coast. Sedimentation from the north eventually ended sometime in the Late Cretaceous and the following period of non-deposition along with continued uplift along the Barrow Arch created a regional Lower Cretaceous Unconformity (LCU) which becomes angular approaching the Barrow Arch from the south. To the north of the Barrow Arch the Ellesmerian sequence is absent. The LCU is an important migration and accumulation element for most of the oil fields on the North Slope, including Prudhoe Bay (Jamison, et al., 1980).

To the south, compressional forces in the Jurassic to early Cretaceous caused thrust faulting in what is now the Brooks Range. Sediments from the thrust faulted blocks in the Brooks Range poured into the Colville basin, progressively filling it from the south, forming the Brookian sequence. Brookian sediments filled the Colville basin and spread out over the Barrow Arch and onto Alaska's continental margin during the upper Late Cretaceous through Tertiary time. Petroleum accumulations in the Brookian sequence are found throughout the North Slope basin, including at West Sak, Schrader Bluff, Flaxman Island, and the Outer Continental Shelf (OCS) accumulation at Hammerhead (Shell Oil's current Sivulliq prospect) (Weimer, 1987).

Onshore present day geology of the sale area is, in general, comprised of a thick section of unconsolidated Quaternary sediments (Brown and Kreig, 1983), deposited within the last 1 million years. These sediments are probably of the Gubik Formation which unconformably overlies the weakly cemented sediments of the upper Brookian sequence. Most Quaternary deposits are unconsolidated sand and gravel composed of reworked Brookian sediments, along with materials from the present-day Brooks Range. Overlying these deposits are ice-rich silts and sandy silts (1.5 meters to 2.5 meters thick at Prudhoe Bay) that include variable amounts of organic matter, which are deposited by the numerous rivers on the North Slope. In addition to these fluvial deposits are local areas of eolian deposits (sand dunes) derived from river silts (Brown and Kreig, 1983).

1. Climate

The entire sale area is within the Arctic climate zone of Alaska. Surface conditions in the Arctic vary dramatically from year to year and day to day. In summer, the climate is generally mild. The three-month ice-free season is critical to biological productivity. In contrast, winters are severe, forcing many species to migrate south.

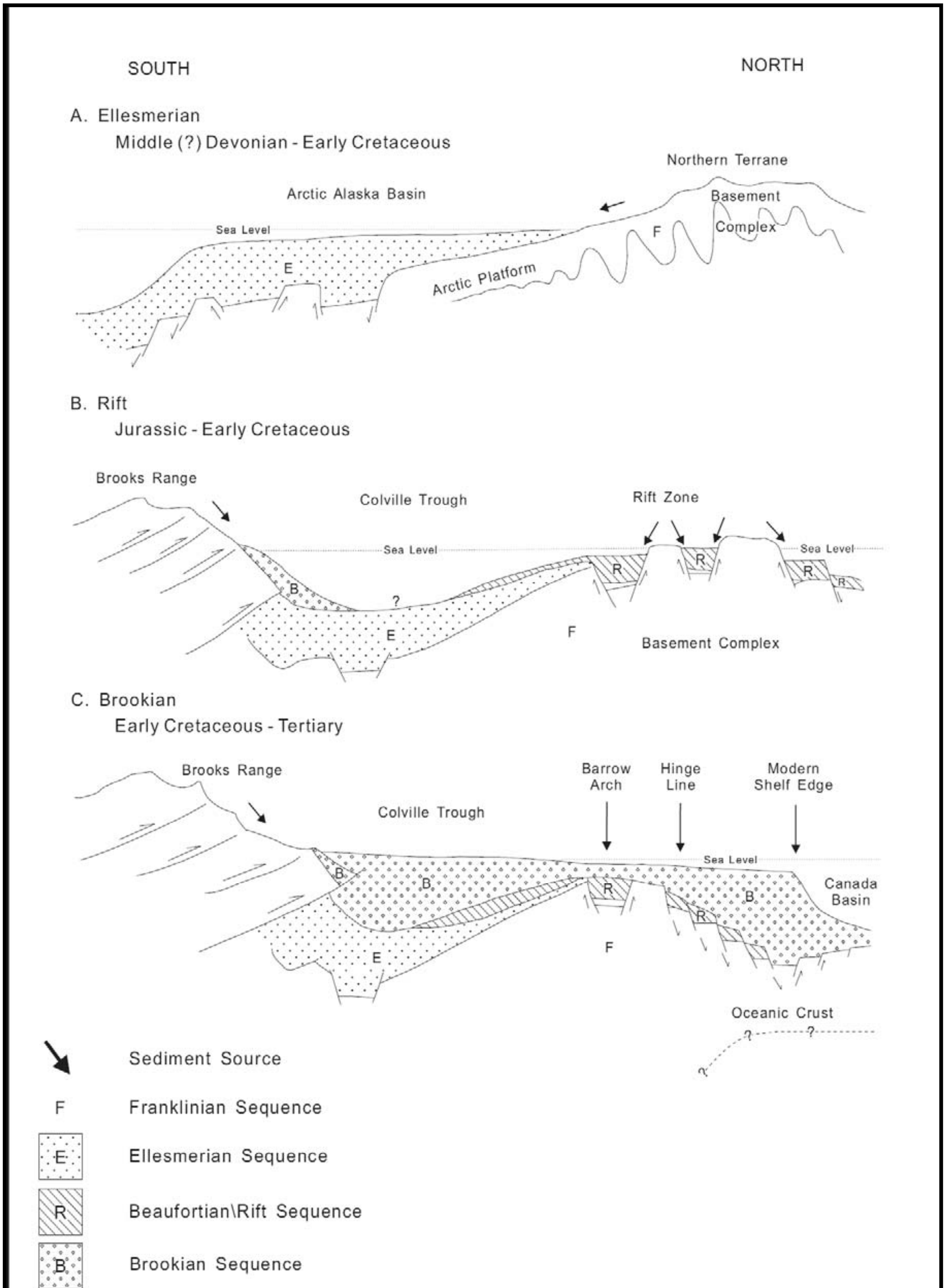
a. Precipitation

Precipitation throughout the sale area varies with location. Heaviest rain and snow falls occur in higher elevations. Along the Beaufort Sea coast, the amount of precipitation is low. Air temperature controls how much moisture the air holds as a vapor. Extremely cold air can contain only very small amounts of water vapor, resulting in low precipitation. Therefore, the frozen region is classified as a desert (AEIDC, 1975). The average annual precipitation ranges from 40 inches in the Brooks Range to 5-8 inches along the foothills and coast (NSSI, 2006). Umiat, at the southern boundary of the sale area receives an average of 5.49 inches of precipitation and 33.0 inches of snowfall each year (Alaska.com, 2006). In contrast, Barrow receives an average of 4.16 inches of precipitation and 29.1 inches of snowfall each year (ACRC, 2006). In the Nuiqsut-Prudhoe Bay area, precipitation averages 4.02 inches with an annual snowfall of 33.1 inches (*Ibid.*). Anaktuvuk Pass, located outside the sale area and deep in the Brook Range receives an average of 11 inches of precipitation and 63 inches of snowfall annually (ADCED, 2006).

a. Temperature

While winters are long, the North Slope is not a year-round icebox. Summer high temperatures range between 40 and 60 degrees Fahrenheit and the sun does not set between May 10 and August 2 (NSSI, 2006). Winter temperatures range between 0 and minus 40 degrees Fahrenheit and the sun does not rise above the horizon from November 18 to January 24 (*Ibid.*). The average annual high temperature for the sale area is around 18 degrees Fahrenheit, with July being the warmest month (Alaska.com, 2006; ACRC, 2006). February is the coldest month and the average annual low temperature is around 4.5 degrees Fahrenheit

Figure 2.1 Evolution of North Slope Geology



Source: Craig and others, 1985

(ACRC, 2006; Alaska.com, 2006). Anaktuvuk Pass is the only part of the sale area with a more continental climate. Average temperature in January, the coldest month, is minus 14 degrees Fahrenheit and the average summer temperature is 50 degrees Fahrenheit (ADCED, 2006).

b. Winds

A semi-permanent area of high pressure is centered approximately 600 miles north of the Alaska Arctic coast. Air continually flows south from this area of higher pressure as a north wind. By the time it reaches the Beaufort Sea coast, its direction is between northeast and east because of the rotation of the earth (AEIDC, 1975). Wind direction is predominately easterly (ACRC, 2006). Sea breezes (air moving inland in response to unequal heating across the coastline) control at least 25 percent of the summer surface wind direction and extend to at least 20 kilometer offshore (MMS, 1996a; Kozo, 1984).

Surface wind speeds along the coast are persistent and strong compared to those in the south. Coastal wind speeds up to 65 mph occur along the coast during winter months, while calm conditions are more common to the south (ACRC, 2006; AEIDC, 1975). Barrow and Barter Island experience calm winds only one percent of the time, while the winds are calm at Umiat about 17 percent (ACRC, 2006; AEIDC, 1975). The average annual wind speed is about 11 mph at Barrow and 13 mph at Barter Island (ACRC, 2006).

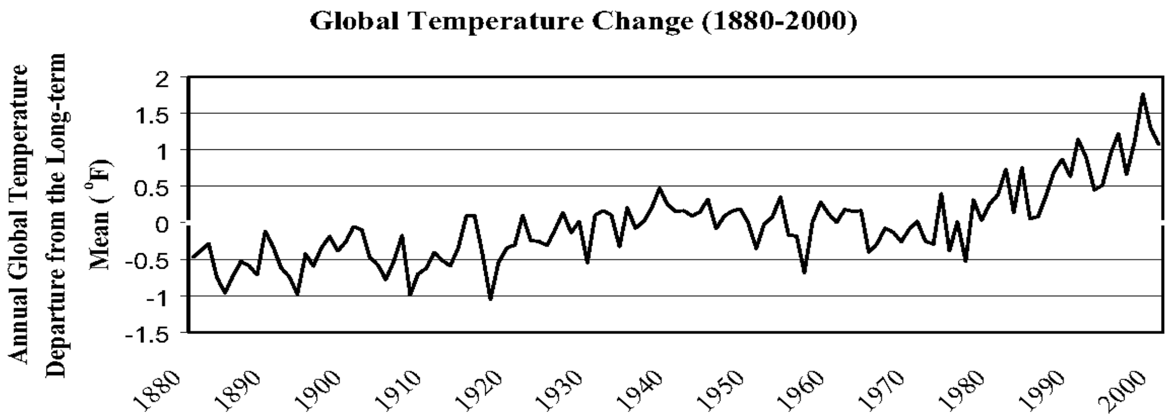
Surface wind conditions affect nearshore currents, the movement of ice floes and oil spills, and the formation and break-up of sea ice. Winds also influence the timing of migratory activity in animals, including arctic fishes, and the relative safety of subsistence harvesting and oil and gas activities in the Arctic (Kozo, 1984). Strong winds produce extensive coastal erosion, and can cause structural damage to buildings. Arctic winds also blow snow and cause whiteout conditions, making surface navigation across the flat, horizon-less coastal plain nearly impossible. Finally, strong winds can severely restrict aircraft travel in the sale area (AEIDC, 1975).

c. Climate Change on the North Slope

Since the late 19th century, average global temperatures have increased 0.5 to 1.0 degree Fahrenheit (BLM, 2005). Temperature increase in Alaska over the last 50 years averages 3.5 degrees Fahrenheit, although the temperature changes vary greatly across the state and more variance has occurred in winter and spring months (ACRC, 2006). A study of oil exploration wells along the Arctic coastal plain and foothills measuring the temperature of permafrost to depths of more than 600 feet estimates that temperatures along the North Slope have increased 4 to 8 degrees Fahrenheit over the last century (BLM, 2005). A general increase in permafrost temperatures in Alaska has also occurred over the last several decades; however the rate of increased slowed in the 1990’s, compared to prior decades (Richter-Menge, et al., 2006). Temperatures in Alaska and throughout the Arctic appear to have fluctuated over the last few centuries. Regional climatic change is difficult to quantify and much less reliable than global estimations (BLM, 2005; ACRC, 2006).

According to the Bureau of Land Management (BLM), global warming would negatively affect the Arctic environment, including tundra, sea ice, and changes in the permafrost depth. Reduction in sea ice as a result of global warming would affect marine mammals (particularly polar bears), fish, and birds, with related implications for Native subsistence harvests. Vegetation is expected to move northward, with forests replacing tundra, and tundra vegetation moving into previously barren areas. Early thawing of rivers may impact caribou migrations to calving grounds. However, some Arctic fisheries may become more productive due to global warming. Global warming would also contribute to a rise in sea level, impacting estuaries and coastal wetlands, and alter regional temperature and rainfall patterns, with major implications to agricultural and coastal communities. In addition, this sea level rise and thawing of tundra could have negative effects on oil and gas-related infrastructure (BLM, 2007). These effects must be considered in determining facility siting, design, construction, and operation and in determining the optimum oil and gas transportation mode. Structural failure can be avoided by proper facility setbacks from coasts and river banks. See Chapter 6, Section A Geophysical Hazards.

Figure 2.2 Global Temperature Change



Source: BLM, 2005, citing USDOC, NOAA, National Climatic Data Center, 2001

2. Hydrology and Soils

The southern half of the sale area lies in the northern foothills of the Brooks Range. These foothills are characterized by irregular buttes, knobs, mesas, east-trending ridges, and intervening, rolling tundra plains. Most streams east of the Colville River are braided with large gravel flats. The Arctic coastal plain west of the Colville River is flat with occasional pingos and a section of active and stabilized sand dunes which rise as high as 40 feet above the plain. East of the Colville River, the White Hills and Franklin Bluffs provide some topographic relief above the plain. The combination of extensive flat terrain, and a continuous layer of permafrost beneath a shallow active permafrost layer result in poorly drained soils and marshes throughout the northern portion of the sale area (AEIDC, 1975).

a. Hydrology

The summer season on the Arctic coastal plain is initiated by extensive spring flooding along the coastal margin. The heaviness of this flooding varies from year to year and depends on factors such as amount of upland snow accumulation and the timing of river ice and sea ice breakup. The speed, direction, and persistence of summer winds determine whether freshwater river runoff accumulates or dissipates in the nearshore waters of the Beaufort Sea. This brief, but heavy, seasonal flood breathes life into all habitats of the sale area after a long dormant winter. River deltas are made up of major and minor channels, and numerous oxbows and lakes. These river deltas, especially the Colville, provide important migrating, spawning, feeding and overwintering habitat for Arctic fish (see Chapter Three). The river systems of the sale area also provide important habitat for many species of birds, like peregrine falcon, and migratory and feeding habitat for caribou, bear, wolves, and foxes. Additionally, subsistence harvesting is heavily dependent on the productivity and species diversity of the rivers, streams, and lakes of the North Slope.

Numerous lakes in the sale area are formed by thermokarst (freeze and thaw) processes. Thermokarst topography consists of mounds, sink holes, tunnels, caverns, short ravines, lake basins, and circular lowlands. Melting of the underlying permafrost creates settling of the soil, resulting in depressional features, such as thaw lakes. On the Arctic coastal plain, thaw lakes are elongated and oriented on a north-northeast axis by prevailing wind patterns. Thaw lakes cover more than half of the total surface area of the plain. In the southern portion of the sale area, lakes are less oriented and are fewer in quantity.

Across the coastal plain, ground-surface depressions cause pooling of water in summer. This pooling causes the underlying permafrost to melt. Thaw continues along lake margins, extending the lake which may merge with other thaw lakes. Eventually, thaw extension of the lake continues until higher ground is breached and the lake is drained through an outlet channel. Some thaw lakes are connected to river channels while others are not. Drained lakes leave behind a marshy depression surrounded by a ridge of surface material (residual), formerly the lake margin. The initial surface residuals rise 10 to 15 feet above the adjacent drained basins and cover about 25 percent of the land surface on the coastal plain (AEIDC, 1975).

b. Soils

Major river corridors of the Colville, Kuparuk, Sagavanirktok, Shaviovik, and Canning are underlain by unconsolidated alluvial (stream laid) deposits. These deposits are: coarse-grained; generally well-drained; not frost-susceptible; provide good foundation material; and are relatively easy to excavate. The uplands between these rivers are overlain by coastal plain deposits. These deposits include both course and fine-grained material, and have generally high silt content, especially near the surface. Coastal plain deposits generally are poorly drained, high in ice content, difficult to excavate, and are frost-susceptible, making them less suitable for foundation material. In the southern portion of the sale area, Tertiary-age bedrock is exposed in the White Hills, Franklin Bluffs, and in the rolling hills to the west of the Canning River. Organic surface material, called peat, is distributed throughout the sale area and provides the bedding to support the tundra mat above. Peat is poorly drained, contains a high content of ice or water, and is commonly removed or filled over prior to construction (AEIDC, 1975). Windblown silts may form thin layers mixed with or underlying the peat layer (AEIDC, 1975).

Permafrost consists of any soil or other superficial deposit, including bedrock, that has been colder that 0 degrees Celsius (C) for two or more years. Permafrost soils may be nearly ice free in coarse, unsaturated materials and may contain more than 50 percent water in finer grain saturated soils. Alaska has two types of permafrost classified as continuous or discontinuous. Continuous permafrost implies that the ground is frozen over nearly all the landscape and is colder than -5 degrees C at the depth below annual seasonal temperature changes (depth varies based on rock type and water content, but is about 15 meters). Discontinuous permafrost is ground that is between 0 degrees C and -5 degrees C and as the term suggests, is not continuous. In discontinuous zones of permafrost, ground on south-facing slopes and under large bodies of water are usually not frozen. Generally the permafrost is continuous north of Atigun Pass (crest of the Brooks Range) (Brown and Kreig, 1983). Heading offshore the permafrost becomes progressively more discontinuous (MMS, 1996).

Near Prudhoe Bay, permafrost extends to a depth of about 600 m, which is also the probable case for most all of the onshore portions of the sale area (Brown and Kreig, 1983; Combellick, 1994, citing to Collett and others 1989). The depth of the active layer, or the layer of seasonal thaw is generally less than 0.9meters and 1.8meters beneath active stream channels. Ice content varies from minor segregated ice to massive ice in the form of ice wedges and pingos. Permafrost, like coastal winds, shallow gas deposits, and earthquakes, is a geophysical phenomenon which may pose hazards to oil and gas operations (see Chapter Six).

D. Exploration History

Oil seeps have long been known to the Inupiat people of the North Slope, who excavated tar-saturated tundra for use as fuel within historic time. Following reports of oil seeps along the coast by early traders, the first geologic and topographic studies were conducted in 1901 and the first formal descriptions were recorded by the U.S. Geological Survey (USGS) in 1919. By 1921, prospecting permits were filed and in 1923, President Harding established the Naval Petroleum Reserve No. 4 (NPR-4) by executive order. The USGS conducted reconnaissance mapping from 1923 through 1926 and published the results in 1930 (Jamison et al, 1980; AEIDC, 1975).

The first exploration phase of NPR-4 ended in 1953. Between 1923 and 1953, the United States Navy drilled 37 test wells and found three oil accumulations and six gas accumulations within and adjacent to the reserve. Only two of these discoveries were considered sizable, namely Umiat, with an estimated 70 million barrels of recoverable oil, and Gubik (partly outside the reserve), with an estimated 600 billion cubic-feet of recoverable gas (Molenaar, 1982; Kumar, et. al., 2002). Gas from another of the discoveries, the small South Barrow gas field, is being produced today for local consumption at Barrow.

BLM opened North Slope lands for competitive bidding in 1958 when 16,000 acres were offered in the area of the Gubik gas field. That same year BLM opened four million acres in an area south and southeast of NPR-4 for simultaneous filing and subsequent drawing. From 1962-1964 industry exploration programs expanded rapidly. During this period, Sinclair and British Petroleum drilled a total of seven unsuccessful wildcat wells in the Arctic foothills (Jamison et al, 1980).

In 1964, under the Statehood Act, the state of Alaska selected some 80 townships across the northern tier of lands between the Colville and Canning Rivers and received tentative approvals on the 1.6 million acres from the federal government in October of the same year. In December 1964, the state held the 13th State Competitive Sale (the first on the North Slope) of leases covering 625,000 acres in the area east of the Colville River delta. In July 1965, the state held the 14th State Competitive Sale, which included the onshore area in the vicinity of Prudhoe Bay. In the 18th State Competitive Sale, held in January 1967, the offshore Prudhoe Bay tracts were offered and leased (Jamison et al, 1980).

Following the succession of dry holes in the Arctic foothills, exploration shifted northward to the central coastal area. In 1965, the first holes drilled in the area immediately surrounding the Prudhoe Bay structure came up dry. In January 1967, in what was essentially a last-ditch effort, a rig was moved to the Prudhoe Bay State No. 1 location near the mouth of the Sagavanirktok River. Twelve months later the discovery of the Prudhoe Bay oil field was announced (Jamison et al, 1980; AEIDC, 1975). Prudhoe Bay field began production in 1977 and, with its satellite fields, is currently estimated to have originally contained in excess of 15 billion barrels of economically recoverable oil (Figure 2.1), making it the largest oil field ever discovered in North America.

Following the Prudhoe Bay discovery, exploration activity increased dramatically. Thirty-three exploration wells were completed in 1969, as industry prepared for the Lease Sale 23 in September of that year. The state offered 413,000 acres along the Arctic coast between the Canning and Colville Rivers and earned more than $900 million in bonus bids on 164 tracts (Weimer, 1987; Jamison et al, 1980). One significant find that came out of this increased activity was the discovery of the Kuparuk River field. In the spring of 1969, the Sinclair Ugnu No. 1 well tested oil from the Kuparuk Formation at a rate of 1,056 barrels of oil per day (Masterson, 1992). Subsequent delineation proved the field to contain over one billion barrels of recoverable oil. Production at Kuparuk began in December of 1981, and current estimates place the ultimate recovery of oil from the field at more than 2.6 billion barrels, including satellite accumulations (PN, 2007). The 1969 sale was the last lease sale on the North Slope until the joint federal-state sale in December 1979. After the discovery of the Prudhoe Bay field and before the 1979 joint sale, more than 100 exploratory wells were drilled on the North Slope, with 19 of those wells discovering oil or gas.

In 1974, spurred by the OPEC oil embargo of 1973, the federal government began a second large exploration program in NPR-4, which was re-designated the National Petroleum Reserve-Alaska (NPRA) in 1976. Between 1974 and 1981, the USGS drilled a total of 27 test wells within NPRA. Other than two additional gas fields that are currently being produced to supply Barrow, no commercial deposits were discovered by this program. The two currently producing fields are the Walakpa field, which contains an estimated 142 billion cubic feet of economically recoverable gas (Imm, per. comm., 1996), and the East Barrow field, which contains an estimated 13 billion cubic feet of economically recoverable gas (Kornbrath, 1995;12). In 1980, Congress authorized competitive leasing within NPRA. From 1982-1984, four lease sales were held. A total of more than 1.3 million acres were leased in the first three sales, generating over $84 million in total bonus bids. The final sale received no bids. Only one industry well was drilled on a lease acquired in these sales. This well, the ARCO Brontosaurus No. 1, was completed, plugged, and abandoned in 1985.

The 1994 discovery of the giant Alpine field in previously unknown Jurassic sandstones on the northeastern border of NPRA demonstrated that the area contained significant untapped potential for commercial oil and gas accumulations. The field began production in late 2000, and is currently estimated to contain 429 million barrels of economically recoverable oil (PNA, 2000). The discovery and subsequent development of the Alpine field has spurred renewed interest in the oil and gas potential of NPRA, as well as the exploration and potential development of similar places in the Colville delta area.

Since the 1979 joint sale, five federal lease sales have been held in the Beaufort Sea, and there have been 28 state lease sales offering both onshore and submerged Beaufort Sea acreage. To date, 31 exploratory wells have been drilled in the federal waters of the Beaufort Sea, resulting in five discoveries: Seal Island/Northstar, Kuvlum, Hammerhead, Sandpiper, and Tern Island/Liberty. Exploration wells drilled through 2006 on North Slope state leases have resulted in 26 discoveries.

It is not surprising that many of these accumulations were found in the vicinity of Prudhoe Bay and Kuparuk, where the density of wells and seismic control is the highest and the geologic conditions optimal. At least eight of these post-Prudhoe Bay discoveries are currently producing oil because of the Prudhoe Bay infrastructure and their relatively close location to the trans-Alaska oil pipeline. Six of these, Lisburne, Kuparuk, Milne Point, Endicott, Niakuk, and Point McIntyre are major fields (See Table 2.1). While initial production on the North Slope was from onshore areas, five fields, Endicott, Point McIntyre, Milne Point, Niakuk, and Northstar, produce at least some of their reserves from offshore areas.

The most recent development projects in the Kuparuk and Prudhoe fields have involved low-gravity oil sands (Shrader Bluff/West Sak, and Ugnu) that were primarily discovered in the Kuparuk River area in 1969. In the Kuparuk area, the West Sak sands alone contain an estimated 16 billion barrels of oil in-place and combined estimates for the West Sak and Ugnu area are as high as 40 billion barrels in-place (Werner, 1987). Start-up of production of the West Sak occurred in 1997, with estimates that the initial pilot area contains 300-500 million barrels of economically recoverable oil (ADN, 1996b). Low-gravity production from the correlative Schrader Bluff formation sands at the Milne Point field exceeded 20,000 barrels of oil per day on average by 2004 (AOGCC, 2007). The geographic area over which this West Sak/Schrader Bluff resource occurs is extensive, and includes portions of the Kuparuk, Milne Point and Prudhoe Bay units. Since the initial production at Kuparuk and Milne Point fields, the Prudhoe Bay field has begun its own Schrader Bluff oil projects in the western portion of the unit, called Orion and Polaris, and recent Schrader Bluff oil discoveries have been unitized to the northwest of Milne Point (Nikaitchuq) and southeast of Kuparuk (Rock Flour).

State lands east of Prudhoe Bay saw renewed exploration activity during the 1990s, yielding oil discoveries in Canning formation sandstones and the Sourdough and Yukon Gold prospects south of the Point Thomson field adjacent to ANWR. Current information indicates Sourdough could contain 100 million barrels of recoverable oil. The Sourdough project would require up to 35 miles of pipeline to link up with the Badami field (Peninsula Clarion, 1997).

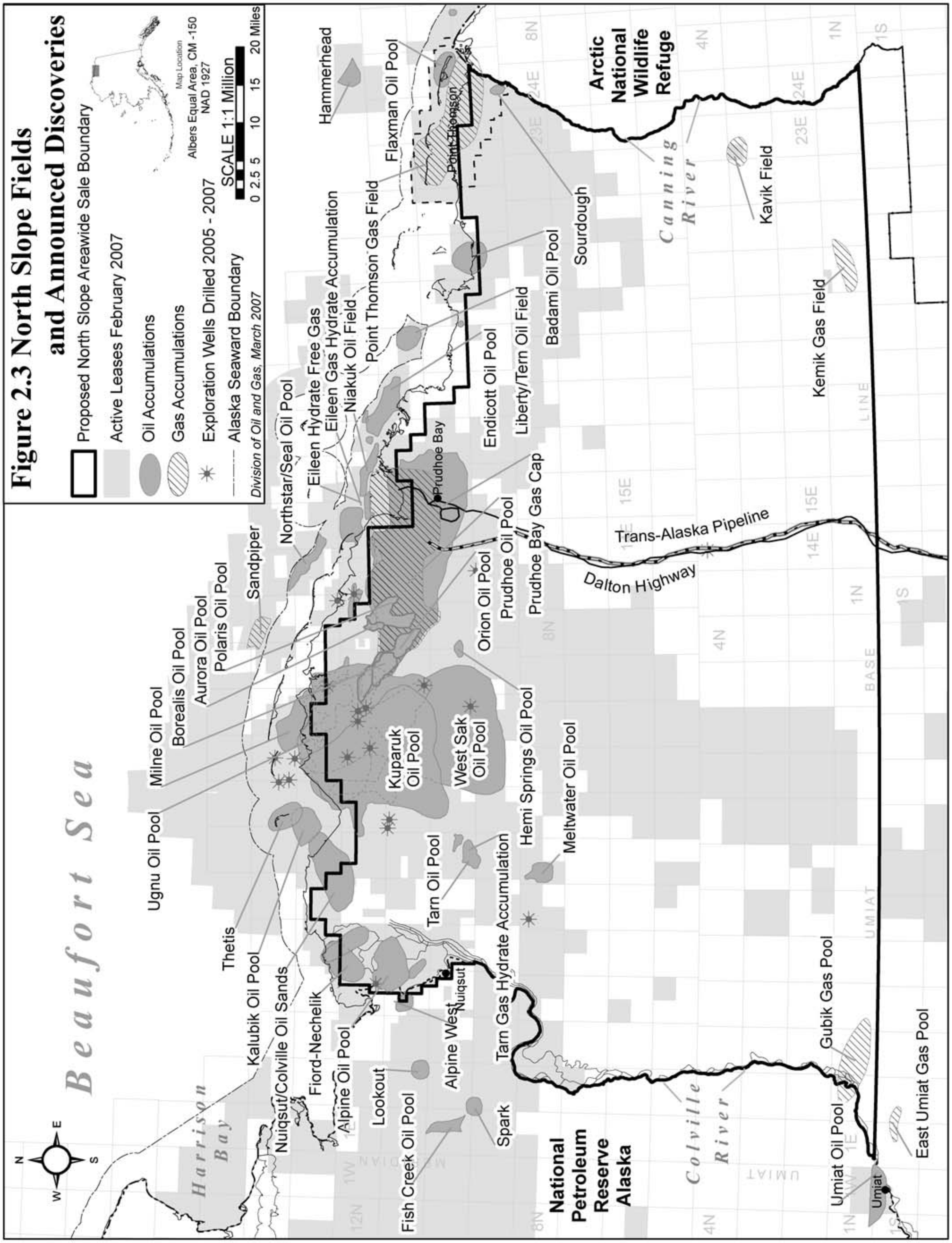


Figure 2.3 North Slope Fields and Announced Discoveries
Proposed North Slope Areawide Sale Boundary
Active Leases February 2007
Oil Accumulations
Gas Accumulations
Exploration Wells Drilled 2005 - 2007
Alaska Seaward Boundary
Division of Oil and Gas, March 2007
Map Location
Albers Equal Area, CM -150
NAD 1927
SCALE 1:1 Million
0 2.5 5 10 15 20 Miles
Beaufort Sea
Harrison Bay
Ugnu Oil Pool
Milne Oil Pool
Borealis Oil Pool
Aurora Oil Pool
Polaris Oil Pool
Sandpiper
Northstar/Seal Oil Pool
Eileen Hydrate Free Gas
Eileen Gas Hydrate Accumulation
Niakuk Oil Field
Point Thomson Gas Field
Flaxman Oil Pool
Hammerhead
Thetis
Kalubik Oil Pool
Nuiqsut/Colville Oil Sands
Fiord-Nechelik
Alpine Oil Pool
Lookout
Fish Creek Oil Pool
Alpine West
Spark
Nuiqsut
Tarn Gas Hydrate Accumulation
Tarn Oil Pool
Kuparuk Oil Pool
West Sak Oil Pool
Hemi Springs Oil Pool
Meltwater Oil Pool
Orion Oil Pool
Prudhoe Oil Pool
Prudhoe Bay Gas Cap
Prudhoe Bay
Endicott Oil Pool
Liberty/Tern Oil Field
Badami Oil Pool
Sourdough
Point Thomson
Arctic National Wildlife Refuge
Canning River
Kavik Field
Kemik Gas Field
Trans-Alaska Pipeline
Dalton Highway
National Petroleum Reserve Alaska
Colville River
Gubik Gas Pool
Umiat Oil Pool
East Umiat Gas Pool
Umiat
UMIAT BASE LINE
UMIAT MERIDIAN

Table 2.2 Major Producing Fields on the North Slope and in the Beaufort Sea

Field Name	Discovery Date	Production Began	Known Current Estimated Ultimate Recoverable Oil (MMBBL)*	Known Current Estimated Ultimate Recoverable Gas (BCF)
Prudhoe Bay	1967	1977	15,201	24,526
Kuparuk River	1969	1981	3,538	1,150
Colville River	1992	2000	675	400
Milne Point	1969	1985	633	14
Endicott	1978	1986	585	843
Northstar	1984	2001	205	450
Badami	1990	1998	6	

* Volumes include satellites
Source: Hartz, 2006

E. Petroleum Potential

The sale area encompasses a vast and diverse area, which makes it difficult to assign an overall petroleum potential. ADNR has determined the petroleum potential to be low to moderate, with the potential generally increasing from south to north. Determining the petroleum potential involves the evaluation of several elements including geology, geophysics, and exploration history of the area.

For an accumulation of hydrocarbons to be recoverable, the geology must be favorable. This may depend on the presence of source and reservoir rock; the depth and time of burial; the presence of migration routes and geologic traps or reservoirs, and the timing of fluid movements from source to trap. Source rocks are organic-rich sediments, generally marine shales, which have been buried for a sufficient time and with sufficient temperature and pressure to form hydrocarbons. As hydrocarbons are formed, they will naturally progress toward the surface if a migration route exists. An example of a migration route might be a permeable layer of rock in contact with the source layer, or fractures which penetrate organic-rich sediments. A hydrocarbon reservoir is permeable rock that has been geologically sealed at the correct time to form a “trap.” The presence of migration routes therefore affect the depth and location where oil or gas may pool and form an accumulation.

For a hydrocarbon accumulation to be economically producible, the reservoir rock must have sufficient thickness, good porosity (the number of pore spaces per volume), permeability (a rock’s capacity for transmitting a fluid), and hydrocarbon volume or fill. The North Slope has all these favorable geologic conditions and, considering the exploration history of the area, the chances of finding undiscovered petroleum reservoirs are very good. However, proximity to the collection, processing, and distribution network, directly affects the economic field size limit for an oil accumulation. Whereas accumulations in the order of a few tens of millions of barrels are considered economic to develop in the vicinity of the existing oil fields, accumulations need to be on the order of hundreds of millions of barrels to be considered economic in the more remote areas of the sale area. Proximity and the resultant economic field size limit generally skew the petroleum potential to be low in the more remote southern portions of the sale area. It is anticipated that the remaining undiscovered accumulations are expected to be near or below the economic size limit. In light of these factors, ADNR considers the petroleum potential of the sale area to generally increase from low in the southern portion to moderate in parts of the northern portion.

The process of evaluating the oil and gas potential for state lease sale areas such as the North Slope involves the use of data, including seismic and well information, which by law the division keeps confidential under AS 38.05.035(a)(8)(C). In order to protect these data, the division must generalize the assessment that is made public.

Chapter Three: Habitat, Fish, and Wildlife

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Chapter Three: Habitat, Fish, and Wildlife

A. Habitats

Habitats that support natural resources of the sale area include the coastal zone, Arctic plain, and northern foothills of the Brooks Range. Freshwater streams and lakes, aquatic plants, wetlands, tussock meadows, and riverine corridors provide species higher up in the food chain with essential nutrition and shelter. Important fish and wildlife species that depend on habitats of the North Slope Areawide sale area are described in Section B of this chapter.

1. Coastal Habitats

Much of the sale area falls within the coastal zone of the Alaska Coastal Management Program, where activities are subject to the North Slope Borough Coastal Management Program once a new plan is in effect. The boundary of the coastal zone extends inland approximately 25 miles. To protect fish spawning and overwintering habitats, the coastal zone also includes certain river corridors, including the Colville, Miluveach, Itkillik, Anaktuvuk, Chandler, Sagavanirktok, Shaviovik, Kavik, and Canning (NSBCMP, 1984b).

Along the Beaufort Sea coast, adjacent to the sale area boundary, saltwater-dependent habitats merge into freshwater habitats. Salt water intrudes in soils and groundwater flows. Coastal vegetation is influenced by sea spray as far as two to three miles inland. Stream slope and freezing action in winter generally determine the distance at which salt water reaches upstream (ADGC, 1985).

The coastal zone supports optimum waterfowl and shorebird nesting habitat, caribou calving and feeding grounds, and polar bear denning sites. The coastal zone is indirectly influenced by activities outside of the sale area. For example, caribou wintering in the Brooks Range are influenced by the availability of food in their preferred summer habitat on the Arctic coastal plain (DGC, 1985). The coastal zone provides important spawning habitat for marine fish and invertebrates. These creatures in turn provide waterfowl and marine birds with plentiful sources of food (DGC, 1985). Rivers flowing into the Beaufort Sea host species that are indirectly influenced by the coastal zone. At a minimum, the coastal zone includes the extent of coastal wet tundra habitat, a range roughly corresponding to the 200-foot contour (DGC, 1985).

The tundra surface is marked by lakes, thaw ponds, frost cracks, and polygonal ground formations. Successive freezing and thawing of moisture-laden soils causes frequent draining and reforming of lakes and surface peat. The soil beneath the tundra freezes each winter, thaws in spring, and is saturated with salt water or fresh water throughout the summer. The freeze-thaw process causes these lakes to reform each year. Tundra and grasses of the barrier islands are also exposed to freeze-thaw processes (AEIDC, 1975).

The vegetation habitats of the sale area can be roughly divided into two eco-regions: the Arctic plain and the northern foothills. Additionally, wetland habitats occur across the North Slope and throughout the sale area, and their characterization is of key interest to scientists, ecologists, government, and industry.

2. Arctic Plain

The distribution of vegetation types on the Arctic plain is strongly associated with microtopographic features which affect soil drainage. Wet soil conditions support wet graminoid herbaceous communities dominated by sedges or grasses. Dwarf scrub communities grow where soil conditions are drier, such as at thaw lake margins, along river bluffs, or other more elevated areas which provide a rooting zone above the standing water table (USGS, 1995).

Most sedge communities are dominated by *Carex aquatilis* and *Eriophorum angustifolium* (narrow-leaf cottongrass). Mosses (usually *Scorpidium spp*. or *Drepanocladus spp*.) may be common (USGS, 1995). Grass communities on the Arctic plain are dominated by *Dupontia fischeri* and *Alopecurus alpinus* (mountain foxtail); however, *Arctophila fulva* (pendent grass) dominates in surface waters of 15 centimeters to 200 centimeters in depth. Dwarf scrub communities include *Dryas integrifolia*, *Vaccinium vitis-idaea*, *Cassiope tetragona*, *Arctostaphylos alpina*, *Arctostaphylos rubra*, *Salix reticulata*, and *Salix phlebophylla* (USGS, 1995). Secondary species include common names of lousewort and buttercup in the wetter sites, and heather and purple mountain saxifrage in the raised, drier habitats (AEIDC, 1975).

3. Northern Foothills

The distribution of vegetation in the northern foothills region of the sale area is also affected by soil conditions, elevation, and drainage. Major streams flowing from the Brooks Range are controlled by bedrock. Plant communities in lakes form concentric bands that correspond with water depth. Lakes deeper than 1.5 meters do not usually support aquatic plant life (USGS, 1995).

Plant communities are commonly dominated by mesic graminoid herbs and dwarf scrub. Mesic graminoid herbaceous communities are commonly dominated by tussock-forming sedges, and include *Eriophorum vaginatum* and *Carex bigelowii*. Low shrubs, such as *Betula nana* (dwarf arctic birch), *Empetrum nigrum* (crowberry), *Ledum decumbens* (Labrador tea), and *Vaccinium vitis-idaea* (mountain cranberry) may also dominate plant communities along with sedges. Mosses and lichens are common between tussocks (USGS, 1995).

Dwarf scrub communities are dominated by *Dryas spp*., ericaceous species, and *Salix reticulata* and *Salix phlebophylla* (prostrate willows). Low scrub communities are dominated by *Alnus crispa* (alder), and *Salix lanata*, *Salix planifolia*, and *Salix glauca*. Mosses are commonly abundant (USGS, 1995). These plant communities provide an important source of nutrition for caribou as they forage on their summer range.

Waterbirds depend on or prefer certain habitat types, and attempts have been made to rank the value of these habitats, especially on the Colville River. Large ungulates (caribou, muskoxen) are equally dependent on vegetation habitats of the North Slope. Most of the oil field areas are considered wetlands.

4. Wetlands

Wetlands are lands where saturation with water is the dominant factor in determining the nature of soils and the types of plant and animal communities living in the soil and on the surface. Wetlands occur where the water table is at or near the surface, the land at least periodically supports plants that grow partly or entirely in water (hydrophytes) and the substrate or surface is saturated with water or covered by water at some time during the growing season each year (Cowardin, et al., 1979).

Concern over wetland loss from gravel infilling associated with oil and gas development and its effects on calving, migration, nesting, and brood rearing, drives classification studies. Bergman et al. (1977) identified eight wetland designations related to birds (see Table 3.1).

Table 3.1 Wetland Designations

Class Designation	Cover type
Class I. Wetland Tundra	Wet sedge meadow, sedge, willow
Class II. Shallow-Carex	Wet sedge meadow, sedge, willow
Class III. Shallow-Arctophila	Wet grass-sedge meadow
Class IV. Deep-Arctophila	Wet grass-sedge meadow, discrete lake
Class V. Deep-open	Discrete lake, tapped lake
Class VI. Basin-complex	Wet sedge meadow
Class VII. Beaded streams	Barren
Class VIII. Coastal wetlands	Midgrass-herb, halophytic sedge, halophytic grass-sedge, halophytic herb

From Meehan and Jennings, 1988.

Meehan and Jennings (1988) studied the distribution and behavior of birds on the Colville delta, and derived nine habitat classes for large waterbirds (tundra swan, greater white-fronted goose, Pacific loon, yellow-billed loon, and brant):

- **Discrete lake** habitat includes lakes and estuarine waterbodies, similar to Bergman's Class V.
- **Tapped lake** habitat includes lakes that are hydrologically connected to a river system. In spring, flooded channels breach these lakes, allowing sediments and salt water to infiltrate. This class is also similar to Bergman's Class V.
- **Wet-moist flooded tundra** habitat includes wet sedge polygonal ground (Bergman's Class I) and moist sedge willow (Bergman's Class II).
- **Wet graminoid** habitat is found along lakeshores and polygonal ponds. Similar to Bergman Classes III and IV, the largest stands on the Colville delta are located in its south-central portion (located within the sale area). This habitat includes dominant species, *Arctophila fulva* and *Carex aquatilis*.
- **Wet-moist polygon** habitat includes moist to wet low tundra meadows, near-lake ponds and margins, flooded basins, and polygonal ground. Similar to Bergman Classes I and II, this habitat is the most abundant vegetation cover on the Colville delta. This vegetation type was used by nesting Pacific and yellow-billed loons, tundra swans, and white-fronted geese.
- **Brackish flat** habitat, similar to Bergman's Class VIII, is found along the fringe of the delta, river channels, and tapped lakes. This habitat type has been associated with high brant use.
- **Shrub dominant** habitat consists of low willow communities on riverbanks, terraces, and dunes. Most bird use was low, and there was no equivalent Bergman class.
- **Barren** habitat includes partially vegetated dunes, grass-forb lakeshore, and partially vegetated and unvegetated floodplain. Similar to Bergman's Class VIII, this habitat is of low use by most birds and covers about 30 percent of the Colville delta's total area.
- **Sedge-tussock tundra** habitat, found in the western part of the delta, has no comparable Bergman class.

Meehan and Jennings (1988) ranked the importance of habitat classes relative to usage by key bird species. Discrete lakes were used the most, followed by wet-moist polygons, brackish flats, wet graminoid, and wet-moist flooded tundra. Tapped lakes and shrub-dominant areas received an equal amount of use after the top six, followed by sedge-tussock tundra and barrens which were used the least. The authors caution that although the classes may apply to habitats across the North Slope, the ranking should only be applied to the Colville River delta.

In a remote sensing study of snow goose brood-rearing habitat on the Sagavanirktok River delta, Burgess and Ritchie (1988) followed the classification scheme of Walker and Weber (1980) to derive a similar habitat classification (see Table 3.2).

Table 3.2 Snow Goose Brood-Rearing Habitat Classification

Plant Community	Description	Dominant plant species
Moist Graminoid	moist upland sites, dry low-centered polygons and polygon rims	*Carex aquatilis, Dryas integrifolia, Salix arctica*
Wet Graminoid	wet areas in sand dune regions	*Carex aquatilis, Dupontia fischeri, Salix ovalifolia*
Wet Coastal Saline Graminoid	coastal estuaries and lagoon area normally flooded with salt water part of the year	*Carex subspathacea, Dupontia fischeri, Eriophorum angustifolium*
Very Wet Graminoid	pond and lake margins	*Carex aquatilis, Arctophila fulva*
Dry Coastal Bluff Barrens	coastal bluffs and ridges	*Dryas integrifolia, Sedum rosea*

From: Pollard, et al, 1992:4

More complex vegetation classification systems have been developed for oil and gas development proposals; some are species specific and some focus on terrain types. Field surveys are expensive, and increased complexity in project proposal documents provides agencies with more information to make permitting decisions. For example, in the Alpine Development Project, habitats on the Colville delta are described with 24 habitat types, a system developed by Viereck, et al. (1992) and modeled after Cowardin, et al. (1979).

For the purposes of carrying out the provisions of Section 404 of the Clean Water Act, Cowardin, et al. (1979) developed a wetlands classification system for the U. S. Fish and Wildlife Service (USFWS). Subsequently, a Corps of Engineers Wetlands Delineation Manual was developed for use by USACE field inspectors who make wetland determinations (USACE, 1987:7). A supplement to the manual was issued in 2007 (USACE, 2007). Since 1979, numerous classification systems have been developed for wetland habitat characterization. Today, the USACE may use many classification systems in making wetland determinations. The more information and detail on site-specific characteristics, the better USACE is able make wetland determinations (Carpenter, 1997).

Regardless of the habitat class system used in planning, the important points to consider are which plant species are associated with various life stages of important animals (feeding, nesting, incubation, brood rearing, etc.), and what is the most appropriate and practical way to identify those terrains and important species. For caribou, some plant species may provide greater nutritional value for migrating, gestating, and newborn animals. Because nearly all of the North Slope is wetland habitat, uplands are rare and may become more valuable to species like caribou, especially during the insect season. Non-wetland habitats include pingos, high-top polygons, steep riverbanks, gravel bars, and dunes (Carpenter, 1997). The following section discusses the sale area's fish and wildlife with references to key supporting habitats.

B. Fish and Wildlife Species and Habitats

1. Fish

Important fisheries are found within the sale area. Freshwater fish present include arctic grayling, lake trout, northern pike, burbot, and several species of whitefish and ciscoes (Ott, 1995). Many area fish species are amphidromous or anadromous. Amphidromous is "a term used to describe fish that spawn and overwinter in rivers and streams, but migrate during the ice-free summer from freshwater into coastal waters to feed." Anadromous fish mature in the sea and enter freshwater rivers and streams to spawn; salmon and arctic ciscoes are examples (BLM, 2005). Stream-resident arctic char occur in the Sagavanirktok and Colville drainages but are not known to be amphidromous in these systems. Dolly Varden also occur in both drainages, and include amphidromous and stream-resident forms (Ott, 1997).

Nearshore waters and lagoon systems provide migration corridors and important feeding habitat for amphidromous and anadromous fishes (USF&WS, 1987). Summer river runoff combined with melting coastal ice creates warm, brackish conditions in nearshore areas, particularly near the mouths of rivers (BLM, 2005). These warmer nearshore waters contain an abundance of amphipods, isopods, euphausids, coelenterates, and chaetognaths (Gertler, 1988), which provide important food sources for amphidromous and anadromous fishes.

Many of the fishes that winter in freshwater habitats and river deltas of the sale area disperse along the coast to feed in the prey-rich nearshore waters, which may extend several miles offshore (BLM, 2005). Amphidromous fish typically leave rivers and enter the nearshore waters of the Beaufort Sea during spring breakup, from mid- to late June. They initially occupy open-water leads near shore before dispersing along the coast to feed as the ice cover melts and recedes. Small fish tend to remain near overwintering rivers such as the Colville, while larger fish may migrate distances of 80 miles or more in search of feeding habitat. It is during this summer period that coastal fishes achieve most of their annual growth and accumulate fat and protein reserves needed to survive the Arctic winter (BLM, 2005, citing Fechhelm). Migration back to rivers varies by species, but most amphidromous fish return to fresh water, where they spawn, by mid-September (ADNR, 1991a).

The Colville River supports an abundance of fish, composed of at least 20 species, the dominant species being whitefishes and ciscoes. Other species found in the Colville River include chum and pink salmon, Dolly Varden, arctic grayling, burbot, ninespine stickleback, and slimy sculpin. Lake trout, northern pike, and Alaska blackfish are rare inhabitants of the lower Colville River and delta (BLM, 2005). Like other North Slope rivers, the Colville discharges fresh water into the Beaufort Sea, forming a zone of warmer brackish water along the coast. This zone is an important factor affecting the distribution and abundance of all Beaufort Sea fish because of its importance to amphidromous and anadromous species for feeding and migrating.

As with most amphidromous fish species, whitefish spend much of their life cycle in salt water. They feed in salt water during the summer, but, unlike other amphidromous fish, generally remain in freshwater plumes extending out from river mouths and in marine waters of lower salinity. As with arctic char, these species move upriver around mid-August and spawn in late September or October (Roguski et al., 1971).

Arctic cisco are among the most abundant anadromous fish captured in the Prudhoe Bay and Sagavanirktok delta areas. They inhabit the nearshore environment and spawn in the fall. The Colville River is a major overwintering area for cisco. During the ice-free period cisco undertake extensive migrations through the nearshore area (NSBCMP, 1984a). No spawning areas for arctic cisco have ever been identified in Alaska (BLM, 2005); arctic cisco of the Colville River are migrants from natal streams and tributaries of the Mackenzie River delta system in Canada. Newly hatched arctic cisco from Canada move westward into the Alaska Beaufort Sea during late July to early August, especially in years with a prevalence of easterly winds. Thus, these fish must pass through the area of coastal development associated with the Prudhoe Bay and Kuparuk oil fields. Arctic cisco of the Colville River delta spend most of the summer feeding in nearshore coastal waters, and then return to the river's channels and lakes in September and October to overwinter (Fechhelm and Griffiths, 1990).

Non-migratory freshwater fishes inhabit fresh water year-round. Virtually all arctic grayling are found exclusively in fresh water throughout the year (Ott, 1997). Dolly Varden and broad and humpback whitefish are amphidromous (BLM, 2005) and remain in fresh water for several months or years, depending on the species, before migrating to coastal waters, returning to inland waters to spawn and overwinter (ADNR, 1990). A lack of overwintering habitat is the primary factor limiting Arctic fish populations. Rivers freeze to the bottom over much of their lengths, leaving only the deeper sections available for overwintering habitat (Sousa, 1992). The Colville River provides the most consistently available overwintering habitat (Baker, 1987). Broad whitefish also use ephemeral stream systems to move into lake habitats of adequate depth for overwintering (Morris et al. 2006).

Table 3.3 Important Amphidromous and Anadromous Fish Streams Located Within the Sale Area

Stream Name	Dolly Varden	Whitefish	Pink Salmon	Chum Salmon
Anaktuvuk River	X			
Canning River	X	X	X	X
Chandler River	X	X		
Colville River	X	X	X	X
Colville River Delta	X	X	X	X
East Badami Creek	X			
East Creek		X		
East Sagavanirktok Creek	X			
Echooka River	X			
Fawn Creek		X		
Itkillik River	X	X	X	X
Ivishak River	X			X
Kachemach River		X		
Kadleroshilik River	X			
Kalubik Creek	X			
Kavik River	X			
Kuparuk River		X		
Little Putuligayuk River		X		
Miluveach River	X	X		
No Name River	X			
Putuligayuk River	X	X		
Sagavanirktok River	X	X	X	X
Sakonowyak River		X		
Shaviovik River	X			
Staines River	X	X	X	
Ugnuravik River		X		
Unnamed Lake, west of West Dock	X			
West Fork Kalubik Creek	X	X		

Source: Ott, 1997

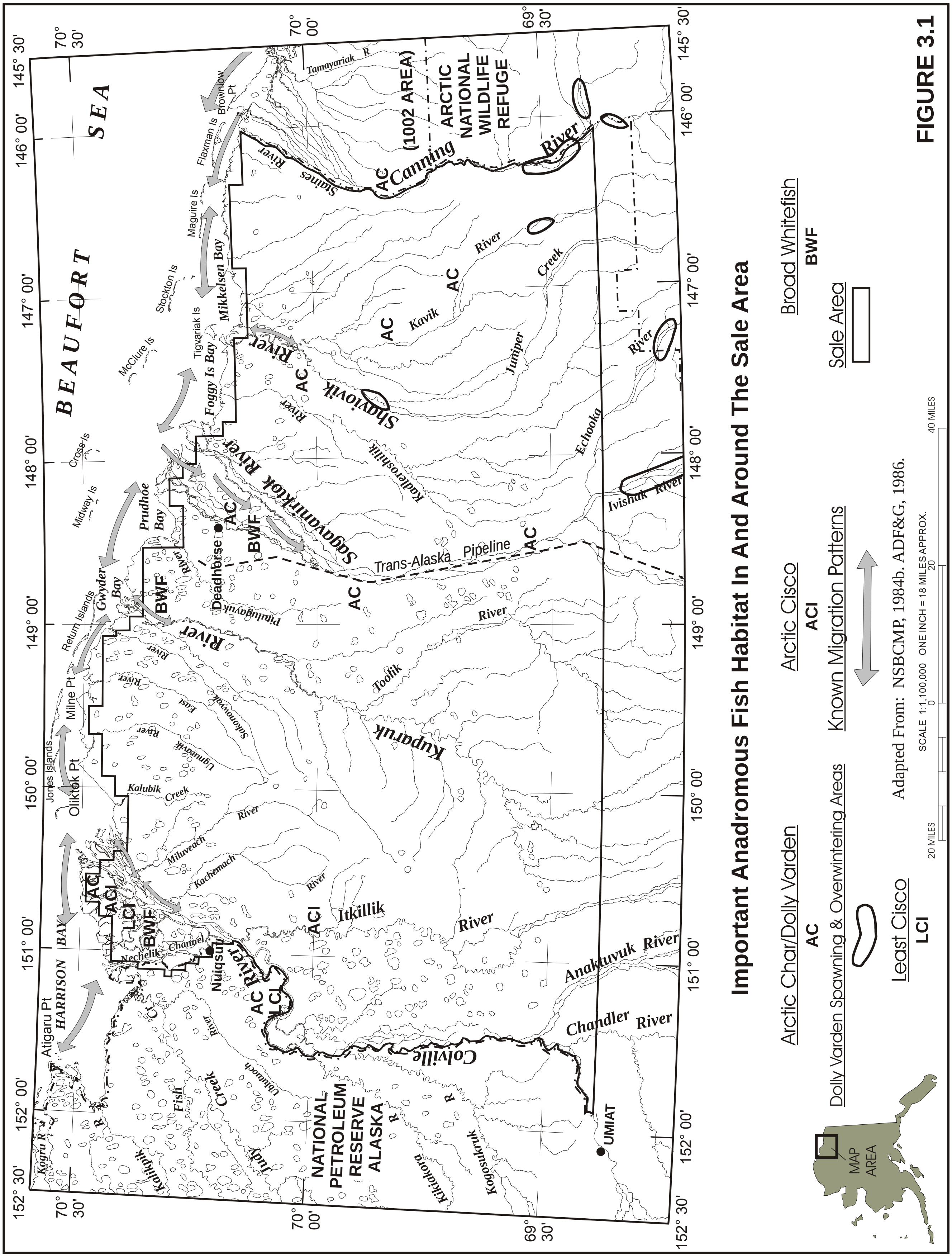


FIGURE 3.1

Important Anadromous Fish Habitat In And Around The Sale Area

2. Birds

Major concentrations of birds occur in and near portions of the sale area (see Figure 3.2 and Table 3.4). Very important nesting and breeding areas for waterfowl include the deltas of the Colville, Sagavanirktok, Kuparuk, and Canning Rivers, Fish Creek, and Simpson Lagoon (MMS, 1996a). A variety of bird species are found among the several habitat types of the sale area.

The deltas of the Colville, Sagavanirktok and Kuparuk Rivers provide important breeding and brood-rearing habitats for tundra swans, black brant, snow geese, and Canada geese. Howe Island, located in the Sagavanirktok River delta, is the location of one of the few known snow goose nesting colonies in the United States (Sousa, 1992). The Return Islands, Jones Islands, McLure Islands, Cross Island, and Lion Point are important for nesting common eider. Thousands of long-tailed ducks concentrate near Flaxman Island to molt (Bright, 1992). Greater white-fronted geese are also found nesting and rearing in the major river deltas and other coastal plain areas (Ott, 1997).

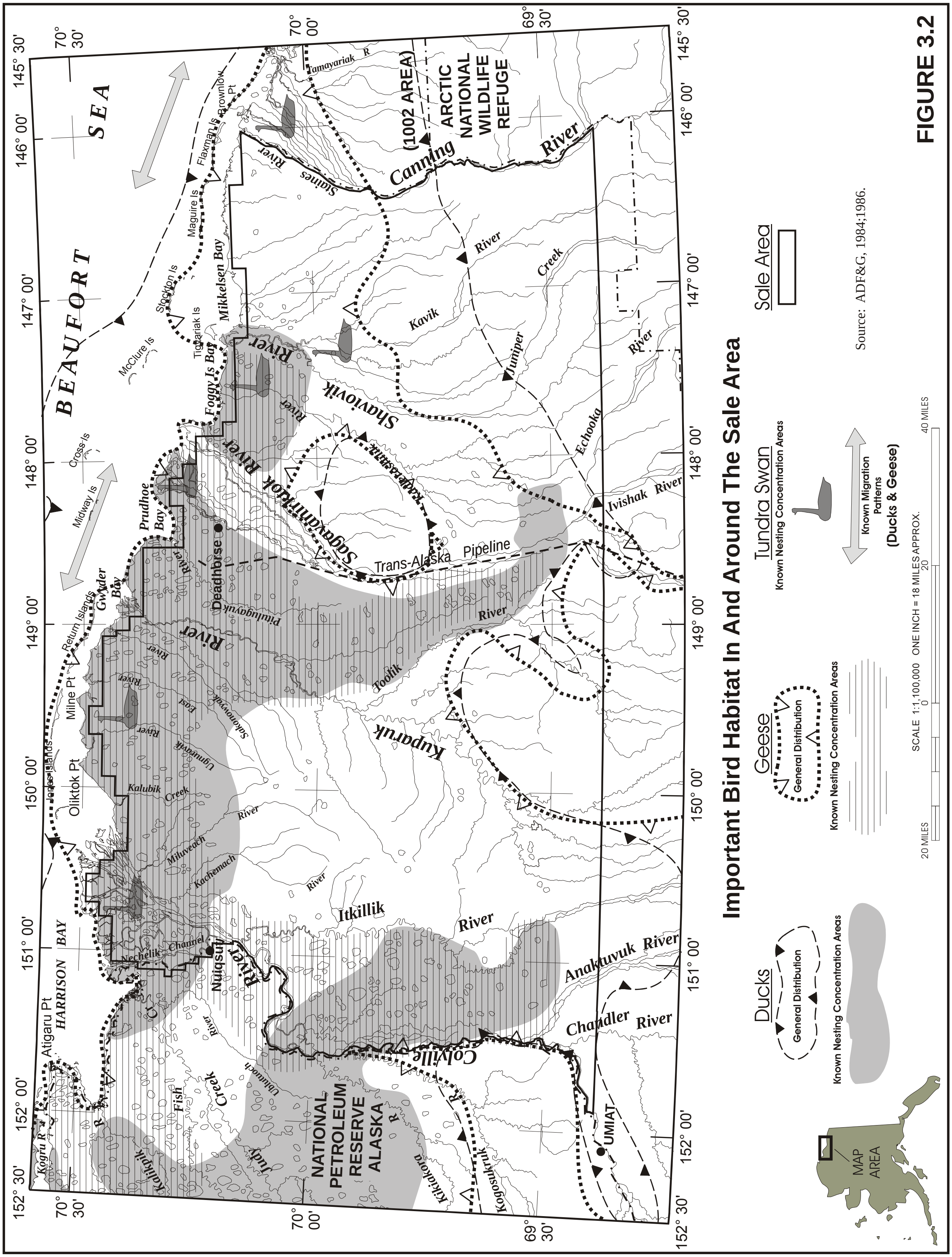
The most abundant marine and coastal species include red phalarope, northern pintail, long-tailed duck, glaucous gull, and king and common eider. Nearly all of these species are migratory and are found in the Arctic seasonally, generally from May through September. Shortly after spring migration, most shorebird and waterfowl populations disperse to nesting grounds, primarily on tundra and marshlands of the Arctic slope. Beginning in late June, large concentrations of long-tailed ducks and eider occur in coastal waters inshore of islands where the birds feed and molt before fall migration. Use of lagoons and other coastal habitats peaks in August to late September before and during the fall migration (MMS, 1996a). Among the least abundant species in the sale area are Steller's eider and spectacled eider. Both are listed as threatened under the federal Endangered Species Act.

Table 3.4 Breeding Season Abundance and Nest Density of Some Shorebird Species on the Arctic Coastal Plain

Species	Abundance on Arctic Coastal Plain	Highest Density (nests per square mile)*
American golden-plover	common	1.6
Baird's sandpiper	uncommon	0.1
Bar-tailed godwit	uncommon	0.3
Black-bellied plover	uncommon	0.9
Buff-breasted sandpiper	uncommon	1.1
Dunlin	uncommon/common	3.7
Pectoral sandpiper	common/abundant	21.5
Red phalarope	common	4.0
Ruddy turnstone	uncommon	data not available
Semipalmated sandpiper	common/abundant	14.4
Stilt sandpiper	uncommon	1.2

* Nest densities are reported in various studies – most data came from studies along the Colville River delta and Point McIntyre.

Source: Adapted from BLM, 2005



Important Bird Habitat In And Around The Sale Area

FIGURE 3.2

Table 3.5 Birds and Bird Habitats Common to the Sale Area

Common Name	Scientific Name	Offshore Areas	Barrier Islands/ Lagoons	Estuary	Wetlands Tide flat	Rivers, Lakes, Streams	Uplands
Yellow-billed loon	*Gavia adamsii*	X	X	X	X	X	
Pacific loon	*Gavia arctica*	X	X	X	X	X	
Red-throated loon	*Gavia stellata*	X	X	X	X	X	
Tundra swan	*Cygnus columbianus*			X	X	X	X
White-fronted goose	*Anser alibifrons*			X	X	X	X
Snow goose	*Chen caerulescens*			X	X	X	X
Canada goose	*Branta canadensis*			X	X	X	X
Black brant	*Branta bernicla*		X	X	X	X	X
Mallard	*Anas platyrhynchos*				X	X	X
Pintail	*Anas acuta*				X	X	X
Green-winged teal	*Anas crecca carolinensis*				X	X	X
American wigeon	*Anas americana*				X	X	X
Northern shoveler	*Anas clypeata*				X	X	X
Greater scaup	*Aythya marila*				X	X	X
Lesser scaup	*Aythya affinis*				X	X	X
Common eider	*Somateria mollissima*	X	X	X	X	X	
King eider	*Somateria spectabilis*	X	X	X	X	X	
Steller's eider	*Polysticta stelleri*	X	X	X	X	X	
Spectacled eider	*Somateria fischeri*	X	X	X	X	X	
Long-tailed duck	*Clangula hyemalis*	X	X	X	X	X	
Surf scoter	*Melanitta perspicillata*	X	X	X	X	X	
White-winged scoter	*Melanitta deglandi*	X	X	X	X	X	
Red-breasted merganser	*Mergus serrator*			X	X	X	
Rough-legged hawk	*Buteo lagopus*			X	X		
Northern Harrier	*Circus cyaneus*				X		X
Golden eagle	*Aquila chrysaetos*				X		X
Gyrfalcon	*Falco rusticolus*				X		X
Peregrine falcon	*Falco peregrinus*				X		X
Willow ptarmigan	*Lagopus lagopus*						X
Rock ptarmigan	*Lagopus mutus*						X
Semipalmated plover	*Charadrius semipalmatus*		X		X	X	X
American golden plover	*Pluvialis dominica*		X		X	X	X
Killdeer	*Charadrius vocifeurs*		X		X	X	X
Black-bellied plover	*Pluvialis squatarola*		X		X	X	X
Bar-tailed godwit	*Limosa lapponica*				X	X	X
Buff-breasted sandpiper	*Tryngites subruficollis*		X		X	X	X
Long-billed dowitcher	*Limnodromus scolopaceus*				X	X	X
Ruddy turnstone	*Arenaria interpress*		X		X	X	X
Common snipe	*Capella gallinago*		X		X	X	X
Whimbrel	*Numenius phaeopus*		X		X	X	X
Spotted sandpiper	*Actitis macularia*		X		X	X	X
Pectoral sandpiper	*Calidris melanotos*		X		X	X	X
Rufus-necked sandpiper	*Calidris ruficollis*	X		X	X	X	
White-rumped sandpiper	*Calidris fuscicollis*		X		X	X	X
Dunlin	*Calidris alpina*		X		X	X	X

Common Name	Scientific Name	Offshore Areas	Barrier Islands/ Lagoons	Estuary	Wetlands Tide flat	Rivers, Lakes, Streams	Uplands
Baird's sandpiper	*Calidris bairdii*		X		X	X	X
Sanderling	*Calidris alba*		X		X	X	X
Semipalmated sandpiper	*Calidris pusilla*	X		X	X	X	
Red phalarope	*Phalaropus fulicaria*	X	X	X	X	X	X
Northern phalarope	*Phalaropus lobatus*	X	X	X	X	X	X
Parasitic jaeger	*Stercorarius parasiticus*	X	X		X		X
Pomarine jaeger	*Stercorarius pomarinus*	X	X		X		X
Long-tailed jaeger	*Stercorarius longicaudus*	X	X		X		X
Glaucous gull	*Larus hyperboreus*	X	X	X	X	X	X
Thayer's gull	*Larus thayeri*	X	X	X	X	X	X
Herring gull	*Larus argentatus*	*X*	X	X	X	X	X
Mew gull	*Larus canus*	X	X	X	X	X	X
Black-legged kittiwake	*Rissa tridactyla*	X					
Sabine's gull	*Xema sabini*	X	X	X	X	X	X
Arctic tern	*Sterna paradisaea*	X	X	X	X	X	X
Thick-billed murre	*Uria lomvia*	X					
Black guillemot	*Cepphus grylle*	X	X				
Short-eared owl	*Asio flammeus*				X		X
Snowy owl	*Nyctea scandiaca*				X		X
Horned lark	*Eremophila alpestris*				X		X
Common raven	*Corvus corax*				X		X
Black-billed magpie	*Pica pica*				X		X
Robin	*Turdus migratorius*				X		X
Gray-cheeked thrush	*Catharus minmus*				X		X
Northern shrike	*Lanius exubitor*				X		X
Wheatear	*Oenanthe oenanthe*				X		X
Bluethroat	*Luscinia avacica*				X		X
Arctic warbler	*Phylloscopus borealis*				X		X
Yellow wagtail	*Motacilla flava*				X		X
Water pipit	*Anthus spinoletta*			X	X		
Wilson's warbler	*Wilsonia pusilla*				X		X
Hoary redpoll	*Carduelis hornemanni*				X		X
Common redpoll	*Carduelis flammea*					X	X
Savannah sparrow	*Passerculus sandwichensis*					X	X
Tree sparrow	*Spizella arborea*						X
White-crowned sparrow	*Zonotrichia leucophrys*					X	X
Fox sparrow	*Passerella iliaca*					X	X
Dark-eyed junco	*Junco hyemalis*					X	X
Lapland longspur	*Calcarius lapponicus*					X	X
Snow bunting	*Plectrophenax nivalis*					X	X

Source: Ott, 1992:4. ADNR, 1990:21.

Northern pintails are among the Arctic coastal plain's most common duck species (BLM, 2005). Numbers fluctuate from year to year and, **though** no significant population trends have been reported in the sale area, declines in northern pintail populations have been documented in the lower 48 states and Canada (BLM, 2005, citing to USFWS, 2003). Northern pintails winter from Southeast Alaska, throughout much of the central and southern U.S., and into Mexico and the Caribbean (BLM, 2005).

Long-tailed ducks are common in the sale area and together with northern pintails make up about 85 percent of the total Arctic coastal plain duck population (BLM, 2005). Male long-tailed ducks begin moving in late June to protected coastal areas in lagoons and large lakes for molting (Ott, 1997). Nests consist of small, cup-like hollows. Long-tailed duck **clutches** of 9 to 12 eggs are common, but most number 5 to 10 eggs. In the Beaufort Sea area, most eggs hatch from July 16 to July 28. Female long-tailed ducks lead their young to the nearest water shortly after the young have hatched and dried. Male long-tailed ducks begin moving in late June to protected coastal areas in lagoons and large lakes and form massive molting flocks (Ott, 1997). Fall migration begins in late September or early October (Johnson and Herter, 1989). Populations on the Arctic coastal plain fluctuate, but have shown declining population trends over their range as a whole. Long-tailed ducks winter along the east and west coasts (BLM, 2005).

Red phalaropes are common migrants and breeders throughout the Beaufort Sea coast. They appear in the sale area in late May or early June. Nesting takes place in hummocky, moss-sedge tundra interspersed with numerous ponds. Females usually lay four eggs; however, if **breeding** is delayed, clutch size is reduced. Males incubate the eggs and care for the young until shortly before they are fledged. The fledging period is 16 to 18 days. Males then abandon the young and depart the breeding area. Adult migration commences from early June to mid-August. The young depart the nesting areas from mid-August to early September (Johnson and Herter, 1989). Phalaropes winter at sea in the Pacific and Indian Oceans, and off the coasts of west and South Africa (BLM, 2005).

Glaucous gulls are common migrants and breeders in the Beaufort Sea area. They usually arrive in the sale area during May. Glaucous gulls select several types of nesting sites, depending on availability. Pairs nest either on low islands and sandbars near or on the coast, or on inland river bars or small islands in lakes. They are most common on barrier islands immediately offshore from rivers that flood in the spring and thereby protect the nests from foxes. On level terrain, nests may be as much as a meter high and are composed of vegetation. Occasionally, nests consist of a simple depression in the beach and have little or no lining material. Egg-laying begins in mid-June and continues through late June. The normal clutch size is three eggs and hatching begins in the second week of July. Chicks are attended by both parents until they fledge in 45 to 50 days. During the breeding season these gulls prey heavily on the eggs and chicks of other birds. Fall migration begins in mid-September with the young remaining somewhat later than most adults (Johnson and Herter, 1989).

King eiders remain the Arctic coastal plain's most abundant eider species even though counts of migrating birds passing Point Barrow suggest the king eider population has declined by approximately 56 percent since 1976 (BLM, 2005). Despite reports of earlier declines, Larned et al. (2003) recorded an increasing trend between 1993 and 2003 for king eiders on the Arctic coastal plain. King eiders winter as far north as open water is available in the Bering and Chukchi Seas and through the Aleutian Islands to Kodiak Island (BLM, 2005).

Common eiders are abundant in the Beaufort Sea area. Sometimes called Pacific eiders, these sea ducks arrive in the sale area from late May to early June. Nearshore coastal distributions conducted on the Arctic coastal plain during nesting surveys suggest that breeding pairs are most numerous along the coast between the Colville River delta and the Canadian border (BLM, 2005). Common eiders most frequently nest on barrier islands and spits from mid- to late June. Clutch sizes range from 1 to 10 eggs, but usually number 4. Nests are usually placed in well-protected areas near logs, in driftwood, between rocks, or in thick vegetation. Young are usually led directly to water soon after they hatch. Fledging occurs from 6 to 12.5 weeks after hatching. Males then leave nesting areas for molting areas in the vicinities of Point Lay, Icy Cape, and Cape Lisburne in western Alaska. Females and their young begin the fall migration in late August or early September (Johnson and Herter, 1989). Most Beaufort Sea common eiders likely winter from the Bering Sea pack ice south to the Aleutian Islands and Cook Inlet (BLM, 2005).

Tundra swans are common breeders on the coastal plain of the North Slope. The Colville River delta supports densities of breeding tundra swans that are three to five times greater than other Arctic areas of

Alaska. Tundra swans begin nesting during the last week of May and the first two weeks of June. Nests are large (approximately 1 meter high and up to 2 meters in diameter) and widely scattered. The nests are generally located on sedge tundra. After hatching in late June or early July, broods are reared in nesting territory (Smith et. al., 1993). Adults molt from mid-July through August. Fall migration occurs from late September to early October. Surveys have suggested an increasing trend in tundra swan numbers on the Arctic coastal plain since 1986, though populations declined in both 2001 and 2002 (BLM, 2005). Tundra swans winter along the east and west coasts of North America, from the Aleutian Islands to California and from Maryland to North Carolina (Johnson and Herter, 1989).

Black brant are common migrants and breeders along the Beaufort Sea coast. These small, coastal geese, weighing 2.5 to 5 pounds or 1.1-2.3 kilograms, nest on islands in the deltas of the Colville and Sagavanirktok Rivers. Nesting takes place in June. Black brant normally lay four to eight eggs and do not re-nest if their first attempt at nesting fails. Newly hatched goslings leave the nest within 48 hours and move to nearby tidal flats where they spend the brood-rearing period. Brood rearing ends and the fall migration begins around the second week of August. Some brant remain in the Beaufort Sea area until late September or early October (Johnson and Herter, 1989). Brant populations on the Arctic coastal plain appear to be increasing since 1992 (BLM, 2005); however, overall numbers in recent years have shown slow downward trends (BLM, 2005, citing USFWS, 2003).

Snow geese nest in three colonies in Alaska according to ADF&G, including one in NPR-A in the Ikpikpuk River delta (1,100 nests) (MMS FEIS 2007, citing Ritchie et al 2006), one in Kaseleguk Lagoon at the Kukpowruk River delta adjacent to the Chukchi Sea coast (50 nests), and one on Howe Island, which is located in the sale area. In 1990, 380 to 450 snow goose nests were counted on Howe Island. In the past, the colony has been decimated by fox predation; however, the island is isolated by discharge from the Sagavanirktok River early in spring, generally preventing foxes from reaching the island in most years (Winters, 1997). This island also is important for black brant nesting (Sousa, 1992).

Snow geese arrive in the Sagavanirktok River delta during the last week of May and occupy nesting habitat on Howe Island in the first days of June. Most adult females arriving on the breeding grounds have already paired and copulated and have well-developed eggs in their oviducts. They lay their eggs within four days to a week after they arrive in nests of grass and bits of willow built on high ground. Clutch size is three to six eggs which usually hatch during the last week of June or the first week of July. Goslings fledge at about seven weeks. They leave the brood-rearing areas by approximately August 15 to August 20 and congregate in immense flocks on the coastal tundra to feed almost continuously. Snow geese and black brant from the Howe Island colonies often move to the Kadleroshilik River delta to rear in the salt marshes (Ott, 1992). Half of the snow geese from the Howe Island colony take their broods to the Kadleroshilik River salt marshes for the months of July and August (Sousa, 1992). Fall migration begins in the second or third week of September (Johnson and Herter, 1989). Howe Island colony snow geese winter primarily in northern California and southern Oregon (BLM, 2005).

Canada Geese arrive along the Arctic coast during the last two weeks of May and the first week of June. They nest primarily away from the sea coast, on bluffs along the Colville River. However, some isolated pairs have been found nesting in moderate densities in coastal wetlands near Prudhoe Bay. They usually lay their eggs during the first or second week of June. The clutch size may vary from 1 to 10 eggs, which hatch within the first two weeks of July. After the goslings have fledged in mid-August, flocks begin dispersing along the Beaufort Sea and begin their southward migration. Populations on the Arctic coastal plain have ranged from lows near 3,000 in 1989 and 1994 to highs near 47,000 in 1986 and 1999 (BLM, 2005).

Greater white-fronted geese are common breeders along the Beaufort Sea coast. They reach Beaufort Sea breeding areas from the second week of May to the first week of June. Females usually select nest sites on well-vegetated (scrub willow tundra) and well-elevated habitat near lakes or rivers. Eggs are laid during the last half of May or the first two weeks of June. The female lays her eggs in a slight depression, building the nest as she completes her clutch of four to seven eggs. The incubation period varies from 23 to 28 days. Breeding adults usually molt when goslings are two to three weeks old. Fall migration may begin as early as August 10 with the last greater white-fronted geese leaving Alaska by the end of September (Johnson and Herter, 1989).

Pacific loons are the most abundant loon species of the Arctic coastal plain; aerial surveys conducted over the past decade indicate the region's population is stable. Pacific loons frequently return to nest at the same lake or pond in successive years (BLM, 2005). Average clutch size is two eggs, which require an incubation period of 23-25 days; young birds fledge in 60-65 days (Ehrlich, P., Dobkin, D., and Wheye, D., 1988). Wintering areas include the Pacific coast from southeastern Alaska to Mexico.

Red-throated loons are less abundant than Pacific loons on the Arctic coastal plain. Although recent surveys conflict — Mallek et al., 2003 reported increasing trends while Larned et al., 2003 observed decreasing trends in the regional population — the birds are relatively common on the sale area's Colville River delta (BLM, 2005). Clutch size averages two eggs, with length of incubation ranging from 24-29 days. Young birds fledge in 49-51 days (Ehrlich et al., 1988). Red-throated loons winter along the west coast from the Aleutian Islands to northwestern Mexico, and on the east coast from the St. Lawrence River to the Gulf of Mexico.

Yellow-billed loons are the least abundant loon species on the Arctic coastal plain (BLM, 2005). The greatest Yellow-billed loon concentrations in Alaska are found on the North Slope, with the highest densities between the Meade and Ikpikpuk Rivers, on the Colville River Delta, and in areas west, southwest and east of Teshekpuk Lake (USF&WS, 2006a). Yellow-billed loons arrive in the sale area in late May. They concentrate during spring with other species of loons in early-melting areas off the deltas of the Sagavanirktok, Kuparuk, and Colville Rivers. The yellow-billed is the largest of the loons (30-36 inches long) and one of the largest diving birds in North America (ADF&G, Undated). Yellow-billed loons prefer gently sloping shores of deep tundra lakes as nest sites. The nest is usually a built-up mound of turf and mud on the shoreline of a lake or occasionally on the shoreline of a large river. Egg laying begins as early as the second week of June and hatching takes place in July and early August. The normal clutch size is two eggs. The age at which yellow-billed loons fledge has not been recorded precisely but may be similar to common loon chicks, which is 45 days. The peak fall migration for yellow-billed loons is in late August or early September (Sousa, 1995; Johnson and Herter, 1989). The population in the Arctic coastal plain has been stable since at least 1986 (BLM, 2005). A Conservation Agreement has been developed as a cooperative effort among local, state, and federal resource agencies for the conservation of this species. The purpose of this agreement is to protect Yellow-billed loons and their breeding, brood-rearing, and migrating habitats in Alaska, such that current or potential threats in these areas are avoided, eliminated or reduced to the degree that they do not cause the species to become threatened or endangered from these threats is the foreseeable future (USF&WS, 2006a). A petition seeking Endangered Species Act protection for the yellow-billed loon was filed on April 5, 2004, and a 90-day finding that the petition presented substantial information indicating that ESA protection may be warranted was made by the USFWS on May 30, 2007 (50 C.F.R. § 17). A status review to determine if listing the yellow-bill loon is warranted is underway and is expected to be completed by February 2009.

a. Species of Special Concern:

The State of Alaska's Species of Special Concern List includes any species or subspecies of fish or wildlife or population of mammal or bird native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. The following bird species present in the sale area are listed by the State of Alaska as Species of Special Concern. The list was last amended in October 1998.

Arctic peregrine falcons nest south of the sale area primarily on bluffs along the Colville River from Umiat to Ocean Point, and at Franklin and Sagwon Bluffs in the Sagavanirktok River drainage. Additional nest sites may occur at other locations. Arctic peregrine falcons are present on the North Slope from late April through September. Nesting begins by mid-May, and the young birds fledge from late July to late August. Immature peregrine falcons from the Colville to the Sagavanirktok River drainages move toward the Beaufort Sea coast in mid- to late August. Peregrine falcons generally have left the North Slope by late September (Ott, 1997).

Steller's eiders and **spectacled eiders** are also listed as Species of Special Concern. More on these birds of the sale area is included below.

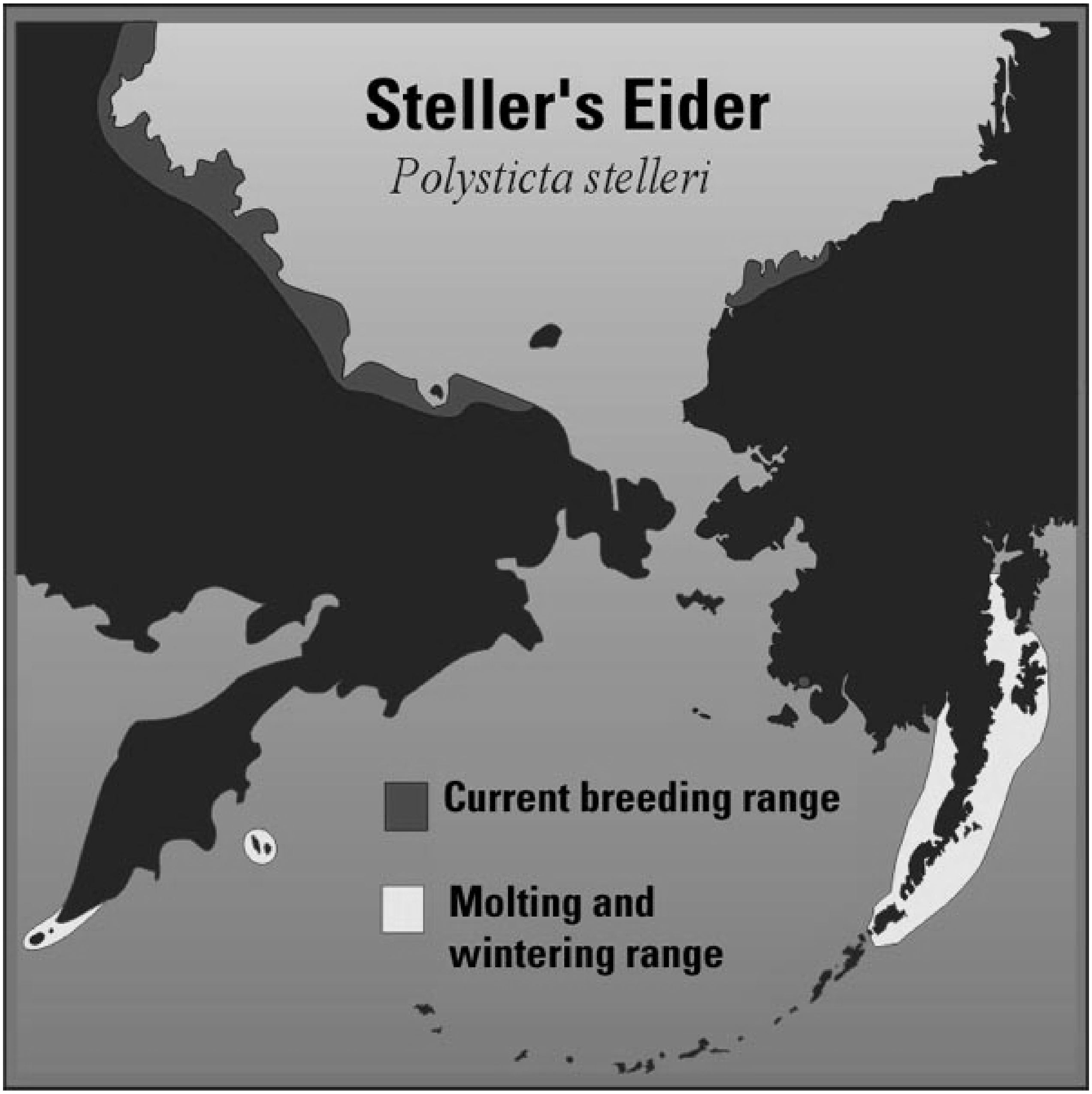
b. Threatened Bird Species:

Steller's eiders were listed as threatened under the federal Endangered Species Act on June 11, 1997, because of a reduction in the number of breeding birds and a suspected reduction of breeding range in Alaska (BLM, 2005). The birds are known to breed in Arctic Russia and Alaska (Figure 3.2a); their range on the Arctic coastal plain is thought to have once extended from Wainwright east to Canada's Northwest Territories. Steller's eiders are currently reported to range east at least as far as Prudhoe Bay, though no recent records place them east of the Sagavanirktok River. Very few sightings are currently reported east of the Colville River (BLM, 2005). Steller's eiders nest on tundra habitats often associated with polygonal ground near the coast and inland. The nest is a deep cup in the tundra; it consists of curly, coarse grasses and various mosses and lichens and is well lined with down and feathers. Females lay between 6 to 10 eggs and incubate them for about three weeks. Hatching along the Beaufort Sea apparently begins during the first or second week of July. Most young are probably ready to fly by August. Steller's eiders migrate from the Beaufort Sea during late September and early October (Johnson and Herter, 1989).

Spectacled eiders were listed as threatened under the federal Endangered Species Act on May 10, 1993, after population declines were reported in important Yukon-Kuskokwin Delta nesting areas (BLM, 2005). The historic breeding range of the spectacled eider includes the coastal tundra areas of the North Slope from Barrow to the U.S.-Canada border (Sousa, 1992). Causes for the declines are not known but may include some combination of reduced food supplies, pollution, over-harvest, lead shot poisoning and increased predation.

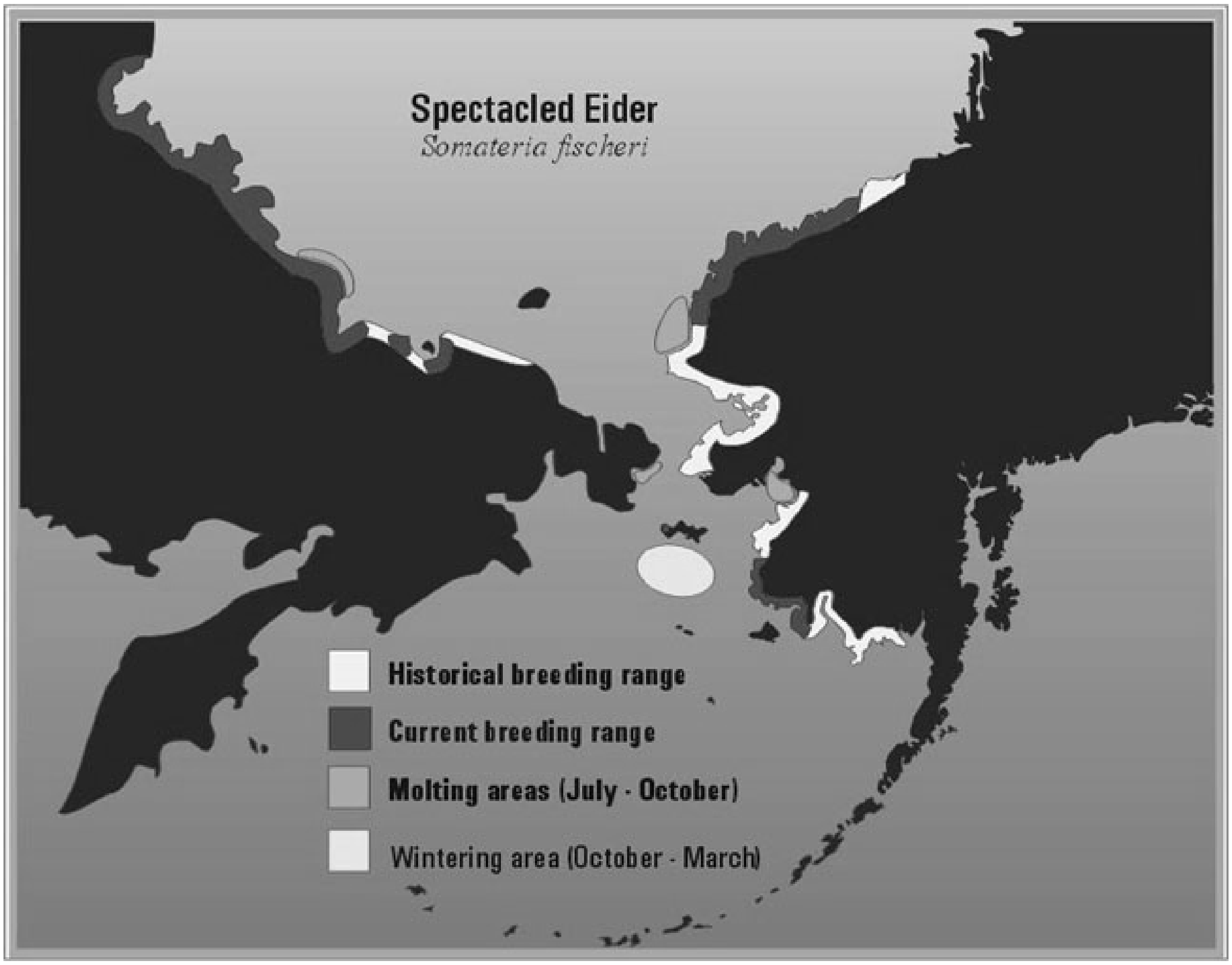
Spectacled eiders occur throughout the sale area (Figure 3.2b). All of the onshore tracts are within the expected breeding range for this species (Sousa, 1997). Important habitats for Arctic-breeding spectacled eiders include large river deltas; tundra rich in lakes; and wet, polygonized coastal plains with numerous water bodies (USF&WS, 1996). Females lay one egg per day and begin incubation with the laying of the last egg. Clutch size averages between 3.8 and 4.5 eggs. Hatching occurs from mid- to late July. Fledging occurs approximately 50 days after hatching. Females and their broods then move directly from freshwater to marine habitats (USF&WS, 1996). During August, productive adults undertake their summer molt. Fall migration from the Beaufort Sea by males may begin in midsummer. Most spectacled eiders have left the coast by September 20 (Johnson and Herter, 1989).

Figure 3.2a Breeding, Molting and Winter Range of the Steller's Eider



Source: USF&WS, 2008b.

Figure 3.2b Range of the Spectacled Eider



Source: USF&WS, 2008a.

3. Terrestrial Mammals

a. Caribou

Caribou (*Rangifer tarandus*) are members of the deer family. Four caribou herds use the coastal habitats within and adjacent to the sale area. A herd is a group of caribou which establishes a calving area distinct from any other group and calves there repeatedly (ADF&G, 1994). The Western Arctic caribou herd ranges over an area that extends approximately from the Colville River to the western coast of Alaska (see Figure 3.3). The Porcupine caribou herd ranges adjacent to the sale area, south from the Beaufort Sea coast, from the Canning River eastward into Canada. The range of the Central Arctic caribou herd extends from the northern foothills of the Brooks Range to the Beaufort Sea and from the Colville River east to the Canning River. A fourth herd, the Teshekpuk Lake herd, occupies the area around Teshekpuk Lake, west of the sale area. Caribou from the Teshekpuk Lake herd have been observed in the Colville River delta seeking relief from insect harassment (Smith et al, 1993). A majority of the Teshekpuk herd winter on the coastal plain. The most common area for wintering is the area around Atqasuk (ADF&G, 2003). A substantial number of Teshekpuk Lake caribou recently (2004-2006) have wintered in the area between the Colville and Itkillik River drainages and the Dalton Highway. In 2003-2004, about one third of the Teshekpuk Lake caribou herd wintered east into ANWR (Carroll, 2005). See Figure 3.3 showing caribou distribution.

Caribou normally move toward the coast to calve and escape the predators of their winter range. In late May or early June a single calf is born (twins are very rare) mostly within 30 miles of the coast. Coastal areas seem to be preferred calving habitats, but calving occurs further inland as well (Baker, 1987). Newborn calves can walk within an hour of birth. After a few days, they can outrun a man and swim across lakes and rivers. Newborn calves weigh an average of 13 pounds and may double their weight in 10-15 days (ADF&G, 1994). Caribou in North Slope oilfields have grown accustomed to above-ground pipelines, as long as traffic on associated roads is infrequent and does not create a barrier. However, they can be sensitive to human activities in calving areas (OPMP, 2006). The authors of the ADF&G report *Effects of Oil Field Development on Calf Production and Survival in the Central Arctic Herd* write: “Several studies have suggested that, during the calving season in late May to late June, pregnant caribou cows and those with newborn calves avoided areas of disturbance associated with oil exploration and extraction. … During the 1990s, the area of greatest concentration of calving by the western segment of the Central Arctic herd shifted southward as development of oil-related infrastructure occurred in what was originally a major calving area” (Arthur and Del Vecchio, 2004).

The Western Arctic herd calves mainly inland on the NPR-A. The Porcupine herd’s calving range is along the Beaufort Sea coast from the Canning River to the Babbage River in Canada. The location of calving areas has changed over time. The Central Arctic herd’s calving area has been described as the area between the eastern channel of the Colville River and Kalubik Creek (Smith et al., 1994, citing Lawhead and Cameron, 1988). Current primary calving concentration areas lie between the Sagavanirktok and Canning Rivers in the area south of Bullen Point, and to the southwest of the Kuparuk oil field (Ott, 1997). Lesser used calving areas have also been identified in the area between the eastern channel and the Nechelik channel of the Colville (Smith, et al. 1994; citing Whitten and Cameron, 1985) and in the foothills of the Brooks Range, south of the Colville River delta. Use of calving habitat varies with weather and snow conditions. The fidelity of caribou to their calving areas suggests that certain areas, such as those mentioned above, may be more important than other seasonal ranges.

Caribou summer on the Arctic coastal plain. The Central Arctic herd spends June through mid-August near the Arctic coast between the Colville and Canning Rivers (Whitten, 1995). In midsummer, from mid- to late June through July, caribou are often harassed by hordes of mosquitoes, warble flies, and nose flies. Movement during the summer is closely tied to insect harassment. In response, caribou move from inland feeding areas to windswept, vegetation-free coastal areas where the insects are limited. Sometimes the animals run in frenzies for long distances, stopping to rest only when exhausted or when wind offers relief from the insects (ADF&G, 1994). Most insect relief areas are found within two miles of the coast (ADF&G, 1986b); however, caribou also tend to congregate on gravel drilling pads and roads which are generally raised above the tundra and more exposed to the elements (USACE, 1984). Caribou that remain inland may move to river bars and bluffs to escape these insects. The frequency and duration of caribou movements to and from the coast depend on weather-related changes that affect the number of mosquitoes. Caribou distribution on the coastal plain can change dramatically within a 24-hour period.

The fall migration south begins in September and ends by mid-November. During both the spring and fall migrations, the Central Arctic herd tends to move along or near major river drainages, such as the Itkillik, Kuparuk, Shaviovik, and Canning. Central Arctic caribou generally winter in the northern foothills of the Brooks Range, although substantial numbers have wintered south of the Brooks Range in recent years. Occasionally, some remain on the coastal plain during mild winters. (Ott, 1992).

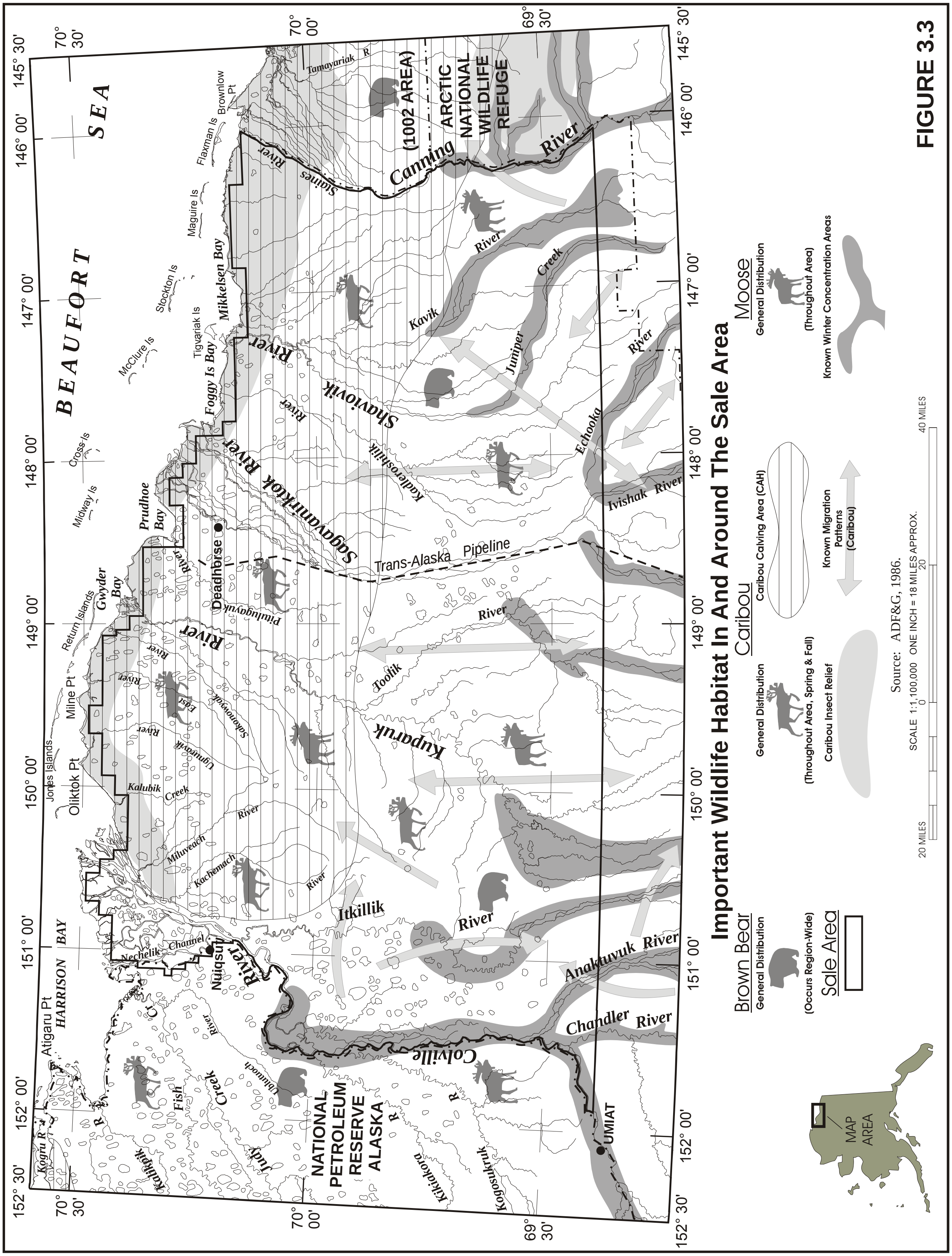


FIGURE 3.3
Important Wildlife Habitat In And Around The Sale Area

Caribou must keep moving to find adequate food. This distributes feeding pressure and tends to prevent overgrazing. Caribou are great wanderers and very efficient at moving across both boggy and rugged terrain. They commonly travel vast distances to reach suitable foraging sites on widely separated seasonal ranges. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases. In summer, caribou eat a wide variety of plants, apparently favoring the leaves of willows, grasses, and herbaceous and flowering plants. During winter, they use windswept upland areas or areas of lighter snow cover where they can dig through the snow to feed on lichens, "reindeer moss," and dried sedges (ADF&G, 1994).

Historic population counts for all four herd populations are depicted in Table 3.5. Caribou calf survival and adult mortality are primary factors affecting the size and growth of caribou herds. ADF&G's 2002 census of the Central Arctic caribou herd revealed an increase of nearly 14,000 animals since 1995 (Arthur and Del Vecchio, 2004). The Western Arctic herd's population grew to about 450,000 by 1993, primarily because calf survival far exceeded adult mortality until the early 1990s. However, biologists note the apparent decline in the 1999 census was the result of problems with the photo census and not an actual decline in population size (Dau, 2005). There is no evidence that any single factor — including human harvests, predation, environmental contaminants, or disease — is currently limiting the size of this herd. (ADF&G, Undated).

Table 3.6 Historic Population Counts for Caribou Herds

Western Arctic Herd		Central Arctic Herd		Teshekpuk Caribou Herd		Porcupine Caribou Herd	
Year	No. of Animals	Year	No. of Animals	Year	No. of Animals	Year	No. of Animals
1976	75,000	1978	6,000	1982	4,000	1972	100,000
1978	102,000	1981	9,000	1989	16,700	1977	105,000
1980	138,000	1983	12,900	1993	27,600	1982	125,200
1982	171,700	1991	18,900	1995	26,000	1983	135,300
1986	229,400	1992	23,400	2002	45,166	1987	165,000
1988	343,200	1995	18,093			1989	178,000
1991	415,700	2002	32,000			1992	163,500
1993	450,000					1994	152,000
1999	430,000					2001	123,000
2003	490,000						

Sources: Cronin, et al., 1994; ADF&G, Undated; Whitten, 1995; Ott, 1997; Arthur and Del Vecchio, 2004; BLM, 2005 3:50; PCMB, 2006.

A 2001 census of the Porcupine caribou herd indicated that the herd had declined by 29,000 since 1994, to 123,000. Estimates in 2005 based on the parturition and cow-to-calf ratios suggested the herd had declined further, to 110,000-115,000 (PCMB, 2006). Meanwhile, the first photo census of the Teshekpuk Lake caribou herd occurred in 1984 and counted 11,822 caribou. Subsequent counts indicate the herd had grown steadily, numbering 45,166 in 2002.

b. Moose

Moose are the world's largest members of the deer family and the Alaska moose (*Alces alces gigas*) is the largest of all the moose. Moose breed annually and both sexes may begin breeding at an age of 16 to 18 months. Calves are born anytime from mid-May to early June after a gestation period of about 230 days. Calves begin taking solid food a few days after birth. Newborn calves weigh 28 to 35 pounds and within five months grow to more than 300 pounds (ADF&G, 1994).

Rutting occurs during the fall between late September and early October. During this period, moose may aggregate in groups of up to 30 bulls and cows, with movement of individuals between the groups (ADF&G 1986a).

Moose eat a variety of plants, particularly sedges, equisetum (horsetail), pond weeds, and grasses. During summer, moose feed on forbs, vegetation in shallow ponds, and the leaves of birch, willow, and aspen. Willow stands along rivers and streams provide essential habitat for moose. These riparian areas are especially important during winter when forage is mainly confined along major drainages where shrubs will not be covered by drifting snow (Sousa, 1992).

Following the snowmelt, usually around the beginning of May, moose occasionally disperse across the tundra, but are mainly found at varying elevations in the foothills (see Figure 3.3). Calving also occurs at this time. Moose have a high reproductive potential and can quickly fill a range to capacity if not limited by predation, hunting, and severe weather. Deep, crusted snow can lead to malnutrition and subsequent death of hundreds of moose and decrease the survival of the succeeding year's calves. Predation by wolves and bears limits the growth of moose populations in Alaska (ADF&G, 1994).

The North Slope represents the northern limit of moose range in North America; thus, habitat sharply limits the potential size of moose populations. Moose in the sale region are generally associated with narrow strips of shrub communities along drainages. Moose concentrate in winter along portions of the Canning, Kavik, Echooka, Sagavanirktok, and Colville Rivers, and Juniper Creek in the southern portion of the sale area (ADF&G, 1986 atlas). Surveys indicate moose may undertake extensive movements within or between North Slope drainages (Lenart, 2004).

General distribution occurs all across the North Slope, but this has not always been the case. Moose were scarce in Arctic Alaska prior to the early 1950s, when populations expanded and reached high densities in the limited riparian habitat of major drainages (LeResche, R.E., et al., 1974). Dramatic declines in moose populations noted during the early 1990s were probably due to a combination of factors including disease, weather, habitat limitations, insect harassment, and heightened predation by increasing populations of wolves and brown bears. Food supplies vary from year to year, and forage is limited. Moose populations along the Colville and Kavik Rivers are at the northern extent of the species' range and are susceptible to bad winters (Carroll, 1996). A lack of forage could lead to a mineral deficiency which can result in increased predation. Studies conducted on dead animals collected along the Colville River and its tributaries in 1996 suggested disease may have been a factor since in 1996 and 1997 the diseases brucellosis and leptospirosis were found in both dead and live moose sampled (Lenart, 2004).

By 2003, state biologists observed increases in moose populations over much of the region. Surveys found the highest concentrations of moose along the Echooka, Ivishak, Kavik, and Canning Rivers. Moose are also found in the Kuparuk, Toolik and Itkillik River drainages. (Lenart, 2004).

c. Brown Bears

Although taxonomists once listed brown bears and grizzly bears separately, the two are now classified as the same species, *Ursus arctos*. Generally, the term brown bear is used for those found in coastal areas while bears found in the interior areas of Alaska are known as grizzlies (ADF&G, 1994).

Brown bears travel major river corridors in the spring and summer and frequently den along riverbanks in the fall (see Figure 3.3). The bears feed extensively in riparian areas of the sale area in spring and summer because these areas provide them with the greatest diversity of foods. Since the main oil field region is situated between the Sagavanirktok and Colville Rivers — two of the largest riparian areas on the North Slope — brown bears have ample opportunity to encounter oil field facilities and activities (ConocoPhillips, 2005). Past investigations of radio-collared bears in the Prudhoe Bay area revealed an unnaturally high and productive population of brown bears in the oil field, most likely due to the supplemental food supply (garbage) available there (Sousa, 1992). Bear weights vary depending on the time of year. Bears weigh the least in the spring or early summer. They gain weight rapidly during late summer and fall just prior to denning (ADF&G, 1994).

In the winter, when food is unavailable or scarce, brown bears enter dens and hibernate. During hibernation, their body temperature, heart rate, and other metabolic rates are reduced, and their need for food and water is eliminated. Brown bears enter their dens from mid-October through November (Ott, 1997) where they may spend 5 to 7½ months. On the coastal plain, bears den in low hills, dry lake margins, pingos, and stream banks to within at least 20 miles of the coast (Ott, 1991). Recent ADF&G brown bear research confirms that some of the bears using the oil fields den within a mile of the coast (Ott, 1997). They normally leave their dens in April and early May; adult males emerge first, followed by single females, then sows with young (ADF&G, 1994).

Except for females with offspring and breeding animals, bears are typically solitary creatures and avoid other bears. Exceptions occur where food sources are concentrated such as marine or terrestrial mammal carcasses. In the spring, brown bears are commonly found in major river valleys, such as the Colville and Itkillik. They later move to small tributaries and poorly drained areas to feed.

Mating takes place from May through July with the peak of activity in early June. Brown bears generally do not have strong mating ties. Individual bears are rarely seen with a mate for more than a week. Males may mate with more than one female during breeding season. The young are born the following January or February in a winter den. Litter size ranges from one to four cubs, but two is most common. Offspring typically separate from their mothers as two-year-olds in May or June. In some areas where food is scarce, females may skip one to three years before producing new litters. Bear populations vary depending on the productivity of the environment. In areas of low productivity, studies have revealed bear densities as low as one bear per 300 square miles (ADF&G, 1994).

Brown bears consume a wide variety of foods including berries, grasses, sedges, horsetails, cow parsnips, fish, ground squirrels, and roots of many kinds of plants. In some parts of Alaska, brown bears prey on newborn moose and caribou. They can also kill healthy adults of these species. Bears are fond of all types of carrion as well as garbage in human dumps. Brown bears have an especially good sense of smell and under the right conditions may be able to detect odors more than a mile distant (ADF&G, 1994). During the summer bears most frequently feed in wet sedge meadows, late snow bank areas, and tussock tundra, concentrating on grasses, sedges, and the fruiting and vegetative stems of horsetails. In the fall, bears use the floodplains of large creeks and rivers, dry ridge areas or mountain slopes to feed on roots, berries, and ground squirrels (ADF&G 1986a).

d. Muskoxen

Muskoxen (*Ovibos moschatus*) are stocky, long-haired animals with cloven hooves, slight shoulder humps, and very short tails. Taxonomists classify muskoxen with sheep and goats. Muskoxen as a species have changed little since the ice age and are perfectly adapted to their harsh Arctic environment (ADF&G, 1994).

Alaska's original muskoxen disappeared in the mid- or late 1800s as a result of over-hunting. They were re-introduced into the Arctic National Wildlife Refuge (ANWR) in 1969 and by 1974 the population had begun to grow rapidly and spread westward beyond the Canning River and into the sale area (USF&WS 1987; USFWS Survey Summaries 2005). The population continued to grow until 1986 and remained stable until 1998. In recent years, however, muskoxen numbers in ANWR have fallen sharply while populations in state Game Management Unit 26 B, which includes the sale area, began to decline in 2004. Muskoxen declines may have been caused by predation, adverse weather conditions such as icing events, deep snow, and long snow seasons that reduce access to winter forage (USFWS, 2005).

Riparian habitat is preferred by muskoxen for virtually their entire annual cycle. River systems that provide diverse low shrub-forbs and tall willow communities in proximity to relatively snow-free uplands, hillsides, and plateaus are important to muskoxen (Sousa, 1992). Small numbers of muskoxen occur in the Colville River delta, in the area of the lower Itkillik River valley, and the headwaters of the Miluveach and Kachemach Rivers (Ott, 1997). Known wintering areas occur along riverside bluffs in the southwest corner of the sale area, in the vicinity of the Sagavanirktok and Ivishak Rivers, and along the Kavik and Shaviovik River drainages near the coast. During summer they also utilize the Kadleroshilik drainage (Sousa, 1992).

Muskoxen are relatively sedentary in the winter (October-May), possibly as a strategy for conserving energy. They are not migratory, but may move in response to seasonal changes in snow cover and vegetation. Many bull muskoxen move from mixed-sex groups during the summer to bull groups during the winter. Females calve from late April to mid-June. Limited data suggests that the majority of the population calves in the southern portion of the Arctic coastal plain on windblown, snow-free banks within riparian areas, and in upland sites in the foothills. The rutting season generally occurs in August (Sousa, 1992).

Muskoxen eat a wide variety of plants, including grasses, sedges, forbs, and woody plants. In summer and fall, both sexes may be found along major river drainages where they feed on willows and forbs. In winter and spring, muskoxen groups of 10 to 20 animals may be found in uplands adjacent to river drainages which afford forage of tussock sedges and have less snow cover (USF&WS, 1987). Muskoxen are poorly adapted for digging through heavy snow for food, so winter habitat is generally restricted to areas with shallow snow accumulations or areas blown free of snow (ADF&G, 1994).

State and federal wildlife agencies have not opened any muskoxen subsistence hunts in the last three regulatory years, mostly affecting villagers in Nuiqsut and Kaktovik (Lenart, 2007). Predation by grizzly bears and flooding on the Colville River are cited as factors in the decline of area muskoxen.

e. Furbearers

Other species that may be found in the area include arctic fox, red fox, wolf, and wolverine. Information on the abundance and distribution of these species is limited.

Arctic foxes *(Alopex lagopus)* are found within the sale area. Both blue and white color phases occur, with the white color phase more common in northern litters. Young of each color phase may occur in the same litter (ADF&G, 1994).

Fully grown arctic foxes weigh from six to 10 pounds. They average 43 inches in length including the tail, which averages 15 inches in length. Arctic foxes may move long distances over sea ice. A fox tagged along the coast of Russia was captured a year later near Wainwright, Alaska (ADF&G, 1994).

Arctic fox pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and river cut banks. Most dens have southerly exposure. They extend from 6 to 12 feet underground. Enlarged ground squirrel burrows with several entrances are often used as dens (ADF&G, 1994).

Mating occurs in early March through early April. Gestation lasts 52 days. Litters average seven pups but may contain as many as 15 pups. Arctic foxes are monogamous in the wild. Both parents aid in bringing food to the den and in rearing the pups. Pups begin eating meat when about one month old and are fully weaned by 1½ months. They emerge from the den when about three weeks old and begin to hunt and range away from the den at about three months. Arctic foxes attain sexual maturity at nine to 10 months, but many die in their first year (ADF&G, 1994).

Arctic foxes have prospered in the Prudhoe Bay oil fields, where their population densities are greater than in surrounding undeveloped areas. They commonly feed, den, and rest around development sites (BLM, 2005). Arctic foxes are omnivorous. In summer, they feed primarily on small mammals, including lemmings and tundra voles. They sometimes eat berries, eggs, and scavenged remains of other animals. Many foxes venture onto the sea ice during winter to eat the remains of seals killed by polar bears. In areas where lemmings and voles are the most important summer prey, fox numbers often rise and fall with cyclic changes of their prey. Fewer pups are successfully reared to maturity when food is scarce. There is evidence that competition for food among young pups accounts for some of the heavy mortality in this age group (ADF&G, 1994).

Wolves *(Canis lupus)* are adaptable and exist in a wide variety of habitats including the Arctic tundra along the Beaufort Sea. Wolves are members of the family Canidae. They are highly social animals and usually live in packs averaging six to seven animals (ADF&G, 1994).

Wolves normally breed in February and March, and litters averaging about five pups are born in May or early June. Litters may include from two to 10 pups, but most often four to seven pups are born. Most female wolves first breed when 22 months old but younger females usually have fewer pups than older females. Pups are usually born in dens dug as deep as 10 feet into well-drained soil. Adult wolves generally center their activities near dens, but may travel as far as 20 miles in search of food, which is regularly brought back to the den. Wolf pups are weaned gradually during midsummer. In mid- or late summer, pups are usually moved some distance away from the den and by early winter are capable of traveling and hunting with adult pack members. Wolves are great travelers, and packs often travel 10 to 30 or more miles in a day during winter. Dispersing wolves have been known to move from 100 to 700 miles from their original range (ADF&G, 1994).

In spite of a generally high birth rate, wolves rarely become abundant because mortality is high. In much of Alaska, hunting and trapping are the major sources of mortality, although diseases, malnutrition, accidents, and particularly preying by other wolves act to regulate wolf numbers (ADF&G, 1994).

Wolves are carnivores, with moose and/or caribou as their primary food. During summer, small mammals including voles, lemmings, ground squirrels, snowshoe hares, beaver, and occasionally birds and fish are supplements in the diet. Wolves are opportunistic feeders; very young, old, or diseased animals are preyed upon more heavily than other age classes. Under some circumstances, however, such as when snow is unusually deep, even animals in their prime may be vulnerable to wolves (ADF&G, 1994).

Wolf populations fluctuate according to changes in prey populations (caribou and moose), and hunting by humans. Some of the highest wolf densities around the sale area occur along the Colville River. Surveys near Umiat revealed wolf density increasing from one wolf per square mile in 1987 to 1.6 wolves per mile in 1994. A survey in 1998 estimated 0.6 wolves per square mile. The decline may have reflected sharp decreases in moose numbers between 1992 and 1998 (BLM, 2005, citing Bente, 1998).

Wolverines are the largest terrestrial member of the family *Mustelidae*, which includes weasels, minks, and martens. Its scientific name is *Gulo gulo*, meaning glutton. Wolverines are primarily found in Alaska's wilder and more remote areas (ADF&G, 1994). They frequent all types of terrain and often utilize rivers as territorial boundaries (USF&WS, 1987). Wolverines occur throughout the Arctic coastal plain but are considered more common in the mountains and foothills of the Brooks Range (BLM, 2005).

Wolverines become sexually mature in their second year. Breeding takes place between May and August. After wolverines mate, the embryos float in the uterus until late fall or early winter. This type of reproduction is known as delayed implantation, and allows female wolverines to become pregnant when food supplies are plentiful and when she is in good physical condition. The abundance of food determines whether a pregnancy will be maintained and the number of young that will be born (ADF&G, 1994).

Litters are born between January and April. In Interior and northern Alaska, most young are born in snow caves. These caves usually consist of one or two tunnels that may be up to 60 yards long. Litters usually number from one to three. Young wolverines, called kits, develop rapidly and are weaned at about eight weeks of age. They leave their mothers at approximately five or six months to forage for themselves (ADF&G, 1994).

Wolverines travel extensively in search of food. They are opportunistic; eating about anything they can find or kill and are well adapted for scavenging. Wolverines can survive for long periods on little food. Their diet varies from season to season depending on food availability. In the winter, wolverines rely primarily on the remains of moose and caribou killed by wolves and hunters or animals that have died of natural causes. Throughout the year, wolverines feed on small and medium-sized animals such as voles, squirrels, snowshoe hares, and birds. In some situations, wolverines can kill moose or caribou, but these occurrences are rare (ADF&G, 1994).

4. Marine Mammals

a. Polar Bears

Polar bears (*Ursus maritimus*) inhabit the coast of the North Slope sale area (see Figure 3.4). They are marine mammals and are protected under the Marine Mammal Protection Act of 1972. On May 15, 2008, the USFWS published a ***Final Rule*** in the Federal Register listing the polar bear as a threatened species under the federal Endangered Species Act. The USFWS based its listing on the loss of sea ice, which it says threatens and will likely continue to threaten polar bear habitat. The USFWS believes that this loss of habitat puts polar bears at risk of becoming endangered in the foreseeable future, the standard established by the Endangered Species Act for designating a threatened species. This final rule activates the consultation provisions of Section 7 of the Act for the polar bear. The special rule for the polar bear, also published in the May 15, 2008, edition of the Federal Register, sets out the prohibitions and exceptions that apply to this species. It recognizes the adequacy of the existing regulatory structure in protecting polar bears.

The State of Alaska has challenged the listing (Office of the Governor, 2008). The state maintains that there is insufficient evidence to support a listing of the polar bear as threatened for any reason at this time. Polar bears are currently well-managed and have dramatically increased over 30 years as a result of conservation measures enacted through international agreements and the Marine Mammal Protection Act.

Polar bears are distributed throughout the Arctic circumpolar region. Within this region, it is estimated that there are currently 20,000 to 25,000 polar bears (IUCN, 2006), a substantial increase from the early 1970s. Although no Distinct Population Segments have been identified across the Arctic circumpolar region, the IUCN (International Union for Conservation of Nature and Natural Resources) has established 19 management units for purposes of research and management (IUCN, 2006). Two of these overlap Alaska, the Southern Beaufort and the Chukchi Sea sub-populations.

Polar bears and brown bears evolved from a common ancestor and are closely related, as demonstrated by matings and production of fertile offspring in zoos (ADF&G, 1994). At least one successful pairing has occurred in the wild, as confirmed in 2006 by DNA analysis of a hybrid bear shot by a hunter on the southern tip of Banks Island, Northwest Territories (National Geographic News, May 2006). Although polar bears may be similar in size to some southern coastal brown bears, they are considerably larger than the brown bears found along the North Slope (Ott, 1997). Adaptations by the polar bear to life on sea ice include a white coat with water-repellent guard hairs and dense underfur, short furred snout, short ears, teeth specialized for a carnivorous diet, and hair nearly completely covering the bottom of the feet (ADF&G, 1994).

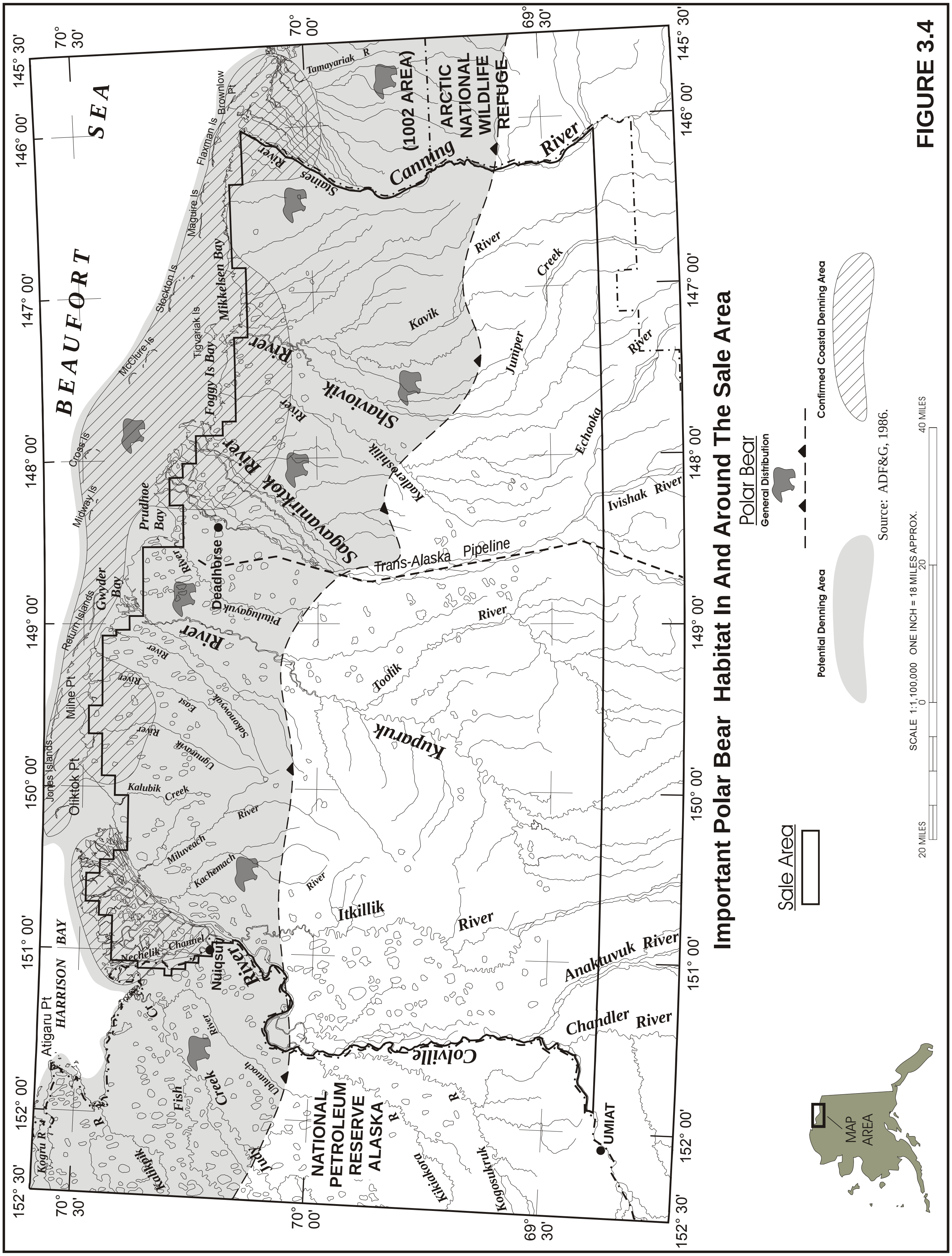
Polar bears breed from late March to May (ADF&G, 1994). During late October and November, pregnant females search for banks, slopes, or rough ice in which to dig a den, either on land or on sea ice (ADF&G, 1994). Litters of one to three cubs are born in December or January (Smith and Walker, 1995). In late March or early April, polar bears emerge from the den with their cubs and begin making excursions to drifting sea ice (ADF&G, 1994). The young remain with the mother until they are about 28 months old (ADF&G, 1994). Females can produce litters about every third year, and polar bears can live to be about 25 years old (ADF&G, 1994).

Radio collar surveys indicate that the Beaufort Sea population dens locally, and is not dependent on reproduction from other known denning areas outside of the region (Amstrup and Gardner, 1994). Polar bears do not exhibit site fidelity in denning, but return only to the general substrate and geographic area upon which they had previously denned: on ice or on land, and in the eastern or the western Beaufort respectively. The most preferred region for land denning is located east of the sale area in the northeast corner of Alaska and adjacent to Canada (Amstrup and Gardner, 1995).

Regehr et al. (2006) compared production indices between two time periods, 1967-1989 and 1990-2006. They found that, in the spring, the proportion and number of adult females with cubs of the year increased significantly between the two periods, but that yearling production was not significantly different. In the autumn, they found that the proportion and number of adult females with cubs of the year was significantly lower in the second time period, but yearling production was not significantly different. Litter size was not significantly different between the two time periods.

Polar bears are usually found near coastlines and the southern edge of sea ice, and they may make extensive seasonal movements related to the ice edge (ADF&G, 1994). This is because their primary food is the ringed seal, which inhabits the Arctic ice (ADF&G, 1994). Bears capture seals by waiting for them at breathing holes and at the edge of leads or cracks in the ice, by stalking resting seals on top of the ice, and by breaking into pupping chambers on top of the ice in the spring (ADF&G, 1994). However, Regehr et al. (2006) found that survival was not clearly related to sea ice coverage. Other prey includes bearded seals, walruses, and beluga whales, and polar bears will eat small mammals, bird eggs, and vegetation. Polar bears also feed on whale, walrus and seal carcasses (ADF&G, 1994).

Regehr et al. (2006) estimated the southern Beaufort Sea polar bear population to be 1,526 (95 percent CI = 1,211; 1,841) in 2006, which was not significantly different from a 1986 estimate of about 1,800 polar bears.



Important Polar Bear Habitat In And Around The Sale Area

FIGURE 3.4

Pinnipeds

Pinnipeds are aquatic mammals having finlike flippers as organs of locomotion; including ringed seals, spotted seals, and walrus. These species are not present in the sale area but are nearby, along the Beaufort Sea coast. Pinnipeds are protected under the Marine Mammal Protection Act of 1972. Ringed seals are the smallest of the pinnipeds and are the most abundant seal in the Beaufort Sea (ADF&G, 1994).

Ringed seals (*Phoca hispida*) are the smallest and most abundant of the Arctic ice seals. The size of the population is estimated from 40,000 in the winter to 80,000 in the summer. Densities of ringed seals near Prudhoe Bay between 1997 and 2002 ranged from 0.15 to 0.28 seals per mile. The differences may be due, in part, to the timing of surveys, the timing of lair abandonment, or a decrease in the abundance of seals since 1980. During winter and spring, ringed seals are found at the highest densities on stable shore-fast ice and during the summer months along the receding edge of the ice pack (BLM, 2007). Activities of ringed seals on the ice vary with the seasons. During the late spring and early summer, ringed seals use the ice as a solid surface on which to haul out and complete their annual molt. They are usually found near cracks, open leads, or holes where they have rapid access to water. During winter and spring, most of the breeding adults are found on stable land-fast ice. From March through May, during the spring breeding and pupping season, high densities of adults remain on the land-fast ice while sub adults are most numerous in adjacent flow ice zones (LaBelle et al., 1983) (see Figure 3.4).

Females give birth to a single, white-coated pup in snow dens on either land-fast or drifting pack ice during March and April. Female seals build lairs in pressure ridges or under snowdrifts for protection from predators and severe weather. There is some evidence that females lacking maternal experience give birth in drifting pack ice and may be more subject to polar bear predation. More experienced females give birth in land-fast ice and may have higher reproductive success (ADF&G, 1994).

Ringed seals molt in May and June. During this time they spend long periods hauled out on the ice basking in the sun. It is thought that warmer skin temperatures cause the new hair to grow more quickly. When hauled out on the ice, ringed seals are very wary, raising their heads every 20 seconds or so to look around. They rapidly enter the water when they detect an approaching human or other predator (ADF&G, 1994).

The amount of time spent on the ice increases as the molt season progresses. In summer, as the nearshore ice melts, most of the adult ringed seals are found along the edge of the pack ice, seaward of the sale area. Subadults may remain in the ice-free areas. Open leads and cracks in the ice are used by ringed seals to surface and breathe. During the fall, as freeze-up begins, seals will actively keep breathing holes open (Stirling, 1990).

Ringed seals spend much of the summer and early fall in the water feeding. Ringed seals eat a variety of invertebrates and fish. The particular species eaten depends on availability, depth of water, and distance from shore. In Alaska waters, the important food species are arctic cod, saffron cod, shrimps, and other crustaceans. Feeding is greatly reduced during the molt (ADF&G, 1994).

Spotted seals (*Phoca largha*) are commonly seen in coastal waters of northern Alaska during ice-free seasons. The name is descriptive of its markings, consisting of numerous dark, irregularly shaped spots (sometimes encircled by a faint ring) on a lighter background, usually of a brownish yellow color. Spots are most numerous on the back and upper flanks (ADF&G, 1994).

Spotted seals enter the sale area in July and are known to haul-out on the outer islands of the eastern Colville River delta. Spotted seals move out of the Beaufort Sea from September to mid-October as the shorefast ice reforms (Ott, 1997).

They are annual breeders, and mating occurs in late April to early May. Pupping occurs anytime from early April to the first part of May, although the peak is during the first two weeks of April. Pups are nursed for three to four weeks, during which time they more than double in weight. Adult females mate about the same time their pups are weaned (ADF&G, 1994).

They eat a varied diet; principal foods are schooling fishes, although the total array of foods is quite varied. There are geographical and seasonal differences in their prey. Along the coast spotted seals feed on herring, capelin, saffron cod, some salmon (especially in lagoons and river mouths), and smelt (ADF&G, 1994).

Bearded seals (*Erignathus barbatus*) are the largest seal normally found in the seas adjacent to Alaska. Bearded seals are heaviest during winter and early spring when they may reach weights of more than 750 pounds (341 kilograms). From June through September adults usually weigh from 475 to 525 pounds (216-239 kilograms). This seasonal weight loss results from decreased feeding during spring and summer and is most obvious in changes of the thick layer of blubber under the skin. Measured from nose to tip of tail (not including hind flippers), adults average about 93 inches (2.4 meters) (ADF&G, 1994). The majority of the bearded seal population in Alaska is in the Bering and Chukchi Seas. In the Beaufort Sea, the bearded seal is restricted primarily to moving ice during the summer (MMS, 1996a). They may be found in near shore areas during summer in the central and western Beaufort Sea. Their most important habitat during winter and spring is active ice or offshore leads. No reliable estimate of the abundance of bearded seals in the Beaufort Sea is currently available (BLM, 2007).

Female seals are able to breed successfully at age 5 or 6. Males become sexually mature at six or seven years. Bearded seals commonly become reproductively active before they attain maximum growth. The incidence of pregnancy in adult females is about 85 percent. During April, adult male bearded seals begin underwater “singing.” The song is a highly characteristic and complex frequency-modulated whistle, parts of which are audible to humans. Hunters are sometimes guided to a seal by its whistle (ADF&G, 1994).

Females bear a single pup, usually during late April or early May. The average weight of pups at birth is around 75 pounds and average length is about 52 inches. By the end of a brief nursing period lasting from 12 to 18 days, pups increase their weight almost three times, to around 190 pounds. This gain is due mainly to an increase in thickness of the blubber layer (ADF&G, 1994).

Bearded seals eat a wide variety of invertebrates and some bottom fishes. The main food items are crabs, shrimp, clams, and snails (ADF&G, 1994).

Pacific walrus are the largest pinnipeds in Arctic and subarctic seas. The majority of the North Pacific walrus population occurs west of Barrow, although a few walrus may move east throughout the Alaska portion of the Beaufort Sea to Canadian waters during the open water season. They are most commonly found in relatively shallow water areas, close to ice or land. The genus name for the walrus, *Odobenus* (meaning tooth-walker), refers to one of their most prominent characteristics, their tusks. These tusks, which are elongated upper canine teeth, are present in both males and females. They are huge animals; adult bulls often approach two tons in weight, and the females may exceed one ton (ADF&G, 1994).

Most females do not begin to breed until six or seven years of age. Mating occurs during January and February, but growth of the fetus does not begin until about mid-June. This delay in fetal growth is thought to occur in all pinnipeds. Walrus calves are born mostly in late April or early May during the spring migration. They weigh 100 to 160 pounds at birth. Calves are dependent upon their mothers for at least 18 months and occasionally for as long as 2½ years (ADF&G, 1994).

Cows will not abandon their calves, and vice versa. The cows make every effort to rescue their offspring. They often carry their dead calves away from hunters. Walruses, especially young males, will push dead and badly wounded animals (often larger than themselves) off an ice floe, out of hunters' reach (ADF&G, 1994).

Walruses feed mainly on bottom-dwelling invertebrates. Major food items include several different kinds of clams. The rejected shells can be found on the seafloor alongside the holes and furrows made by feeding animals. Other food items include snails, crabs, shrimps, worms, and occasionally seals. Walruses usually find food by brushing the sea-bottom with their broad, flat muzzles. The tusks are probably not used to any great extent during feeding (ADF&G, 1994).

Chapter Four: Current and Projected Uses in the Lease Sale Area

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Chapter Four: Current and Projected Uses in the Lease Sale Area

A. Historical Background

Evidence of human occupation and use of the Arctic coastal plain dates back to 10,000 BC. Marine mammal harvesting on winter sea ice has occurred for at least 4,000 years, and evidence of whaling is 3,400 years old (Langdon, 1996). The record of human existence on the North Slope is characterized by several distinct cultural periods marked by changes in tool style (NSBCMP, 1984a). The environmental characteristics of the Arctic shaped Inupiat culture into a semi-nomadic society with a tradition of whaling and an emphasis on seasonal inland hunting. This pattern of land use remained unchanged until the second half of the 19th century with the arrival of westerners and new tools, along with natural events, such as caribou population decline (NSBCMP, 1984a; NSB, 1979).

Numerous sites across the North Slope containing sod houses, graves, storage pits, ice cellars, bones, and relics attest to the historical use and presence of Arctic people in the proposed sale area; however, much of the archaeological record has been destroyed by erosion (Hoffman, et al., 1988). For centuries, trading centers at the mouth of the Colville River, like Barter Island and Nigalik, were used by Canadian and Alaska Inupiat (Jacobson and Wentworth, 1982). North Slope Inupiat also traded with Asia across the Bering Strait as early as the mid-1700s (Langdon, 1996; NSBCMP, 1984a).

European explorers and fur traders began arriving in the proposed sale area in the 1820s and 30s. This contact introduced metal tools, traps, and guns to support trading and hunting. Russian trading posts were established from Norton Sound southward. After 1850 and into the 1880s, once bowhead whale paths were discovered, commercial whaling increased dramatically in the Arctic. Several whaling stations were built along the coast and provided regular contact and trading with Natives. Steamships replaced sailing vessels facilitating year-round access. Increased hunting pressure and a natural decline reduced the population of the western Arctic caribou herd. This, coupled with western diseases like measles and influenza, resulted in an increase in the death rate of the inland Inupiat. Coastal Inupiat also suffered population decline from foreign diseases (NSBCMP, 1984a).

By World War I, declining whale populations and decreased demand for whale oil and baleen brought an end to the commercial whaling period. However, demand for fur, particularly arctic fox, resulted in a continued presence of westerners along the Beaufort Sea coast and North Slope. Native residents engaged in trapping, which provided income from non-subsistence resources. By 1914, trapping camps used in the thriving fur trade were established from Barrow to the Canadian border (NSBCMP, 1984a; Hoffman, et al., 1988). In the 1930s, the price of fur plummeted, forcing many traders to leave the region near the lower Colville River. Many residents moved to other settlements in Alaska (Hoffman, et al., 1988).

World War II brought an influx of military personnel into Alaska and the petroleum exploration period began. Inupiat were hired to work on construction projects, including the Naval Arctic Research Laboratory near Barrow in 1947 and the Distant Early Warning (DEW) line defense sites in the early 1950s (NSBCMP, 1984a). The lower Colville River supported many families until 1950 when the Bureau of Indian Affairs required that children attend schools and most residents relocated to Barrow (NSB, 1979).

The contemporary period of modernization and change began in the 1960s. The discovery of the Prudhoe Bay Oil Field in 1967 prompted a renewed interest in petroleum exploration and development, but before oil reserves could be developed, Native land claims had to be settled. “In response to rapid change that threatened Native land rights through land transfers, biological resource limitations, and natural resource leasing (primarily oil and gas), Inupiat political groups formed regional organizations to protect their rights and culture" (NSBCMP, 1984a). The Alaska Native Claims Settlement Act, passed in 1971, created village and regional Native corporations and provided a mechanism for the transfer of land ownership to Native Alaskans (NSBCMP, 1984a).

B. North Slope Borough and Communities in and Near the Lease Sale Area

1. North Slope Borough

The North Slope Borough, incorporated in 1972, is Alaska's largest borough, covering more than 15 percent of the state's total land area. The area encompasses 88,817.1 square miles of land and 5,945.5 square miles of water. Communities located within the borough include: Anaktuvuk Pass, Atqasuk, Barrow, Deadhorse/Prudhoe Bay, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright (ADCA, 2006). The borough is located within the Barrow Recording District.

In 2000, the population of the North Slope Borough was 7,385 (USCB, 2006). The majority of permanent residents are Inupiat, who have lived in the region for centuries. Traditional marine mammal hunts and other subsistence practices are a prevalent part of the culture (ADCA, 2006).

Oil exploration in the 1960s led to the development of Prudhoe Bay and construction of the Trans-Alaska Pipeline in the 1970s. The North Slope Borough government is funded primarily by oil tax revenues and provides public services to all of its communities. Local government is the largest employer of borough residents and the median household income is $63,173 (USCB, 2000).

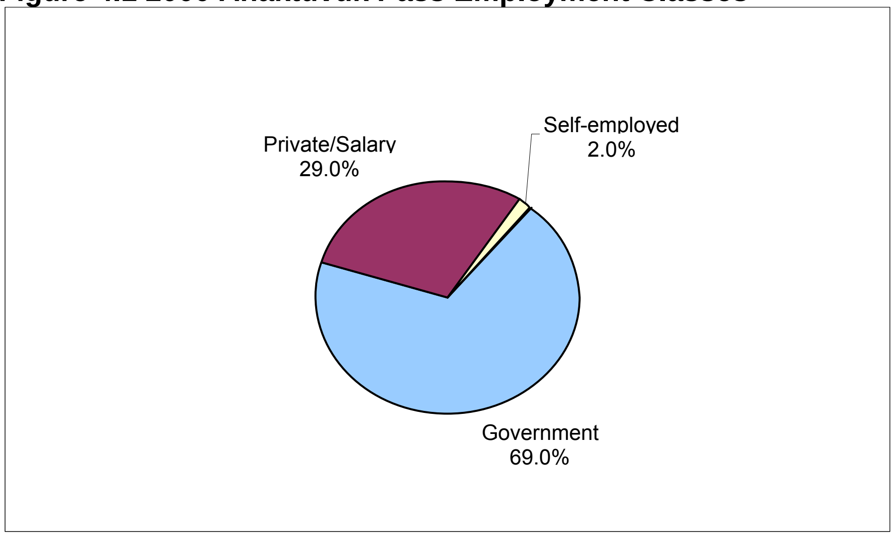
The borough's climate is arctic, with temperatures ranging from -56 degrees Fahrenheit in the winter to 78 degrees Fahrenheit in the summer. Precipitation is light at 5 inches, with snowfall averaging 20 inches (ADCA, 2006).

2. Anaktuvuk Pass

Anaktuvuk Pass, which encompasses 4.8 square miles of land and 0.1 square miles of water, is located on the divide between the Anaktuvuk and John Rivers in the central Brooks Range. In 1926-1927, the Nunamiut left the Brooks Range and scattered due to the collapse of caribou and cultural changes brought by the influx of Western civilization. In 1938, several Nunamiut families left the coast and returned to the mountains at Killik River and Chandler Lake. In 1949, the Chandler Lake group moved to Anaktuvuk Pass ("the place of caribou droppings"), where they were later joined by the Killik River group. This settlement attracted Nunamiut from many other locations and the City of Anaktuvuk Pass was incorporated in 1959 (ADCA, 2006).

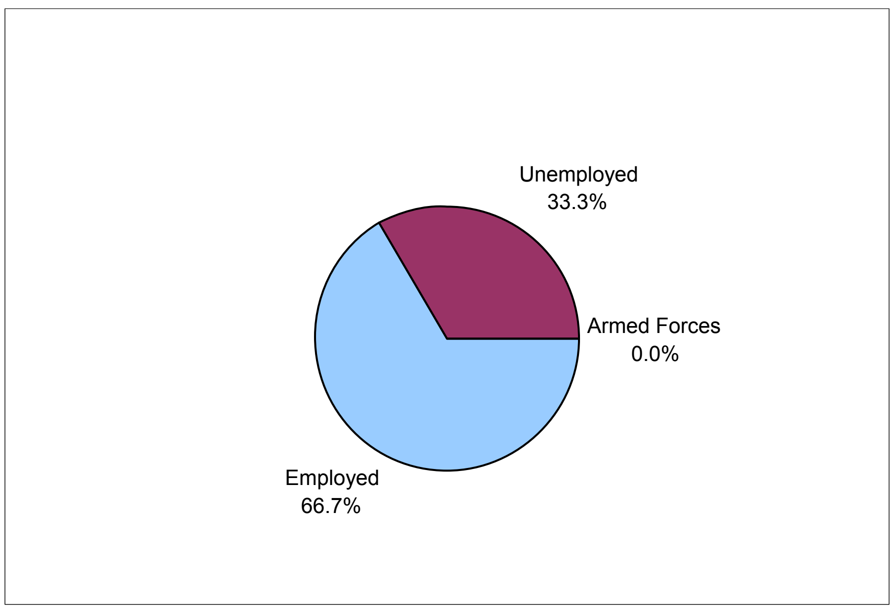
The population of Anaktuvuk Pass is 308 (DCCED, 2005). Like other communities within the North Slope Borough, Anaktuvuk Pass is dependent upon subsistence activities (ADCA, 2006). Economic and employment opportunities are limited due to the isolation of the community. Hunting and trapping for the sale of skins, guiding sport hunters, and craft-making provide some income. Seasonal employment is also available to some residents outside the community. The median household income in 1999 was $52,500 (USCB, 2000). The following figures display Anaktuvuk Pass' employment classes and employment rates from the year 2000.

Figure 4.1 2000 Anaktuvuk Pass Employment Classes



Source: (USCB, 2000)

Figure 4.2 2000 Anaktuvuk Pass Employment Rate



Source: (USCB, 2000)

The North Slope Borough provides utilities to Anaktuvuk Pass. Two central water wells and a treated watering point at the Nunamiut School provide water. Most water is delivered by truck to holding tanks and individual households. Approximately 80 percent of homes have running water in the kitchen. In 1996, construction began on a $17 million project to provide piped water, sewer and household plumbing (ADCA, 2006).

The borough owns and operates a 4,800-foot gravel airstrip and year-round access is provided by air travel. Snowmachines are used for local transportation in winter months (ADCA, 2006).

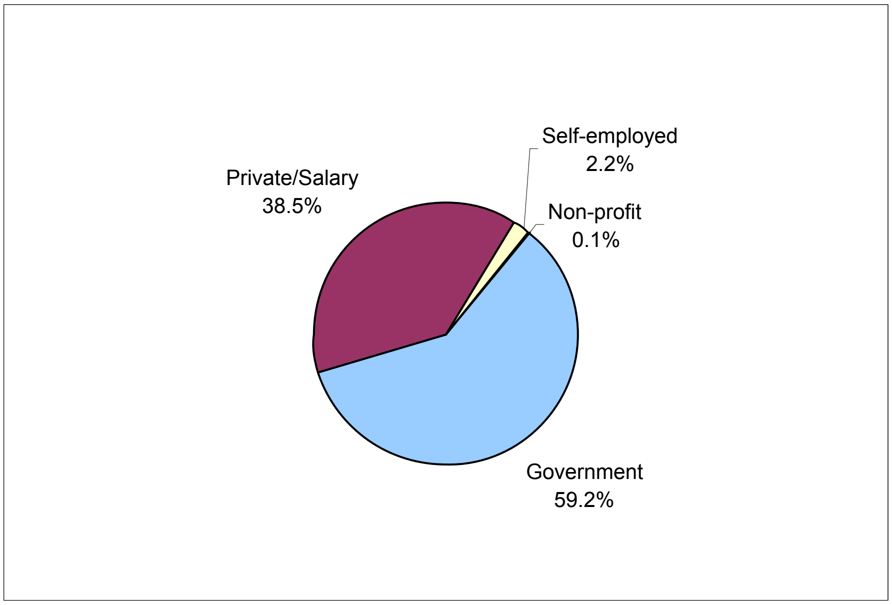
Anaktuvuk Pass' climate is continental and differs from the rest of the North Slope Borough. Average temperatures range from -14 degrees Fahrenheit in the winter to 50 degrees Fahrenheit in summer months. Precipitation averages 11 inches and snowfall averages 63 inches per year (ADCA, 2006).

3. Barrow

Barrow, which was incorporated in 1958, is located 10 miles south of Point Barrow on the Chukchi Sea coast. The area encompasses 18.4 square miles of land and 2.9 square miles of water. Formation of the North Slope Borough in 1972, the Arctic Slope Regional Corporation, and construction of the Prudhoe Bay oil fields and the Trans-Alaska Pipeline have contributed to Barrow's development (ADCA, 2006).

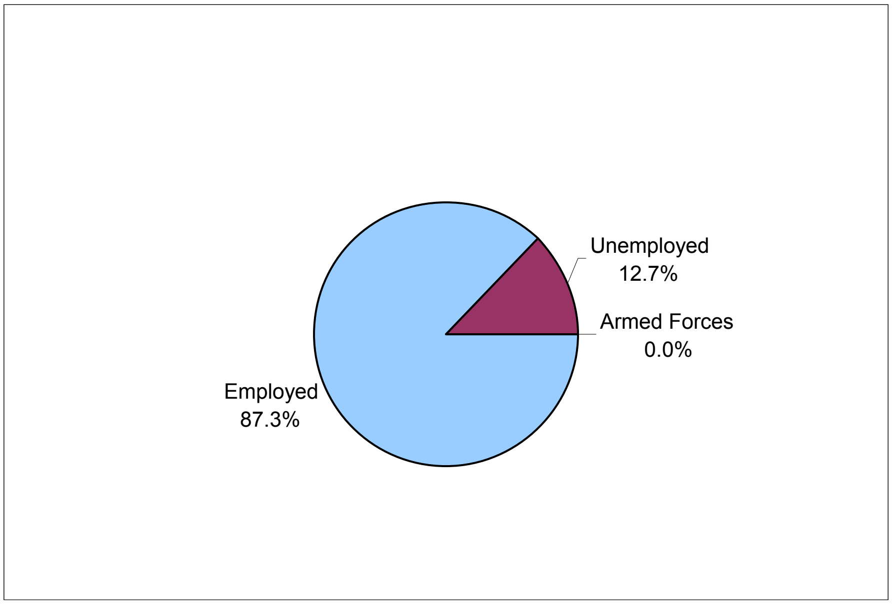
The population of Barrow is 4,351 (DCCED, 2005). The majority of the population is Inupiat, who practice a traditional subsistence lifestyle dependent on marine mammal hunting and supplemented by inland hunting and fishing (ADCA, 2006). The North Slope Borough is Barrow's primary employer; however employment is also provided by state and federal agencies and numerous other businesses that provide support services to oil and gas field operations. The median household income in 1999 was $67,097 (USCB, 2000). The following figures display Barrow's employment classes and employment rates from the year 2000.

Figure 4.3 2000 Barrow Employment Classes



Source: (USCB, 2000)

Figure 4.4 2000 Barrow Employment Rate



Source: (USCB, 2000)

The North Slope Borough provides utilities to Barrow. Water is derived from a dam on Isatkoak Lagoon and is stored in a holding tank. The Barrow Utilities & Electric Cooperative operates the water and sewage treatment plants, generates and distributes electric power, and distributes piped natural gas for home heating. The local power plant is fueled by natural gas (ADCA, 2006).

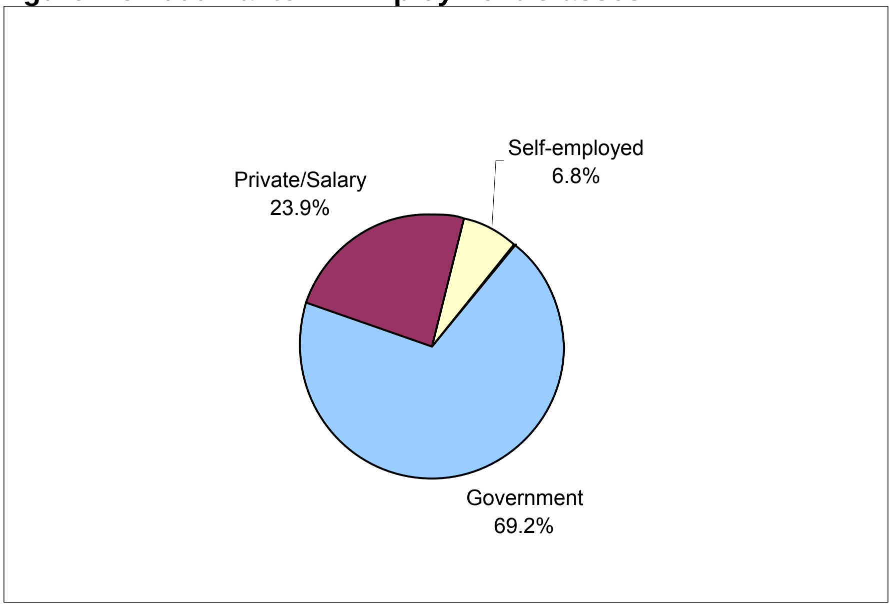
Year-round access is provided by air travel. The state owns the Wiley Post-Will Rogers Memorial Airport, which serves as the regional transportation center for the borough. The airport has a 6,500-foot-long asphalt runway. Marine and land transportation also provide seasonal access (ADCA, 2006).

4. Kaktovik

Kaktovik, which was incorporated in 1971, is located on the north shore of Barter Island, between the Okpilak and Jago Rivers. The village encompasses 0.8 square miles of land and 0.2 square miles of water and lies within the Arctic National Wildlife Refuge. The island served as a major trade center for the Inupiat, particularly as a bartering place for Alaska Inupiat and Canadian Inuit (ADCA, 2006).

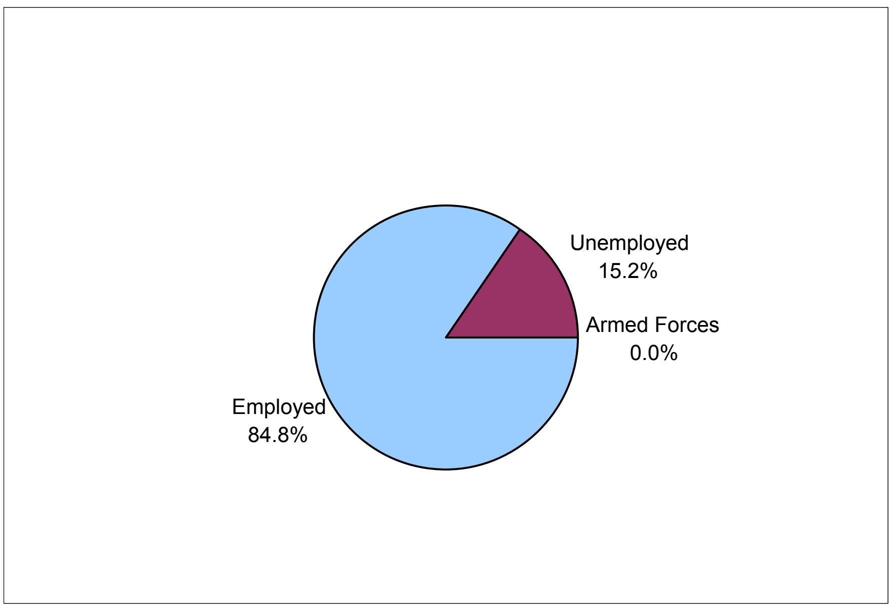
The population of Kaktovik is 276 (DCCED, 2005). The isolated village has maintained traditions and its subsistence is mainly dependent upon caribou (ADCA, 2006). Unemployment is high in Kaktovik and economic opportunities are limited due to the isolation of the community. The median household income in 1999 was $55,625. The North Slope Borough and school provide most of the year-round employment; however, part-time seasonal jobs, such as construction, also provide income (USCB 2000). The following figures display Kaktovik’s employment classes and employment rates from the year 2000.

Figure 4.5 2000 Kaktovik Employment Classes



Source: (USCB, 2000)

Figure 4.6 2000 Kaktovik Employment Rate



Source: (USCB, 2000)

The North Slope Borough provides utilities to Kaktovik. Water is derived from a surface source, treated and stored in a 680,000-gallon water tank, and delivered by truck to home holding tanks. Approximately 80 percent of homes have running water in the kitchen. Homes that are not connected to the water and sewer system utilize holding tanks that are pumped and hauled on a regular basis (ADCA, 2006).

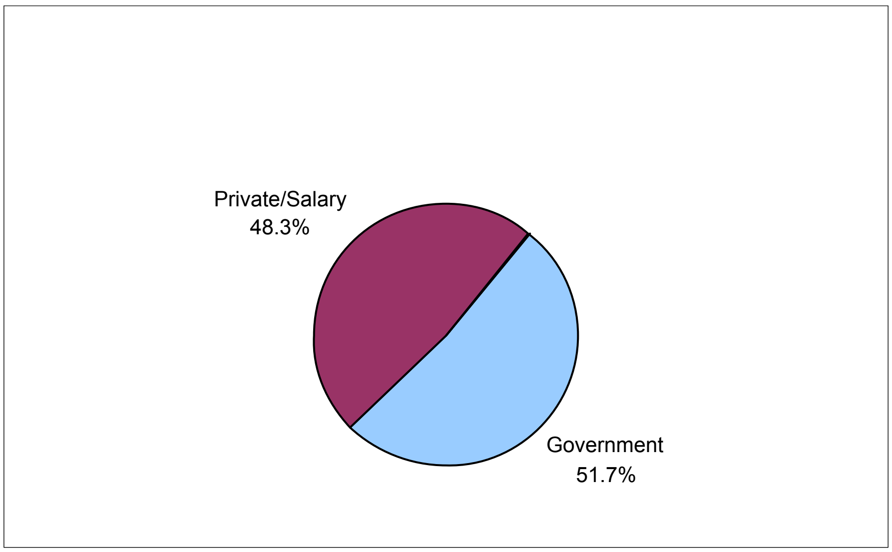
Year-round access is provided by air travel. The Barter Island Airport is owned by the U.S. Air Force and operated by the borough. Marine and land transportation also provide seasonal access (ADCA, 2006).

5. Nuiqsut

Nuiqsut, which encompasses 9.2 square miles of land, is located approximately 35 miles from the Beaufort Sea on the west bank of the Nechelik Channel of the Colville River delta. The Colville delta has traditionally been a gathering and trading place for the Inupiat and offers good hunting and fishing. The old village of Nuiqsut was abandoned in the late 1940s for lack of a school. In 1973, the village was resettled by 27 families from Barrow. In 1973 and 1974, a school, housing, and other facilities were constructed by federal agencies. The City of Nuiqsut was incorporated in 1975 (ADCA, 2006). The majority of the population is Inupiat, who practice a traditional subsistence lifestyle. A recent census reported the population of Nuiqsut to be 411 (DCCED 2005).

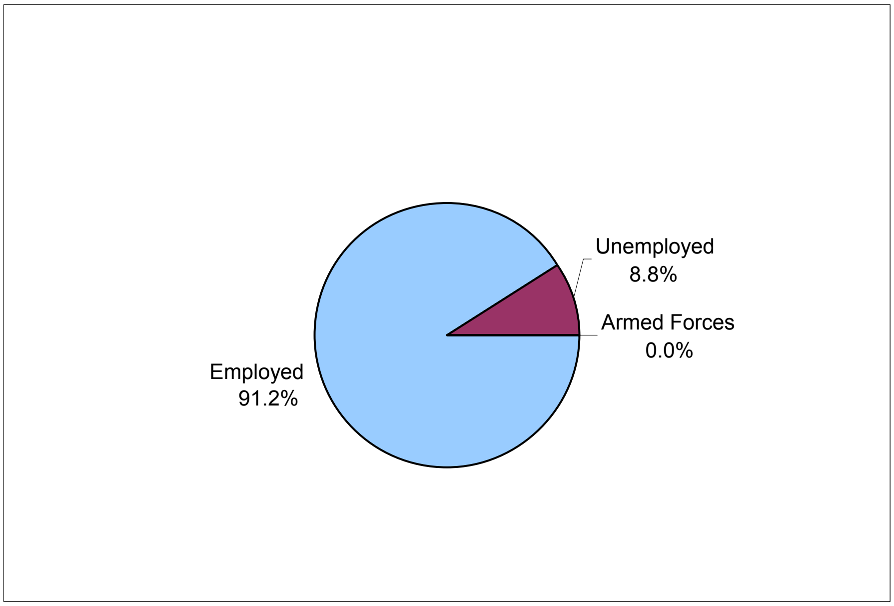
The median household income in 2000 was $48,036 (USCB, 2000). The Kuukpik Native Corporation, school, borough, and store provide most of the year-round employment in the village. Trapping and craft-making also provide some income. Caribou, bowhead and beluga whale, seal, moose, and fish are staples of the diet. Polar bears are also hunted (ADCA, 2006). The following figures display Nuiqsut's employment classes and employment rates from the 2000 census.

Figure 4.7 2000 Nuiqsut Employment Classes



Source: (USCB, 2000)

Figure 4.8 2000 Nuiqsut Employment Rate



Source: (USCB, 2000)

The North Slope Borough provides utilities to Nuiqsut. Water is derived from a lake, treated and delivered to individual resident's water tanks. Most homes have running water to the kitchen. The Alpine oil field will soon provide piped natural gas to Nuiqsut, which will lower the cost of running diesel electric generators for heating homes and other facilities (ADCA, 2006).

The borough owns and operates a gravel airstrip and year-round access is provided by air travel. Marine and land transportation also provide local seasonal access and snowmachines are used for local transportation in winter months (ADCA, 2006).

6. Prudhoe Bay/Deadhorse

Extensive development of the Prudhoe Bay/Deadhorse area for oil drilling operations began in the 1970s. Despite the low census figures–the population in 2000 was five–Prudhoe Bay is a very busy place and serves as a hub for oil and gas field workers (USCB, 2000). The airport, lodging, a general store, and other facilities are clustered in Deadhorse. The median household income in 1999 was $90,957 (USCB, 2000).

The Prudhoe Bay oil fields provide approximately 20 percent of the nation's domestic oil supply. More than 5,000 individuals are employed in drilling, pipeline operations, cargo transportation, and a variety of support positions (ADCA, 2006).

The airport at Deadhorse is the primary means of public transportation. The state owns a 6,500-foot-long asphalt airstrip and a heliport. Arco Alaska Inc. owns and maintains a 5,000-foot private gravel airstrip. The Dalton Highway is used year-round by trucks to haul cargo to the North Slope (ADCA, 2006).

C. Subsistence

For a thorough compilation of subsistence baseline information for the proposed sale area, see Pedersen et al., (1985) and (1991); Hoffman et al., (1988); MMS (1995b) (1990) and (1987); Jacobson and Wentworth (1982); ADF&G, (1995); NSBCMP (1984a)(1984b) and (1988); and NSB (1997)(1979). For attention to social and cultural impacts, see (MMS, 1995b) socioeconomic indicators study, and (NSB, 1979).

1. The Meaning and Protection of Subsistence Values

In its most minimal definition, subsistence is sustenance. Subsistence uses include at least hunting, fishing, and gathering for the primary purpose of acquiring food (Bryner, 1995, citing to Case, 1984). Under Title 19 of the North Slope Borough Municipal Code (NSBMC), subsistence is defined as "an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities" (NSBMC 19.20.020(67)). ANILCA defines subsistence usage as "the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade" (16 U.S.C. § 3113; Bryner, 1995).

Subsistence in Alaska is more than harvesting, gathering, processing, sharing, and trading. It also includes cultural, social, and economic values associated with the taking, use, and exchange of plants, fish, and game. Subsistence embodies the essence of Inupiat culture. As described by the Alaska Federation of Natives, subsistence is "a way of life in rural Alaska that is vital to the preservation of communities, tribal cultures, and economies. Subsistence resources have great nutritional, economical, cultural, and spiritual importance in the lives of rural Alaskans" (BLM, 2005).

Inupiat culture is characterized by strong kinship ties, cooperative efforts, and sharing. Inupiat who maintain a close relationship to the land and perpetuate an understanding of the seasons and animals by educating youth are highly respected. Land and the natural environment are primary and sacred in the Inupiat world view. Names and songs identify the land and Inupiat see man's place in the universe as a member of the world. The Inupiat view, being a part of the environment rather than apart from it, resulted in a subsistence life of complete dependence on the near environment, weather, and living resources (NSB, 1979).

Rural residents in Arctic Alaska annually harvest roughly 10,507,255 pounds of wild food, or 516 pounds per person, according to the Alaska Department of Fish and Game (BLM, 2005, citing ADF&G, 2000). Harvest levels vary broadly between communities and most subsistence resources are shared, traded, or given to others. Non-subsistence goods purchased with wages are also shared. Subsistence resources cannot be purchased with money; rather, they must be "earned" by hunting and gathering. On the other hand, subsistence technology, such as boats, all-terrain vehicles, fuel, and gear can be purchased with cash.

The collection, processing, and distribution of subsistence resources nearly always involve some group activity. Accordingly, to Alaska Natives subsistence "also encompasses a complex web of relationships that define and distinguish their traditional culture" (Bryner, 1995). The continued opportunity to engage in subsistence activities is a fundamental component of all Alaska Native cultures, and serves as the keystone to social, ethnic, and psychological identity.

Since the discovery of oil in Prudhoe Bay and the advent of oil and gas infrastructure development in the Arctic, village elders and traditional Inupiat have persistently expressed concerns that subsistence is threatened. The once open range of the Kuparuk and Sagavanirktok Rivers is now complicated by the presence of above-ground pipelines, spine roads, utility lines, and large facilities. Village leaders affirm that outside pressures and pressures within communities are challenging the system of values that has bonded them together (NSB, 1979).

Some Western institutions have been willfully adopted into village life, such as education, health care, and economic necessities like home-building materials and fuel (NSB, 1979). Others have not, such as some fish and game regulations. For example, catch-and-release fishing may be considered disrespectful in some Native cultures (Noland and Gallagher, 1989). Imposed seasons and bag limits restrict the taking of game, like caribou, which were previously harvested year-round (Jacobson and Wentworth, 1982). Many traditional hunting, fishing, and gathering sites are on federally or state managed land. Private and public ownership of lands and waters can determine where, when, and sometimes how people may hunt.

The Nuiqsut Cultural Plan (NSB, 1979), published just after the construction of the trans-Alaska oil pipeline, identified forces converging upon the Inuit culture: competing interests, oil and gas development, environmental degradation, access and use limitations, land tenure problems, socio-economic instability, and loss of cultural privacy (NSB, 1979). All of these forces pose a threat to subsistence life and the traditional Inupiat culture.

To assure subsistence is protected, the locations of harvest areas and sites, and the harvest and participation levels (demand for resources), must be identified. Also, it is essential and legally mandated that healthy populations of fish and wildlife be conserved. When it is necessary to restrict the taking of fish and wildlife, subsistence uses are given priority over all other consumptive uses. Federal and state laws regulate subsistence use, access, and the trading of subsistence resources. On federal lands, the federal government is required by Title VIII of ANILCA (1980) to provide a subsistence priority for rural Alaska residents unless the state provides this priority through its laws. Subsistence use and allocation of fish and game is codified in state law under AS 16.05.258. Subsistence uses in Alaska are regulated by the U.S. Fish and Wildlife Service, Office of Subsistence Management, and the Alaska Department of Fish and Game, Division of Subsistence. For a discussion on the effects of the proposed lease sale on subsistence uses, see Chapter Five of this best interest finding.

2. Subsistence and the Mixed-cash Economy

The ADF&G conducts subsistence harvest surveys of communities throughout Alaska and compiles results in a computer database. Indicators tracked by ADF&G help to describe how the modern subsistence economy is functioning. Some indicators include species availability and abundance within traditional subsistence harvest zones, as well as levels of participation by community members in subsistence harvesting. These are discussed in some detail below. Another indicator characterizing the cash/non-cash economic mix is the amount and distribution of cash income among residents of the area or community. This varies among communities, depending on subsistence resource availability and the availability of jobs.

The costs and availability of goods and services in a community also affect the cash/non-cash mix. In a 2004 survey of 24 locations around Alaska, the Cooperative Extension Service of the University of Alaska Fairbanks listed Nuiqsut as the second most expensive place for food costs for a family with school-age children. Food items were more than 2.3 times more expensive in Nuiqsut than in Anchorage. Costs in the study did not factor in Native peoples' reliance on subsistence foods (Alaska Economic Trends, ADOL, 2005).

The relationship between earning cash wages and engaging in subsistence activities is different for each individual and depends on individual life choices and the flexibility of the available wage employment. Many residents choose to work seasonally, part-time, or just temporarily. Use preferences of individuals depend on cash availability (cash for supplies and transportation), job or village responsibilities, and resource preferences (NSB, 1979). Those who choose to hunt are likely to benefit from shared resources derived from wage earners and vice versa (NSB, 1979; Jacobson and Wentworth, 1982). Residents holding cash-paying positions conduct subsistence activities during non-work periods, weekends, and vacations (NSBCMP, 1984a).

Employment for wages, including full-time, part-time, temporary, and seasonal positions, has advantages and sacrifices for village residents. Wages provide residents with cash necessary to function in modern village communities, and provide families with money for housing and associated costs. The increase in job opportunities created by the North Slope Borough has resulted in more disposable income in the communities of the borough. However, time spent earning cash wages is generally time not spent engaging in subsistence activities (Bryner, 1995). Employers are encouraged to provide residents with opportunities to participate in subsistence activities during key seasonal events, such as fall whaling, without losing their jobs.

A small percentage of full-time oil industry jobs on the North Slope is held by local residents. This is partly explained by the small labor supply of the North Slope Borough relative to the large labor demands of industry. While some full-time oil industry positions may be available in a community, the social costs of not participating in the traditional portion of the village economy may be greater than the cash benefits and income stability derived from participation in an oil field development labor force. The remoteness of villages with respect to oil field infrastructure coupled with long shift hours means that employees are more likely to be separated from their families and children.

3. Seasonal Cycle of Economic Activity and Subsistence Use Areas

Seasons on the Arctic coast are marked by the arrival and departure of sea ice, river ice, and changing winds. After the breakup of river ice and the retreat of fast ice along the shoreline, the tundra thaws and mobility is mostly restricted to open waterways and established trails. Seasons are also marked by the arrival and departure of migrating caribou, waterfowl, and bowhead whale. In the summer, the primary mode of transportation is by small skiff (14 to 18 feet), which can navigate the shallow channels of the river deltas and lagoons and by ATV for overland access. In winter, snowmachines and, to a lesser degree, dogsled teams provide transportation to hunting and fishing camps and trade fairs. Subsistence activities may require rural people to travel seasonally to hunting and fishing areas and camps as far as 70 miles offshore and inland to the Brooks Range (BLM, 2005). Historical subsistence access routes on the North Slope follow all major rivers and skirt the coast from the Canada border to Wainwright and beyond. The seasonal cycles of subsistence harvesting and subsistence use areas in the proposed sale area are depicted below in Figures 4.9, 4.11, and 4.12.

Nuiqsut: For residents of Nuiqsut, primary subsistence resources include bowhead whale, caribou, fish, waterfowl, and ptarmigan. Seals, muskox, Dall sheep, beluga whale, polar bear, moose, and walrus are also taken, but to a lesser extent (BLM 2005).

Fishing occurs both during the summer and in the fall when the ice first becomes thick enough for snowmachine travel. In June, after the ice goes out, broad whitefish move upriver. Two to four weeks after breakup, when muddy waters clear, fishing begins (Hoffman, et al., 1988). Residents travel from the village to fish camps along the river channels and fish and hunt for several days. Often several family members participate in the fishing activity, and family members employed in wage earning positions may travel to the fish camp on weekends (George and Nageak, 1986). Important traditional use sites along the lower Colville include Uyagagviit, and Nigliq (Nannie Wood’s Camp), which according to Nuiqsut leader Leonard Lampe (1996) has hosted subsistence fishers and trappers since the late 1940s. Numerous other sites in use today are recorded in the North Slope Borough Traditional Land Use Inventory. Some important traditional use sites are depicted in Figure 4.10 (Hoffman, et al., 1988; NSB, 1979; ADF&G, 1986b; Jacobson and Wentworth, 1982).

Geese and king eiders fly low from west to east across the deltas and along the coast in June, and are hunted with shotguns (Hoffman, et al., 1988). Caribou of the Central Arctic herd approach the Colville delta in late May and early June, and calve in the area between the main channel of the Colville and Sagavanirktok River deltas. Also during June and into July, moose travel north along the upper Colville and Itkillik Rivers where they may be harvested later in the fall (Hoffman, et al., 1988).

Summer fishing with gill nets lasts throughout the open water season, from early June to mid-September with the broad whitefish being the preferred and most numerous species caught. Species harvested include arctic char, whitefish, cisco, burbot and grayling. A few chum and pink salmon are also taken. Gill nets account for almost all the fish caught (ADF&G, 1995). Grayling may be caught with rod and reel or with nets in creeks. Hunting of ringed and bearded seal begins in July in the open water off the delta and continues throughout the summer months (Hoffman, et al., 1988).

Figure 4.9 Annual Cycle of Subsistence Activities – Nuiqsut

Species	Winter					Spring		Summer			Fall	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Fish	High		Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low to Medium	High	High	High	Low to Medium	High
Birds/Eggs	Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low to Medium	High	High	High	High	Low to Medium	Low to Medium	High
Berries								Low to Medium	Low to Medium	High		
Moose									Low to Medium	High	Low to Medium	
Caribou	Low to Medium	High	Low to Medium	Low to Medium	High	High	High	Low to Medium	High	High	Low to Medium	High
Furbearers	Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low to Medium	High	Low to Medium					Low to Medium
Polar Bear	High	Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low to Medium	Low to Medium				Low to Medium	Low to Medium
Seals	Low to Medium	Low to Medium			Low to Medium	High	Low to Medium	High	High	High	High	Low to Medium
Bowheads										Low to Medium	High	

(white)	No to Very Low Levels of Subsistence Activity
(grey)	Low to Medium Levels of Subsistence Activity
(black)	High Levels of Subsistence Activity

Source: BLM, 2005, citing Research Foundation of the Sate University of New York, 1984 and SRBA, 2003

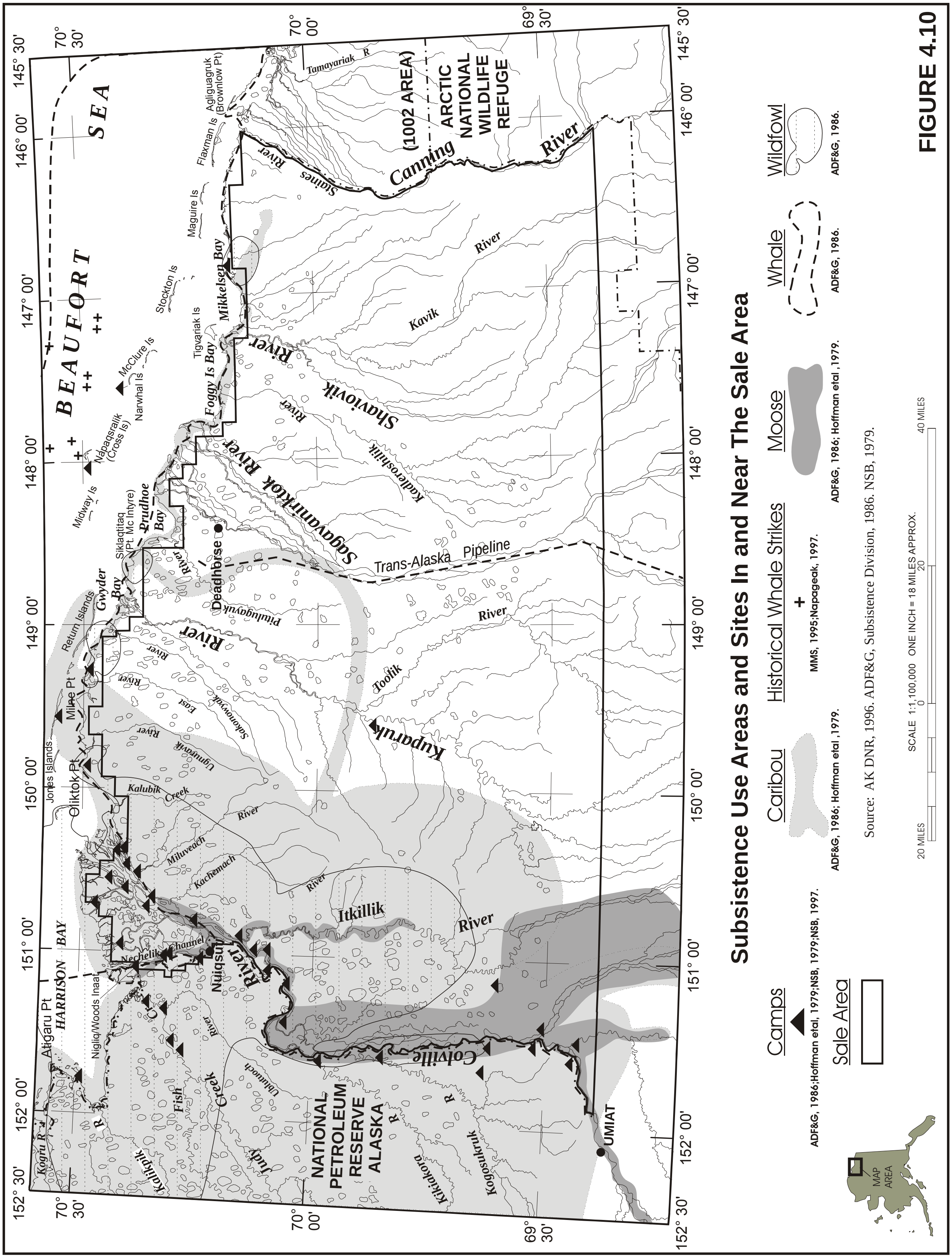


FIGURE 4.10
Subsistence Use Areas and Sites In and Near The Sale Area
Camps
ADF&G, 1986;Hoffman etal, 1979;NSB, 1997.
Sale Area
Caribou
ADF&G, 1986; Hoffman etal ,1979.
Historical Whale Strikes
MMS, 1995;Napageak, 1997.
Moose
ADF&G, 1986; Hoffman etal ,1979.
Whale
ADF&G, 1986.
Wildfowl
ADF&G, 1986.
Source: AK DNR, 1996. ADF&G, Subsistence Division, 1986. NSB, 1979.
SCALE 1:1,100,000 ONE INCH = 18 MILES APPROX.
BEAUFORT SEA
ARCTIC NATIONAL WILDLIFE REFUGE
(1002 AREA)
NATIONAL PETROLEUM RESERVE ALASKA
Trans-Alaska Pipeline
Deadhorse
UMIAT
Prudhoe Bay
Gwyder Bay
Harrison Bay
Foggy Is Bay
Mikkelsen Bay
Canning River
Shaviovik River
Sagavanirktok River
Kuparuk River
Colville River
Itkillik River
Kavik River
Toolik River
Nuiqsut
Fish Creek
Judy Creek
MAP AREA

In the fall, the fish harvest consists mainly of least and arctic cisco, though other species of fish are also caught, and generally the harvest lasts only two to three weeks. The rate of fish harvest is significantly higher in the fall than in the summer season (George and Nageak, 1986) when arctic char and salmon begin their migration upriver. Small whitefish and arctic cisco are harvested near the ocean, but these species do not move far upriver. Spotted seals, valued for their skins, follow salmon and char upstream where they are hunted as far south as the confluence of the Itkillik and Colville Rivers.

In a study conducted between June 2005 and May 2006, 46 successful Nuiqsut hunting households reported harvesting 300 caribou, or an average of 8.3 caribou per successful household. The community caribou harvest for that year was estimated at 362 (Pedersen, 2007). Of the 362 caribou harvested in 2005-2006, ADF&G estimated 109 came from the Central Arctic herd; 217 from the Teshekpuk Lake herd; and 36 from the Western Arctic herd (Pedersen and McIntosh, 2007).

Late August is the optimum time to harvest caribou. At this time, caribou are fat from grazing all summer and fit for their long migration south. The hides are in good condition for making clothing and it is before rutting season, when the bulls are not good to eat (Hoffman, et al., 1988). In September, caribou begin moving down the Ublutuoch River and east across the Colville, before heading south toward the Brooks Range. After calving, caribou from the Central Arctic herd move toward the Sagavanirktok River and follow it south to the mountains.

As in Kaktovik, blueberries, cloudberries, cranberries, wild potato, and wild rhubarb are harvested (Jacobson and Wentworth, 1982). Arctic cisco and small whitefish run upriver just before freeze-up (Hoffman, et al., 1988). Residents hunt moose in an area between the village and the confluence of the Anaktuvuk and Colville Rivers.

For Nuiqsut, one of 10 Alaska whaling communities (BLM, 2005), whaling begins in the first week of September. Whaling teams travel by boat down the Colville River through Simpson Lagoon and set up camp at Cross or Nora Island; a trip that takes about eight hours, according to whaling captain Frank Long (1996). From there, teams in either skin boats or moderately-sized skiffs travel as quietly as possible into the Beaufort Sea, north, northeast, and east of Cross Island as far as 44 miles out (Long, 1996) into the fall migratory path of the bowhead whale. A well-known whaling captain and former mayor of the North Slope Borough describes the method: “During the fall hunt, boats move at very low speeds until a whale is spotted.” (Ahmaogak, G., 1996b). Whaling boats are based out of Cross Island camp as long as two weeks or more. Often, seas are rough, and the farther offshore crews must travel to find whales, the greater the risk. Ringed and bearded seals, king eider, caribou, and polar bear may also be hunted during whaling expeditions (Hoffman, et al., 1988). After a whale is struck, it is towed to Cross Island, pulled onshore with a winch, and butchered. The whale is then transported by boat to Nuiqsut, or to West Dock, or Endicott and trucked to Olitok Point (Long, 1996). Historically, whole villages have participated in the processing and distribution of whales taken from the Beaufort Sea. The whale is shared during potlucks throughout the year, and at Thanksgiving, Christmas, and *Nalukataq* – the harvest feast where fish, caribou, whale meat, and muktuk is portioned out to every member of the community (NSB, 1997; MMS, 1996a; Jacobson and Wentworth, 1982).

In 1996, Nuiqsut harvested two whales (about four miles north of Narwhal Island), and transferred the remainder of its quota to Barrow, because two was enough to feed the community (AEWC, 1997). This general description of traditional whaling is included here because of its importance to Inupiat culture; however, whaling should not be affected by activities in the proposed sale area because all sales and leasing activities will be entirely onshore.

By mid-October, after the rivers freeze, residents travel by snowmachine to fish camps on the Colville River or Fish Creek to fish for arctic cisco and small whitefish (Hoffman, et al., 1988). Ice fishing is accomplished by cutting holes in the ice and stretching gill nets under the ice (George and Nageak, 1986). Hook and line is used to ice-fish for burbot and grayling. Some moose and caribou hunting may occur during October and November (Hoffman, et al., 1988). Few polar bears are harvested by Nuiqsut hunters, though when hunting does occur, it's usually after the fall whaling season (BLM 2005) from October to May (NSB, 1979).

Furbearers, including arctic fox, red fox, wolf, and wolverine are trapped or shot throughout the winter, though most hunters and trappers avoid going out during the dark, often harsh days of midwinter (BLM 2005). Some caribou and moose may be harvested, and seals taken in the remaining open leads of sea ice. From January to March, trapping continues, and some hunting of caribou and moose may occur, depending on the depth of the snow and ability to move about (Hoffman, et al., 1988).

Mid-April brings an end to trapping season. Hook-and-line fishing for burbot and lake trout resumes. Wolf and wolverine are hunted with rifles by hunters on snowmachines, and seals sunning themselves on the sea ice are also harvested year round. These conditions persist through May until the river ice again washes out to sea, completing the annual cycle of subsistence harvest (Hoffman, et al., 1988).

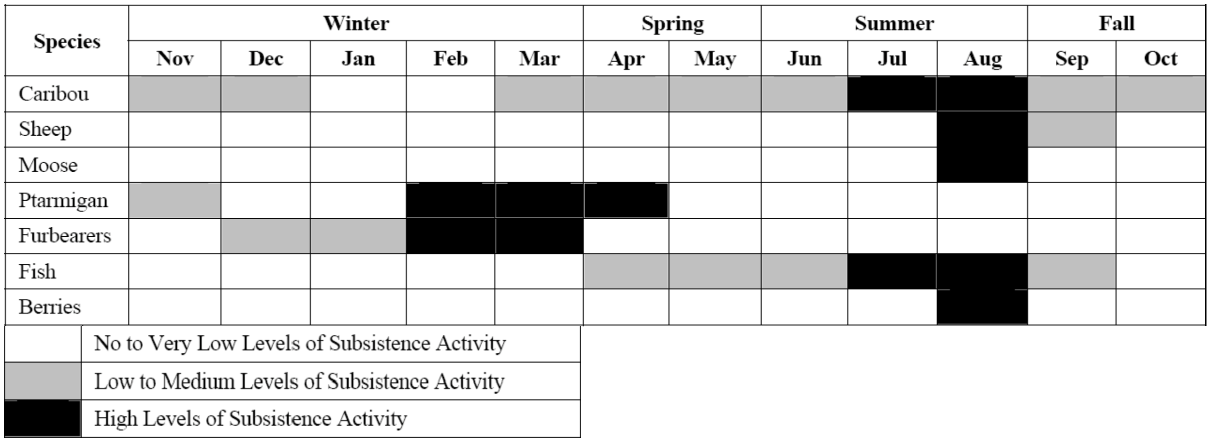
Anaktuvuk Pass is located 60 miles west of the Dalton Highway in a low pass slightly south of the Brooks Range continental divide (BLM, 2005). Residents mainly use the corridors of the Colville, Itkillik, and Anaktuvuk Rivers for subsistence activities within the proposed sale area (Pedersen, 1997). Unlike other North Slope Borough communities, Anaktuvuk Pass residents have no direct access to marine mammal resources (BLM, 2005). The annual subsistence cycle of Anaktuvuk Pass revolves around caribou, though Dall sheep and moose are also important subsistence resources (BLM, 2005). In a survey conducted by the North Slope Borough Department of Wildlife Management, caribou accounted for 82.5 percent of the harvest in edible pounds for a 1-year period. The reported number of caribou harvested during the study period (July 1, 1994, to June 30, 1995) was 311. This is low when compared with previous years for which harvest data are available. For example, in 1990-91, the estimated harvest was 592 and in 1993-94 it was 574 (NSB, 1996).

Intensive caribou hunting occurs in April and May as animals move through the Brooks Range on spring migrations northward. Caribou hunting intensifies again in the fall as the animals begin to move southward. Caribou are also hunted in winter. One Anaktuvuk Pass hunter was quoted to say:

> I hunt mostly in the winter time; it is easier. That is when the caribou are pretty fat. I hunt mostly in winter when there is snow on the ground; you can go further. The summer time you cannot go too much unless you have a good Argo. My dad has one (BLM, 2005).

Fish and birds are generally of lesser subsistence value to Anaktuvuk Pass residents but become crucial during times when other resources are scarce. Anaktuvuk Pass residents harvest fewer ducks and geese than hunters in other North Slope villages because waterfowl in the central Brooks Range are generally scarce. The types of birds harvested include long-tailed ducks, pintails, and white-fronted geese. Ptarmigan are considered the most important species and are harvested year round (NSB, 1996). Important fish species include grayling, arctic char, lake trout, and whitefish.

Figure 4.11 Annual Cycle of Subsistence Activities – Anaktuvuk Pass



Source: BLM, 2005, citing Brower and Opie, 1996 and SRBA, 2003

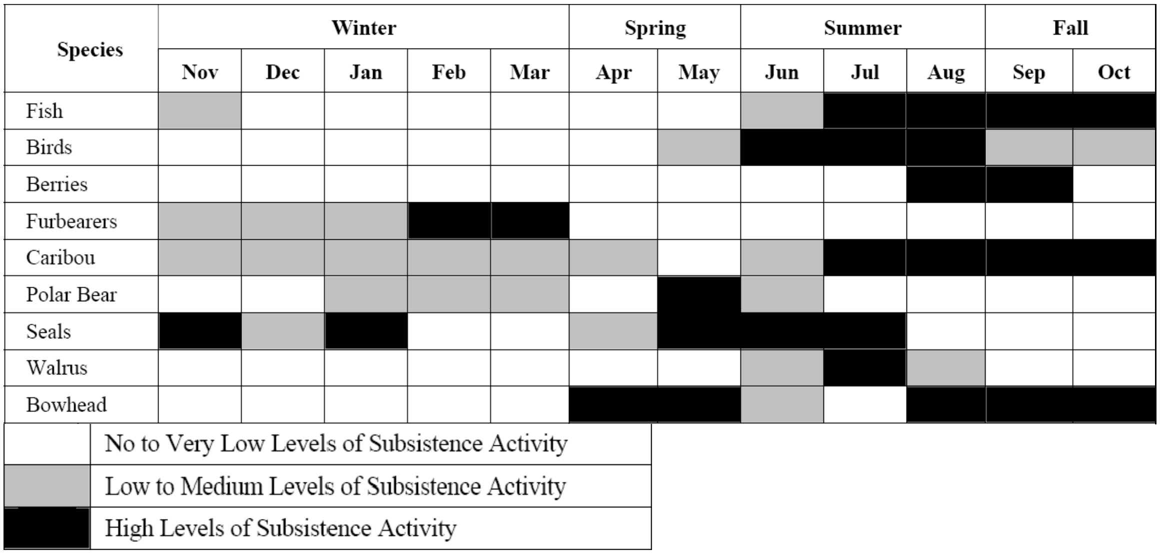
Kaktovik subsistence harvest areas range from east of the Canada border to Camden and Mikkelson Bays. Traditional Land Use Inventory sites are discussed in Jacobson and Wentworth (1982). Important locations in the Kaktovik Traditional Land Use Inventory (TLUI) in or adjacent to the sale area include Flaxman Island, Brownlow Point, and Tigutaaq at the confluence of the Tamayariak and Canning Rivers. The primary early winter camps of Kaktovik people are located along the Hulahula and Sadlerochit Rivers (Jacobson and Wentworth, 1982).

The annual cycle of subsistence activity for Kaktovik is similar to that of Nuiqsut; the same species are harvested at the same time, but from different lakes, rivers, uplands, islands, estuaries, and marine waters. Residents travel to the mountains to hunt wolf, sheep, wolverine, and moose in March. April and May are important months for the taking of ground squirrel, ptarmigan, and marmot. In late May and early June, residents camp in the Camden Bay area to hunt migrating waterfowl, such as eider and brant. By June, mobility is increasingly restricted due to spring thaw. Birds, seals, and caribou are hunted closer to Barter Island. After calving in late May and early June, caribou of the Porcupine herd graze about the area between the Canning River and the Mackenzie River delta. By late June, land travel is restricted and the sea ice still remains. In July, the sea ice goes out, and hunting of caribou and fishing of arctic char with nets is accomplished by boat. In the fall, caribou begin moving toward winter habitat on the south side of the Brooks Range. August is good for fishing char and arctic cisco (Jacobson and Wentworth, 1982).

Barrow is located approximately 130 miles northwest of the proposed lease sale area; however, the community's subsistence activities occur within a large geographical region that includes the proposed sale area's western portion. The city is set on a point of land bordered by the Chukchi and Beaufort Seas, and subsistence hunting centers largely around marine mammal hunting, especially whaling (BLM, 2005). Other important subsistence resources include caribou, waterfowl, and fish.

Many Barrow residents with ancestral ties to Nuiqsut utilize the proposed sale area as they continue to return to traditional subsistence use areas (BLM, 2005). Although most terrestrial hunting is done west of the proposed sale area, caribou, wolf, and wolverine are sometimes hunted in the Colville River delta region.

Figure 4.12 Annual Cycle of Subsistence Activities – Barrow



Source: BLM, 2005, citing SRBA and ISER, 1993 and SRBA, 2003

4. Harvest Levels of Plants, Fish, and Game; Species Variety; and Participation Levels

Factors affecting subsistence harvests include the availability of fish and wildlife populations; weather; terrain; methods of harvest; availability of transportation; state and federal hunting and fishing regulations; local economic conditions; availability of cash for supplies and transportation; the changing condition of the meat, hide or fur; and community needs (Jacobson and Wentworth 1982; Pedersen, et al.,1985). Soggy tundra and shallow rivers restrict most summertime activities to coastal areas, but frozen ground, snow cover, ATVs, and snowmachines expand harvest areas during the winter.

Subsistence resources are shared between wage-earning and non-wage earning members of the community, as well as with relatives and others living in North Slope communities, Fairbanks, and Anchorage (NSBCMP, 1984a). Fish, caribou, and bowhead whales comprise the bulk of the nutritional needs of the Inupiat, but other animals are also important for both nutritional and cultural uses (ADF&G, 1995).

Nuiqsut residents harvested an average of 741.8 pounds per person of usable subsistence resources for home use and noncommercial exchange between households in 1993 (see Table 4.1). Fish comprised nearly a third of the subsistence wild resource harvested by Nuiqsut residents, land mammals another third and marine mammals the final third. Birds and eggs accounted for about 2 percent of the community harvest (ADF&G, 1996a).

Species harvested in the proposed sale area include salmon, cod, rainbow smelt, burbot, arctic char, arctic cisco, least cisco, lake trout, grayling, sheefish, whitefish, brown bear, polar bear, caribou, moose, muskox, arctic fox, red fox, ground squirrel, wolf, wolverine, weasel, marmot, mink, ducks, geese, brant, ptarmigan, sandhill crane, tundra swan, salmonberries, blueberries, crowberries (regionally called blackberries (ARCUS, 2002)), cranberries, greens, and mushrooms (ADF&G, 1995; NSB, 1997). On average, Nuiqsut households used more than 20 different kinds of wild resources, about 12 types of resources were shared, and 11 varieties given away (ADF&G, 1996a). Edible pounds harvested from selected resources are listed below.

Table 4.1 Nuiqsut Subsistence Harvests

Nuiqsut Per Capita Edible Pounds Subsistence Resources Harvested, 1993	
Resource	Per Capita Harvest (pounds)
Fish	250.6
Caribou	227.6
Bowhead Whale	213
Ringed Seal	20
Moose	12.2
Bearded Seal	3
White-fronted Geese	3
Ducks (Eider)	2.9
Canada Geese	2.3
Brown Bear	2
Vegetation and Berries	1.1
Brant	1
Total (including other resources harvested in 1993)	741.8

In the 1985 survey year, subsistence harvests averaged about 400 pounds per person, most of which consisted of caribou and whitefish. At that time, the bowhead harvest was limited, but in the following years, marine mammal harvests gained an increasing proportion of the total subsistence harvest for the community. With the per capita harvest nearly doubling between 1985 and 1993, the importance of Nuiqsut's subsistence harvest is underscored. "This is significant to keep in mind as Nuiqsut's immediate subsistence resource area is presently undergoing intensive oil and gas exploration, and increasing industrial development associated with oil extraction is taking place within Nuiqsut's general subsistence resource area." (ADF&G, 1996a)

Caribou are a staple food that is eaten fresh, frozen, and dried. When available, caribou provide a source of fresh meat throughout the year. The skins of caribou are used to make blankets, sleeping pads, parkas, boot soles, mitts, and masks. In survey years 2002-2003 to 2005-2006, ADF&G estimated Nuiqsut households harvested between 292 and 436 caribou annually, or an average of 379.75 caribou per year (Pedersen and McIntosh, 2007).

Hunting for moose and brown bear also occurs along the Colville River. Nine moose were harvested by village residents in 1993; however, the moose population near Nuiqsut declined rapidly in that decade. About 600 small land mammals were harvested by Nuiqsut residents in the survey year, including more than 300 ground squirrels, 200 foxes, 31 wolves, about 20 wolverines, and 10 weasels (ADF&G, 1995).

More than half of the 12-pound per capita harvest of birds in 1993 consisted of geese; the remainder consisted of ducks and ptarmigan. Nuiqsut village harvested about two eider ducks, one brant, two Canada geese, two white-fronted geese, and three ptarmigan per person in 1993. Sixteen snow geese, seven tundra swans, 78 long-tailed ducks and 25 pintail ducks were harvested by village residents in that year. Additionally, more than 100 pounds of eider and goose eggs were harvested by Nuiqsut residents in 1993 (ADF&G, 1995).

In 1993, bowhead whale made up 90 percent of the 236-pound per capita marine mammal harvest. Ringed seals made up the remaining 20 pounds or about one seal for every four people. About six bearded seals were harvested in Nuiqsut. Polar bears are also hunted in the proposed sale area. Occasionally, walrus are taken if the opportunity arises (ADF&G, 1995).

Broad whitefish are considered one of the most important subsistence fish in the region for the villages of Nuiqsut, Barrow, and Atqasuk. They are traded with other villages as well (NSB 2007, citing Braund et al., 1993). In 1993, 46 percent of the 250-pound per capita fish harvest consisted of broad whitefish, 39 percent were either arctic cisco or least cisco, 7 percent were burbot, 5 percent were grayling, and the remainder included arctic char and salmon (ADF&G, 1995).

All Nuiqsut households used subsistence resources in 1993. Ninety-four percent attempted to harvest subsistence resources, with 90 percent being successful. Ninety-eight percent of all households in the community received wild resources, and 92 percent gave away wild resources (ADF&G, 1995).

In addition to being personally consumed, a large, but unknown portion of the fish caught are either shared with other communities in the area, or sold (George and Nageak, 1986). Most Nuiqsut families participate in subsistence fishing activities. The bulk of the fishing in the 1980s was probably done by about half the families in the area (George and Nageak, 1986).

Subsistence resources are utilized for much more than nutrition. Many non-edible parts of the animals harvested are used to make functional items and arts and crafts. Driftwood and willow brush are collected for firewood and building materials. Marine mammal bones and hides have also been used to construct temporary shelters and traditional boats. Caribou hides are used for bedding, clothing, and masks. Seal skins are used for carrying water and for covering traditional boats. Whale baleen is decorated and etched into storytelling artworks and baskets. Ivory, caribou antler and bone, and whale bones are carved into miniature animals, umiaks, and hunting scenes or made into functional items, like needle cases or knife and ulu handles. Jewelry is made out of many things, including ivory, antler, feathers, and imported beads. Bearded seal whiskers are used in making earrings. Wolverine, wolf, polar bear, seal, and fox fur are used to make parkas, slippers, mukluks, and hats, and are used in making dolls, Eskimo yo-yos, and caribou-skin masks. Feathers and skins are used to make drums and many other craft items, such as spirit masks.

Approximately one in 10 residents of the borough produces arts and crafts. These items may be traded, shared, given away, or sold. Prices of such items vary widely from $10 or $20 to thousands. These items are made for two basic reasons: recreation and artistic expression, or to raise cash for a specific purpose, such as an airline ticket. The items are likely not produced solely for the purpose of generating income in order to perpetuate the craft (Steihn and Hayes, 1996).

D. Commercial and Sport Fishing

In the entire North Slope Borough, nine residents held commercial fishing permits in 2005 (CFEC, 2007). A commercial fall whitefish fishery is located outside of the sale area on the east channel of the Colville River. This gillnet fishery is the only commercial fishery within the proposed sale area. In 1995, nearly 6,000 pounds of humpback or broad whitefish were harvested, a catch valued at $4,480 to fishers. In the same year, 9,121 pounds of arctic cisco worth $12,541 to fishers were landed (Busher and Borba, 1996).

ADF&G tabulates non-subsistence sport fishing catch and harvest estimates for the entire North Slope drainage area. Fishing effort, catch, and harvest for the Sagavanirktok River are also tracked. Most fish caught by sport anglers are not harvested, but released back to the water. For example, ADF&G estimates that 1,716 arctic char were caught on the Sagavanirktok River by sport fishers in 1994, but only 147 were harvested. Similarly, an estimated 2,644 grayling were caught on the river, but only 147 were harvested (ADF&G, 1996b).

E. Sport Hunting, Guiding, and Outfitting

Sport hunting of big and small game in the onshore portion of the sale area is managed by ADF&G, Division of Wildlife Conservation. The state is divided into 26 game management units (GMUs). All Arctic Ocean drainages between Cape Lisburne and the Alaska-Canada border are contained in GMUs 26A, 26B, and 26C. Unit 26A lies west of the Itkillik River drainage, and west of the east bank of the Colville River between the mouth of the Itkillik River and the Arctic Ocean. A significant portion on Unit 26A overlaps with the NPR-A. Unit 26B extends from the eastern boundary of 26A to the west bank of the Canning River, and the west bank of the Marsh Fork of the Canning River. All of Unit 26C is within the Arctic National Wildlife Refuge. It is unknown exactly how many animals of each species are harvested within the proposed sale area in any given year.

Sport hunting statistics collected by ADF&G are not specific to the proposed sale area, but estimate the harvest of whole GMUs. Statistics on hunter residency, success rate, mode of transportation, and whether commercial services were used are also collected. Transportation data reflects the mode each hunter used to get to the point where they started walking (ADF&G, 1996b).

Hunting seasons and guidelines are determined by the Alaska Board of Game, and administered by ADF&G. The Prudhoe Unit is closed to big game hunting (5 AAC 92.510), however, residents may sport hunt in other oil fields. The Dalton Highway corridor (extending five miles from each side of the highway) is closed to hunting for big and small game, except with bow and arrow, and use of motorized vehicles is restricted in the corridor. Firearms possession by industry employees is restricted and workers are not likely to sport hunt in the area during their active-duty shifts. Moose hunting is closed to nonresidents on the North Slope (ADF&G, 1996c).

1. Brown bear

Total annual hunter harvest during 1989 through 2001 ranged from 21-35. Most brown bear were taken in Units 25A, 26B and 26C. The overall harvest was nearly stable in recent years except in Unit 26B where the number of brown bears taken increased during 1996 and 1997 (Stephenson, 2003). In 2005, 32 brown bear were taken in Unit 26 (ADF&G, 2005)

2. Caribou

According to a June 2005-May 2006 survey, Nuiqsut hunters ranged north to the mouth of the Nechelik Channel (of the Colville River), south as far as the confluence of the Chandler and Colville Rivers, west as far as the upper Judy Creek, and south-east as far as the White Hills on the upper Kuparuk River. In Nuiqsut, 46 successful hunting households reported harvesting 300 caribou (an average of 8.3 caribou per successful household); the annual community harvest is estimated to be 362 caribou (ADF&G, 2007). For the entire Central Arctic Herd, there were 625 caribou harvested in 2004-2005 (ADF&G, 2005).

3. Moose

Access plays a dominate role in the chronology of the moose harvest. Most moose are killed during the first 10 weeks of the regular hunting season, when lack of snow makes it feasible to highway vehicles or boats (ADF&G, 1986b). In the 2004-2005 year, 8 moose were harvested from GMU 26. This harvest total does not include unreported harvest which may be substantial (ADF&G, 2005).

4. Wolf

In spite of a generally high birth rate, wolves rarely become abundant because mortality is high. In much of Alaska, hunting and trapping are the major sources of mortality, although diseases, malnutrition, accidents, and particularly intraspecific strife act to regulate wolf numbers. There were 10 wolves taken from Unit 26 in 2004-2005 (ADF&G, 2005).

5. Other Animals

Muskoxen populations in Alaska declined substantially in Unit 26B beginning in 1999. In 1998, ADF&G determined that a harvest of no more than 20 muskoxen was necessary to provide a reasonable opportunity for subsistence use. In all of Unit 26B, reported harvest of muskoxen was 9, 3, and 8, respectively in regulatory years 2002, 2003, and 2004 (Lenart, 2005). In 2004-2005 there were 8 muskoxen taken in Unit 26. Restrictions in regulations ensure a low harvest. Some hunters may not have reported their harvests, despite the permit systems.

The level of sport hunting of waterfowl on the North Slope is currently very low. This is likely due to the number of hunters seeking them, rather than other factors, such as low population levels, climatic conditions affecting migration, or regulatory constraints. The estimated number of hunter-days afield (number of active waterfowl hunters multiplied by the number of days spent in the field) was 17 for the 1994-95 year; down from 157 hunter-days in the previous year. ADF&G reports that "there are fewer Alaskans hunting waterfowl than any time since the surge in the state's population during the 1970s." (ADF&G, 1996b).

F. Tourism and Recreation

Cultural heritage tourism development, wilderness adventure travel, and ecotourism hold the greatest potential for future tourism growth within the North Slope region. Cultural and historical tourism opportunities in the North Slope Borough offer visitors unique experiences found nowhere else in Alaska. For example, visiting a historical site such as the Cape Smythe Whaling and Trading Station in Browerville near Barrow, which was built as a whaling station in 1893 and is the oldest frame building in the Arctic. For the more adventurous visitors, river rafting, dog mushing, backpacking, and fishing opportunities are available. The remote, natural environment of the North Slope appeals to the ecotourist who seeks an educational experience without the crowds (ADCED, 2006).

Barrow is known as America's "northernmost city" and serves as the primary transportation hub for the North Slope Borough. Barrow and other places, such as the oil fields at Prudhoe Bay, the supply center at Deadhorse, and the Simon Paneak Memorial Museum at Anaktuvuk Pass, are popular packaged tour destinations. The trans-Alaska oil pipeline is one of Alaska's biggest attractions. It follows the Dalton Highway, a 414-mile gravel road that parallels the northernmost portion of the pipeline. Amenities are limited and public access is not allowed through the oil fields. A visitor to the North Slope Borough can expect to observe rich and varied cultural opportunities, including whaling, traditional dancing, storytelling, mask making, beadwork, and basket making.

Substantial opportunities exist for the adventure traveler for sport fishing, hunting, and other forms of outdoor recreation. Scenic rivers in the Arctic National Wildlife Refuge offer both river rafting and fishing experiences. The uplands provide hunting opportunities for caribou, bear, and sheep. Adventure travelers enjoy guided backpack tours and are showing an increasing interest in winter recreation activities, such as snowmachining, dog mushing, and northern lights viewing.

Ecotourism, which focuses on educational aspects, is one of the fastest growing segments of the visitor industry (ADCED, 2006). Visitors who enjoy bird watching and wildlife viewing hold great potential for the North Slope Borough. The Barrow Birding Center provides a checklist of 185 species. Several new hotels offer accommodations specifically for visiting birdwatchers. Wildlife viewing opportunities also exist for moose, wolves, caribou, brown and polar bears, muskoxen, wolverine, arctic fox, and lynx.

Potential tourism markets have been identified as cultural, adventure, and ecotourism on the North Slope. However, economic issues exist for tourism development, including a limited basic infrastructure and services and distance from major tourism corridors. The aim of North Slope tourism planners is to develop a coordinated response to these issues and develop a tourism marketing program that ensures a quality experience for visitors. Questions and concerns remain about the compatibility of tourism with the village lifestyle (ADCED, 2006).

Some local residents feel that their homes and cultures are on display and believe the tourism industry may have a negative affect on the community. Comprehensive tourism planning takes into consideration the importance of the subsistence way of life. Responsible tour operators in the area ask permission before entering private property and educate their clients about subsistence values and incorporate these principles into their marketing programs. These and other important concerns are being addressed with tourism management planning efforts (ADCED, 2006).

Protecting traditional subsistence gathering areas also remains a top priority. Sometimes conflicts occur when visitors trespass on private land to camp, fish, and hunt or view wildlife. Subsistence users may be hunting the same birds that birdwatchers have come to view. Sport fishing and commercial hunting activities may compete with resident subsistence users of fish and wildlife resources (ADCED, 2006).

G. Oil and Gas Extraction

In 1968, Atlantic Richfield announced the discovery of commercial oil deposits at Prudhoe Bay. Exploration and development grew dramatically and production began in 1977 with the construction of the trans-Alaska oil pipeline between Prudhoe Bay and port of Valdez. The North Slope produced nearly 13 billion barrels of oil and natural gas liquids by 1999, 80 percent of it from Prudhoe Bay and 13 percent of it from Kuparuk. Production of oil, condensate, and natural gas liquids from the North Slope fields peaked at 2.2 million barrels per day in 1988 and declined to 1.1 million barrels per day by 1999. By the year 2021, the production is forecast to fall to about 408,000 barrels per day (ADCED, 2006).

Exploration and development activity has boomed on the North Slope over the last 50 years. In 1969, the state held a lease sale and offered over 450,000 acres along the Arctic coast between the Canning and Colville Rivers. They earned $900 million in bonus bids on 164 tracts. Since 1969, the state continues to conduct lease sales on the North Slope and Beaufort Sea. Many factors contribute to the continuous production from North Slope oil fields including the state leasing program, additional fields coming online, improved technology in oil recovery, improved drilling technology and higher oil prices (ADCED, 2006).

Other areas in northern Alaska also have potential for oil and gas production. Significant national debate has occurred regarding possible oil development within the Arctic National Wildlife Refuge. Additionally, the Northstar oil field is a joint state and federal unit located offshore in the Beaufort Sea and the first field to produce outer continental shelf oil. Northstar contains an estimated 176 million barrels of recoverable oil, with a field life of some 15 years. Most of these post-Prudhoe discoveries are currently producing oil and are taking advantage of the Prudhoe Bay infrastructure and proximity to the Trans-Alaska Pipeline. Five of these major fields include the Lisburne, Kuparuk, Milne Point, Endicott, and Point McIntyre. Fields more recently brought into production include the Badami Tarn, Alpine, and West Sak (ADCED, 2006).

North Slope oil fields also contain significant amounts of natural gas. Natural gas production on the North Slope was 3.2 trillion cubic feet in 1999, 93 percent of which was injected into wells for enhanced oil recovery. This gas can be retrieved again in the future once a gas transportation system is put into place. The remaining gas is used as fuel for oil field equipment and pipeline operations (ADCED, 2006). Construction of a natural gas pipeline from the North Slope to North American markets is under active consideration. Recent increases in natural gas prices have improved the economics of constructing a gas pipeline.

Arctic National Wildlife Refuge (ANWR): ANWR was created in 1980 with the passage of the Alaska National Interest Lands Conservation Act. Section 1002 of that act deferred a decision regarding future management of the 1.5 million-acre coastal plain in recognition of the area's potential oil and gas resources and its importance as wildlife habitat. Substantial national controversy surrounds opening the Alaska National Wildlife Refuge to oil and gas development.

Eastern North Slope Pipelines: The ADNR, OPMP submitted applications for the Eastern North Slope Oil and Gas Pipeline Conditional Rights-Of-Way on September 19, 2005. The Joint Pipeline Office (JPO) accepted the applications as complete on February 26, 2006. The proposed pipeline corridor is 45 miles long, beginning at Point Thomson and ending near Pump Station 1, and 700 feet wide to allow for construction, operation, and maintenance. In February 2006, the JPO public noticed the applications.

Bullen Point Road: The State of Alaska is exploring plans for the Bullen Point Road, which will connect the road system at Prudhoe Bay with oil and gas prospects near Point Thomson and the eastern end of the North Slope. Road construction is projected to start in the year 2008.

Gas Pipeline: Almost 26 trillion cubic feet of gas reserves are exportable from areas near the Prudhoe Bay oil fields. High natural gas prices have increased the prospect of an Alaska natural gas pipeline in recent years. In addition to commercializing gas from state lands, new gas infrastructure from the North Slope to market would improve the economic viability of gas prospects on federal lands

Chapter Five: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

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Chapter Five: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

Until discoveries are made, the Division of Oil and Gas (DO&G) cannot predict when any oil and gas activity might occur or the type, location, duration, or level of activity. Therefore, it is impossible to predict the potential effects of all possible activities. General mitigation measures and lessee advisories have been developed to minimize pollution and habitat degradation and disturbance to fish and wildlife species, subsistence users, and local residents. In addition, project-specific and site-specific mitigation measures will be applied to exploration and development proposals when they are submitted. Despite these protective measures, impacts may occur. This section discusses the potential impacts and briefly summarizes the measures to mitigate these impacts. See Chapter Seven for complete mitigation measures and lessee advisories. Chapter Six also provides a discussion of the effects related to geophysical hazards and likely methods of transportation.

Strategies used to explore for, develop, produce, and transport petroleum resources will vary depending on factors unique to the individual area, lessee, operator, or discovery. If a commercially viable deposit is found, development will require construction of one or more drill sites. If commercial quantities of oil and gas are located, construction of pipelines would be likely, and other production and transportation facilities would be necessary. New roads may be required, and machinery, labor, and housing would be transported to project sites.

The state of Alaska as a whole, the North Slope Borough, and especially local communities may experience the effects of oil and gas development activities. The potential effects of exploration, development, and production are listed in Table 5.1. All leasing activities are subject to applicable local, state, and federal statutes, regulations, and ordinances, along with the mitigation measures presented in Chapter Seven.

Table 5.1: Potential Effects of Oil and Gas Exploration, Development, and Production

Erosion	Water quality changes
Use conflicts	Chemical/pollutant releases
Disturbance to wildlife	Impacts to human environment
Oil spills	Air quality degradation
Alteration of hydrology	Siltation
Loss of fish and wildlife	Employment opportunities
Increased noise and traffic	Road, dock, airstrip, sanitary facilities, and utilities construction
Habitat loss or change	State petroleum tax and royalty revenues
Environmental studies	Local oil and gas property tax revenues

A. Post Leasing Phases

Lease-related activities proceed in phases with each subsequent phase’s activities depend on the completion or initiation of the preceding phase. Table 5.2 lists activities that may occur during these phases.

Table 5.2: Exploration, Development, and Production Phase Activities

Exploration	Development	Production
Permitting	Gravel pits, pads, and roads	Well work over (rigs)
Water usage	Docks and bridges	Gravel pads and roads
Environmental studies	Drilling rigs	Produced water
Seismic tests	Pipelines	Air emissions
Exploratory drilling	Work camps	Pipeline maintenance
Land clearing	Permitting	Work camps
Drilling muds and discharges	Monitoring	Trucking
Gravel road beds	Well heads	
Work camp	Re-injection wells	
Increased air traffic		
Temporary gravel pads		
Research and analysis		

1. Exploration

Exploration activities are designed to gather as much information about the petroleum potential of an area as possible. Exploration activities may include the following: examination of surface geology, conducting geophysical surveys, researching data from existing wells, performing environmental assessments, and drilling exploratory wells. Surface analysis includes the study of surface topography or the natural surface features of the area; near-surface structures revealed by examining and mapping exposed rock layers; and geographic features such as hills, mountains, and valleys.

a. Geophysical Exploration

Geophysical companies usually conduct seismic surveys under contract with leaseholders. Geophysical exploration activities are regulated by 11 AAC 96. The Alaska Department of Natural Resources (ADNR) tailors each permit approval to the specifics of the proposed project. Restrictions on geophysical exploration permits depend on the duration, location, and intensity of the project. They also depend on the potential effects the activity may have on fish and wildlife resources or human use in the area. The extent of effects on important species varies, depending on the survey method and the time of year the operation is conducted.

Geophysical surveys help reveal what the subsurface may look like. Before proceeding, companies must acquire one or more permits from the state, depending on the timing and extent of the proposed activity. Companies will gather two-dimensional (2-D) and possibly three-dimensional (3-D) seismic data; 2-D seismic programs usually have fewer crewmembers and employ less equipment than 3-D programs.

Land-based seismic surveys are typically conducted in winter. To gather seismic data, an energy source is required to generate energy waves that travel into the subsurface. The difference in densities of the layers of rock beneath the surface influences the energy waves, which are reflected back from the various rock layers and are received by vibration-sensitive devices called geophones. Impulses are recorded, processed on high-speed computers, and displayed in the form of a seismic reflection profile.

Geophysical companies use various methods of generating energy, depending on the terrain and conditions. These methods include explosives, vibroseis, or weight dropping. Explosives may be placed into drill holes and detonated, or they may be suspended on stakes above the ground (Poulter Method). Drill holes are typically 15 to 25 feet deep with five pounds of explosive set at the bottom of the hole. The drill holes are either drilled with track-mounted drills or, if in remote or sensitive areas, slung into position by helicopters. Vibroseis, a more common methodology, utilizes a vibrator as the energy source. The vibrating plate is attached to a low ground pressure tracked vehicle and creates a sinusoidal vibration of continuously varying frequency, typically lasting seven seconds or longer. Weight dropping can be accomplished with specially designed vehicles or with helicopters. Depending on the location, terrain, and vegetation cover, several energy source techniques might be needed. As discussed in Chapter One, all seismic surveys must go through the permitting process before they are authorized.

b. Exploration Drilling

Exploratory drilling only occurs after seismic surveys are conducted, and only if interpretation of the seismic data reveals oil and gas prospects. Exploration drilling is the only way to learn whether a prospect contains commercial quantities of oil or gas and aides in determining whether to proceed to the development phase. Drilling operations collect core samples, well logs, cuttings, along with a variety of other data. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled. A well log is a record of one or more physical measurements as a function of depth in a borehole and is achieved by lowering measuring instruments into the well bore.

If the exploratory well is successful, the operator may drill additional wells to delineate the extent of the discovery and gather more information about the field. The lessee needs to know how much oil and gas may be present and must determine the quality of the product to decide whether to proceed to the next phase.

The drilling process is as follows:

- Special steel pipe (conductor casing) is bored into the soil.
- The bit rotates on the drill pipe to drill a hole through the rock formations below the surface and into the earth.
- Blowout preventers are installed on the surface and only removed when the well is plugged and abandoned. Blowout preventers are large, high-strength valves that close hydraulically on the drill pipe to prevent the escape of fluids to the surface.
- Progressively smaller sizes of steel pipe, called casing, are lowered into the hole and cemented in place to: keep the hole from caving in; seal off rock formations; seal the well bore from groundwater; and provide a conduit from the bottom of the hole to the drilling rig.
- The well produces, is capped, or is plugged and abandoned.

An exploratory drilling operation generates approximately 12,000 cubic feet of drilling cuttings. Cuttings are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by the mud pumped into the well (Gerding, 1986). Gas, formation water, and fluids and additives used in the drilling process are also produced from drilling operations. The fluids pumped down the well are called “mud” and are naturally occurring clays with small amounts of biologically inert products. Different formulations of mud are used to meet the various conditions encountered in the well. The mud cools and lubricates the drill bit, prevents the drill pipe from sticking to the sides of the hole, seals off cracks in down-hole formations to prevent the flow of drilling fluids into those formations, and carries cuttings to the surface.

ADNR discourages the use of permanent reserve pits, and most operators store drilling solids and fluids in tanks until they can be disposed of, generally down the annulus[1] of the well, in accordance with 20 AAC 25.080. Frozen cuttings may also be temporarily stored on the pad. In most circumstances, the cuttings are transported to a grind and inject facility. If necessary, a flare pit may be constructed to allow for the safe venting of natural gas that may emerge from the well. If the exploratory well reveals an oil or gas reservoir, it is likely that the pad used for the exploratory well will also be used for production testing operations.

[1] The annulus of a well is the space between any piping, tubing, or casing and the piping, tubing, or casing immediately surrounding it.

2. Development and Production

The development and production phases are interrelated and overlap in time; therefore, this section discusses them together. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. These phases can begin only after exploration has been completed and tests show that a discovery is economically viable (Gerding, 1986).

After designing the facilities, the operator constructs production facilities to last the life of the field and drills production wells. As production proceeds, the operator may have to design and add new facilities for enhanced recovery operations. Figure 5.1 depicts a production wellbore schematic for the North Slope. Gravel pads are used for production facilities and can be rehabilitated following field depletion.

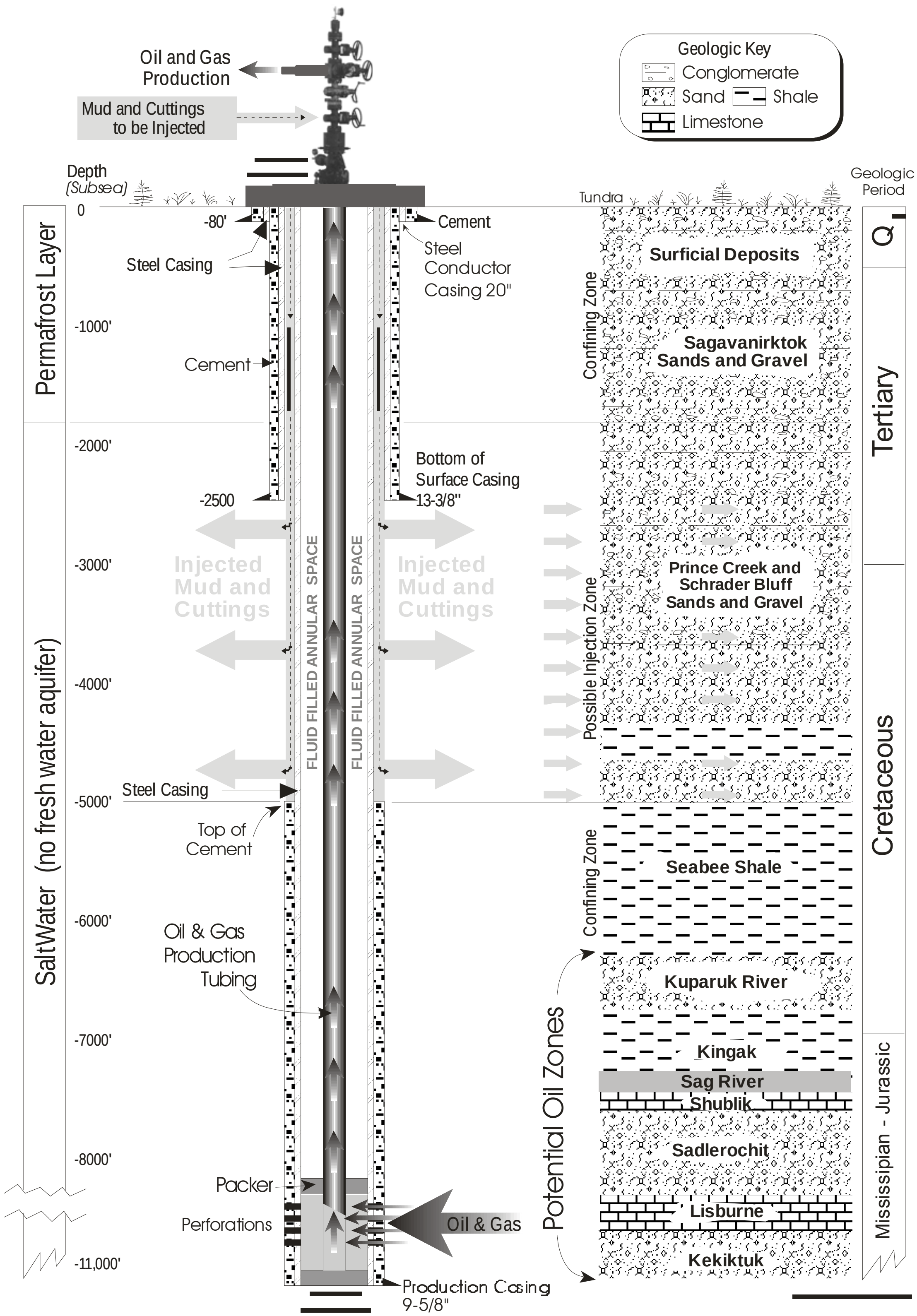
The development "footprint" in terms of habitat loss or gravel fill has continued to decreased in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes (see Figure 5.2). A single production pad and several directionally drilled wells can develop more than one and possibly several 640-acre sections. Unless pool rules (oil or gas field rules governing well drilling, casing, and spacing that are designed to maximize recovery and minimize waste) have been adopted under 20 AAC 25.520, existing spacing rules stipulate that where oil has been discovered, not more than one well may be drilled to that pool on any governmental quarter section (20 AAC 25.055(a)). This would theoretically allow a maximum of four well sites per 640-acre section. Where gas has been discovered, not more than one well per section may be drilled into the pool.

Directional drilling means extracting more oil and gas from a larger subsurface area (by increasing the drainage area) than would be possible from a single straight wellbore. See also Appendix C.

Production facilities will likely include several production wells, water injectors, gas injection wells, and a waste disposal well. Wellhead spacing may be as little as 10 feet. A separation facility would remove water and gas from the produced crude, and pipelines would carry the crude to the Trans-Alaska Pipeline System (TAPS). Some of the natural gas produced is used to power equipment on the facility but most is re-injected to maintain reservoir pressure. Produced water is also reinjected. Often, seawater is treated and injected into the reservoir in order to maintain pressure, improve recovery, and replace produced fluids.

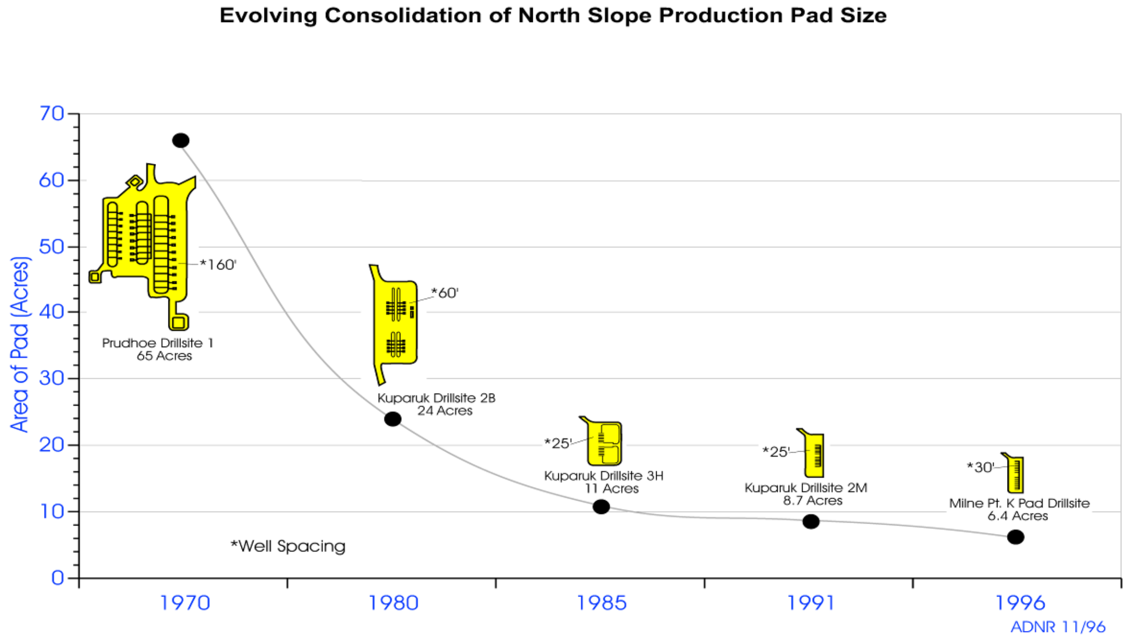
At this phase it is impossible to predict what a full development scenario will entail. The final project parameters will depend upon the surface location, size, depth, and geology of a specific commercial discovery.

FIGURE 5.1 Typical Production/Injection Well (North Slope, Alaska)



Please Note:
1. When injection phase is completed, the 9-5/8" X 13-3/8" annular space is pumped full of cement and permanetly sealed.
2. In the Kuparuk River Unit the surface casing is set through the West Sak interval (to approxima tely -4000 ss). ADNR 3/07

Figure 5.2



B. Statewide and Local Fiscal Effects

1. Statewide Fiscal Effects

Alaska's economy depends heavily on revenues related to oil and gas production, and the government spending resulting from those revenues. The following statistics illustrate various ways in which the leasing program could generate income to state government.

Bonus Payments. Bonus payments are the amounts paid by winning bidders for the individual tracts leased. Since 1959, 6,710 tracts have been leased, generating more than $2 billion in bonus income and interest to the state (ADNR, 2007).

Rentals. Each lease requires an annual rental payment. The first year rent is $1 per acre or fraction of an acre, and the rent increases in 50-cent increments to $3 per acre or fraction of an acre in the fifth and all subsequent years of the lease. The lessee must pay the rent in advance and receives a credit on the royalty due under the lease for that year equal to the rental amount. Rental income from state leases for fiscal year (FY) 2007 (July 2006 through June 2007) were approximately $7.4 million. Rentals from federal leases were approximately $2 million (ADNR, 2008).

Royalties. Royalties represent the state's share of the production as the mineral interest owner. Royalties, including bonuses, rents, and interest provided more than $2.0 billion in revenue to the state in FY 2007. Royalty rates can vary depending on the area. For the most recent North Slope Areawide Oil and Gas Lease Sale held in October 2007, the royalty rate was 12.5 percent to 16.666 percent (ADNR, 2008).

Production Taxes. In 2007, the state replaced the Petroleum Profits Tax (PPT) with the Alaska's Clear and Equitable Share (ACES). The revision boosted overall rates and narrowed allowances for cost deductions and investment credits. With the new law, oil revenue estimates are significantly higher than would have been expected under the prior law. For FY 2007 production taxes were 2.29 billion; for FY 2008 they are forecast to be 3.40 billion (ADOR, 2007).

Income Taxes. All corporations in the state must pay corporate income tax for all taxable income derived from sources within the state. Special provisions apply to apportioning total income worldwide for corporations involved in producing or transporting oil and gas. Most, if not all, producers and transporters of oil and gas in Alaska are corporations. For FY 2007, oil and gas corporation taxes were $594.4 million (ADOR, 2007).

Petroleum Property Taxes. An annual tax is levied each year on the full and true value of property taxable under AS 43.56. This includes exploration property, production property, and pipeline transportation property. Property taxes amounted to $65.6 million in FY 2007 (ADOR, 2007).

In addition, tax settlements to the Constitutional Budget Reserve Fund amounted to approximately $560 million and National Petroleum Reserve-Alaska (NPR-A) royalties, rents, and bonuses amounted to $12.8 million, for total oil revenue of $5.2 billion (ADOR, 2007).

Together these revenues comprised approximately 87 percent of the state's general fund unrestricted revenue in FY 2007 (ADOR, 2007). Such revenues finance the state's education funding, operating budget, and capital budget. State spending supports nearly one out of every three jobs, and $3 of every $10 of personal income result from state spending. Nearly one of every two local government jobs (including school district jobs) in Alaska relies on state funding (ISER, 1990). Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to every eligible state resident.

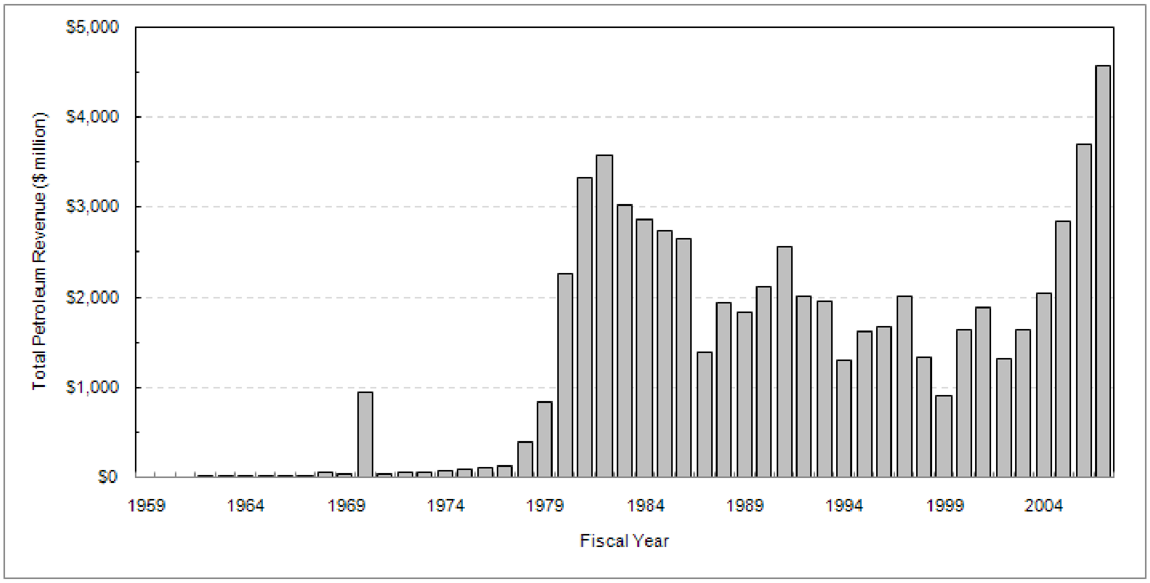
In FY 1988, Alaska North Slope production peaked at 2.006 million barrels per day and has steadily declined since (Figure 5.4). ADOR projects Alaska North Slope oil prices will average $72.64 per barrel for the fiscal year ending June 30, 2008, and $66.32 for FY 2009. Alaska North Slope crude production is forecast to be 731,000 barrels per day for the fiscal year ending June 30, 2008, a 1.2 percent decrease over FY 2007. Production for FY 2009 is projected to decrease to 701,000 barrels per day.

In November 2007, one year after the implementation of the Petroleum Profits Tax (PPT), the legislature passed the Alaska Clear and Equitable Share (ACES). Like the PPT, ACES is levied on the net value of oil and gas production. The base tax rate under ACES is 25% (it was 22.5% under PPT) and the progressive surcharge tax rate under ACES is 0.4% for every dollar that the net profit per barrel exceeds $30 (it was 0.25% on profits exceeding $40 per barrel under PPT). ACES continues to authorize credits for capital expenditures, exploration costs, prior year investments, and small producer incentives as did the PPT. The majority of ACES is retroactive to July 1, 2007, although some provisions are retroactive to the implementation of the PPT on April 1, 2006.

The energy industry is Alaska's largest industry, spending $2.1 billion annually in the state. The industry directly spends $422 million on payroll in Alaska and $1.7 billion on goods and services in the state. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and value added to the Alaska economy of $1.8 billion for total output of $3.1 billion. Oil and gas accounts for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest average wage in Alaska. The average producer company pays a monthly wage of $7,754, which is 2.8 times higher than the statewide average of $2,798 (McDowell, 2001).

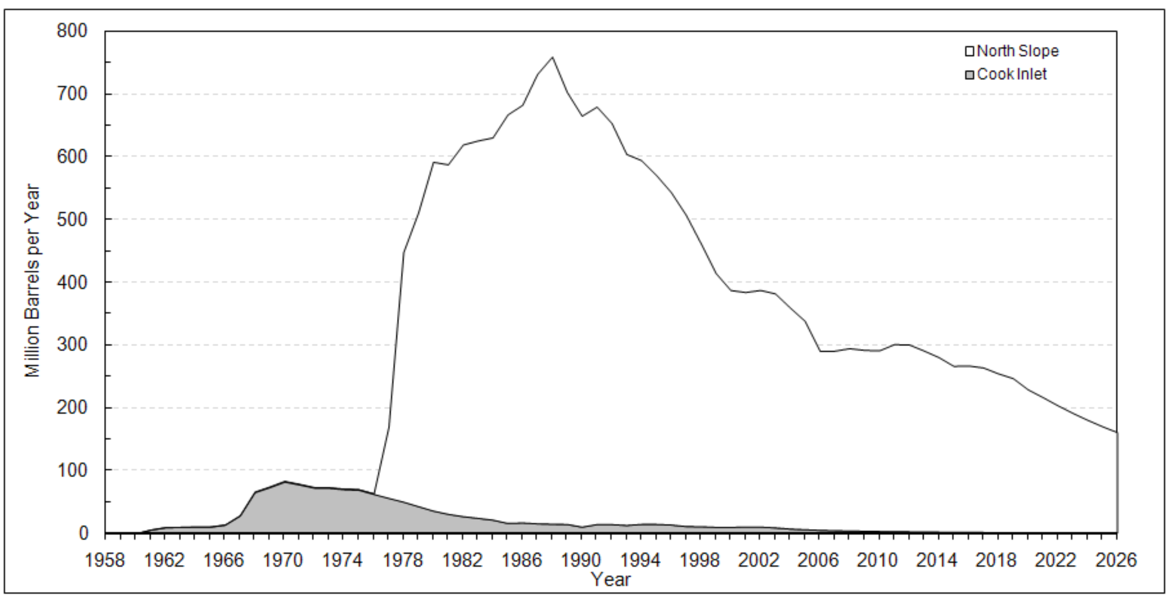
Through state and local government spending of oil and gas revenues, Alaska's petroleum industry has significant indirect impacts on local communities. In 1999, $1.5 billion was spent throughout the state, including capital projects, support of basic government operations (including payroll for state government employees), revenue sharing and municipal assistance, education funding, and Permanent Fund dividends (McDowell, 2001). Furthermore, the total economic effect of any spending, including state government

Figure 5.3: Historic Alaska Petroleum Revenue



Notes: Includes petroleum corporate income tax; production tax; petroleum property tax; oil and gas royalties (net); bonuses, rents and interest (net); and petroleum special settlements. Does not include Permanent Fund contributions and Constitutional Budget Reserve Fund.

Figure 5.4: Historic and Projected Alaska Oil Production



(DO&G Annual Report, 2007)

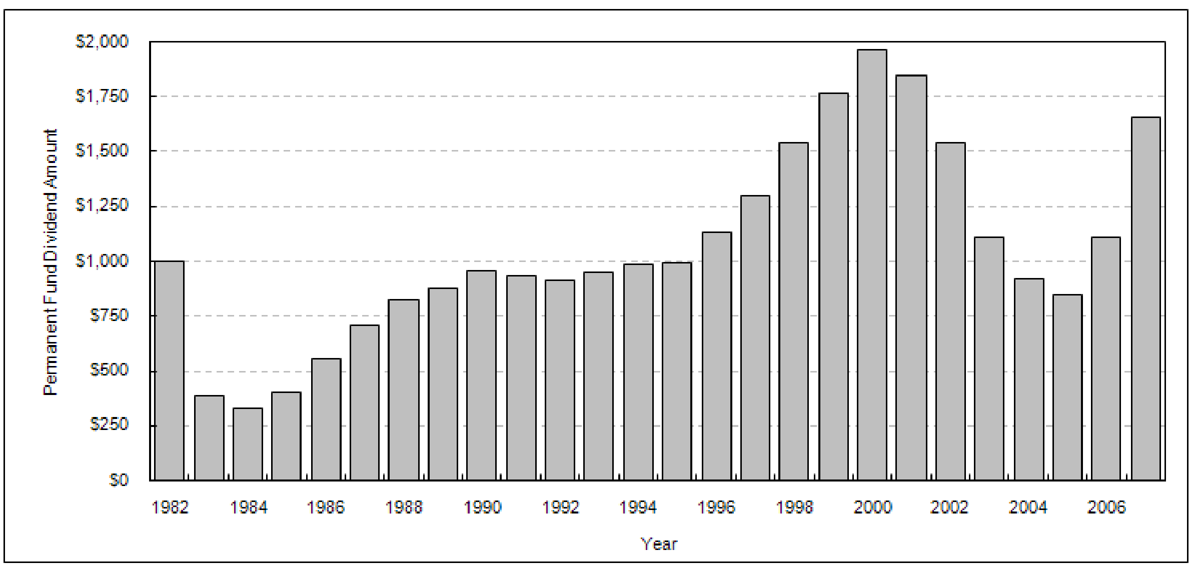
spending and salaries paid to private oil and gas industry employees, is always greater than the direct effect. When money is re-spent in the economy, its original value multiplies. For example, this “income multiplier” is calculated at 1.35 for state spending. This means that for every dollar of income Alaskans receive directly from state spending, an additional 35 cents of income is generated when that dollar is re-spent in the local economy (ISER, 1990).

In 2005, statewide oil industry (major oil companies and oilfield services) nonresidents accounted for 29.6 percent of the industry’s workforce, a nearly one and a half percentage point increase over 2003. Earnings paid to nonresidents working in the oil industry increased from $191.4 million in 2003 to $226.6 million in 2004. The nonresident share of earnings in the oil industry rose from 25.1 percent in 2003 to 26.7 percent in 2004, a figure much higher than the statewide private sector average of 14.2 percent. By comparison, Alaska’s seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2004 – more than 72 percent of workers were nonresidents (ADOL, 2007).

The mitigation measures encourage lessees to employ local Alaska residents and contractors, to the extent they are available and qualified. Lessees must submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator’s plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors.

The Alaska Permanent Fund Dividend (PFD) is also funded with oil and gas revenues. The fund was established by ballot proposition in 1976. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund. The state’s oil-wealth savings account is forecast to exceed $39 billion in FY 2008. All eligible Alaskans who timely apply receive an annual dividend from the earnings of the fund. In 2007, the dividend check totaled $1,654; more than $999 million was distributed under the program to 604,129 eligible Alaskans (ADOR, APFC, 2007). See Figure 5.5. The PFD is an equitable benefit transfer because it reaches every eligible individual regardless of income or socio-economic status. The PFD, with its large annual infusion of cash, has contributed to the growth of the state economy like any other basic industry.

Figure 5.5: Alaska Permanent Fund Dividends (1982-2007)



Source: ADOR, Alaska Permanent Fund Corporation, 2007

C. Effects on Municipalities and Communities

1. Fiscal Effects

The North Slope Borough (NSB) is host to the production center for the state's oil industry and no other borough is more influenced by the oil and gas industry. More than two thirds of all jobs in the NSB are directly linked to the oil industry or to its support industries (Table 5.3).

Although the borough relies on oil revenues, most local residents pursue a traditional and community-based economic life. The finances of the NSB government depend predominately on tax revenues from oil properties. Approximately 98 percent of all local property tax collections come from oil producers. In 2006, property tax receipts were $198.4 million (NSB, 2006).

Oil and gas property is exempt from local municipal taxation, but the state levies a 20-mill tax against this property. Each municipality with oil and gas property within its boundaries is reimbursed an amount equal to the taxes which would have been levied on the oil and gas property, up to the 20-mill limit. The 2005 property tax rate for the NSB was 19.03 mills. Since the 1980s, the NSB property tax base has consisted mainly of high-value property owned or leased by the oil industry in the Prudhoe Bay area (BLM, 2007)

A critical issue facing the NSB is the growing shortfall in revenues due to the decline in assessed value resulting from depreciation of petroleum-production related facilities. The real property assessed valuation for the NSB has declined from $11.5 billion in 1992 to $194 million in 2005. The full value determination of real property was $10.36 billion in 2005. Future assessed values could be higher than current projections if industrial infrastructure is built in the NSB. In the near term, a decline in tax revenues and bonding capacity is anticipated (BLM, 2007).

A primary goal of the NSB has been to create employment opportunities for Alaska Native residents. The NSB has been successful in hiring large numbers of Alaska Natives for NSB construction projects and operations. The NSB employs many permanent residents directly and finances construction projects under its Capital Improvement Program. The NSB pay scales have been equal to, or better than, those in the oil and gas industry, while working conditions and the flexibility offered by the NSB are considered by Alaska Native employees to be superior to those in the oil and gas industry. In addition, NSB employment policies permit employees to take time off, particularly for subsistence hunting (BLM, 2007).

While the NSB ranks highly on income statistics, it also has one of the highest costs of living in the state. The Cooperative Extension Service of the University of Alaska Fairbanks surveys food prices in 24 locations in the state. In June 2004, it listed Nuiqsut and Barrow as the second and fourth most expensive places for weekly food costs for a family with two school-age children. Food items were more than 2.3 times higher in Nuiqsut and 2.1 times higher in Barrow than in Anchorage (ADOL, 2005).

Table 5.3: NSB Employment Profile: Average monthly employment and earnings, First Quarter 2007

Industry	Workers	Average Monthly Earnings
Mining (includes Oil and Gas)	7,299	$8,143
Construction	163	$7,628
Transportation/Trade/Utilities	444	$6,075
Retail Trade	204	$2,842
Federal Government	18	$4,953
State Government	62	$5,006
Local Government	1,713	$3,413
Financial Activities	208	$9,141

According to a spring 2004 construction cost survey conducted for the Alaska Housing Finance Corporation, Barrow bears the highest material costs among 11 surveyed Alaska locations. A basic construction market basket that does not include doors or windows was quoted to cost $37,873, exceeding the Anchorage price by 114 percent. Most of the additional price is attributed to transportation costs. Airfares are also among the highest in the state because of the distance and the costs involved with service to remote locations (ADOL, 2005).

The NSB established its own permanent fund that contains assets that are to be held in perpetuity. At the end of fiscal year 2006, the value of the fund was approximately $483 million (NSB, 2006). Income from the fund is to be added to the corpus of the fund, except that an annual transfer is made to the general fund in an amount up to eight percent of the average total fair value of the fund at the end of the three preceding fiscal years (NSB Comprehensive Annual Financial Report, 2005).

2. Employment

Very few Alaska Native residents of the North Slope have been employed in oil-production facilities and associated work in and near Prudhoe Bay since production started in the late 1970s (Table 5.4). A study contracted by MMS showed that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised less than 1percent of the 6,000 North Slope oil-industry workers (BLM, 2007).

Table 5.4: Estimated Number of Resident Jobs by Sector, NSB Communities, 2003

Sector	Anatuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright
Federal Government	1	0	45	1	0	10	2	2
State Government	2	0	22	0	1	0	1	0
City Government	12	1	21	3	5	14	2	8
NSB Government	51	20	464	27	29	44	24	48
NSB School District	30	20	194	21	27	62	29	44
NSB CIP	0	0	4	0	2	0	1	3
Oil industry	3	0	14	1	3	2	0	0
Private Construction	4	0	23	5	3	1	4	4
ASRC	3	0	69	5	3	1	4	3
Village Corporation	19	27	87	18	37	60	9	38
Finance	0	0	5	0	0	0	1	0
Transportation	0	0	48	0	1	3	1	1
Communications	0	0	8	0	0	0	0	0
Trade	0	1	27	0	0	2	0	1
Service	4	0	103	0	0	0	1	0
Ilisavik College	0	0	58	0	0	2	1	1
Other	2	3	132	3	10	25	5	18

Source: BLM, 2007

The NSB is concerned that the oil industry has not done enough to accommodate training of workers, or to accommodate their cultural and economic needs to participate in subsistence-hunting activities. In response, BP Exploration initiated the Itqanaiyagvik Program, a training partnership with Arctic Slope Regional Corporation (ASRC), Illisagvik College, and the NSB School District to provide education and training for oil industry professional and craft jobs.

ConocoPhillips has worked closely with Kuukpik Corporation, ASRC, and other companies to hire and train Alaska Natives. ConocoPhillips, in cooperation with Kuukpik Corporation, sponsors mentoring and training at the Alpine field for North Slope residents. As a result of current development of the Alpine field, Nuiqsut has received a number of economic benefits and employment opportunities including construction, catering, seismic, surveying, trucking, and security.

As exploration takes place, and if development occurs, the North Slope Areawide Oil and Gas Lease Sale would add jobs to the local economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered and developed. Discovery and development of commercial quantities of petroleum or natural gas in the sale area would bring direct economic benefits to the local and regional economy.

3. Effects on Public Health

In commenting on the preliminary best interest finding, the NSB asked ADNR to consider the reasonably foreseeable effects of the sale on public health. Health status on the North Slope is determined by a wide array of factors, including genetic susceptibility, behavioral change, environmental factors, diet, and socio-cultural impacts. The state is currently developing a policy regarding Health Impact Assessments (HIA) for large resource extraction projects. HIA is a predictive tool that seeks to identify potential lasting or significant changes, both positive and negative, of different actions on the health and social well-being of a defined population as a result of a program, project, or policy. The Alaska Inter-Tribal Council received a grant from the Robert Wood Johnson Foundation to integrate an HIA into the federal environmental impact process. In 2007, the NSB was awarded a $1.67 million NPR-A impact grant to perform an HIA. The goal of the HIA is to aid the NSB in analyzing and understanding potential impacts of proposed development on the health of communities and to design appropriate mitigation measures.

Each year, under AS 38.05.035(e)(6)(F), ADNR issues a call for comments requesting substantial new information that has become available since the most recent finding for that sale area was written. Based on information received, ADNR will determine whether it is necessary to supplement the finding. By this mechanism, ADNR will have the opportunity to consider health impacts once the Alaska Inter-Tribal Council and NSB complete their HIAs and the state finalizes its HIA policy.

HIA’s have not been routinely performed in the United States, however, BLM in its NPR-A Draft Supplemental considered health effects of North Slope oil and gas development. BLM’s analysis is summarized below.

The overall health of Alaska Natives, including the North Slope Inupiat, has improved significantly since 1950 due to the combination of improved socio-economic status, housing, sanitation, and health care and infection control efforts. Health status on the North Slope has continued to improve as measured by overall mortality and life expectancy. Since 1979, overall mortality has declined roughly 20 percent (BLM 2007, citing to Goldsmith 2004; Bjerregaard, Young et al 2004; Day et al 2006). Despite these improvements, significant disparities remain between Alaska Natives and the general U. S. population as cancer, social pathology, and chronic diseases are rapidly increasing (BLM, 2007).

The incidence and the mortality rates for cancer have increased roughly 50 percent since 1969. Cancer is now the leading cause of death on the North Slope. Three cancers, breast, colon, and lung, account for much of the overall increase. By a small margin, North Slope Alaska Natives have the highest incidence of cancer in Alaska, at 579/100,000. The increase in lung cancer and possibly breast and colon cancer may be due to smoking, although there are no definitive studies to prove this (BLM, 2007). However, smoking rates on the North Slope are extremely high (BLM 2007 citing to Wells, 2004).

Psychological and social problems including alcohol and drug abuse, depression, assault, sexual abuse, and suicide are highly prevalent on the North Slope, as they are in many rural Alaska Native and Arctic Inuit villages in Canada and Greenland. The prevalence of suicide on the North Slope in recent years has been estimated at roughly 45/100,000, more than four times the rate in the general U.S. population. Unintentional injury rates are high in the North Slope because of factors such as high rates of alcohol and substance abuse and risk-taking behavior in youth. Research suggests that social pathology problems are related to the rapid cultural changes that have occurred. Alcohol prohibition has been demonstrated to reduce rates of suicide, homicide, and other social pathology (BLM, 2007).

Diabetes, obesity, and related metabolic disorders were previously rare or non-existent in the Inupiat but are now increasing. The prevalence of diabetes in the North Slope is estimated at only 2.4 percent compared with the U.S. rate of roughly 7 percent. However, between 1990 and 2001, the rate of diabetes climbed roughly 110 percent, nearly three times the rate of increase in the general U.S. population (Alaska Native Medical Center Diabetes Program). Subsistence diets and the associated active lifestyle are known to be the main protective factors against diabetes. The increase in diabetes may reflect the increased use of store-bought food, a more sedentary lifestyle, and potentially genetic susceptibility (BLM, 2007, citing to Murphy, Schraer et al., 1995; Naylor, Schraer et al., 2003; Ebbesson, Kennish et al., 1999).

Cardiovascular disease rates are significantly lower in Alaska Natives than in non-Natives in the U.S. On the North Slope, recent mortality figures show death rates roughly 10 percent less than the U.S. population (BLM, 2007, citing to Day, et al., 2006). However, many of the risk factors are increasing, and as noted above, smoking rates are already extremely high (BLM 2007 citing to Wells, 2004).

North Slope residents have the highest mortality rate in the state from chronic lung diseases, at nearly three times the mortality rate for the U.S. (130/100,000 compared with 45/100,000) (Day et al 2006). The disparate rates of increase and mortality from pulmonary disease are accompanied by high smoking rates, which many public health experts believe to be the primary explanation. It is impossible to estimate the contribution of environmental factors because there are no available data on local fine particulate concentrations, hazardous air pollutants, and indoor air quality. Data generally does not exist to allow the direct attribution of a particular illness to a specific development project. However, an ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999 as a State of Alaska permit condition for the Alpine field. Data collected indicate that air quality is in compliance with National Ambient Air Quality Standards and Alaska Ambient Air Quality Standards (BLM, 2007).

BLM concludes that while the health status of the North Slope Inupiat people has improved significantly since the 1950s due to reductions in infectious diseases, the rates of cancer, chronic diseases such as diabetes, hypertension, asthma, and social pathology have increased. At present, no evidence exists to conclusively link rates of any of these problems to oil and gas development. Current public health efforts focus on smoking cessation, early detection, surveillance of carcinogens in subsistence foods, and curtailing exposure to known carcinogenic compounds as much as possible (BLM, 2007).

D. Cumulative Effects

1. Effects on Water

Water quality characteristics that may be altered by oil and gas activities include: pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential impacts that may alter surface water quality parameters include accidental spills of fuel, lubricants, or chemicals; increases in erosion and sedimentation causing elevated turbidity and suspended solids concentrations; and oil spills.

Geophysical exploration with tracked seismic vehicles is not expected to alter water quality because seismic surveys are conducted in winter and permit conditions mitigate potential damage. Under standard ADNR permit conditions for winter seismic exploration, the use of ground-contact vehicles for off-road travel is limited to areas where adequate ground frost and snow cover prevent damage to the ground surface. Operations are restricted to the winter seasonal opening. Equipment, other than vessels, must not enter open-water areas of a watercourse during winter, and any roads, bridges, or approach ramps constructed near river, slough, or stream crossings must be free of extraneous material before breakup. Alterations of the banks of a watercourse are prohibited. Adherence to these conditions avoids or minimizes post-seismic increases in erosion, turbidity, and suspended solids in a drainage area.

The extent and duration of water quality degradation resulting from accidental spills depends on the type of product, the location, volume, season, and duration of the spill or leak, and the effectiveness of the cleanup response. Heavy equipment, such as trucks, tracked vehicles, aircraft, and tank trucks, commonly use diesel fuel, gasoline, jet fuel, motor oil, hydraulic fluid, antifreeze, and other lubricants. Spills or leaks could result from accidents, during refueling, or from corrosion of lines (Parametrix, 1996). Under standard ADNR permit conditions for off-road activity, fuel and hazardous substances must have secondary containment apparatuses. A secondary containment or surface liner must be placed under all container or vehicle fuel tank inlet and outlet points. Appropriate spill response equipment must be on hand during any transfer or handling of fuel or hazardous substances. Vehicle refueling is prohibited within annual floodplains (ADGC, 1995). Impacts of oil spills are discussed in Chapter Six.

Other standard ADNR land use permit conditions serve to protect water quality from facility construction and operation. Work areas must be kept clean. Trash, survey markers, and other debris that may accumulate in camps or along seismic lines and travel routes that are not recovered during the initial cleanup must be picked up and properly disposed. All solid wastes, including incinerator residue, must be backhauled to a solid waste disposal site approved by ADEC. Vehicle maintenance, campsites, and the storage or stockpiling of material on the surface of lakes, ponds, or rivers is prohibited (ADGC, 1995).

The federal Clean Water Act established NPDES to permit discharges of pollutants into U.S. waters by “point sources,” such as industrial and municipal facilities. In Alaska, the U.S. Environmental Protection Agency (EPA) issues NPDES permits, designed to maximize treatment and minimize harmful effects of discharges as water quality and technology improvements are made. ADEC certifies that these discharge permits will not violate the state’s water quality standards.

ADEC issues industrial and municipal wastewater permits and monitors wastewater discharges and the water quality of waterbodies receiving the discharges. ADEC certifies federal wastewater permits with mixing zones that allow industrial and municipal facilities to meet state water quality standards. Industrial and municipal wastewater facilities are inspected annually. ADEC also certifies U.S. Army Corps of Engineers dredge and fill permits in wetlands and navigable waters to ensure compliance with state water quality standards. ADEC provides technical assistance for design, installation, and operation of industrial and municipal wastewater systems.

a. Effects of Drilling Muds and Produced Water

For onshore operations, most drilling wastes are disposed of under ADEC’s solid waste disposal program. Re-injection is the preferred method of drilling fluid disposal and the method of disposal of drilling mud and cuttings requires permit approval. Byproducts of drilling and production activities include muds and cuttings, produced water, and associated wastes. During drilling and after a well is in production, water comes to the surface mixed with oil and gas and must be separated before further refining. Drilling employs the use of carefully mixed fluids, called muds. Cuttings are small fragments of rock up to an inch across that are dislodged and carried to the surface by drill muds. Drilling muds are mostly water-based mixtures of clay and other earthen materials, such as almond husks, which are used to cool and lubricate the drilling bit, facilitate the drilling action, flush out cuttings within the well bore, seal off cracks in down-hole formations to prevent the flow of drilling fluids into these formations, and maintain reservoir pressure. Chemicals may be added to maximize the effectiveness of drilling and casing (See Table 5.5). Oil-based muds and synthetic-based muds may also be used depending on the well depth, well diameter, and subsurface formations (NRC, 1983;Veil, Burke and Moses, 1996).

Produced water contains natural occurring substances such as clay, sand, oil, water and gas. These substances are found in the subterranean strata. Produced waters are usually saline with some level of hydrocarbons. Associated wastes are other production fluids such as tank bottom sludge, well work-overs, gas dehydration processes, tank wastewater, and other residues that are considered non-hazardous (low-toxicity) by the EPA. Like drilling muds, chemicals may be added to produced water to remove harmful bacteria, halt corrosion, break up solids, prevent scale buildup, and break oil/water emulsions (EPA, 1995).

Table 5.5: Drilling Additives

	Common Additive	Use
Weighting material	Barite (barium sulfate ore)	Adds density and counters formation pressures
Viscosifiers	Bentonite clay (mostly sodium montmorillonite)	Removes cuttings, prevents fluid loss, helps seal wellbore
Natural and synthetic polymers	Bentonite and drilled clays, corn and potato starch, modified starch, natural gums	Mud cake, prevent fluid loss, cuttings transport, hydraulics
Thinners	Plant tannins, polyphosphates, lignitic materials	Reduce temperature effects, reduce viscosity
pH and ion control	Soda ash, baking soda, sodium hydroxide	Control corrosion, remove harmful gas (H2S)
Lubricants	Natural and synthetic oil-based compounds	Reduce friction in wellbore
Bacteria control agents	Depends on ability to meet effluent guidelines	Mitigate fermentation of organics in drill system
Surfactants	Salts, soaps, fatty acid derivatives	Emulsifier, wetting agent, foamers, defoamers, reduce clay hydration

(NRC, 1983)

According to a 1993 EPA report, the use of water-based muds generates 7,000 to 13,000 barrels of waste per well. Depending on the depth and diameter of the well, 1,400 to 2,800 barrels of those are cuttings. Oil-based mud volumes are generally used less than water-based muds, because they are more efficient, may be reconditioned, reused, and re-sold. Newer synthetic-based muds produce even less waste, improve drilling efficiency, are reusable, and have advantages in environmental protection over oil or water-based muds (Veil, et al., 1996). Discharge of untreated oil-based muds into any water column violates federal and state pollution laws.

b. Current Waste Treatment and Disposal Practices

Most oil field wastes are considered non-hazardous and waste fluids are recycled, filtered, and treated before reinjection or disposal. Cuttings and waste fluids must be made non-hazardous before injection. Produced water is treated using heat, gravity settling, and gas flotation devices to remove hydrocarbons. After treatment, produced water is reinjected into either the oil-bearing formation to maintain pressure and enhance recovery or into an approved disposal well. Cuttings disposal is done through grinding and injecting on-site, or cuttings are transported to an approved disposal site. Cuttings disposal can cost more than the total cost to drill a well (Powell, 1996). Wastewater, including sanitary and domestic graywater, is also treated to meet effluent guidelines before discharge.

The AOGCC ensures proper and safe handling and disposal of drilling wastes. The AOGCC functions as the regulatory agency overseeing the underground operation of the Alaska oil industry on private and public lands and waters. The commission administers the Underground Injection Control Program for oil and gas wells, acts to prevent waste of oil and gas resources and ensure maximum recovery, and protects subsurface property rights. All disposal wells inject fluids deep beneath any drinking water aquifers.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to water quality. For a complete listing of mitigation measures and lessee advisories, see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Stream buffers: To the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses. In addition, no facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Shaviovik, and Kavik rivers.
- Wetland protection: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas.
- Habitat loss minimization: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Additionally, pipelines must utilize existing transportation corridors where conditions permit. Finally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Turbidity reduction: Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Water quality monitoring: A fresh water aquifer monitoring well, and quarterly water quality monitoring, is required down gradient of a permanent storage facility, unless alternative acceptable technology is approved by ADEC.
- Drilling waste: The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands. Discharge of produced waters into open or ice-covered marine waters of less than ten meters in depth is prohibited.

- Water conservation: Removal of water from fish-bearing water bodies requires prior written approval by DMLW and ADF&G. Regulations for Appropriation and Use of Water are subject to the provisions of 11 AAC 93.035 - 11 AAC 93.147.

2. Effects on Air Quality

Air quality throughout the sale area is good, with concentrations of regulated pollutants below the maximum allowed under the National Ambient Air Quality Standards. In order to ensure that air quality standards are maintained, emissions of nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone and particulate matter are closely watched under the provisions of the Prevention of Significant Deterioration Program, which is administered by ADEC (ADEC, 2007).

Routine activities associated with oil and gas exploration, development, and production that are likely to affect air quality are emissions from construction, drilling, and production. Air pollutants include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter, and volatile organic compounds (VOC) (MMS, 1995). Effects from VOC emissions would be insignificant because of the low potential for ozone formation. Photochemical pollutants, such as ozone, form in the air of the lower atmosphere from the interaction of hydrocarbons and nitrogen oxides in the presence of strong sunlight .In the upper atmosphere ozone is beneficial because it absorbs solar ultraviolet radiation. In the lower atmosphere its strong oxidizing trait can be harmful to humans and plant life. There is a low potential for ozone formation on the North Slope because the summertime air temperatures remain relatively low (MMS, 1996b).

Trucks, heavy construction equipment, and earth-moving equipment would produce emissions, such as engine exhaust and dust. Sources of air emissions during drilling operations include rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, incinerators, and well test flaring equipment. Emissions would be generated during installation of pipelines and utility lines, excavation and transportation of gravel, mobilization and demobilization of drill rigs, and during construction of gravel pads, roads, and support facilities. Emissions would also be produced by engines, turbines, and heaters used for oil/gas production, processing, and transport. In addition, aircraft, supply boats, personnel carriers, mobile support modules, as well as intermittent operations such as mud degassing and well testing, would produce emissions (MMS, 1996b).

Other sources of air pollution include evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOC and sulfur dioxide (MMS, 1995c). Gas blowouts, evaporation of spilled oil and burning of spilled oil may also affect air quality. Gas or oil blowouts may catch fire. A light, short-term coating of soot over a localized area could result from oil fires. However, soot produced from burning oil spills tends to slump and wash off vegetation in subsequent rains (MMS, 1995).

The probability of a gas blowout from a pad is estimated to be low. If a gas blowout did occur, it is estimated that it would not persist more than one day and that it would release less than two tons of volatile organic compounds (MMS, 2003).

Other effects on the environment of air pollution from oil and gas activities and other sources not specifically addressed by air quality standards include the possibility of damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks), long term (seasons or years), regional (North Slope), or local (near the activity only) (BLM, 2005).

Mitigation Measures

At the lease sale stage, it is not possible to predict with certainty the amount of pollutants that may be produced. Regardless, all industrial emissions must comply with the Clean Air Act (42 U.S.C. §§ 7401-7642) and state air quality standards. 18 AAC 50 provides for air quality control and contains the state air quality standards, permit requirements, permit review criteria, and regulation compliance criteria, and state statutes and regulations that will mitigate potential impacts to air quality include:

- 42 U.S.C. §§ 7401-7671: Federal Clean Air Act;
- AS 46.03: Which provides for environment conservation; control of water, land, and air pollution; radiation and hazardous waste protection; and
- 18 AAC 50: The purpose of which is to identify, prevent, abate, and control air pollution in a manner that meets the purposes of AS 46.03, AS 46.14. and 42 U.S.C. 7401 – 7671q (Clean Air Act).

ADEC's Air Permit Program regulates stationary sources of air contaminants to protect and enhance air quality and abate impacts on public health and the environment. The Act established air quality programs to regulate air emissions from stationary, mobile, and other sources that pose a risk to human health and the environment. ADEC monitors compliance with regulations and air quality standards through annual inspections and enforcement procedures. The agency issues operating permits to existing major facilities incorporating all applicable requirements and issues construction permits to new facilities and for expansions of existing facilities.

3. Effects on Fish and Wildlife Habitat, Populations and Their Uses

a. Effects on Land Habitat

During oil and gas development and production, various activities could impact vegetation in the sale area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

<u>Transportation</u>: Winter seismic surveys can affect tundra vegetation depending on snow depth, vehicle type, traffic pattern, and vegetation type. Camp-move trails disturb vegetation more than seismic trails. Multiple vehicles in a single narrow trail cause more disturbance than dispersed tracks. Trails in shrub-dominated tundra recover slower than other vegetation types (Jorgenson and Martin, 1997).

Seismic surveys can compress microtopography, resulting in a wetter microenvironment and decreased vegetation cover of upright shrubs (willows), lichens, and mosses. Winter seismic trails have little adverse effect on, and may possibly enhance growth of, *C. aquatalis* and *E. angustifolium* due to the resulting wetter microenvironment (Noel and Pollard, 1996, citing to Felix and Raynolds, 1989). Effects can be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra that should disappear with the recovery of the vegetation within a few years. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact so that plants should recover. Dry, snowless ridges and vegetated sand dunes are at higher risk of damage. Damage to vegetation can be avoided by limiting travel to areas with at least 6 inches of snow cover, and avoiding minimum radius turns. In areas where damage is extensive and natural recovery not expected, restoration may be required of operators (Schultz, 1996).

Overland moves and seismic surveys could alter the thermal balance, and increase the risk of thermokarsting. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, surface travel could be come more difficult. The amount of soil erosion would increase with an increase in disturbance to soil and vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible (BLM, 2005).

Observations by the BLM and others (NRC, 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about one percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about one percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting land seismic surveys to areas with adequate snow cover would greatly reduce the potential for thermokarst and long-term impacts to the tundra (BLM, 2005). Based on earlier studies there should be no long-term impacts to vegetation from seismic lines (BLM, 2005).

Important lease stipulations for thermokarst would be the restriction on bulldozing of trails, the requirement that snow depth average six inches before overland activities could commence, and the lease stipulation that trails could not be used repeatedly, to avoid formation of ruts. These lease stipulations, along with the minor impact of modern seismic equipment, should be highly effective in minimizing thermokarst erosion of the tundra and transport of soil to waterbodies

After a review of study results and the available scientific literature, ADNR established the minimum combination of ground and snow conditions which are needed to achieve the protection for both wet sedge tundra and tussock dominated tundra.

DNR will implement tundra opening for general cross country travel in wet sedge tundra when a minimum 15 centimeters (6 inches) of snow cover is available and ground temperature is -5°C at 30 centimeters (1 foot) depth in coastal areas and with 23 centimeters (9 inches) of snow in the foothills.

Drilling and Production Discharges: During exploration well drilling, muds and cuttings are stored on-pad, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site or reinjected into the subsurface at an approved injection well. All production muds and cuttings on the North Slope are reinjected into a Class II injection well. All produced waters are reinjected either into the producing formation to enhance recovery or into an injection well. The Underground Injection Control program is administered by AOGCC. Drilling and production discharges are expected to have no impact on tundra habitat.

Effects of Construction and Gravel Infilling: Effects of constructing production pads, roads, and pipelines include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth. Construction activity involving vehicular passage (see above, Effects of Seismic), such as a rollogon, may upset the thermal balance of the permafrost beneath the tundra, especially in non-winter months. Road construction, vehicular passage, and oil spills can alter surface albedo (reflectivity of sunlight off the earth’s surface) or water drainage patterns, resulting in thaw and subsidence or inundation. Such changes can affect regeneration and revegetation of certain species, and species composition may also change after disturbance from construction activities (Linkins, et al., 1984).

After an oil field is abandoned, rehabilitation will be required to restore areas impacted by oil and gas activities. Recovery of wetlands disturbed by gravel infilling varies depending on soil moisture content and amount of available soil organic matter (Kidd, et al., 1997, citing to Jorgenson and Joyce, 1994). Removal of gravel from pads and roads is the initial step in rehabilitation. At sites on the North Slope where gravel fill has been removed, problems have emerged associated with ponding, thaw subsidence, and nutrient cycling. One method preferred by the state is to remove all gravel and create pond habitat that resembles pre-construction conditions. In some cases, full gravel removal may not be the optimum recovery option. In most cases, plant cultivation is desirable with the use of plant species identified as important for waterbird habitat. While rehabilitation methods for gravel pad and roads vary depending on site-specific conditions, the overall goal of rehabilitation in the existing oil fields is to create a mosaic of moist meadows, sedge meadows, and grass marshes. Several plant cultivation treatments have been used on the North Slope, including fertilizer only, native-grass cultivation, Arctophila transplantation, and sedge-plug transplantation. Optimum recovery of the tundra marsh would include re-establishing vegetation, soil microbiotia, phytoplankton, aquatic invertebrate, and wildlife communities at the impacted site (Kidd, et al., 1997).

Ice roads and Pads: Ice roads and pads cause depressions in microtopography due to compaction. The thaw depth in summer increases beneath the impacted area after melt and there is an increase in wetness due to compression. Ice roads and pads also affect tundra regeneration, with certain species recovering faster after summer melt than others. Most vegetation should recover within three seasons following melt. Ice road thaw depths return to pre-impact levels after several years (Noel and Pollard, 1996).

Single season ice roads melt in spring and leave little if any trace. Multi-season ice pads can result in limited short-term impact, if tundra around the perimeter of the pad thaws and is blocked from sunlight. Insulated paneling held down by fabric and timbers at the perimeter of a multi-season pad can result in sun-blockage and impeded growth.

Gas Blowouts: If a natural gas blowout occurred, plants in the immediate vicinity could be destroyed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. Insects such as mosquitoes would also be affected or killed by a gas blowout. 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 one kilometer downwind or for more than one day. Natural gas development is expected to have little to no effect on lower trophic-level organisms (MMS, 1996b). Impacts to vegetation from pollutants would likely not substantially alter the plant communities in the sale area (BLM, 2005).

Oil Spills: Spilled oil will affect tundra depending on time of year, vegetation, and terrain. Oil spilled on the tundra will migrate both horizontally and vertically. This flow depends on many factors, including the volume spilled, type of cover (plant or snow), slope, presence of cracks or troughs, moisture content of soil, temperature, wind direction and velocity, thickness of the oil, discharge point, and ability of the ground to absorb the oil (Linkins, et al., 1984). The spread of oil is less when it is thicker, cooler, or is exposed to chemical weathering. If the ground temperature is less than the pour point of the oil, it will pool and be easier to contain. Absorption of the oil by the tundra itself will also limit flow and reduce the area contaminated. Experiments in Canada by MacKay, et al. (1974) revealed that mosses have high absorption capacity. Moss-covered tundra can absorb more than 13 gallons of oil per square meter, compared to less than a gallon for tundra not covered by moss (Linkins, et al., 1984). If there is a vertical crack through different soil horizons, oil will migrate down to the permafrost. If no cracks are present in the soil layers beneath the tundra, oil moves laterally in the organic material, does not penetrate the silty clay loam mineral soils beneath, and oil contamination would be restricted to the top few centimeters of the soil layer. Dry soils have greater porosity and the potential for vertical movement is greater (Linkins, et al., 1984, citing to Everett, 1978). If oil penetrates the soil layers and remains in the plant root zone, longer-term effects, such as mortality or reduced regeneration, would occur in following summers.

Fungi are important decomposers of organic material in tundra soil. Large numbers of fungi have been found in association with a natural oil seep at Cape Simpson. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the crude being spilled, bacteria assist in the breakdown of hydrocarbons in soils. Petroleum-contaminated soils are commonly treated with fertilization, raking, and tilling (bioremediation).

In the March 2006, severe corrosion in a BP transit pipeline caused more than 200,000 gallons of oil to leak onto almost 2 acres of tundra. The spill resulted in a $6 million cleanup (see Chapter Six, "Oil Spill Risk, Prevention and Response"). ADEC officials believe the environmental damage to the tundra was minimal (ADN, 2006a).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to land and habitat. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Wetland protection: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas.
- Habitat loss minimization: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Additionally, pipelines must utilize existing transportation corridors where conditions permit. Finally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Rehabilitation: Upon abandonment of material sites, drilling sites, roads, buildings or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the Director, unless the Director, in consultation with DMLW, ADF&G, ADEC, NSB, and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Drilling waste: The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands. Discharge of produced waters into open or ice-covered marine waters of less than ten meters in depth is prohibited.

b. Effects on Fish

Anadromous streams within the sale area include the Colville, Sagavanirktok, Shaviovik, and Kadleroshilik Rivers. The Canning River is adjacent to the eastern boundary of the sale area. Numerous other rivers and streams that flow through the sale area also support anadromous fish populations. Several species of anadromous fish spawn and overwinter in these rivers and during summer migrate to nearshore coastal waters of the sale area to feed. Migration patterns vary by species and within species by life stage (see Chapter Three). Potential effects include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal, facility siting, and water removal; impediments to migration; and fish kills due to oil spills.

<u>Habitat Loss</u>: Potential impacts at all phases include erosion. Erosion results in siltation and sedimentation, which in turn may result in a reduced or altered stream flow that may affect overwintering habitat availability and the ability of fish to migrate upstream. Protecting the integrity of stream bank vegetation and minimizing erosion are important elements in preserving fish habitat. Streambeds could be affected if stream banks are altered, such as in cases of damage from equipment crossings. Overwintering habitat may be limited; the Colville River provides the most consistently available overwintering habitat for anadromous fish in the sale area.

Withdrawal of water from lakes and ponds could affect fish overwintering habitat by entraining juvenile fish, lowering water levels, and increasing disturbance. The construction of roads across rivers and streams may also affect the ability of fish to reach overwintering areas by blocking movement and causing direct loss of overwintering habitat. Blockage of movement could also occur from the improper installation of culverts in streams for permanent roads.

During oil- and gas-related development, gravel removal from fishbearing streams to support oil and gas activities could adversely impact the habitat in these streams and the fish they support. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration.

Removal of water from lakes where fish are overwintering may affect the viability of overwintering fish, and longer-term effects of lake drawdown may impede the ability of fish to return to the lake in subsequent years. Removal of snow from lakes may increase the freeze depth of the ice, kill overwintering and resident fish, and adversely affect the ability of fish to utilize the lake in future years.

During development, unregulated gravel removal from fishbearing streams to support oil and gas activities could adversely impact anadromous fish they support. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration. Gravel removal from stream beds could also cause potential damage to overwintering fish populations. Alternatively, gravel mine sites can be restored as overwintering habitat and thus add to total available fish habitat.

Seismic Activities: Seismic activities are typically conducted during the winter months using drills and helicopters to minimize the effect on the environment. Seismic operations using high explosives could cause direct injury to fish resources in lakes and streams (Fink, 1996). Pressure waves from high explosives can potentially kill and injure fish near the explosion; however, the impulses dissipate to a non-lethal level within a short distance – less than 328 feet (MMS, 1996b). Overpressures of 30-40 pounds per square inch (psi) will kill fish with swim bladders. Overpressures of just 3 to 4 psi can kill juvenile salmonids. Shockwaves from explosions can also shock and jar fish eggs at sensitive stages of development. These types of impacts are mitigated by restricting the use of explosives in close proximity to fishbearing lakes and streams. Mitigation measures to protect fish eggs may include limiting the timing of seismic work and are considered by DO&G on a case-by-case basis as a condition for obtaining a geophysical exploration permit. Other restrictions include requiring that seismic activities be set back far enough from freshwater fish spawning areas that shockwaves are reduced to safe levels before reaching incubating eggs during sensitive stages of development (Fink, 1996). Seismic surveys are not expected to have any measurable effect on Arctic fish populations (BLM, 2005).

Causeways: The state discourages the use of continuous-fill causeways. Though remote, the possibility of needing a causeway into the nearshore Beaufort Sea to support development in portions of the sale area does exist. Placement of causeways, particularly continuous-fill causeways into the nearshore Beaufort Sea or in river deltas, can alter patterns of nearshore sediment transport, alter patterns of water discharge to the nearshore environment, and alter temperature and salinity regimes in areas near the causeway. The extent of alterations depends on the size or length of the causeway, its location relative to nearby islands and river mouths or deltas, and pre-causeway oceanographic characteristics. Minimizing alterations is accomplished by proper siting, minimal size, and by ensuring that breaches are sized and located to maximize goals. Changes to the physical environment may alter patterns of use of the deltaic area by anadromous and marine fishes. Changing marine current flow and circulation patterns result in physical changes to delta channeling and shorelines which could affect use by animals which feed on fish, such as shorebirds and waterfowl (Winters, 1996).

Any gravel structure that obstructs the natural migratory corridor near river mouths has the potential to adversely affect anadromous fish. Altering temperature and salinity in nearshore waters may affect the distribution and abundance of organisms upon which fish feed. For these reasons, solid-fill causeways are discouraged, and many designs, although ideal for field development, are unsuitable for the nearshore environment. Additionally, significant alterations of the shoreline or changes to natural temperature and salinity patterns are prohibited. Overall, the construction of causeways is not expected to have a measurable effect on fish populations in and adjacent to the sale area (BLM, 2005).

Oil Spills: Oil spills could range from small chronic leaks from equipment or facilities to catastrophic pipeline failures or drilling blowouts. The effects of oil spills on fish would depend on many factors, including the time of year, size of the spill, and waterbody affected. Potential adverse effects from an oil spill could include direct mortality from oiling of the gills, mortality of prey species, mortality from consumption of contaminated prey, and blockage of movement or displacement from important habitats. Mortality of egg and larvae could occur in spawning or nursery areas from the toxic effects of the oil. Sublethal effects may also reduce fitness and affect the ability to endure environmental stress. Effects of oil spills during the winter would be expected to be negligible but could potentially be major during the open-water season, depending on the site-specific conditions. Mitigation measures to protect fish and eggs from an oil spill include: siting facilities away from fishbearing streams and lakes, development of oil spill contingency plans, and providing adequate spill response training. Oil spills are not expected to have a measurable effect on freshwater or anadromous fish populations within and adjacent to the sale area (BLM, 2005)

Gas Blowouts: If a natural-gas blowout occurred, some fish in the immediate vicinity might be killed. Natural gas 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 for more than one day (MMS, 1998).

Mitigation Measures

Title 41 of the Alaska Statutes requires protection of documented anadromous streams from disturbances associated with development. The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to fish. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Stream buffers: To the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses. In addition, no facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Shaviovik, and Kavik rivers.
- Obstructions to migration and movement: The State of Alaska discourages the use of continuous-fill causeways. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulations patterns and water quality characteristics that result in exceedances of water quality criteria, and must maintain free passage of marine and anadromous fish. Causeways and docks shall not be located in river mouths or deltas. To protect designated anadromous fish-bearing lakes and streams and to ensure the free and efficient passage of fish in all fish-bearing water bodies: alteration of

riverbanks may be prohibited; the operation of equipment, excluding boats, in open water areas of rivers and streams may be prohibited; bridges or non-bottom founded structures may be required for crossing fish spawning and important rearing habitats; and culverts or other stream crossing structures must be designed, installed, and maintained to provide free and efficient passage of fish.

- Protection from seismic activities: The lessee will consult with the NSB prior to proposing the use of explosives for seismic surveys. The Director may approve the use of explosives for seismic surveys after consultation with the NSB.
- Habitat protection: Removal of snow from fish bearing rivers, streams and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fish bearing waterbodies is prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice or snow bridges may be required. Water intake pipes used to remove water from fish bearing waterbodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed. Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean, R. F. 1993, North Slope Gravel Pit Performance Guidelines, ADF&G Habitat and Restoration Division Technical Report 93-9, available from ADF&G.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Production discharges: Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI and VIII wetlands, is prohibited. Additionally, unless authorized by an ADEC permit, surface discharge of reserve pit fluids and produced waters is prohibited. Also, if authorized by ADEC and EPA, disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques.

c. Effects on Birds

Some bird species, during periods of nesting, molting, and staging, are sensitive to activities associated with development. Generally, responses to industrial activities depend on species exposed, the physiological or reproductive state of the birds; distance from the disturbance; type, intensity, and duration of the disturbance; and possibly other factors (MMS, 1996). Potential impacts are more likely to occur after the exploration phase, as few resident species are present during winter when exploration occurs. Potential impacts include habitat loss, barrier to movement, disturbance during nesting and brooding, change in food abundance and availability, and oil spills.

<u>Habitat loss</u>: Siting of onshore facilities, such as drill pads, roads, airfields, pipelines, housing, oil storage facilities, and other infrastructure, could eliminate or alter some preferred bird habitats such as wetlands. Onshore pipeline corridors may include a road and associated impacts from traffic noise and dust may deter nesting in the immediate vicinity. The construction of offshore pipelines or re-supply activities could have temporary effects on the availability of food sources of some birds within a mile or two of the construction area due to turbidity and removal of prey organisms along the pipeline route. Impacts to waterfowl and shorebird populations are not likely to persist after development phase activities are completed (MMS, 1996b).

After facilities are built, some birds (individuals) can no longer nest in areas because the areas are covered by the new facility. Additional birds may avoid the area adjacent to the facility due to disturbance effects. However, these habitat changes do not translate into reduced numbers of birds in the area, as the displaced birds are found nesting in nearby areas and returned at rates similar to unaffected birds. There is no indication that displaced birds settled in habitat inferior to that from which they were displaced because they did not incur disproportionately lower nest success at their new nest sites. Habitat availability does not limit most bird populations at Prudhoe Bay. Nest predation by arctic foxes is proposed as the factor most likely limiting population levels (TERA, 1990). The USFWS disputes this conclusion, citing the small sample size (only one marked bird lost its nest site, and an additional seven had nest sites that were physically altered in some way). They note, however, the results lend no support to the hypothesis of habitat limitation (Sousa, 1997).

A five-year monitoring program to assess the effects of construction and operation of the Lisburne oil field on white-fronted geese, brant, snow geese, and tundra swans was conducted from 1985-1990. The purpose was to determine whether development-related disturbance and habitat loss have caused changes in the extent and nature of use of the Lisburne development area by geese and swans. The study concluded that the Lisburne development did not change the extent or nature of use of the area by geese and swans during construction and the first three years of operation of the oil field (Murphy and Anderson, 1993). This study synthesized the results from pre-construction studies conducted in 1983 and 1984. The pre-construction studies, however, did not investigate all aspects of goose and swan ecology and therefore a complete comparison with pre-development results was not possible (Murphy and Anderson, 1993).

Barriers to movement: Black brant populations have experienced periodic nesting failures in the Sagavanirktok and Kuparuk River deltas (Ott, 1993). Adults and young are flightless during the brood-rearing period, so roads, causeways, and other related structures may be barriers to brant movements (Sousa, 1992). There is no evidence that the Endicott road/causeway has been an obstruction to black brant movements (Johnson, 1994).

An initial concern expressed before construction began was that the Endicott road/causeway would act as a barrier to the movements of brood-rearing flocks of snow geese as they dispersed eastward from Howe Island after hatching in early July. Overall, 14 years of data show no indication that the Endicott development has impeded eastward movements of snow geese from their nesting colony on Howe Island. However, other studies document abandonment of brood-rearing areas near the Endicott road, and unsuccessful crossing attempts and failure of crossing the road for periods up to two weeks (Ott, 1997, citing to Envirosphere Co., 1986). Many negative behavioral reactions to the road/pipeline corridor were noted, although no population effect was detected (Sousa, 1997).

Seismic Activities: Most seismic surveys to collect geological data and exploration drilling activities would occur during the winter months when birds are mostly absent from the sale area. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats. Conducting support activities after the completion of the nesting and broodrearing periods would eliminate the potential for nest abandonment and loss of productivity (BLM, 2005).

Disturbance: Human activities such as air traffic and foot traffic near nesting waterfowl, shorebirds, and seabirds, could cause some species to temporarily abandon important nesting, feeding and staging areas. Birds have keen eyesight, and even slight movements may cause adults to abandon young hatchlings. A study of effects of aircraft on molting brant in the Teshekpuk Lake area (Derksen et al., 1992) concludes that helicopters, and to a lesser extent fixed-wing aircraft, cause serious disturbance. However, as pointed out in the Habitat Loss section, disturbance does not translate into a population reduction. Some species, such as tundra swans, are particularly sensitive to humans on foot, and may abandon their nests when humans approach within 500 m to 2000 m of the nest (MMS, 1996b).

Research has indicated that some birds may not be readily disturbed. A 1993 study, Bird Use of the Prudhoe Bay oil field, concluded that on the order of five percent of the birds in the Prudhoe Bay oil field may have been displaced by gravel placement and secondary alterations of adjacent areas, but that these birds most likely occupy nearby areas. Overall, there is rearrangement of birds but probably no net change in bird abundance within the oil field (TERA, 1993). The nesting of most local birds is widely dispersed over the coastal tundra and disturbance probably would have little effect on North Slope bird populations as a whole (MMS, 1996b).

In 1985, ARCO Alaska, Inc. initiated a five-year monitoring program to assess the effects of construction and operation of the Lisburne oil field on Canada geese, greater white-fronted geese, snow geese and tundra swans. Pre-construction studies were conducted in 1983 and 1984; however, they did not investigate all aspects of goose and swan ecology evaluated during construction and post-construction. In addition, the Lisburne field is located within the existing Prudhoe Bay oil field, where oil development activities have been ongoing since the early 1970s. The study encompassed the construction phase (1985-1986) and the first three years of operation (1987-1989). The final synthesis report concluded that the Lisburne development did not change the extent or nature of use of the development area by geese and swans during construction and the first three years of operation. No major shifts in the use of the sale area were detected when comparing survey results between construction and post-construction and the limited data on bird distribution from pre-development studies (ABR, 1993).

In 1983, Sohio Alaska stockpiled more than one million cubic meters of gravel on the western tip of Thetis Island. Operations also involved the installation of a temporary support camp, construction of helicopter landing pad, gravel berms to support two large conveyor belts, and a fleet of barges to haul the gravel. Sohio instituted a series of mitigation measures — the establishment of an aircraft flight corridor and buffer zone, a restricted access zone for camp personnel, and at the request of USFWS, a program to remove arctic foxes. The numbers of common eiders nesting on Thetis Island in 1983 were higher than had been recorded in any previous year. The mitigation program implemented by Sohio may have been at least partly responsible for the increase. Three eiders established nests and successfully incubated and hatched eggs at different sites within 300 m of the helicopter landing pad (LGL Associates, 1984).

The level of impacts is dependent on the location and extent of facilities. However, once exploration and development or production ceases in an area, bird populations could recover from the effects of disturbance, reducing overall effects in the sale area (BLM, 2005).

<u>Oil Spills</u>: Direct contact with spilled oil by birds is usually fatal, causing death from hypothermia, shock, or drowning. Oil ingestion from preening oily feathers or consumption of oil-contaminated foods may reduce reproductive ability, and could lead to chronic toxicity through the accumulation of hydrocarbon residues. Oil contamination of eggs by oiled feathers of parent birds significantly reduces egg hatching through toxic effects on chick embryo or abandonment of the nest by parent birds (MMS 1996). The presence of humans, aircraft, boat and vehicular traffic involved in cleanup activities is expected to cause displacement of nesting, molting, and feeding birds in the oiled areas and contribute to reduced reproductive success of the birds (MMS, 1996). The number of birds impacted by a spill would depend on the time of year and the density of local bird populations. Oil entering a river or stream could potentially spread into delta or coastal areas, where impacts to birds could be more severe (BLM, 2005). Spill prevention and response are described in Chapter Six, and would apply to any new development in the sale area.

Gas Blowouts: In the event of a natural gas explosion and fire, birds in the immediate vicinity could 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 toxic fumes would affect birds or their food sources except those very near to the source of the blowout (MMS, 1996).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to fish. For a complete listing of mitigation measures and lessee advisories, see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat protection: Permanent, staffed facilities must be sited to the extent practicable outside identified brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas. Additionally, to the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Lessees must comply with USFWS and NMFS requirements regarding the Endangered Species Act, Migratory Bird Treaty Act and the Marine Mammals Protection Act (See Lessees Advisories). Finally, lessees must comply with the provisions of Appendix B of the "Yellow-billed Loon Conservation Agreement," dated July 31, 2006 between the ADF&G, ADNR, USFWS, BLM and NPS.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- NSB municipal code: In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle, and vessel operations regulated by NSB code.

If oil development occurs, some alteration of bird habitat can be expected. However, with state and federal government oversight, any activities within the sale area should not prevent overall bird population levels from remaining at or near current levels.

d. Effects on Wildlife

i. Caribou

Since 1975, government and industry have conducted research on caribou biology and on various aspects of their interaction with North Slope oil and gas developments. Population characteristics (calf production and survival, and adult mortality), habitat use, movement and distribution, and behavioral responses of caribou to oil and gas developments have been studied, but there is disagreement regarding the interpretation of data with respect to the effects of oil and gas development. Some researchers attribute declines in caribou populations to oil and gas development, while others think populations (reproduction and viability) are subject to natural cycles in the ability of the land to support large numbers of caribou (carrying capacity). Still others think caribou numbers are influenced by many factors, such as disease, nutrition, predator abundance (including insects), and weather. Hunting pressure and loss of high-quality tundra from oil and gas development is not a primary factor in the rise and fall of caribou populations. Nonetheless, studies show that local distribution and behavior of caribou are affected by infrastructure and human activities within producing oil fields.

Potential impacts can occur at all phases, but most are likely to occur during development and production. Adverse effects are discussed below. Potential effects to caribou populations from the sale include displacement from insect relief and calving areas due to construction and operations, and from oil spills.

Disturbance: One source of disturbance to caribou is construction. During construction, small groups of caribou may be temporarily displaced; however, the disturbance reaction would diminish after construction is complete. Furthermore, construction will not take place over the entire sale area at the same time. If caribou are displaced from calving in a certain area due to construction, they are likely to calve in an area where construction is not taking place. The use of specific calving sites within the broad calving area varies from year to year. If calving caribou are displaced from high nutrition forage near a drill site or facility, they are likely to seek any protective area regardless of the forage. The cumulative effect of displacement from high value tundra could be lower calf survival. On the other hand, high populations would force the caribou into lower nutrition areas anyway (MMS, 1996b).

Cow and calf groups are most sensitive to human disturbance just prior to calving, and during the post-calving period (Cronin et al., 1994). Caribou may use portions of the coastal plain for calving, but most calves are born in the uplands (USFWS, 1987). Ground-vehicle traffic, aircraft, and human presence near cows with newborn calves also affect individuals as they migrate (MMS, 1996b). Caribou may be more affected by oil development than previously thought, particularly during calving, according to ADF&G (Smith and Cameron, 1991).

Motor-vehicle and aircraft traffic can also disturb caribou. Caribou can be briefly disturbed by low-flying aircraft. The response of caribou to potential disturbance is highly variable, ranging from no reaction to violent escape reactions. Reactions depend upon: distance from human activity; speed of approaching disturbance source; altitude of aircraft; frequency of disturbance; sex, age, and physical condition of the animals; size of caribou group; and season, terrain, and weather. Habituation to aircraft, vehicle traffic, and other human activities has been reported in several studies of hoofed-mammal populations in North America. The variability and instability of Arctic ecosystems dictate that caribou have the ability to adapt behaviorally to some environmental changes (MMS, 1996b).

Aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females can be displaced by road systems (Cameron, et al., 1992). After construction of the Milne Point road, caribou were significantly less numerous within one kilometer of roads and significantly more numerous five to six kilometers from roads. In addition to the locally perturbed distribution of caribou, researchers observed a decline in relative use of a portion of the sale area between Oliktok Point and Milne Point roads. However, the causes of reduced use of oil field tundra by calving caribou of the Central Arctic herd is difficult to determine by aerial observations, because of unpredictable random factors, such as weather. "Annual variation in the numbers of caribou observed near Milne Point is primarily an effect of spring snow conditions." (Cameron, et al., 1992) Distribution of caribou tends to be skewed inland in years of late snow melt, and concentrated near the coast in years of early melt. In addition to snow conditions and resultant forage availability, relative occurrence of caribou in the Kuparuk River calving area is influenced by predator and insect avoidance behavior. Overall caribou use of an area could be greatly reduced if roads with moderate traffic are routed too closely (Cameron, et al., 1992). "[A]nd inaccessible habitat is habitat lost." (Cameron, et al., 1995).

Some displacement of the Central Arctic herd caribou from a portion of the calving range near Prudhoe Bay and Milne Point facilities has been documented. Ground observations of caribou within the Kuparuk area from 1978 to 1990 indicate that caribou increasingly avoided zones of intense activity, especially during the calving period. Pregnant caribou could be delayed in reaching calving grounds because of delays in crossing roads or attempts to detour around oil fields. Calving en route to calving grounds could result in reduced calf survival (BLM, 2005).

In the absence of insect harassment, caribou within 1,640 feet of roads with no traffic spent more time feeding than did caribou 1,640 feet and farther from roads with traffic. Avoidance of roads during periods of high traffic in the post calving period was noted by Roby in 1978 and by Dau and Cameron in 1986. Some research indicates that roads that receive little use by humans need not be separated from pipelines (Curatolo and Reges, 1985). Pipelines elevated at least five feet allow for effective crossing, except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles per hour). The Alaska Caribou Steering Committee concludes the most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet (Cronin et al., 1994). Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee.

Disturbance of caribou associated with cumulative oil exploration, particularly by helicopter traffic, is expected to have minor effects on caribou, particularly large groups, with animals being briefly displaced from feeding and resting areas when aircraft pass nearby. Vehicle traffic associated with transportation corridors has the potential to affect habitat use in intensely developed areas of the Prudhoe Bay and Kuparuk oil fields. Acute disturbance effects may in combination result in a cumulative effect on habitat availability for those individuals with fidelity to the Kuparuk River calving area, but may have little or no effect on the Central Arctic herd population. It is expected these disturbances would be short term (BLM, 2005). Despite the fact that cumulative effects at the population level are difficult to quantify, measures should be incorporated into operations planning and facility design to avoid both direct and indirect impacts to caribou.

<u>Habitat Loss and Displacement</u>: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Caribou are subject to mosquito harassment from mid-to-late June through July, and to oestrid fly harassment from mid-July to late-August. In response, caribou move from inland feeding areas to windswept, vegetation-free coastal areas, where the insects are limited. Most mosquito relief areas are found within 4.5 miles of the coast (ADF&G, 1986b). Caribou use various coastal habitats such as sandbars, spits, river deltas, and some barrier islands for relief from insect pests. (MMS, 1987b). Caribou may use some of the barrier islands and adjacent areas for insect relief. If coastal habitat is unavailable for insect relief, caribou may use foothills south of the Coastal Plain for insect relief (USFWS, 1987). Insect relief zones not only include coastal areas, but mountain tops, river deltas, flood plains, and river bars.

In the absence of available insect-relief habitat, caribou gather into large groups or continue to move into the wind without feeding. A period of extensive insect harassment can result in weight loss. In addition, caribou lose up to 125 grams of blood a day to mosquitoes and suffer increased parasitism from skin warbles and nasal bot flies. If caribou are delayed or prevented from free access to insect-relief habitat, the result may be deterioration in body condition resulting in decreased growth, increased winter mortality, and lowered herd productivity (USFWS, 1987).

The frequency and duration of caribou movements to and from the coast depend on weather related changes in the number of mosquitoes, and caribou distribution on the coastal plain can change dramatically within a 24-hour period. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases (Shideler, 1986). Caribou that remain inland may move to river bars and bluffs to escape insects.

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. Biologists representing both industry and ADF&G have agreed that facilities built earlier in the development of the Prudhoe Bay oil field have created impediments to caribou movements. Flow and gathering pipelines were elevated only one to four feet above the surface, thus forming an effective barrier to caribou crossing. However, extensive research on the response of caribou to development has now shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field. Factors influencing the crossing success of caribou beneath elevated pipelines include group size or composition, topography, insect activity, traffic levels, the intensity of local construction, as well as road or pipeline configuration (Shideler 1986). The mere physical presence of a pipeline would probably have a minimal effect on behavior, movement or distribution of caribou, except perhaps when heavy snow prevented some animals from crossing under or over the pipeline (BLM, 2005).

In the Kuparuk field where all pipelines are elevated a minimum of five feet above ground, mosquito harassed caribou were able to pass through the field on their way to and from insect-relief habitat, although they typically detoured around drill pads and were often delayed up to several hours at road crossings (BLM, 2005).

If displacement from coastal insect-relief areas did occur during the construction of oil and gas facilities, it would be temporary and disturbance reaction would diminish after construction is complete, provided that road systems are not spaced too closely. Routes that caribou take as they migrate to and from the coast depend on their location at the beginning and end of the insect harassment season, and thus as weather phenomena are random, so are the resultant caribou movements (Cameron, et al., 1995). Whereas calving caribou are highly sensitive to development, “female caribou will tolerate considerable surface development in summer, especially when passage under (or over) pipelines is possible” (Cameron et al., 1995, citing to Smith et al., 1994).

The Central Arctic herd has grown considerably during the period of oil field development, but lack of pre-development data makes assessment of effects of oil field development difficult. Also, the understanding of the population dynamics of the North Slope caribou herds is incomplete and no firm conclusions about the effects of oil field development on reproductive success of the herd can be drawn. Based upon comparisons with other herds, there have been no apparent effects of oil field development on the growth of the Central Arctic herd. This does not suggest that there may not be effects in the future, or that other herds under different ecological conditions may not be affected (Cronin et al., 1994). The Central Arctic herd was estimated at approximately 5,000 caribou in 1975. The most recent photocensus conducted in 2002 documented approximately 32,000 caribou (BLM, 2005).

Post-sale activities have the potential to affect caribou of the Central Arctic herd, Teshekpuk Caribou herd, and the Porcupine Caribou herd. While the summer range of the Teshekpuk Caribou herd is outside of the sale area to the west of the Colville River, caribou of the herd may pass through the sale area during their annual migration from the Brooks Range (Philo, et al., 1993). Caribou of the Central Arctic herd migrate in a north-south direction along major river corridors of the sale area and thus could be affected year-round by oil and gas activities. Caribou of the Porcupine Caribou herd also can be found year-round in the far eastern portion of the sale area, although winter and summer populations are concentrated in the Arctic National Wildlife Refuge, and in Canada (Cronin, et al., 1994).

“Although new development within existing oil fields may increase cumulative effects, new technologies can reduce the infrastructure surface area (see figure 5.2). The use of directional drilling to maximize the number of wells at drill sites, the centralization of power plants and utility systems, and the joint use of roads, pipeline corridors, and airports all contribute to less area impacted by oil field infrastructure” (Cronin, 1994 citing to Senner, 1989).

Documenting positive effects of oil field development is as equally challenging as documenting adverse effects. Dust settling alongside roads in the spring leads to earlier snowmelt and green-up of vegetation. Caribou may feed in these areas in late May prior to calving (Cronin, et al., 1994, citing to Lawhead and Cameron, 1988). Caribou commonly congregate on gravel pads and roads, and in areas shaded by facilities, possibly for insect relief, particularly from oestrid flies (Cronin, et al., 1994, citing to Johnson and Lawhead, 1989; Lawhead, 1997). Caribou were observed using roads and gravel pads and the shade of pipelines and buildings as insect relief areas, which at other times they tended to avoid. Caribou were also observed using unvegetated gravel pads at more than twice the average number of those using vegetated pads of comparable size (BPX, 1990). Caribou have habituated to onshore facilities and have been observed using roads, gravel pads, and the shade provided by pipelines and buildings, for insect relief (USFWS, 1987). However, researchers have noted that use of existing oil field facilities as insect relief habitat may cause caribou to avoid preferred foraging areas thought to be further inland (Cronin et al., 1994, citing to Roby, 1978).

Measures can be taken in oil field facility design to reduce the potential for adverse effects on caribou, such as displacement. If pipelines must be elevated, they should be so at least seven feet above the tundra. Where possible, sections of pipeline should be buried, especially at key migration corridors, such as river and stream crossings. There is a correlation between crossing success and the presence and use of an adjacent road. Adverse effects caused by roads with heavy traffic adjacent to pipelines can be mitigated by increasing the distance between the road and the pipeline, and by restricting traffic flow. Roads should be separated from elevated pipelines by at least 500 feet. Installing ramps to facilitate crossings is another option; however, studies indicate the effectiveness of ramps is debatable. Ramps are not likely to play a significant role in facilitating direct and underlayed road and pipeline crossings, but may be important facilitators during large-scale post-calving movements. Construction and re-supply activities should be scheduled to not occur during calving periods or when significant caribou movements are anticipated. Other measures include horizontal and vertical aircraft flight restrictions; restricting unnecessary public access to the oil field road system; training of oil field employees; and caribou migration monitoring. Biologists should be included in initial field design and in making decisions regarding the placement of facilities and routing of roads and pipelines in key areas (Cronin, et al., 1994). Finally, to reduce the potential for adverse effects on caribou from direct habitat loss, facility pad size should be minimized. When possible, facilities such as processing units, drill pads, and airstrips should be consolidated. Multiple wells should be drilled from a single surface location when possible, and the use of extended-reach drilling techniques should be employed where feasible.

<u>Oil spills</u>: Caribou may also be impacted by oil spills. Caribou that become oiled could die from toxic-hydrocarbon inhalation and absorption through the skin. If caribou were to ingest oil-contaminated vegetation, the result would be significant weight loss and aspiration pneumonia, leading to death. In the event of an oil spill that contaminated tundra or coastal habitats, however, caribou probably would not ingest the oiled vegetation. Caribou are selective grazers and are particular about the plants they consume (MMS, 1996b). The majority of impacts would result from disturbance associated with spill clean-up activities, such as the presence of humans and boat, vehicle, and air traffic operating in the spill cleanup operations, rather than direct oiling (BLM, 2005). Such activity is expected to cause disturbance and displacement of caribou. (MMS, 1996b).

<u>Gas Blowouts</u>: Impacts of a gas blowout on caribou would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, caribou in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Therefore, toxic fumes would not affect animals, except those very near the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to terrestrial mammals. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- AS 38.05.035(e) provides the Director with the authority to impose conditions or limitations, in addition to those imposed by statute, to ensure that a resource disposal is in the state's best interests.
- Habitat loss: Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important caribou or other large ungulate calving and wintering areas during the plan of operations approval stage.
- Disturbance: Pipelines shall be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-ground pipelines must be elevated 7 feet. ADNR may require additional measures to mitigate impacts to wildlife movement and migration. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 feet or a lateral distance of 1 mile from caribou and muskoxen concentrations.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee: Cronin, M. et al, 1994. "Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou." LGL Alaska Research Associates, Inc., July.

ii. Muskoxen and Moose

Muskoxen are present in low numbers in the Sagavanirktok drainage and other drainages west of the Canning River and are expanding their range. Little is known regarding the influence of roads, traffic, and pipelines on muskox movements (Ott, 1996).

Moose occur all across the North Slope with the largest concentration along the Colville River and its tributaries. Moose generally remain in the foothill portions of the sale area along river corridors. Post-sale activities are expected to have little effect on the North Slope moose population.

<u>Habitat Loss</u>: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure (Ott, 1996). Muskoxen have a high fidelity to particular habitat areas because of factors favorable to herd productivity and survival, such as food availability, snow conditions, or absence of predators. Displacement from preferred habitat could have a negative effect on muskoxen populations. The magnitude of the effect is difficult to predict, but would likely be related to the magnitude and duration of the displacement (USFWS, 1987). Muskoxen populations on the North Slope have been declining in recent years. Herds elsewhere in the state are healthy. Most of the losses have been in ANWR. Biologists are not certain why, but starvation, drowning in floods, and predation by grizzly bears may play a role. Hunting has not played a big role but state and federal managers have restricted hunting because herd numbers are so low (ADN, 2006d).

Moose prefer riparian habitat – stands of willow and brush. Very little if any of this habitat is expected to be lost as a result of post-sale activities because of mitigation measures that: prohibit alteration of river banks, except for approved permanent crossings; and except for approved stream crossings, prohibit equipment operation within willow stands (*Salix* spp.) and permanent facility siting is prohibited within one-half mile of major rivers in the sale area, including the Colville.

Disturbance: Muskoxen and moose may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Muskoxen remain relatively sedentary in the winter, possibly to conserve energy. The energetic costs associated with forced movements during winter may be as significant an impact as disturbance during calving. Mixed groups of muskoxen showed a greater sensitivity to fixed-wing aircraft in winter and during calving than in summer, fall, or during rut. Increased activity during exploration and development in muskoxen overwintering areas may have an adverse effect on muskoxen survival (Sousa, 1992). Muskoxen may be able to habituate to aircraft and seismic disturbance (USFWS, 1987).

Moose adapt readily, and habituate to the presence of human activity and are not easily disturbed (USFWS, 1987, citing to Denniston, 1956; and Peterson, 1955). However, they can become agitated and may be more sensitive to disturbance when calves are present from mid-May to early June. In the Kenai National Wildlife Refuge, moose distribution, movements or behavior were not affected by helicopter-supported winter seismic surveys using explosives (USFWS, 1987, citing to Bangs and Bailey, 1982). Moose generally do not venture as far north as the existing oil fields, however in the southern portion of the sale area, some moose-oil field interaction may become common. Some fencing may be appropriate around facilities. Moose mortality may occur as a result of collisions with vehicles (USFWS, 1987).

Oil Spills: In general, the effects of an oil spill on muskoxen and moose would be similar to that of other terrestrial mammals. An oil spill may result in oil contamination of individual animals in the immediate vicinity, contamination of habitats, and contamination of some local food sources. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of muskoxen or moose, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement during cleanup operations.

Gas Blowouts: Impacts on muskoxen and moose of a gas blowout would be similar to that of other terrestrial mammals. In the event of a natural gas explosion or fire, muskoxen or moose in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to muskoxen and moose. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat loss: To the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Disturbance: Pipelines shall be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-

ground pipelines must be elevated 7 feet. ADNR may require additional measures to mitigate impacts to wildlife movement and migration. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 feet or a lateral distance of 1 mile from caribou and muskoxen concentrations.

- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

iii. Brown Bear

Brown bears can be found throughout the Arctic region in varying densities. The lowest densities occur along the coastal plain; brown bears are at the northern limits of their range in the Arctic. The availability of food is limited and their reproductive potential is low (ADF&G, 1986a).

Habitat Loss: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Quantifying the number of animals involved is difficult. Brown bears travel along the major river corridors and feed in riparian areas of the sale area. Siting facilities outside these areas will reduce potential impacts on brown bears (USFWS, 1987).

Disturbance: Brown bears may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Seismic activity that occurs in winter may disturb denning bears. Studies have found that radio-collared bears in their dens were disturbed by seismic activities within 1.2 miles of their dens, demonstrated by an increased heart rate and greater movement within the den. However, no negative effect, such as den abandonment was documented (USFWS, 1987).

Interaction with Humans: During exploration and development, human activity may attract foraging bears, especially to refuse disposal areas. Omnivores are attracted to food and food odors associated with human activity, and may become conditioned to non-natural food sources (Baker, 1987). This may pose a threat to human safety and the potential need to shoot “problem” animals. Bears can also be displaced by human land use activities.

Oil Spills: The potential effects of oil spills on brown bears include contamination of individual animals, contamination of coastal habitats, and contamination of some local food sources. Bears feed on fish concentrations at overwintering and spawning areas. Bears may also feed on beached marine mammal carcasses along the coast (Ott, 1997). If an oil spill contaminates beaches along the coast, bears are likely to ingest contaminated food sources. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of brown bears, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of brown bears during cleanup operations.

Gas Blowouts: Impacts on brown bear of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, brown bear in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to brown bears. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Human-bear interaction plan: For projects in proximity to areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears.
- Habitat protection: Before commencement of any activities, lessees must consult with ADF&G to identify the locations of known brown bear den sites. Exploration and production activities must not be conducted within one-half mile of occupied brown bear dens. Additionally, gravel mining must be limited to the minimum necessary to develop a field efficiently.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.

iv. Furbearers

Wolves, Wolverines, and Foxes: Fox populations vary in response to fluctuations in their natural prey sources, but a constant food supply could maintain the fox population at artificially high levels. This could cause near total nest failure of all waterfowl and shorebirds in the development area because foxes prey on eggs and young birds. Foxes and wolves are also noted for their rabies outbreaks, which increase when population densities are high and create health risks to humans. Activity during exploration and development may attract foraging foxes and wolves, especially to refuse disposal areas. Wolverines apparently are not attracted to garbage (USFWS, 1986).

Habitat Loss: Winter arctic fox habitat is primarily along the coast and sea ice. Denning occurs up to 15 miles inland. Red foxes also may den within 10 miles of the coast but are generally found farther inland (Ott, 1996). Habitat destruction would primarily affect foxes through destruction of den sites. Placement of oil and gas infrastructure at or near den sites may either destroy den sites or cause foxes to den elsewhere (USFWS, 1986). However, foxes have been known to use culverts and other construction materials for denning. Wolverines occur exclusively in remote regions where human activity is unlikely; therefore, displacement of wolverines from local areas of development is unlikely (USFWS, 1987).

The effects of direct habitat loss on wolves would likely be negligible. The abundance of wolves is ultimately determined by the availability of prey. The ability of adults to provide food is the key determinant in wolf pup survival. Reduction in prey species, such as caribou, could reduce wolf populations (USFWS, 1987).

Disturbance: Wolves are unlikely to be disturbed by development because they readily habituate to human activity. During construction of the Dalton Highway and trans-Alaska oil pipeline, wolves readily accepted handouts from construction workers (USFWS, 1987). Primary sources of disturbance are seismic activities and aircraft traffic. Helicopters generally invoke a stronger response from wolves and foxes than fixed-wing aircraft. Ice roads connecting well sites and supply areas would provide a source of disturbance from vehicles. Impacts of seismic exploration and drilling on wolves are unknown (USFWS, 1986).

Oil Spills: The general effects of an oil spill on wolves, wolverines, and foxes are similar to that of other terrestrial animals. The potential effects of oil spills include contamination of individual animals, contamination of habitats, and contamination of some local food sources. Furbearers, particularly foxes, may be attracted to dead oiled wildlife at a spill site. Foxes may be attracted to the human activity at a spill site by the possibility of finding food or garbage. In the event of a large oil spill contacting and extensively oiling habitats with concentrations of wolves, wolverines, and foxes, the presence of humans and traffic from vehicles and aircraft are expected to cause disturbance and displacement of these animals during cleanup operations, with the possible exception of foxes.

Gas Blowouts: Impacts on wolves, wolverines, and foxes of a gas blowout would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred, animals in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site; thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to furbearers. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Habitat protection: Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.

v. Polar Bear

On May 15, 2008, the USFWS published a *Final Rule* in the Federal Register listing the polar bear as a threatened species under the Endangered Species Act (ESA) See Chapter Three, Section 4.a.

Potential impacts to polar bears include disruption of denning, attraction to areas of activity, and adverse interaction with humans; in the case of an oil spill, potential effects could include ingestion of oil and oil contamination.

Habitat loss: Construction of offshore oil and gas facilities such as pipelines, gravel islands, causeways, and production platforms could have local effects on ice movements and fast ice formation around the structures. Construction activities could have a short-term (less than one year) effect on polar bear distribution (MMS, 1996b).

Disturbance: The primary sources of noise disturbance would come from air and marine traffic. Seismic activities and low-frequency noise from drilling operations would also be a source of noise. Disturbance from human activities, such as ice road construction and seismic work, could cause pregnant females to abandon dens early. Early abandonment of maternal dens can be fatal to cubs. However, a study of den disturbances found that most of the denned bears tolerated exposure to exceptional levels of disturbance (Amstrup, 1993). In addition, denning habitat is not limiting and the timing of denning is predictable (Amstrup and Gardner, 1994). Therefore, potential effects of disturbances can be mitigated by spatial and temporal management (Amstrup, 1993; Amstrup and Gardner, 1994).

Habitat Modification: Polar bears continually search for food. Once bears find a camp or industrial site, they will often enter to explore and search for food. If a bear receives a food reward, it is more likely to return. Polar bears often investigate not only things that smell or act like food, but also novel sights or odors. Subadults are more likely to be food-stressed and attracted to human activity more commonly than well-fed bears. Subadults are also less likely to leave if a potential food source is present. Attractants include kitchen odors, deliberate feeding, accessible garbage, sewage lagoons, carcasses, industrial materials, and alteration of habitat (MMS, 1993).

Oil contamination: Polar bears have been observed eating hydraulic fluid and other petroleum lubricants, and at least one bear in the Prudhoe Bay area died as a result of ingesting ethylene glycol antifreeze (Ott, 1990). In the case of a potential oil spill, bears could contact oil directly by swimming or wallowing in contaminated areas, or indirectly by scavenging oiled carcasses along the beach, by preying on oiled seals, or while maintaining their fur. In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of polar bears, the presence of humans (boat, vehicle, and aircraft traffic operating in the area) could cause disturbance and displacement of polar bears during cleanup operations. Conversely, polar bears could be attracted to a spill site by the presence of dead birds or other animals killed by the spill, or by the human activity previously associated with a food source (MMS, 1996b).

Amstrup et al. (2006) conducted a modeling study to predict the probability that polar bears on the North Slope would be exposed to hypothetical oil spills from two locations in the Beaufort Sea, one that is currently operating offshore (Northstar) and one that was proposed for offshore (Liberty). The model incorporated actual weather data such as wind, ice, and currents, and used NOAA methods for modeling oil spills. Data from studies of radio-collared polar bears from 1985-2003 were also used. The model examined the worst case scenario: the largest anticipated catastrophic spill; the largest anticipated chronic spill; the worst possible times, the maximum open water period (September), and the period of maximum polar bear density (October); no attempt at cleanup or other human intervention; and maximum effect (all bears touched by oil killed). The model did not take into account uncertainty in polar bear population estimates or oil weathering. Median numbers of polar bears oiled by a worst-case scenario spill at Liberty were 1 bear in September and 3 bears in October; median numbers oiled at Northstar were 3 bears in September and 11 bears in October. Based on this model, there is a very low probability that a large number of polar bears would be affected by an oil spill; and, if an oil spill were to happen, there is a large probability that a low number of bears would be affected (Amstrup et al., 2006).

The Amstrup et al. (2006) model did not take into account the risk of an oil spill in the first place. There have been no marine oil spills in the Beaufort Sea in more than 25 years of exploration and development and there has never been an oil spill from a platform blowout in Alaska. The Northstar pipeline is designed to operate without leaking even if all the potential sources of failure (ice gouging, strudel scour, settlement) occur at the same time and same location. This is an extraordinarily conservative design basis. MMS evaluated the design of the Northstar project and concluded the risk of an oil spill of 1,000 bbl or greater was on the order of 1 to 2 percent. From all approaches reviewed, zero was the most likely number of spills (MMS, 2000).

Interaction with humans: Some polar bears could be killed as a result of human-bear encounters near industrial sites and settlements associated with oil and gas development. Some of these losses might be unavoidable and would represent a small source of mortality on the polar bear population that would be replaced by reproduction within one year. The incidental loss of polar bears due to oil and gas development in the sale area is unlikely to significantly increase the mortality rate of the polar bear population above that which is occurring due to subsistence harvests and natural causes (MMS, 1996b).

Polar bears are protected under the MMPA of 1972, which prohibits the “taking” of marine mammals. By interpretation, taking is said to occur whenever human activity causes a polar bear to change its behavior. Disturbing a polar bear by trying to take a picture of it or scaring a bear away from a building are violations under the law (MMS, 1993). Taking a polar bear by individuals is legal under some circumstances, such as federal, state, or local government officials acting in the course of their official duties. Additionally, native Alaskans living on the coast are allowed to hunt polar bears for subsistence and handicraft purposes, provided it is not done in a wasteful manner.

In 1987, the North Slope Borough Fish and Game Management Committee and the Inuvialuit Game Council of Canada signed an agreement on polar bear management in the southern Beaufort Sea region. Among other measures, the agreement protects bears in dens and family groups with cubs, sets a hunting season, provides a framework for setting annual quotas for each country, and establishes a reporting system. The agreement is voluntary and has no regulatory backing (MMS, 1993).

In 1993, amendments to the MMPA made the USFWS responsible for the conservation of polar bears in Alaska. These amendments allowed for the incidental, but unintentional “take” of small numbers of polar bears. To comply with the requirements of the “take” regulations, oil and gas activities in Important Habitat Areas in the Beaufort Sea are subject to a Letter of Authorization (LOA) from the USFWS Regional Director of the Alaska Region. The northern coastal portion of the sale area has been identified as an Important Habitat Area. The decision to request a LOA is up to the individual operator, although the operators are liable for incidental takes in the absence of a LOA. LOA’s specify terms and conditions appropriate for the conservation of polar bears, such as interaction plans and detection efforts. Through the LOA, the USFWS has the authority to require and specify the type of interaction plans. LOA’s are tailored to the individual project and take into consideration factors including the time period and specific location where the activity is to take place.

Bear den and seal lair detection efforts are not required of operators, although these could be imposed at the plan of operations stage. Under terms of Letters of Authorization (LOAs) and the Mitigation Measures, industry is required to contact USFWS to identify the locations of known active polar bear dens (with industry activities) and must avoid known dens by one mile, withdraw immediately from any new dens, and report new dens to the USFWS (USFWS, 1995). Detection methods consist of reconnaissance by snow machine, and aerial surveys. Infrared radar locates animals by the heat their bodies give off. Infrared radar has successfully detected a 100-watt light bulb placed in a manmade den (Schliebe, 1997).

At the leasing phase, it is not possible to predict if, when, where, how or what kind of exploration, development or production might occur, but any activities that could occur subsequent to the lease sale will be subject to the mitigation measures in Chapter Seven. In addition, a host of other rigorous state, federal, and NSB permitting restrictions and regulatory mechanisms addressing polar bears, or applicable to them, are in place. Additional state regulatory mechanisms include large project planning (OPMP), ACMP, DMLW permits and approvals, ADF&G habitat and permitting, and SPCO mitigation measures and stipulations.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to polar bears. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Human-bear interaction plan: For projects in proximity to areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears.
- Habitat protection: Before commencement of any activities, lessees shall consult with the USFWS to identify the locations of known polar bear den sites. Operations must avoid known polar bear dens by one mile. A lessee who encounters an occupied polar bear den must report it to the USFWS and avoid the new den by one mile.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Waste management: Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.
- Disturbance: In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle, and vessel operations regulated by NSB code.

vi. Other Marine Mammals

Despite protective measures, development of leases in the sale area could add to cumulative impacts on ringed, spotted and bearded seals, and walrus. The majority of the North Pacific walrus population occurs west of Barrow, although a few walrus may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open water season. Both ringed and bearded seals are commonly distributed throughout the coastal portion of the sale area, and populations vary considerably with seasonal weather changes. Spring and summertime oil and gas exploration and development activities in the sale area and elsewhere in the Beaufort Sea could disturb seals and walrus and depending on other human activity in the area, and could ultimately contribute to some limited displacement.

Bowhead whales traverse the NPR-A coast during the spring and fall migrations, although they generally travel several miles offshore. During the spring migration, the near shore waters are completely ice covered and the migration occurs far from shore (BLM, 2007).

Studies conducted in recent decades have shown that bowhead whales do respond to vessels by moving away, or altering their surfacing and diving patterns. However, evidence is not conclusive to support that permanent changes to feeding or migratory patterns have occurred (Fraker, et al., 1985: Green 1987). These biologists believe that little information is available showing that bowheads abandon an area, travel far, or remain disturbed for extended periods after a ship passes. In terms of displacement from areas with heavy traffic, past observations and studies demonstrate that various cetacean species react differently to long-term disturbances, and consequently, bowhead whale responses to repeated disturbances cannot be predicted accurately (LGL Limited, 1991).

Habitat Loss: Some pinnipeds could be temporarily displaced by construction activities associated with causeway construction or creating a gravel drilling/production is land. Onshore development near the coast could also disturb a small number of pinnipeds. However, the amount of displacement is likely to be very small in comparison with the natural variability in seasonal habitat use and is not expected to affect seal populations. Effects are likely to be one year or one season or less, with any disturbance of pinnipeds declining after construction activities are complete (MMS, 1996).

Disturbance: The primary sources of noise and disturbance of pinnipeds would come from marine traffic, air traffic, and geophysical surveys. A secondary source would be low frequency noises from drilling operations. Boat traffic could disturb some pinnipeds concentrations; however, such traffic is not likely to have more than a short-term (a few hours to a few days) effect. Helicopter traffic is assumed to be a source of disturbance to pinnipeds hauled out along the beaches of the Colville River Delta and other haulout areas. Such brief occasional disturbances are not likely to have any serious consequences. Noise and disturbance from island or causeway construction may also adversely affect pinnipeds in the area. Noise and disturbance from seismic operations could cause a brief disturbance response from seals and walrus. However the affected animals are likely to return to normal behavior patterns within a short period of time (MMS, 1996b).

Oil Spills: Direct contact with spilled oil by pinnipeds may result in mortalities. Newborn seal pups that come in contact with oil may lose their thermo-insulation capabilities and die from hypothermia. Adults may only suffer from temporary eye and skin irritations. The specific effects would depend on many factors, including the seal's age and health. Seals are known to be capable of metabolizing as well as excreting and absorbing oil. In general, deaths from contact with oil among adult seals are most likely to occur during periods of high natural stress, such as during the molting season, times of inadequate food supply or if affected by disease (MMS, 1987). In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of pinnipeds, boat, vehicle, and aircraft traffic operating in the area is expected to cause disturbance and displacement of pinnipeds during cleanup operations. If operations occurred in the spring they would contribute to increased stress and reduced pup survival of seals (MMS, 1996b).

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to marine mammals. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Obstructions to migration and movement: The State of Alaska discourages the use of continuous-fill causeways. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulations patterns and water quality characteristics that result in exceedances of water quality criteria, and must maintain free passage of marine and anadromous fish. Causeways and docks shall not be located in river mouths or deltas.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

4. Effects on Subsistence Uses

For centuries, survival in the Arctic has centered on the pursuit of subsistence foods and materials as well as the knowledge needed to find, harvest, process, store, and distribute the harvest. The development of Inupiat culture depended on passing on traditional knowledge and beliefs about subsistence resources. This knowledge included observations of game behavior, how to use those observations to successfully locate and harvest game, and how hunters and their families should behave to ensure successful harvests in the future. For the Inupiat, subsistence and culture continue to be inextricably intertwined. The process of obtaining, refining, and passing on subsistence skill is inextricably linked to the Inupiat culture, which is based on interdependent family groups, and a tradition of sharing harvested resources (BLM 2007).

Traditional subsistence uses include: bowhead and beluga whaling; walrus, polar bear and seal hunting; brown bear, caribou, musk ox, and moose harvesting; hunting and trapping of furbearers, such as wolf, fox, weasel, wolverine, and squirrel; hunting migratory waterfowl and collecting their eggs; fishing of whitefish, char, salmon, smelt, grayling, trout, and burbot; collecting berries, edible plants, and wood; and producing crafts, clothing, and tools made from these wild resources. Equally important, subsistence also includes social activities of consuming, sharing, trading and giving, cooperating, teaching and celebration among members of the community.

Direct effects on subsistence uses may include: increased access and land use limitations; less privacy; immediate effects of oil spills; and potential increase in wage earning opportunities to supplant subsistence activities. Indirect effects include: the potential reduction in local fish and wildlife populations due to development; increased travel distance and hunting time required to harvest resources; potential reductions in harvest success rates; increased competition for nearby subsistence resources; improvements in community transportation, trade, and utilities infrastructure; and increased revenues to local government through petroleum revenue taxes.

Alteration of the physical environment may affect migration, nesting, breeding, calving, denning and staging of animals that are sensitive to oil and gas development activities. For example, noise propagation from jet aircraft is known to affect the behavior of molting waterbirds. Above-ground pipelines can disrupt annual caribou migrations, if not elevated properly or buried. Vehicle traffic may adversely affect foraging caribou by displacing them from preferred forage areas. Such effects can be reduced or avoided by observing mitigation measures which restrict oil and gas activities.

Other physical alterations of the environment from post-sale activity could affect subsistence. For example, if a road adjacent to a pipeline was heavily traveled, as might occur during a project’s construction phase, caribou may avoid the area of higher vehicle activity. The result could be that a subsistence hunter may have to travel farther from the village in order to capture the affected caribou. Another example might be the industrial use of water, which could affect the drainage pattern of a river tributary, thereby affecting a particular anadromous fish run that are part of a subsistence fishery.

Any activity that has the potential to harm fish or wildlife has the potential to affect subsistence. Mitigation measures have been designed to avoid, reduce or minimize biological alterations to the sale area. Reducing impacts to subsistence resources from oil and gas development is a primary goal in lease sale planning. The objective of protecting subsistence uses lies in protecting cultural and biological resources.

The effects of an oil spill on marine mammals and fish is the most feared adverse impact from oil and gas development offshore. Residents are concerned that the technology does not exist to clean up a major spill, which, regardless of the time of year, would not be possible to fully clean up and which would have incalculable effects on subsistence resources. Residents, having witnessed decades of sea-ice activity, continue to question the structural integrity of drill rigs in the face of tremendous ice forces. An older resident observed sea ice suddenly rise up a 20-foot bluff, threatening homes in Barrow (MMS, 1996b).

Fish, such as arctic cisco or broad whitefish, which utilize portions of the sale area for migration and feeding, could also be affected by excessive disturbances from some oil and gas activities, such as causeways or oil spills. These fish could be directly damaged, or otherwise made less accessible to subsistence fishers. The inability to harvest seals or other marine mammals due to avoidance behavior or loss of supporting habitat could affect subsistence uses other than for food consumption, such as use of seal skins for covering umiaks, or skins and furs for clothing and handicrafts. Traditional whaling harvests are not expected to be affected by post-sale activities.

Community well-being depends on the continued use of subsistence resources because of their cultural and economical significance. The subsistence way of life, with its associated values of sharing food and influence on the extended family and traditional knowledge, is considered an integral part of being Inupiat (Kruse, et al., 1983). In addition to this cultural component, subsistence is the direct source of economic well being for NSB residents. Subsistence resources enter into household income as a food source that does not have to be purchased. A loss of subsistence resources would be a loss of income for the entire community (MMS, 1996b:).

While noise, traffic disturbance, and oil spills would produce chronic short-term impacts on subsistence species none of these impacts would lead to the elimination of any subsistence resource (BLM 2007). Most impacts to subsistence species associated with oil and gas exploration development and production would be localized and would not substantially affect subsistence species numbers, as long as the activities occurred outside of key habitat areas or migratory zones when animals are present (BLM, 2005).

As new discoveries are made, the number of development-related facilities will increase, and portions of the developed areas could be closed to public access, reducing the area available for subsistence activities. If subsistence hunters are displaced from traditional hunting areas, they might have to travel greater distances and spend more time harvesting resources. At the same time, increased public access to hunting, fishing, and trapping areas, due to construction of new roads, could increase competition between user groups for subsistence resources. If competition for scarce resources, like moose, on the North Slope were to increase, game managers would restrict non-subsistence hunting and fishing. Management practices to restrict non-local resident hunting are in place for Game Management Unit 26. See Chapter Four for a description of sport hunting and fishing in the sale area.

Mitigation Measures

Previous subsections of this chapter describe the potential impacts to fish and wildlife populations due to habitat loss, disturbance, oil spills, and gas blowouts. They also discuss the mitigation measures that will be imposed on the sale to maintain fish and wildlife populations. Additional site-specific and project-specific mitigation measures may be required later if exploration and development take place. The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to subsistence activities. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Harvest disruption: Lease-related use will be restricted when the Director determines it is necessary to prevent conflicts with local subsistence, commercial and sport harvest activities. Restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the Director.
- Harvest conflict resolution: Prior to submitting a plan of operations for activities that have the potential to disrupt subsistence activities, lessees must consult with the potentially affected communities and the NSB. The lessee must make reasonable efforts to assure that activities are

compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests. Additionally, the lessee must notify the Director of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns

- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Unrestricted access: Traditional and customary access to subsistence areas shall be maintained unless reasonable alternative access is provided to subsistence users. The lessee shall make reasonable efforts to assure that activities are compatible with subsistence and will not result in unreasonable interference with subsistence harvests.
- Protection of prehistoric, historic and archaeological sites: Prior to construction or placement of any structure, road, or facility, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected. The inventory must include an analysis of the effects that might result from the activity. If a site or area could be adversely affected, the Director, after consultation with SHPO and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects. If a site, structure, or object of significance is discovered, the lessee must make reasonable effects to preserve and protect the site, structure, or object until directed as to the course of action to take for its preservation.
- Training: A plan of operations must include a training program to inform each person working on the project of environmental, social, and cultural concerns. The program must use methods to ensure that personnel understand and use techniques to preserve geological, archeological, and biological resources and increase their sensitivity and understanding of values, customs, and lifestyles in areas where they will be operating.
- Community participation: Lessees are encouraged to bring residents of communities in the area into their planning process. Local communities have a unique understanding of their environment. Involving residents in the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams can help communities understand permitting obligations and help industry understand community values and expectations.

5. Effects on Historic and Cultural Resources

Historic and cultural resources are those sites and artifacts that have significance to the culture of people in the state. Historic and cultural sites are identified by the National Register of Historic Sites, and include those identified in the NSB Traditional Land Use Inventory by the Commission on Inupiat History, Language, and Culture and sites identified in other published studies. Many places, such as ancient village locations along the distributaries of the Colville River, contain archaeologically important relics and continue to be used today.

a. Resources and Regulatory Framework

ADNR, Office of History and Archaeology maintains the Alaska Heritage Resources Survey (AHRS), which is an inventory of all reported historic and prehistoric sites within the state. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Historical and cultural resources identified within the lease sale area include: isolated Native villages, gravesites, cabins, fish camps, mine sites, and transportation and mining-related sites. Information regarding important cultural and historic sites can be obtained by contacting ADNR, Office of History and Archaeology and the North Slope Borough Planning Department. See also Hoffman, et al., (1988), Jacobson and Wentworth (1982), the Nuiqsut Cultural Plan (NSB, 1979), and the North Slope Borough Coastal Management Program (NSBCMP) Background Report and Coastal Resource Atlas (NSBCMP, 1984b) and the NSB Municipal Code (NSBMC) 19.70.050(E).

ADNR researched available sources and found 339 known historic and archaeological sites within the lease sale area. A high potential for discovery of additional sites also exists. State policy on these resources is reflected in AS 41.35.010, which says, “It is the policy of the state to preserve and protect the historic, prehistoric, and archaeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in those resources may pass undiminished to future generations.” Existing statutes, which apply to both known sites and newly discovered sites, are:

- **AS 41.35.200. Unlawful acts.** (a) A person may not appropriate, excavate, remove, injure, or destroy, without a permit from the commissioner, any historic, prehistoric, or archaeological resources of the state. “Historic, prehistoric, or archaeological resources” includes “deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of people in the state as well as to the natural history of the state.” (AS 41.35.230(2).)
- **AS 41.35.210. Criminal penalties.** A person who is convicted of violating a provision of AS 41-35.010 – 41.35.240 is guilty of a class A misdemeanor.
- **AS 41.35.215. Civil penalties.** In addition to other penalties and remedies provided by law, a person who violates a provision of AS 41.35.010 – 41.35.240 is subject to a maximum civil penalty of $100,000 for each violation.

Under North Slope Borough municipal code, proposed development shall not impact any historic, prehistoric, or archaeological resource prior to the assessment of that resource by a professional archaeologist (NSBMC 19.50.030(F)). Borough municipal code 19.70.050(F) says, “Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the Coastal Management Program.” These provisions give the NSB authority to protect cultural and historic resources and current subsistence uses of these sites.

b. Potential Impacts

Potential impacts could occur in the exploration, development, or production phases, but are more likely to occur if development occurs. Impacts include disruption of culture and disturbance of historic and archeological sites. Impacts could be associated with installation and operation of oil and gas facilities, including: drill pads, roads, airstrips, pipelines, processing facilities, and any other ground-disturbing activities. Damage to archaeological sites may include: direct breakage of cultural objects; damage to vegetation and thermal regime, leading to erosion and deterioration of organic sites; shifting or mixing of components in sites resulting in loss of association between objects; and damage or destruction of archeological or historic sites by crews collecting artifacts (USFWS, 1986).

Many sites along the coast are currently eroding into the sea. Storm surges during the summer and fall open water season have caused rapid coastline erosion. Sediments are reworked to varying depths by current transport and ice gouging, which makes the survival of any prehistoric sites offshore unlikely (MMS, 1996b).

Cumulative effects on archaeological sites from oil and gas exploration, development, and production are expected to be low. In the event that an increased amount of ground-disturbing activity takes place, state and federal laws and regulations should mitigate effects to archaeological resources. The expected effects on archaeological resources from an oil spill are uncertain, but data from the *Exxon Valdez* oil spill indicates that less than 3 percent of the resources within a spill area would be significantly affected (MMS, 1998).

Oil Spills: Oil spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon dating methods (USFWS, 1986). The most important understanding obtained from past, large-scale oil spill cleanups is that archaeological resources generally were not directly affected by the spilled oil. Following the *Exxon Valdez* oil spill, the greatest effects came from vandalism because more people knew about the locations of these archaeological resources and were present at the sites. The detrimental effects of cleanup activity on these resources were minor because the work plan for cleanup was constantly reviewed, and cleanup techniques were changed as needed to protect archaeological and cultural resources (Bittner, 1993). Various mitigation measures used to protect archaeological sites during oil-spill cleanups include: avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs.

Well Blowout or Explosion: Disturbance to historical and archaeological sites might occur as a result of activity associated with accidents, such as an oil or gas well blowout or explosion. Archaeological resources in the immediate vicinity of the blowout might be destroyed, and cleanup activities could result in disturbance by workers in the vicinity of the accident site.

Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts to cultural resources. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Protection of prehistoric, historic and archaeological sites: Prior to construction or placement of any structure, road, or facility, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected. The inventory must include an analysis of the effects that might result from the activity. If a site or area could be adversely affected, the Director, after consultation with SHPO and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects. If a site, structure, or object of significance is discovered, the lessee must make reasonable effects to preserve and protect the site, structure, or object until directed as to the course of action to take for its preservation.
- Training: A plan of operations must include a training program to inform each person working on the project of environmental, social, and cultural concerns. The program must use methods to ensure that personnel understand and use techniques to preserve geological, archeological, and biological resources and increase their sensitivity and understanding of values, customs, and lifestyles in areas where they will be operating.
- Oil spill prevention and control: Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Containers with an aggregate storage capacity of greater than 55 gallons, which contain fuel or hazardous substances, shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.
- Community participation: Lessees are encouraged to bring residents of communities in the area into their planning process. Local communities have a unique understanding of their environment. Involving residents in the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams can help communities understand permitting obligations and help industry understand community values and expectations.

Chapter Six: Specific Issues Related to Oil and Gas Exploration, Development, Production, and Transportation

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Chapter Six: Specific Issues Related to Oil and Gas Exploration, Development, Production, and Transportation

A. Geophysical Hazards

The primary geophysical hazards within the sale area include earthquakes, faulting, shore-ice movement, permafrost and frozen-ground phenomena, waves, coastal erosion, seasonal flooding, overpressured sediments, and shallow gas deposits and hydrates. These geohazards could impose constraints on exploration, production, and transportation activities associated with possible petroleum development, and should be considered prior to the siting, design, and construction of any facilities.

1. Faults and Earthquakes

Faults and folds are mapped on the surface and in the subsurface across the sale area. Geologic and seismic evidence indicate that recent and historic seismic activity varies across the sale area. In the western side, little evidence of any Quaternary movement exists, with no evidence of displacement of Pleistocene or Holocene deposits, and no recent seismicity associated with faults (Craig and Thrasher, 1982; AEIC, 2006). However, evidence of deformation in Pleistocene deposits east of the lease sale area exists and earthquakes in the eastern lease sale area indicate that seismic hazards should be considered (Dinter et al., 1990).

A number of potentially shallow faults are mapped north of the Arctic Platform. Included in these faults are the upper extensions of detached listric growth faults that exist deep in the Brookian[1] section. These faults are mapped in the greatest detail in the Camden Bay area northeast of the area of interest. Some of these faults may have been reactivated in the late Cenozoic and can have several tens of meters of offset. Shallow faults are mapped beneath the outer shelf, west of Cape Halkett, and are reported to show from 3 to 10 meters of Quaternary offset (Grantz and Biswas, 1983).

In contrast to the rest of the Beaufort shelf, the Camden Bay area is seismically active. This region is located at the northern end of a north-northeast trending band of seismicity that extends north from east-central Alaska (Biswas and Gedney, 1979). Since monitoring began in 1978, a large number of earthquakes, ranging from magnitude one to over five, have been recorded in this area, with the majority of events clustering along the axis of the Camden anticline[2]. The largest earthquake recorded in the area was a magnitude 5.3 event located 30 km north of Barter Island in 1968. In this region, the Tertiary and Quaternary units dip away from and are truncated at the top of the Camden anticline, indicating that it has been growing in recent geologic time. The faults in this region trend northwest-southeast, parallel to the hinge line,[3] and as they approach and intersect the axis of the Camden anticline, they offset progressively younger units. This suggests that these faults are older hinge line-related structures that were reactivated during late Tertiary and Quaternary by the uplift of the Camden anticline.

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[1] The Brookian section began about 100 million years ago and continues into the late Tertiary.
[2] An “anticline” is a fold, the core of which contains the stratigraphically older rocks; it is convex upward. The opposite is called a syncline (American Geological Institute, Glossary of Geology, 1973).
[3] Generally, a hinge line refers to a line or boundary between a stable region and a region undergoing upward or downward movement (American Geological Institute, Glossary of Geology, 1973).

North of the sale area, on the outer Beaufort shelf and upper slope are gravity faults that are related to large rotational slump blocks (Grantz and Dinter, 1980).[4] South of these slumps, which bound the seaward edge of the Beaufort Ramp, these faults have surface offsets ranging from 15 meters to as high as 70 meters (Grantz, et al., 1982). Grantz, et al., (1982) have inferred that these faults have been active in recent geologic time based on the age of the faults and therefore pose a hazard to bottom-founded structures in this area. Large-scale gravity slumping of the blocks here could be triggered by shallow-focus earthquakes centered in Camden Bay or in the Brooks Range.

Figure 6.1 shows the locations of recorded earthquake epicenters in the sale area. Most of the seismicity in the region is shallow (less than 20 miles deep), indicating near-surface faulting. Recent significant events include two magnitude 5 earthquakes in the eastern part of the sale area, one in 1993 and one in 1995. The largest event in the region was a magnitude 5.3 earthquake north of Kaktovik in 1968 (Combellick, 1998).

Algermissen et al., (1991) estimate a 10 percent probability of exceeding 0.025 g[5] earthquake-generated horizontal acceleration in bedrock during a 50-year period in the eastern part of the sale area. The estimated 10-percent-in-50-year acceleration decreases to 0.01 g in the western part of the area. For comparison, ground acceleration in Anchorage during the great 1964 earthquake was estimated at 0.16 g. In isolated areas throughout the sale area underlain by thick, soft sediments, the ground accelerations are likely to be higher than in bedrock, due to amplification. However, thick permafrost beneath most of the area may cause the earthquake response of sediments to be more like bedrock, which would limit amplification effects and would also tend to prevent earthquake-induced ground failure, such as liquefaction.

It is standard industry practice that facility siting, design, and construction be preceded by site-specific, high-resolution, shallow seismic surveys that reveal the location of potentially hazardous geologic faults. These surveys are required by the state prior to locating a drilling rig. Facility planners are encouraged to consult with the American Petroleum Institute's publication, "*Planning, Designing, and Constructing Structures and Pipelines for Arctic Conditions, Second Edition*," December 1, 1995 (Reaffirmed: January 2001). This document contains considerations that are unique for planning, designing, and constructing Arctic systems.

The sale area lies within seismic zones 0 and 1 of the Uniform Building Code (on a scale of 0 to 4, where 4 represents the highest earthquake hazard), and earthquake potential is low. Regardless, all structures in the sale area should be built to meet or exceed the Uniform Building Code requirements for zone 1 (Combellick, 1994).

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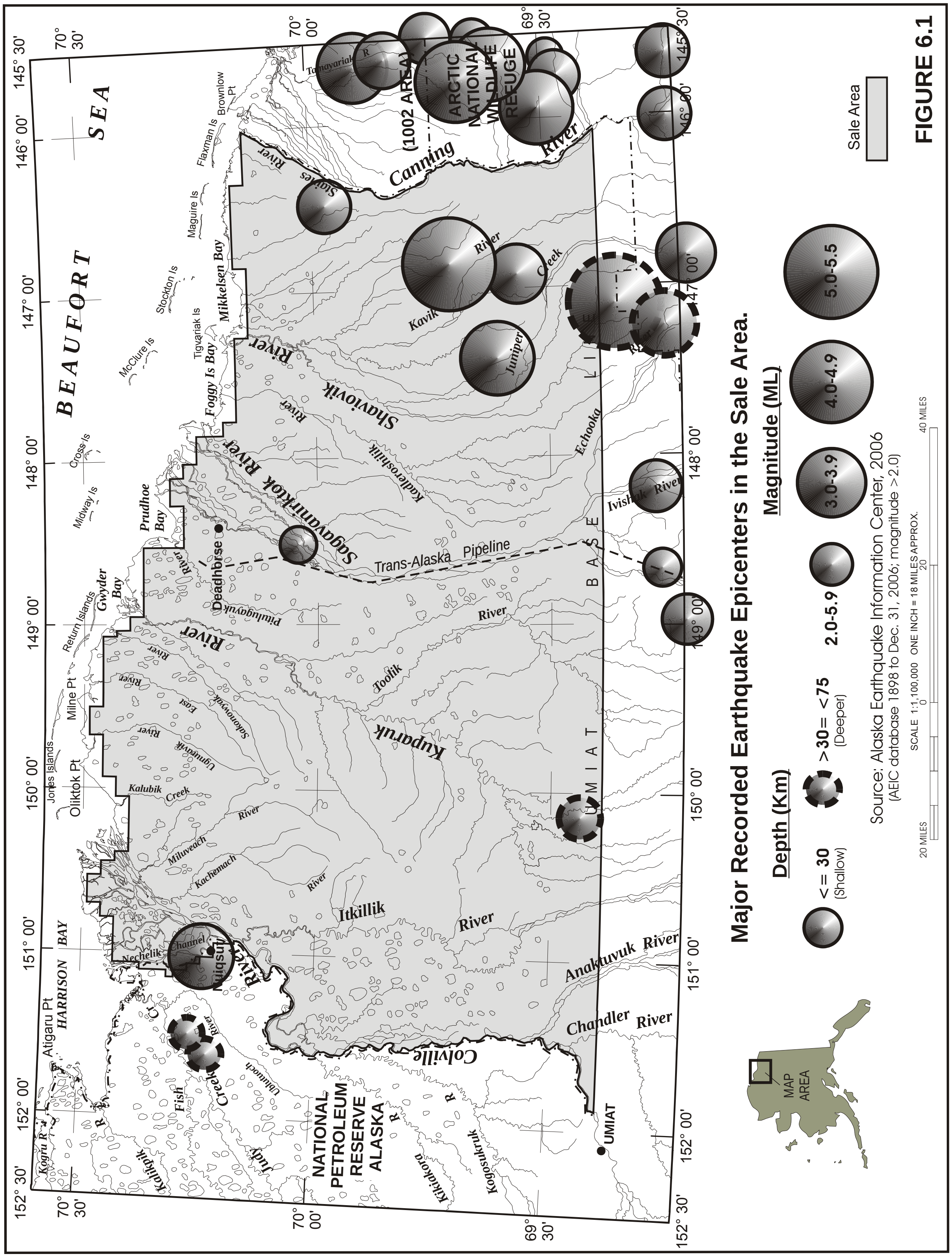
[4] A "slump block" is the mass of material torn away as a coherent unit during a block slump. The rotation refers to the apparent fault-block displacement in which the blocks have rotated relative to one another, so that alignment of formerly parallel features is disturbed (American Geological Institute, Glossary of Geology, 1973).
[5] Gravitational acceleration. One g equals an acceleration rate of 32 feet per second per second.


Major Recorded Earthquake Epicenters in the Sale Area.
Depth (Km)
<= 30 (Shallow)
>30= <75 (Deeper)
Magnitude (ML)
2.0-5.9
3.0-3.9
4.0-4.9
5.0-5.5
Source: Alaska Earthquake Information Center, 2006
(AEIC database 1898 to Dec. 31, 2006; magnitude >2.0)
Sale Area
MAP AREA
BEAUFORT SEA
ARCTIC NATIONAL WILDLIFE REFUGE
(1002 AREA)
NATIONAL PETROLEUM RESERVE ALASKA
Trans-Alaska Pipeline
Deadhorse
UMIAT
UMIAT BASE LINE
Prudhoe Bay
Gwyder Bay
Harrison Bay
Mikkelsen Bay
Foggy Is Bay
Canning River
Sagavanirktok River
Shaviovik River
Kuparuk
Itkillik River
Colville
Chandler River
Anaktuvuk River
Kavik River
FIGURE 6.1

2. Ice Push

Ice push is the process whereby ice blocks are forced onshore by strong wind or currents. Ice push can transport sediment from the coast inland, resulting in the formation of ridges or mounds. Throughout the Beaufort Sea, ice push and ice override events can transport and erode significant amounts of sediment. It is most important on the outer barrier islands where ice push ridges up to 2.5 meters high, extending 100 meters inland from the beach have been identified (Hopkins and Hartz, 1978a). Over most of the Arctic coast, ice-push rubble is found at least 20 meters inland with boulders in excess of 1.5 meters in diameter (Kovacs, 1984). A number of accounts of ice push events have been documented where man-made structures have been damaged along the Beaufort coast. In January of 1984, ice over-topped the Kadluck, an 8-meter-high caisson-retained drilling island located in Mackenzie Bay (Kovacs, 1984). Ice override hazards are highest on spits and bluff margins. Piled-up ice at the base of a bluff can provide a ramp for additional ice to ride up onto the bluff top (Mason et al., 1997).

Ice push has the potential to alter shorelines and nearshore bathymetry, which in the longer term may pose a threat to nearshore facilities with increased erosion. Design parameters to mitigate the effects of ice push are similar to those employed to resist sea ice and coastal erosion forces. These include concrete armoring, berm construction, and coastal facility setbacks.

3. Onshore Permafrost and Frozen Ground

Permafrost exists throughout most of the Arctic coastal plain and is, for the most part, a relict[6] feature overlain by a thin layer of seasonally frozen sediment. Permafrost thickness has been measured from numerous onshore wells indicating that it thins from east to west. East of Oliktok Point, it is 500 meters thick, whereas west of the Colville River it is 300 to 400 meters thick (Osterkamp and Payne, 1981). The depth of seasonal thaw is generally less than one meter below the surface and two meters beneath the active stream channels. Ice content varies throughout the region from segregated ice to massive ice in the form of wedges and pingos, and is the highest in the fine-grained, organic-rich deposits and the lowest in the coarse granular deposits and bedrock (Collett et al., 1989).

Increased thawing of permafrost is often initiated by both natural (forest fire, floods, and erosion) and human-made ground disturbances (Richter-Menge et al., 2006). Ground settlement, due to thawing, occurs when tundra overlying permafrost is disturbed or when a heated structure is placed on the ground underlain by shallow, ice-rich permafrost, and the proper engineering measures are not taken to adequately support the structure and prevent the building heat from melting the ground ice. In addition, the seasonal freeze-thaw processes will cause frost jacking of nonheated structures placed on any frost-susceptible soils unless the structures are firmly anchored into the frozen ground with pilings or supported by non-frost-susceptible fill (Combellick, 1994a). Frost susceptibility is highest in fine-grained alluvium, colluvium, thaw-lake deposits, and coastal-plain silts and sands; moderate in alluvial-fan deposits and till; and lowest in coarse-grained floodplain deposits, alluvial terrace deposits and gravelly bedrock (Carter et al., 1986; Carter and Galloway, 2005; Ferrians, 1971; Yeend, 1973a, b). Case studies indicate that permafrost degradation can result in landslides and suggest that landslide frequency may increase in permafrost environments as climate warms (Huscroft and others, 2004). Ground subsidence, increased erosion, change in the hydrologic regime and the other potential impacts of permafrost degradation described above will negatively impact infrastructure as climate warms unless new mitigation techniques are adopted (Report of the Alaska Regional Assessment Group, 1999).

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[6] A "relict" feature pertains to a mineral, structure, or feature of a rock that represents those of an earlier rock and which persist in spite of processes tending to destroy it (American Geological Institute, Glossary of Geology, 1973).

Frozen-ground problems are successfully mitigated through siting, design, and construction, as demonstrated at Prudhoe Bay and elsewhere. Structures, such as drill rigs and permanent processing facilities, should be insulated to prevent heat loss into the substrate. Pipelines can be trenched, back-filled, and chilled (if buried) or elevated to prevent undesirable thawing of permafrost. In addition, ADNR regulates winter travel across the tundra and authorizes travel only after determining that the tundra is sufficiently frozen and protected by ample snow cover so that the travel will not have major environmental effects such as permafrost degradation.

Long-term records indicate that permafrost temperatures at the depth of zero seasonal temperature variations in permafrost (20 m) are warming on the North Slope (Richter-Menge et al., 2006). As a result, continued monitoring of permafrost stability and continued assessment of mitigation techniques are necessary.

4. Waves, Storm Surge, and Coastal and River Erosion

Waves provide energy for erosion and can cause flooding if wave heights are sufficient to inundate onshore areas. Wave heights along the Beaufort coastline are low throughout most of the year because pervasive ice cover reduces potential fetch. However, during the fall open-water season, a considerable fetch develops both seaward and shoreward of barrier islands. During this time, fetch of around 800 km can result in storm waves 7 to 9 meters high. Such waves are effective erosive agents capable of removing significant amounts of material from beaches, cliff faces and barrier islands (Appel, 1996). Wind-induced storm surges can raise sea level as much as 3 meters, increasing erosion and potentially transporting ice and water onshore. An additional meter of surge height may result when low atmospheric pressures are associated with storms (Reimnitz and Barnes, 1974).

Even with the short open-water season along the Beaufort coastline, the wave action, in combination with the melting of coastal permafrost, can cause dramatic rates of coastal erosion. Average rates of erosion across the Beaufort coastline range from 1.5 to 4.7 meters per year with short term erosion rates of 30 meters per year. In one case, near Oliktok Point, the coastline eroded 11 meters during one two-week period (Hopkins and Hartz, 1978a).

The highest rates of erosion occur along the coastal promontories where the bluffs are composed of fine-grained sediments and ice lenses, and where thermal erosion, a dynamic process involving the wearing away by thermal means (melting ice) and by mechanical means (hydraulic transport), is the dominant process. In some areas, beaches have been formed from the gravel eroded from bluffs composed of coarse-grained deposits and act to partially isolate those bluffs from wave action. In other areas, where the bluffs are composed of fine sediment, the sand eroded from the bluffs does not form protective beaches, causing the bluffs to erode more rapidly. In the Harrison Bay area, where the bluffs are composed primarily of coarser-grained sediments, the average retreat rates are between 1.5 to 2.5 meters per year (Craig et al., 1985).

The only prograding (advancing) shoreline areas along the Beaufort coastline occur off the deltas of major rivers. In those areas, the rate of progradation is very slow. The progradation rate of the Colville River delta was estimated to be 0.4 meters per year (Reimnitz et al., 1985).

Factors influencing the nature of erosion along the North Slope coastline also affect erosion along the region’s rivers, although the driving forces (currents, waves with a short fetch) are somewhat different. Permafrost and sediment cohesiveness are important factors in determining the river bank erodibility. High erosion rates occur along the braided channels, which usually develop in areas composed of noncohesive sediment (Scott, 1978). In a study along the Sagavanirktok River, aerial photographs showed a maximum erosion rate of 4.5 meters per year during a 20-year period. In this area, most of the erosion appeared to occur in small increments during breakup flooding and was concentrated in specific areas where conditions were favorable for thermo-erosional niching (Combellick, 1994).

Erosion rates, river bank and shoreline stability, and the potential impacts of waves and storm surge must all be considered in determining facility siting, design, construction, and operation. They must also be considered in determining the optimum oil and gas transportation mode. Structural failure can be avoided by proper facility setbacks from coasts and river banks.

5. Seasonal Flooding

Floods occur annually along most of the rivers and many of the adjacent low terraces due to the seasonal snowmelt and ice jams (Rawlinson, 1993). Spring ice breakup on the rivers in the region often occurs over the first few days of a three-week period of flooding in late May through early June. Up to 80 percent of the flow occurs during this period (Walker, 1973). Spring floodwaters inundate large areas of the deltas, and on reaching the coast, spread over stable ground and floating ice up to 30 km from shore (Arnborg et al., 1967; Barnes et al., 1988; Reimnitz et al., 1974; Walker, 1974). When the floodwater reaches openings in the ice, it rushes through with enough force to scour the bottom to depths of several meters by the process called strudel scouring (Reimnitz and others, 1974).

In addition to the seasonal flooding, many of the rivers along the coast are subject to seasonal icing prior to the spring thaw. This is due to the overflow of the stream or groundwater under pressure, and in the areas of repeated overflow, the residual ice sheets often become thick enough to extend beyond the flood-plain margin. These large overflows and residual ice sheets have been documented on the Sagavanirktok, Shaviovik, Kavik, and Canning Rivers (Dean, 1984; Combellick, 1994).

Storm surges along the Beaufort coast frequently occur in the summer and fall. Sea-level increases of 1 to 3 meters have been observed, with the largest increases occurring on the westward-facing shores. Storm surges can also occur from December through February, although the sea-level elevation changes are generally less than in summer and fall. Decreases in the elevation of the sea level can occur and do so more frequently during the winter months (MMS, 1995c).

Seasonal flooding of lowlands and river channels is extensive along major rivers that drain into the sale area; thus, measures must be taken prior to facility construction and field development to prevent losses and environmental damage. Pre-development planning should include hydrologic and hydraulic surveys of spring breakup activity as well as flood-frequency analyses. Data should be collected on water levels, ice flow direction and thickness, discharge volume and velocity, and suspended and bedload sediment measurements for analysis. Also, historical flooding observations should be incorporated into a geophysical hazard risk assessment. All inactive channels of a river must be analyzed for their potential for reflooding. Containment dikes and berms may be necessary to reduce the risk of floodwaters that may undermine facility integrity.

6. Overpressured Sediments

Along the central Beaufort region, extremely high pore pressures can be expected to be found where Cenozoic strata (sedimentary layers) are very thick, such as in the Kaktovik, Camden, and Nuwuk Basins. Onshore, in the Camden Basin, high pore pressures have been measured in both the Tertiary and Cretaceous formations where the burial depths of the Tertiary strata exceeded 3,000 meters (Craig et al., 1985).

In the Point Thomson area, the pore pressure gradients were measured as high as 0.8 pounds per square inch per foot (psi/ft) in sediments at burial depths of 4,000 meters. In this area a pore pressure gradient of 0.433 psi/ft is considered normal (Hawkings et al., 1976). High pore pressures have also been measured throughout the Cenozoic strata of the Mackenzie Delta in the Canadian Beaufort. Here, the pore-pressure gradients were measured as high as 0.76 psi/ft and have been observed at depths as shallow as 1,900 meters (Hawkings et al., 1976).

Drilling mud in the wellbore is mixed to a specific density that will equal or slightly exceed the pressure in the formation. When formation pressures exceed the weight of the drill mud in the wellbore, the result can be a kick[7] or blowout; accordingly, encountering over-pressured sediments while drilling can result in a blowout or uncontrolled flow. The risk of a blowout is reduced by identifying locations of overpressured sediments via seismic data analysis, and then adjusting the mud mixture accordingly as the well is drilled. If a kick occurs, secondary well control methods are employed. The well is shut-in using the blowout prevention (BOP) equipment installed on the wellhead after surface casing is set. The BOP equipment closes off and contains fluid pressures in the annulus and the drillpipe. BOP equipment is required for all wells and surface and subsurface safety valves are required to automatically shut-off flow to the surface.

7. Shallow Gas Deposits and Natural Gas Hydrates

Shallow pockets of natural gas have been encountered in boreholes throughout the Arctic, both onshore and offshore. This gas usually exists in association with faults that cut Brookian strata, and as isolated concentrations in the Pleistocene coastal plain sediments (Grantz et al., 1982). The presence of shallow gas has been inferred from studies by Boucher et al. (1980), Craig and Thrasher (1982), Sellmann et al. (1981), and Grantz et al. (1982). Sediments in which gas has accumulated are a potential hazard if penetrated during drilling as well as for any manmade structures on top of them.

Natural gas hydrates commonly occur offshore under low-temperature, high-pressure conditions (Macleod, 1982) as well as at shallower depths associated with permafrost (Kvenvolden and McMenamin, 1980). In the central Beaufort, gas hydrates have been found at shallow depths under permafrost along the inner shelf (Sellmann et al., 1981) as well as onshore at Prudhoe Bay (Kvenvolden and McMenamin, 1980). During drilling, the rapid decomposition of gas hydrates can cause a rapid increase in the 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 can occur, and the escaping gas could be ignited. In addition, the flow of hot hydrocarbons past a hydrate layer could result in hydrate decomposition around the wellbore and the loss of strength of the affected sediments. If this happened and the well was shut-in for a period, the reformation of the hydrates could induce high pressures on the casing string (MMS, 1995c).

Because gas hydrates and shallow gas deposits pose risks similar to overpressured sediments, the same mechanisms for blowout prevention and well control are employed to reduce the danger of loss of life or damage to the environment. For more detail on oil spills and their effects, see Chapter Five. For a discussion of oil spill prevention and response, see Section C of this chapter.

8. Mitigation Measures

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts of geophysical hazards. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- The siting of facilities will be prohibited within at least 500 feet of all fish-bearing waterbodies. Additionally, the siting of facilities will be prohibited within one-half mile of

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[7] A kick is a condition where the formation fluid pressure (pressure exerted by fluids in a formation) exceeds the hydrostatic pressure (pressure exerted by mud in the borehole) resulting in a “kick”; formation fluids enter the borehole.

the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers.

- The state discourages the use of continuous-fill causeways. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulation patters and water quality characteristics. Causeways and docks must not be located in river mouths or deltas. Each proposed structure is reviewed on a case by case basis and may be permitted if the director, in consultation with ADF&G, ADEC and the North Slope Borough, determines that the structure is necessary for field development and no practicable alternatives exist. A monitoring program may be required.
- Pipelines must utilize existing transportation corridors and must be designed to facilitate the containment and cleanup of spilled fluids. Onshore pipelines must be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed, and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion and other hazards.
- Pursuant to regulations 18 AAC 75 administered by ADEC, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Containers with a total storage capacity of greater than 55 gallons that contain fuel or hazardous substances shall not be stored within 100 feet of a waterbody.

B. Likely Methods of Transportation

A discussion of specific transportation alternatives for oil from the sale area is not possible at this time because strategies used to transport potential petroleum resources depend on many factors, most of which are unique to an individual discovery. The location and nature of oil or gas deposits determine the type and extent of facilities necessary to develop and transport the resource. ADNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed. Generally speaking, modern oil and gas transportation systems usually include the following major components: 1) pipelines; 2) marine terminals; 3) tank vessels. Oil and gas produced in the sale area would most likely be transported by a combination of these depending on the type, size and location of the discovery.

If commercial quantities of oil are found in the sale area, the oil will go to market via the trans-Alaska pipeline system (TAPS), a 798-mile pipeline from Prudhoe Bay to Valdez. From Valdez, the oil is transported to markets in Cook Inlet, the U. S. West Coast, and the U. S. Gulf Coast using tankers. In-field gathering lines bring the oil from individual well sites to processing facilities for injection into TAPS.

Buried or elevated pipelines are the only feasible means for transporting oil and gas from developed fields to TAPS and a gas pipeline system, if constructed. The advantages and disadvantages of the two options are set forth below. It is possible that a transportation system used for oil or gas from the sale area will be buried in sections and elevated in sections, much like TAPS. The mode of transport from a discovery will be an important factor in determining whether future discoveries can be economically produced – the more expensive a given transportation option is, the larger a discovery will have to be in order to be economically viable.

1. Elevated Pipelines

Elevated pipelines are typically used in North Slope oil field development to prevent heat transfer from the hot oil in the pipeline to frozen soils, since heat would degrade the permafrost. Elevated pipelines are relatively easy to maintain and visually inspect for leaks; however, above-ground pipelines can restrict caribou and other wildlife movements unless provisions are made to allow for their safe passage. Additionally, the cumulative effect of roads and adjacent pipelines can create a barrier to caribou crossing.

Pipelines elevated at least 5 feet have been shown to be effective except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles/hour). Roads with low levels of traffic and no adjacent parallel pipeline are not significant barriers to movement of caribou. The most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet, according to the Alaska Caribou Steering Committee (Cronin et al., 1994). The mitigation measures require above-ground pipelines be elevated a minimum of 7 feet. Lessees must consider increased snow depth in the sale area in relation to pipe elevation and ADNR, through consultation with ADF&G, may require additional measures to mitigate impacts to wildlife movement and migration. Additionally, lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee.

2. Buried Pipelines

Buried pipelines are feasible in the Arctic, provided that the integrity of the frozen soils is maintained. Such pipeline configurations have been used for portions of the Milne Point area and Alpine developments. Some important considerations regarding long sections of buried pipe include: cost, which depends on length, topography, soils, and distance from the gravel mine site to the pipeline; buried pipe is more difficult to monitor and maintain, however, significant technological advances in leak detection systems have been made that increase the ease with which buried pipelines can be monitored; buried pipelines may involve increased loss of wetlands because of gravel fill; and buried pipelines are sometimes not feasible from an engineering standpoint because of the thermal stability of fill and underlying substrate (Cronin et al., 1994).

3. Tankers

Tankers are currently used in Alaska to transport oil from Cook Inlet and from the Alyeska Terminal in Valdez. The biggest disadvantage for tankers is the potential for a large oil spill such as the Exxon Valdez spill in Prince William Sound in 1989 (see Oil Spill Risk below).

4. Mitigation Measures

Any product ultimately produced from sale tracts will have to be transported to market. It is important to note that the decision to lease oil and gas resources in the state does not authorize the transportation of any product. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation. The state has broad authority to withhold, restrict, and condition its approval of transportation facilities. In addition, both the North Slope Borough and the federal government have jurisdiction over various aspects of any transportation alternative.

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts of transportation. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Pipelines must utilize existing transportation corridors and must be designed to facilitate the containment and cleanup of spilled fluids. Onshore pipelines must be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion and other hazards.

- Pipelines must be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At a minimum, above-ground pipelines must be elevated seven feet. Ramps or pipeline burial may also be required to facilitate caribou movement. ADNR, through consultation with ADF&G, may require additional measures to mitigation impacts to wildlife.
- The siting of facilities will be prohibited within at least 500 feet of all fish-bearing waterbodies. Additionally, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers.
- Lessees must avoid siting facilities in sensitive habitats and important wetlands.
- Lessees are advised in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee.
- The state discourages the use of continuous-fill causeways. Approved causeways must be designed, sited and constructed to prevent significant changes to nearshore oceanographic circulation patters and water quality characteristics. Causeways and docks must not be located in river mouths or deltas. Each proposed structure is reviewed on a case-by-case basis and may be permitted if the Director, in consultation with ADF&G, ADEC and the North Slope Borough, determines that the structure is necessary for field development and no practicable alternatives exist. A monitoring program may be required.
- Pursuant to regulations 18 AAC 75 administered by ADEC, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Containers with a total storage capacity of greater than 55 gallons that contain fuel or hazardous substances shall not be stored within 100 feet of a waterbody.

C. Oil Spill Risk, Prevention and Response

1. Oil Spill History and Risk

The risk of a spill exists any time crude oil or petroleum products are handled. Oil spills associated with the exploration, development, production, storage and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels and other vehicles used in exploration and development activities. A worst case oil discharge from an exploration facility, production facility, pipeline, or storage facility is restricted by the maximum tank or vessel storage capacity or by a well's ability to produce oil. Companies do not store large volumes of crude at their facilities on the North Slope; rather produced oil is processed and transported as quickly as possible. This reduces the possible size of a potential spill on the North Slope.

The oil and gas industry has been actively exploring and producing North Slope resources for more than three decades. In this time, the vast majority of oil, produced fluid, seawater and other industry-related spills have been less than 10 gallons (1/4 bbl), with very few larger than 100,000 gallons (2,380 bbl) (BLM, 2005, citing NRC, 2003). The probability of a spill larger than 1 million gallons is extremely low (*Ibid.*, citing USDOI BLM and MMS, 1998). The 2003 National Research Council report *Cumulative Environmental*

Effects of Oil and Gas Activities on Alaska's North Slope, concluded that, while small spills have occurred in the fields, the spills have not been large or frequent enough to have accumulated effects (NRC, 2003). The report also noted, however, that a large spill in open water would have substantial effects, as current clean-up methods are not effective at removing oil from marine waters, particularly waters with floating ice (*Ibid*.).

a. Exploration and Production

Spills related to petroleum exploration and production must be distinguished from those related to transportation because the phases have different risk factors and spill histories. Exploration and production facilities in the sale area may include onshore gravel pads; drill rigs; pipelines; and facilities for gathering, processing, storage and moving oil. These facilities are discussed below. Spills occurring at these facilities are usually related to everyday operations, such as fuel transfers. Cataclysmic spills are rare at the exploration and production stages because spill sizes are limited by production rates and by the amount of crude stored at the exploration or production facility.

The most dramatic form of spill can occur during a well blowout, which can take place when high pressure gas is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that oil, gas, or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers, which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and work-over rigs and are routinely inspected by the AOGCC.

A blowout that results in an oil spill is extremely rare and has never occurred in Alaska. Natural gas blowouts have occurred; however, at the Cirque No. 1 well in 1992. The accident occurred while ARCO workers were drilling an exploratory well and hit a shallow zone of natural gas. Drilling mud spewed from the well and natural gas escaped. It took two weeks to plug the well (Anchorage Times, 1992). In 1994, a gas kick occurred at the Endicott field 1-53 well. BP Exploration was forced to evacuate personnel and shut down most wells on the main production island. No oil was released to the surface, as the well had not yet reached an oil-bearing zone. There were no injuries, and the well was killed three days later by pumping heavily weighted drilling muds into it (Schmitz, 1994; ADN, 1994a).

b. Pipelines

The pipeline system that carries North Slope crude from the development area includes gathering lines and pipelines that carry the crude to treatment facilities and to Pump Station 1, where the oil enters TAPS for transport to the port of Valdez. Pipelines vary in size, length and amount of oil contained. A 14-inch pipeline can store about 1,000 bbl per mile of pipeline length. Under static conditions, if oil were lost from a five mile stretch of this pipeline (a hypothetical distance between emergency block valves), a maximum of 5,000 bbl of oil could be discharged if the entire volume of oil in the segment drained from the pipeline.

In January 1994, a pipeline break caused by wind-induced vibration occurred at a Prudhoe Bay drill site. Response to the oil spill was swift and approximately 360 bbl were recovered of an estimated 300-400 bbls spilled. (Alaska Journal of Commerce, 1994; Schmitz, 1994). A leak in a Kuparuk pipeline carrying oil to a processing facility was also discovered in 1994. About 6,000 square feet of surrounding tundra was affected, but there was no danger to the nearby Ugnuravik River (Anchorage Daily News, 1994).

In 2006 the oil and gas industry, general public and local, state and federal regulators, became acutely aware of potentially widespread pipeline corrosion issues on the North Slope. On March 2, 2006, more than 200,000 gallons (4,790 bbls) from a transit line in Prudhoe Bay spilled over approximately two acres of tundra – the largest spill in Prudhoe history (ADN, 2006a). The cause of the leak was internal microbiological corrosion of the pipeline (PN, 2006b). A one-quarter inch hole formed in the bottom of the pipeline in a section that had been buried under a caribou crossing. The snow covered the leak, causing delayed detection; ultimately the odor exposed the leak to a worker (PN, 2006b). An ADEC report issued in April 2006 stated that spill alarms went off for four consecutive days in late February; however the alarms were dismissed by operators monitoring the system as false (ADN, 2006a). Crews recovered over 60,000 gallons of the spilled oil, and, after the $6 million cleanup was completed, ADEC estimated the tundra suffered minimal environmental damage (PN, 2006a; ADN, 2006a). BP Exploration Alaska, the Prudhoe Bay operator, had not pigged the pipeline that leaked to test for internal corrosion since 1998 (ADN, 2006a).

Additionally, on March 9, 2006, spill responders found 500 gallons of oily water that had leaked from a gathering line in the Kuparuk unit and another 200 gallons were collected in a catch basin (PN, 2006d). The cause of the leak was also determined to be holes caused by internal corrosion.

On August 6, 2006, BP announced that it needed to shut down the Prudhoe Bay field in order to address pipeline corrosion issues (PN, 2006c). A corrosion test detected a small leak in a transit line and the entire eastern operating area was completely shut in. In response to the August 2006 shutdown, transit lines were pigged weekly and continuous corrosion inhibitor was added to the transit lines (PN, 2007b). BP is currently in the process of replacing the entire transit system in the Prudhoe Bay area (except for Lisburne), a task that will take until the end of 2008 (PN, 2007b).

Despite the oil spills, the State Pipeline Coordinator's Office's (SPCO) August 2006 report on surveillance of North Slope common carrier lines found the lines generally in good operating condition. The SPCO regulates common carrier pipelines; it does not regulate or inspect the transit and gathering pipelines. The SPCO's compliance oversight team focused on corrosion issues and found that in the past three years, all of the pipeline operators have run smart pigs through the pipelines regulated by the SPCO. Other monitoring techniques include radiographic testing, magnetic flux leakage, the use of coupons, and regular ground and aerial inspections. Additionally, each pipeline has a leak detection system that issues an alarm when the amount of fluids delivered from the pipeline differs from the amount entering. The report indicates the most significant corrosion issue on the Kuparuk and Endicott pipelines is external corrosion. The Milne Point Pipeline appears to have a higher rate of internal corrosion, and the SPCO report states that operators have increased pigging. The Badami pipeline has some internal corrosion but it does not appear to threaten safe pipeline operations. Finally, the Alpine pipeline did not appear to have significant corrosion problems (SPCO, 2006). The SPCO will coordinate with the USDOT to confirm that lessees are meeting requirements for pipeline integrity management.

The 2006 oil spills brought the issues of corrosion and pipeline monitoring to the top of the state's agenda. Increased awareness, both statewide and nationally, brought forth a number of changes in both the public and private sectors. To begin, operators assert they are monitoring corrosion more closely, including pigging transit and common carrier lines on a regular basis, and updating and strictly enforcing best industry standards for routine maintenance practices. The state has also taken a closer look at pipeline corrosion issues and has expanded efforts to monitor and regulate both gathering and common carrier lines. Additionally, in 2006, ADEC promulgated new regulations (18 AAC 75) regarding education, preparation for spills, and spill response.

Additionally, state and federal officials are currently investigating the pipeline corrosion issues, including whether companies deliberately avoided pipeline maintenance in order to boost profits, and whether company officials ignored repeated information regarding the corrosion and other necessary maintenance issues. The federal government is also investigating whether state officials knowingly ignored poor industry habits, including routine pipeline maintenance procedures.

c. Marine Terminals and Tanker Vessels

No marine terminals are located on the North Slope due to the presence of ice for most of the year. The Valdez terminal receives North Slope crude through TAPS, stores it and loads it onto tanker vessels for transport to the west coast of the United States and Pacific Rim. Most North Slope crude is transported to the U.S. west coast.

Petroleum hydrocarbons may enter Port Valdez harbor from ballast water that is off-loaded from incoming tankers. The water is treated to remove residual petroleum hydrocarbons and then discharged via a submarine diffuser into the inlet (Jarvella 1987:582). A four year, pre- and post-operational study undertaken by the University of Alaska (Jarvella 1987, citing Colonell 1980) concluded that no adverse effects on the fjord were presently evident (Jarvella 1987:582). Monitoring continues under National Pollutant Discharge Elimination System (NPDES) permits.

The stationary nature of exploration, production and terminal facilities and the predictability of maximum spill rates based on production rates and storage amounts somewhat simplifies the development and implementation of oil spill contingency plans for those facilities. In contrast, the mobile nature of tankers, the large volumes carried and the exposure to marine hazards places tankers at higher risk for oil spills. A badly damaged tanker can spill millions of gallons of oil in a matter of hours.

A tanker accident can result in the release of large quantities of oil in a short time, causing severe environmental damage. An oil spill in a marine water setting is also much more difficult to contain than one on land since ocean currents and tidal actions carry the oil over a much larger area. An example of the potential magnitude of a tanker spill is the March 1989 *Exxon Valdez* spill, the largest recorded spill in U.S. waters (nearly 261,900 bbls). Oil from the *Exxon Valdez* contaminated fishing gear, fish, and shellfish, killed numerous marine birds and mammals, and led to the closure or disruption of many Prince William Sound, Cook Inlet, Kodiak, and Chignik fisheries (Alaska Office of the Governor, 1989).

2. Oil Spill Prevention

A number of measures contribute to the prevention of oil spills during the exploration, development, production, and transportation of crude oil. Some of these prevention measures are presented as mitigation measures in Chapter Seven, and some are discussed at the beginning of this section. Prevention measures are also described in the oil discharge prevention and contingency plans that the industry must prepare prior to beginning operations. Thorough training, well-maintained equipment and routine surveillance are important components of oil spill prevention. Additionally, technical design of pipelines and other facilities at the plan of operations phase reduces the chances of oil spills.

The oil industry employs, and is required to employ, many techniques and operating procedures to help reduce the possibility of spilling oil, including:

- Use of existing facilities and roads;
- Waterbody protection, including proper location of onshore oil storage and fuel transfer areas;
- Use of proper fuel transfer procedures;
- Use of secondary containment, such as impermeable liners and dikes;
- Proper management of oils, waste oils, and other hazardous materials to prevent ingestion by bears and other wildlife;
- Consolidation of facilities;
- Placement of facilities away from fishbearing streams and critical habitats;
- Siting pipelines to facilitate spilled oil containment and cleanup; and
- Installation of pipeline leak detection and shutoff devices.

Each well has a blowout prevention program that is developed before the well is drilled. Operators review bottom-hole pressure data from existing wells in the area and seismic data to learn what pressures might be expected in the well to be drilled. Engineers use this information to design a drilling mud program with sufficient hydrostatic head to overbalance the formation pressures from surface to the total depth of the well. They also design the casing strings to prevent various formation conditions from affecting well control performance. Blowout prevention (BOP) equipment is installed on the wellhead after the surface casing is set and before actual drilling begins. BOP stacks are routinely tested in accordance with government requirements (BP, 1996a).

Wells are drilled according to the detailed plan. Drilling mud and well pressures are continuously monitored, and the mud is adjusted to meet the actual wellbore pressures. The weight of the mud is the primary well control system. If a kick (sudden increase in well pressure) occurs, the well is shut-in using the BOP equipment. The BOP closes off and contains fluids and pressures in the annulus and in the drillpipe. Technicians take pressure readings and adjust the weight of the drilling mud to compensate for the increased pressure. BOP drills are performed routinely with all crews to ensure wells are shut-in quickly and properly. Rig foremen, tool pushers, drillers, derrick men and mud men all have certified training in well control that is renewed annually (BP, 1996a).

If well control is lost and there is an uncontrolled flow of fluids at the surface, a well control plan is devised. The plan may include instituting additional surface control measures, igniting the blowout, or drilling a relief well. Regaining control at the surface is faster than drilling a relief well and has a high success rate. A blowout may bridge naturally due to the pressure drop across the formations. Under these conditions, reservoir formations flow to equalize pressure and the resulting bridging results in decreased flow at the surface. The exact mechanical surface control methods used depend on the individual situation. Operators may pump mud or cement down the well to kill it; replace failed equipment, remove part of the BOP stack and install a master valve; or divert the flow and install remotely-operated well control equipment (BP, 1996a).

While operators consider mechanical surface control methods, they also begin planning to drill a relief well by assessing the situation and determining the location for the relief well. Additionally, logistical plans to move another drill rig to the site are necessary. Conditions may require the construction of an ice or gravel pad and road. The operator will look for the closest appropriate drill rig. If the rig is in use, industry practice dictates that, when requested, the operator will release the rig for emergency use. Arranging for and drilling a relief well could take from 10 to 15 weeks depending on weather, cause of the blowout, choice of surface location and depth of the well (BP, 1996a).

Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil from any pipeline which might be constructed in the sale area. Once a leak is detected, valves at both ends of the pipeline, as well as intermediate block valves, can be manually or remotely closed to limit the amount of discharge. The number and spacing of the block valves along the pipeline will depend on the size of the pipeline and the expected throughput rate (Nessim and Jordan, 1986). Industry on the North Slope currently uses the volume balancing method, which involves comparing input volume to output volume.

The technology for monitoring pipelines is continually improving. Leak detection methods include acoustic monitoring, pressure point analysis, ultrasound, radiographic testing, magnetic flux leakage, the use of coupons, regular ground and aerial inspections, and combinations of some or all of the different methods. The approximate location of a leak can be determined from the sensors along the pipeline. A computer network is used to monitor the sensors and signal any abnormal responses. Design and use of “smart pigs,” data collection devices that are run through the pipeline while it is in operation, has greatly enhanced the ability of a pipeline operator to detect internal and external corrosion and differential pipe settlement in pipelines. Pigs can be sent through the pipeline on a regular schedule to detect changes over time and give advance warning of any potential problems.

Leak detection methods include acoustic monitoring, pressure point analysis, and combinations of some or all of the different methods (Yoon, Mensik, and Luk, 1988). The approximate location of a leak can be determined from the sensors along the pipeline. A computer network is used to monitor the sensors and signal any abnormal responses. In recent years, computer-based leak detection through a Real-Time Transient Model has come into use. This technology can minimize spills from both new and old pipelines (Yoon and Mensik, 1988a).

A similar technology for detecting leaks in oil and gas pipelines is termed Pressure Point Analysis (PPA). The method uses measured changes in the pressure and velocity of the fluid flowing in a pipeline to detect and locate leaks. PPA has successfully detected holes as small as 1/8-inch in diameter within a few seconds to a few minutes following a rupture (Farmer, 1989). Automated leak detection systems such as PPA operate 24 hours per day and can be installed at remote sites. Information from the sensors can be transmitted by radio, microwave, or over a hard wire system.

Three other systems can be employed which detect leaks down to 0.12 percent of rated capacity (100 bbl per hour). These include Line Volume Balance, Deviation Alarms, and Transient Volume Balance.

Line Volume Balance. LVB checks the oil volume in the pipeline every 30 minutes. The system compares the volume entering the line with the volume leaving the line, adjusting for temperature, pressure, pump station tank-level changes, and slackline conditions.

Deviation Alarms. There are three types of deviation alarms: pressure, flow, and flow rate balance. Pressure alarms are triggered if the pressure at the suction or discharge of any pump station deviates beyond a certain amount. Flow alarms are triggered if the amount of oil entering a pump station varies too much from one check time to the next. Flow rate balance alarms are triggered if the amount of oil leaving one pump station varies too much from the amount entering the next pump station downstream. This calculation is performed on each pipeline section about six times a minute.

Transient Volume Balance. TVB can both detect whether a leak may be occurring and identify the probable leak location by segment, especially with larger leaks. While the LVB leak detection system monitors the entire pipeline, the TVB system individually monitors each segment between pump stations. Since the TVB indicates in which area a leak may be occurring, focused reconnaissance and earlier response mobilization are possible (Alyeska Pipeline, 1999).

LEOS. Another detection system that is available is LEOS (Leck Erkennung und Ortangs System), a leak detection and location system manufactured by Siemens AG. The system has been in use for 21 years and in over thirty applications.

LEOS consists of a three-layer gas-sensor tube that is laid next to the pipeline. The inner layer is a perforated gas transport tube of modified PVC. A diffusion layer of EVA surrounds and allows gasses to enter the inner tube. A protective layer of braided plastic strips forms the outer layer. The tube is filled with fresh air, and the air is evacuated through a leak detector at regular intervals. If leak occurs, hydrocarbon gasses associated with the leak enter the tube and are carried to the gas detector. The system is totally computer controlled, self-checking and re-setting. Background gasses are calibrated at setup and checked regularly. The system will pick up previous contamination and organic decomposition. The location of the leak is determined by monitoring the time that leaked gas arrives at the detection device.

The system is very low maintenance and will last the life of the pipeline. Special protective adaptations will be made for the cold temperatures in which the system will operate and for the backfill installation method that will be used to install the pipeline. The tube will be placed in a protective cover, and the system will be tested continuously as the segments are installed. LEOS will be strapped to the oil pipeline next to the poly spacers that will separate the gas line from the oil line. The system will detect leaks from both lines, and operators will be able to tell the difference between the two. Engineers estimate that it will take about 5 to 6 hours for leaked molecules to migrate to the LEOS tube. The air inside the tube will be evacuated and tested every 24 hours

Smart Pigs. Design and use of "smart pigs," data collection devices that are run through the pipeline while it is in operation, has greatly enhanced the ability of a pipeline operator to detect internal and external corrosion and differential pipe settlement in pipelines. These pigs can be sent through the pipeline on a regular schedule to detect changes over time and give advance warning of any potential problems. The Trans Alaska Pipeline System (TAPS) operation has pioneered this effort for Arctic pipelines. The technique is now available for use worldwide and represents a major tool for use in preventing pipeline failures.

FLIR. Conoco Phillips utilizes a comprehensive FLIR (Forward Looking InfraRed) pipeline monitoring program in the Kuparuk oil field to assist in detecting pipeline leaks and corrosion. Infrared sensors have the ability to sense heat differentials. Since Kuparuk oil flows from the ground at temperatures in excess of 100F, a leak shows up as a "hot spot" in a FLIR video. In addition, water-soaked insulation surrounding a pipeline is visible because of the heat transfer from the hot oil to the water in the insulation and finally to the exterior surface of the pipeline. FLIR is effective 80 percent of the time in discovering water-soaked insulation areas that have produced corrosion on the exterior wall of the pipeline (ARCO, 1998).

FLIR also has applications in spill response and was used to image spills at both Prudhoe Bay and Kuparuk. The video frames were processed and registered into a GIS map database. The map database with the overlaid picture of the spill site was then used to quickly and accurately determine the area of the spill. This action allowed swift and accurate reporting of the spill parameters to the appropriate agencies. The video footage of the spill area allowed the incident command team to receive near real-time information in IR and color. This information permitted timely decisions to be made and the results of those decisions to be reviewed with the subsequent fly-over zone site. Various agencies involved in the process were able to see and verify the results of the cleanup process (ARCO, 1998).

To ensure safe operation, pipeline operators would follow the appropriate American Petroleum Institute recommended practices. They would inspect the pipelines regularly to determine if any damage was occurring and would also perform preventive maintenance. Preventive maintenance includes installing improved cathodic protection, using corrosion inhibitors and continuing regular visual inspections.

No oil or gas may be transported until the operator has obtained the necessary permits and authorizations from federal, state, and local governments. ADNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed.

If pipelines are used in the development of the sale area, operators must follow the appropriate American Petroleum Institute recommended practices. Regular inspection of the pipelines to determine if any damage was occurring would be required, as would regular maintenance, including installing improved cathodic protection, using corrosion inhibitors and continuing regular visual inspections. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation.

The fixed location of loading facilities at marine terminals improves oil spill response and contingency planning. Additionally, Oil Pollution Act of 1990 requires that single-hull tankers in Alaska be replaced by double-hull tankers by 2010. All tanker crews participate in spill prevention and response training and substance abuse testing. The oil discharge prevention and contingency plans for vessel operations contain more detailed information regarding spill prevention programs.

3. Oil Spill Response

a. Incident Command System

An Incident Command System (ICS) response is activated in the event of an actual or potential oil or hazardous material spill. The ICS system is designed to organize and manage responses to incidents involving a number of interested parties in a variety of activities. Since oil spills usually involve multiple jurisdictions, the joint federal/state response contingency plan incorporates a unified command structure in the oil and hazardous substance discharge ICS. The unified command consists of the Federal On-Scene Coordinator, the State On-Scene Coordinator, the Local On-Scene Coordinator and the Responsible Party On-Scene Coordinator. The ICS is organized around five major functions: command, planning, operations, logistics, and finance/administration (ADEC, 2006).

The Unified Command jointly makes decisions on objectives and response strategies; however, only one Incident Commander is in charge of the spill response. The Incident Commander is responsible for implementing these objectives and response strategies. If the Responsible Party is known, the Responsible Party Incident Commander may remain in charge until or unless the Federal On-Scene Coordinator and the State On-Scene Coordinator decide that the Responsible Party is not doing an adequate job of response (ADEC, 2006).

b. Response Teams

The Alaska Regional Response Team (ARRT) monitors the actions of the Responsible Party. The Team is composed of representatives from 15 federal agencies and one representative agency from the state. The ARRT is co-chaired by the U.S. Coast Guard and Environmental Protection Agency. ADEC represents the state of Alaska. The team provides coordinated federal and state response policies to guide the Federal On-Scene Coordinator in responding effectively to spill incidents. The Statewide Oil and Hazardous Substance Incident Management System Workgroup, which consists of ADEC, industry, spill cooperatives, and federal agencies, published the *Alaska Incident Management System* (AIMS) for oil and hazardous substance response (ADEC, 2006).

Each North Slope operator identifies a spill response team (SRT) for their facility, and each facility must have an approved spill contingency plan. Company teams provide on-site, immediate response to a spill event. The responders first attempt to stop the flow of oil and may deploy boom to confine oil that has entered the water. The responders may deploy boom to protect major inlets, wash-over channels, and small inlets. Finally, deflection booming would be placed to enclose smaller bays and channels to protect sensitive environmental areas. If the nature of the event exceeds the facility's resources, the Responsible Party calls in its response organization. The Spill Response Team (SRT):

1) identifies the threatened area;
2) assesses the natural resources, i.e., environmentally sensitive areas such as major fishing areas, spawning or breeding grounds;
3) identifies other high-risk areas such as offshore exploration and development sites and tank-vessel operations in the area;
4) obtains information on local tides, currents, prevailing winds, and ice conditions; and

5) identifies the type, amount, and location of available equipment, supplies and personnel.

The next action would be containment. It is especially important to prevent oil spills from reaching the Beaufort Sea where they could spread rapidly over a large area. Cleanup activities continue as long as necessary, without any time frame or deadline. A winter spill might require initial on-site response followed by further cleanup of oil melting out of the ice in the spring or summer (MMS, 1990).

c. Training

Individual members of the SRT train in basic spill response; skimmer use; detection and tracking of oil; oil recovery on lakes; river booming; radio communications; ATV, snowmobile, and four-wheeler operations; oil discharge, prevention, and contingency plan review; communication equipment operations; Arctic survival; oil spill burning operations; pipeline leak plugging; and spill volume estimations.

d. Response Organizations

Alaska Clean Seas (ACS) is a non-profit spill response organization for the North Slope operators between the Colville and Canning rivers, including the TAPS corridor to Pump Station No. 4 and the three-mile offshore limit of state waters. ACS provides personnel, material, equipment and training response capability for use in support of its members in preparing from, responding to, and cleaning up a hazardous spill on the North Slope (ACS, 2007). ACS maintains approximately 70 full-time staff, all of whom are available for response operations. Approximately half of ACS's staff is located in the fields, where they perform daily spill response and preparation duties under the direction of ACS's member companies (ACS, 2007).

Immediate spill response requirements are met through the use of Spill Response Teams (SRTs) comprised of company and contractor employees at each of the fields who voluntarily enlist in their particular field's SRT. The SRTs are integrated into a single North Slope Spill Response Team (NSRT), comprised of 115 field responders per shift, each of which has or will receive a minimum of 24 hours of hazardous materials (HAZWOPER) training. The North Slope Operators who furnish the SRTs from their employee and contractor staffs have committed to make the SRT's available on a Slope-wide basis for up to 36 hours upon call-out (ACS, 1995).

ACS and the North Slope operators employ a "tiered system" for responding to spills. Small, non-emergency spills are cleaned up by the Operator or ACS personnel. Spills requiring the resources of ACS and the responsible party's SRT are considered "Level I" spills. Depending on activity levels and the duration of work to do, off-site contractor-supplied personnel may be used to complete the cleanup and may be obtained through one or more of the master agreements which ACS maintains with labor contractors (ACS, 1995).

If a spill requires more than the resources of ACS and the RP, it is considered to be a Level II spill. Additional manpower resources would be obtained through mutual aid. Mutual aid is a system that utilizes SRTs from companies other than that of the responsible party. Such spills usually require some longer term cleanup. Under its master service agreements, ACS can obtain 100 contract responders within 36 hours (ACS, 1995).

If a spill exceeds the resources available on the North Slope, it is classified as a Level III spill. These types of spills will not only receive initial response from the full North Slope Response Team (NSRT), but will likewise require the work of off-site contract responders under ACS's master service agreements (ACS, 1995).

ACS established a central Incident Command Post at Deadhorse as a control point for oil spill response radio and telephone systems for the entire North Slope area, extending north from 68 degrees latitude (approximately Cape Seppings on the Chukchi Sea) and east to the Canadian border, including a range of several hundred miles offshore in the Chukchi Sea. This radio and telephone communications system is capable of being rapidly deployed by sea, land, or air to local and remote areas in support of offshore exploration or oil spill response actions. Remote control circuits for 10 permanent very high frequency (VHF) repeaters and marine coast stations, installed at strategic locations in the production area and pipeline corridor, are routed via private microwave circuits into the system. Other high frequency (HF) and ultra high frequency (UHF) radios are also connected to the system. Communication is then possible among all users, whether marine-based radios, company headquarters or supply depots, ICP, hand held portable radios, or aircraft radios. This gives each member company access to all of the radio systems, regardless of the type of radio it is using. ACS also has eight mobile VHF radios and about 150 handheld radios for field use in its oil spill response program (ACS, 1991a; ADEC, 2006). ADEC has three permanently installed VHF repeaters in Lisburne, Kuparuk, and the ADEC office in Deadhorse, along with three portable VHF repeaters (ADEC, 2006).

Other operational equipment includes four INMARSAT satellite telephone systems, operating independently of wires and separate from the VHF, UHF, and other radio systems, at Deadhorse on the North Slope. The name INMARSAT is derived from "international, marine, satellite." The system can reach anywhere in the world via satellite. An INMARSAT system can be mounted on a boat in such a way that, regardless of heavy seas or other disturbance, the antenna beam cannot be shaken off the satellite and communication disconnected. Ships, barges, aircraft, oil spill response agencies, ground personnel, and anyone with a telephone can be reached via this system. The equipment can be used immediately in case of an emergency anywhere in the state (Wheeler, 1991).

ACS and member companies own spill containment and clean-up equipment totaling over $50 million, including: more than 300,000 feet of oil containment boom; 185 skimmers; eight helitorch aerial ignition systems; 96 vessels; two 128-barrel and twelve 249-barrel mini-barges; various sizes of storage tanks and bladders; and wildlife hazing and stabilization equipment (ACS, 2007). ACS also provides arctic-oriented spill response training to member companies, contractors, village response teams and government agencies. ACS averages over 34,000 student hours, with over 450 classes annually (ACS, 2007).

Important aspects of response are planning, preparation and practice. North Slope and Beaufort Sea operators and state and federal agencies participate in a mutual aid drill at least once each year.

4. Cleanup and Remediation

Cleanup plans for terrestrial and wetlands spills must balance the objectives of maximizing recovery and minimizing ecological damage. Many past cleanup operations have caused as much or more damage than the oil itself. All oils are not the same, and knowledge of the chemistry, fate and toxicity of the spilled oil can help identify those cleanup techniques that can reduce the ecological impacts of an oil spill. Hundreds of laboratory and field experiments have investigated the fate, uptake, toxicity, behavioral responses, and population and community responses to crude oil (Jorgenson and Carter, 1996).

The best techniques are those that quickly remove volatile aromatic hydrocarbons. This is the portion of oil that causes the most concern regarding the physical fouling of birds and mammals. To limit the most serious effects, it is desirable to remove the maximum amount of oil as soon as possible after a spill. The objective is to promote ecological recovery and not allow the ecological effects of cleanup to exceed those caused by the spill itself. Table 6.1 lists cleanup objectives and techniques that may be applicable to each objective. Table 6.2 compares the advantages and disadvantages of cleanup techniques for crude oil in terrestrial and wetland ecosystems (Jorgenson and Carter, 1996).

Table 6.1 Objectives and Techniques for Cleaning Up Crude Oil in Terrestrial and Wetland Ecosystems

Objectives	Cleanup Techniques
Minimize:	
Movement of oil	Absorbent booms Sand bagging Sheet piling
Surface-water contamination	Same as above
Soil infiltration	Flood surface
Soil and vegetation contact and oil adhesion	Flood surface Use surfactants to reduce adhesion
Vegetation damage	Use boardwalks to reduce trampling Use flushing instead of mechanical techniques Perform work when vegetation is dormant
Thawing of Permafrost	Avoid vegetation and surface disturbance
Wildlife contact with oil	Fencing to prevent wildlife from entering site Plastic sheeting to prevent birds from landing on site Guards to haze wildlife Devices to haze wildlife
Acute and chronic toxicity of oil to humans, fish, and wildlife	Removal of oil Enhance biodegradation of remaining oil
Waste disposal	Use flushing Avoid absorbents and swabbing
Cost	Remove oil as fast as possible Achieve acceptable cleanup level quickly to minimize monitoring
Liability	Achieve acceptable cleanup level
Maximize:	
Recovery potential of tundra ecosystems	All of the above Add nutrients to aid recovery of plants
Worker safety	Air testing, training, clothing

Source: Adapted from Jorgenson, 1996

Table 6.2 Advantages and Disadvantages of Techniques for Cleaning Up Crude Oil in Terrestrial and Wetland Ecosystems

Technique	Advantage	Disadvantage	Recommended
Wildlife:			
Fencing	Keeps out large mammals	Does not keep out birds	Yes
Plastic sheeting	Keeps out both birds and mammals	Can no longer work area	Sometimes
Wildlife guard	Flexibility to respond	Higher cost	Sometimes
Devices	Lower cost	Animals become habituated	No
Containment:			
Absorbent booms	Contains floating oil, quickly deployed	Misses water soluble oil	Yes
Sand bags	Contains both floating and soluble fractions, follows tundra contours	Slower to mobilize, some leakage	Yes
Sheet piling	Maximum containment	Slow to install, doesn't fit contours well	Sometimes
Earthen berms	Can easily be adapted to terrain, heavy equipment rapidly can create berms	Destroys existing vegetation and soil	No
Snow/ice berms	Can be used during winter cleanup or to prevent runoff during breakup	Can only be used during freezing periods	Yes
Contact:			
Flooding	Keeps heavy oil suspended	Spreads out oil	Yes
Surfactants	Reduces stickiness, aids removal, and reduces volatilization	Reduces effectiveness of rope mop skimmer	Yes
Thickening agents	Untried, aids physical removal	Must be well drained, physical removal more difficult	No
Access:			
Boardwalks	Reduces trampling	None	Yes
Removal:			
Complete excavation	Eliminates long-term liability	Eliminates natural recovery, disposal costs	Sometimes
Partial excavation	Quickly reduces oil levels, less waste to dispose of than complete excavation	Causes partial ecological damage, disposal costs, still long-term liability	Sometimes
Burning	Low cost, high removal rate	Little testing, ecological damage	Sometimes
Flushing, high pressure	High removal rate	High ecological damage	No
Flushing, low pressure, cold	Moderate removal rate, little damage, easy waste disposal	Spreads oil, not as effective as warm water	No
Flushing, low pressure, warm	High removal rate, little vegetation damage, easy disposal of waste	Spreads oil	Yes
Aeration	Accelerates volatilization	Volatiles lost to air, may pose risk to humans	Yes
Raking	Can target hot spots	Partial vegetation damage	Sometimes
Cutting and trimming	Targets hot spots, reduces stickiness	Partial vegetation damage	Sometimes

Technique	Advantage	Disadvantage	Recommended
Swabbing	Targets hot spots	Not very effective, adds to waste disposal, adds to trampling	No
Oil skimmers and rope mops	Removes heavier oil, works well with flooding, lowers disposal costs	Requires personnel to push oil to skimmer, adds to trampling	Yes
Vacuum pumping	Removes surface and miscible oil, works well with flooding, lowers disposal cost	None	Yes
Biodegradation	Removes low levels of hydrocarbons, non-destructive, lowers disposal costs	Long-term monitoring, site maintenance, may require wildlife protection	Yes

Source: Adapted from Jorgenson, 1996

After a spill, the physical and chemical properties of the individual constituents in the oil begin to be altered by the physical, chemical, and biological characteristics of the environment; this is called weathering. The factors that are most important during the initial stages of cleanup are the evaporation, solubility and movement of the spilled oil. As much as 40 percent of most crude oils may evaporate within a week after a spill. Over the long term, microscopic organisms (bacteria and fungi) break down oil (Jorgenson and Carter, 1996).

Cleanup phases include initial response, remediation and restoration. During initial response, the responsible party: gains control of the source of the spilling oil; contains the spilled oil; protects the natural and cultural resource; removes, stores and disposes of collected oil; and assesses the condition of the impacted areas. During remediation, the responsible party performs site and risk assessments; develops a remediation plan; and removes, stores and disposes of more collected oil. Restoration attempts to re-establish the ecological conditions that preceded the spill and usually includes a monitoring program to access the results of the restoration activities (Jorgenson and Carter, 1996).

5. Regulation of Oil Spill Prevention and Response

a. Federal Statutes and Regulations

Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. §9605), and §311(c)(2) of the Clean Water Act, as amended (33 U.S.C. §1321(c)(2)) require environmental protection from oil spills. CERCLA regulations contain the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. §300). Under these regulations, the spiller must plan to prevent and immediately respond to oil and hazardous substance spills and be financially liable for any spill cleanup. If the pre-designated Federal On-Scene Coordinator (FOSC) determines that neither timely nor adequate response actions are being implemented, the federal government will respond to the spill, and then seek to recover cleanup costs from the responsible party.

The Oil Pollution Act of 1990 (OPA 90) requires the development of facility and tank vessel response plans and an area-level planning and coordination structure to coordinate federal, regional, and local government planning efforts with the industry. OPA 90 amended the Clean Water Act (§ 311(j)(4)), which established area committees and area contingency plans as the primary components of the national response planning structure. In addition to human health and safety, these area committees have three primary responsibilities:

1. prepare an area contingency plan;

2. work with state and local officials on contingency planning and preplanning of joint response efforts, including procedures for mechanical recovery, dispersal, shoreline cleanup, protection of sensitive areas, and protection, rescue and rehabilitation of fisheries and wildlife; and
3. work with state and local officials to expedite decisions for the use of dispersants and other mitigating substances and devices.

In Alaska, the area committee structure has incorporated state and local agency representatives, and the jointly prepared plans coordinate the response activities of the various governmental entities that have responsibilities regarding oil spill response. The area contingency plan for Alaska is the Unified Plan. Since Alaska is so large and geographically diverse, the federal agencies have found it necessary to prepare sub-area contingency plans, also discussed in the Government Contingency Plans section below.

OPA 90 also created two citizen advisory groups: the Prince William Sound and the Cook Inlet Regional Citizens Advisory Councils.

b. Alaska Statutes and Regulations

As discussed in Chapter One, ADEC is the agency responsible for implementing state oil spill response and planning regulations under AS 46.04.030. As of publication of this final finding, the following statutes and regulations are in effect. These provisions are subject to change in the future, particularly in response to recent spill activities. In 2006, ADEC adopted new regulations (18 AAC 75) for monitoring oilfield flowlines, new construction and maintenance standards which apply to oil tanks and pipeline facilities. Additionally, ADEC is placing increased emphasis on oil spill prevention training.

ADF&G and ADNR support ADEC in these efforts by providing expertise and information. The industry must file oil spill prevention and contingency plans with ADEC before operations commence. ADNR reviews and comments to ADEC regarding the adequacy of the industry oil discharge prevention and contingency plans (C-plans).

c. Industry Contingency Plans

C-plans for exploration facilities must include: a description of methods for responding to and controlling blowouts; the location and identification of oil spill cleanup equipment; the location and availability of suitable drilling equipment; and an operations plan to mobilize and drill a relief well. If development and production should occur, additional contingency plans must be filed for each facility prior to commencement of activity, as part of the permitting process. Any vessels transporting crude oil from the potential development area must also have an approved contingency plan.

AS 46.04.030 provides that unless an oil discharge prevention and contingency plan has been approved by ADEC, and the operator is in compliance with the plan, no person may:

1. operate an oil terminal facility, a pipeline, or an exploration or production facility, a tank vessel, or an oil barge, or
2. permit the transfer of oil to or from a tank vessel or oil barge.

Parties with approved plans are required to have sufficient oil discharge containment, storage, transfer, cleanup equipment, personnel, and resources to meet the response planning standards for the particular type of facility, pipeline, tank vessel, or oil barge (AS 46.04.030(k)). Examples of these requirements are:

- The operator of an oil terminal facility must be able to "contain or control, and clean up" a spill volume equal to that of the largest oil storage tank at the facility within 72 hours.

That volume may be increased by ADEC if natural or manmade conditions exist outside the facility that place the area at high risk (AS 46.04.030(k)(1)).

- Operators of exploration or production facilities, or pipelines, must be able to "contain, control, and cleanup the realistic maximum oil discharge within 72 hours." (AS 46.04.030(k)(2)). The "realistic maximum oil discharge" means "the maximum and most damaging oil discharge that [ADEC] estimates could occur during the lifetime of the tank vessel, oil barge, facility, or pipeline based on (1) the size, location, and capacity; (2) ADEC's knowledge and experience with such; and (3) ADEC's analysis of possible mishaps." (AS 46.04.030(r)(3)).

Discharges of oil or hazardous substances must be reported to ADEC on a time schedule depending on the volume released, whether the release is to land or to water, and whether the release has been contained by a secondary containment or structure. For example, 18 AAC 75.300(a)(1)(A)-(C) requires the operator to notify ADEC as soon as it has knowledge of the following types of discharges:

- Any discharge or release of a hazardous substance other than oil;
- Any discharge of or release of oil to water; and
- Any discharge or release, including a cumulative discharge or release, of oil in excess of 55 gallons solely to land outside an impermeable secondary containment area or structure.

The discharge must be cleaned up to the satisfaction of ADEC, using methods approved by ADEC. ADEC will modify cleanup techniques or require additional cleanup techniques for the site as ADEC determines to be necessary to protect human health, safety, and welfare, and the environment (18 AAC 75.335(d). ADF&G and ADNR advise ADEC regarding the adequacy of cleanup.

A C-plan must describe the existing and proposed means of oil discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). A C-plan and its preparation, application, approval, and demonstration of effectiveness require a major effort on the part of facility operators and plan holders. The C-plan must include a response action plan, a prevention plan, and supplemental information to support the response plan (18 AAC 75.425). These plans are described below.

The Response Action Plan (18 AAC 75.425(e)(1)) must include an emergency action checklist of immediate steps to be taken if a discharge occurs. The checklist must include:

1. names and telephone numbers of people within the operator's organization who must be notified, and those responsible for notifying ADEC;
2. information on safety, communications, and deployment, and response strategies;
3. specific actions to stop a discharge at its source, to drill a relief well, to track the location of the oil on open water, and to forecast the location of its expected point of shoreline contact to prevent oil from affecting environmentally sensitive areas;
4. procedures for boom deployment, skimming or absorbing, lightening, and estimating the amount of recovered oil;
5. plans, procedures, and locations for the temporary storage and ultimate disposal of oil contaminated materials and oily wastes;
6. plans for the protection, recovery, disposal, rehabilitation, and release of potentially affected wildlife; and
7. if shorelines are affected, shoreline clean up and restoration methods.

The Prevention Plan (18 AAC 75.425(e)(2)) must:

1. include a description and schedule of regular pollution inspection and maintenance programs;
2. provide a history and description of known discharges greater than 55 gallons that have occurred at the facility, and specify the measures to be taken to prevent or mitigate similar future discharges;
3. provide an analysis of the size, frequency, cause, and duration of potential oil discharges, and any operational considerations, geophysical hazards, or other site-specific factors, which might increase the risk of a discharge, and measures taken to reduce such risks; and
4. describe existing and proposed means of discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation.

The Supplemental Information Section (18 AAC 75.425(e)(3)) must:

1. include bathymetric and topographic maps, charts, plans, drawings, diagrams, and photographs that describe the facility, show the normal routes of oil cargo vessels, show the locations of storage tanks, piping, containment structures, response equipment, emergency towing equipment, and other related information;
2. show the response command system; the realistic maximum response operation limitations such as weather, sea states (roughness of the sea), tides and currents, ice conditions, and visibility restrictions; the logistical support including identification of aircraft, vessels, and other transport equipment and personnel;
3. include a response equipment list including containment, control, cleanup, storage, transfer, lightering, and other related response equipment;
4. provide non-mechanical response information such as in situ burning or dispersant, including an environmental assessment of such use;
5. provide oil spill primary response action contractor information;
6. include a detailed description of the training programs for discharge response personnel;
7. provide a plan for protecting environmentally sensitive areas and areas of public concern; and
8. include any additional information and a detailed bibliography.

The Best Available Technology Section (18 AAC 75.425(e)(4)) must:

1. identify technologies applicable to the applicant's operation that are not subject to response planning or performance standards;
2. for each applicable technology listed, the plan must identify and analyze all available technologies; and
3. include a written justification that the technology proposed to be used is the best available for the applicant's operation.

The Response Planning Standard Section (18 AAC 75.425(e)(5)) must include a calculation of the applicable response planning standards, including a detailed basis for the calculation of reductions, if any, to be applied to the response planning standards.

The current statute allows the sharing of oil spill response equipment, materials, and personnel among plan holders. ADEC determines by regulation the maximum amount of material, equipment, and personnel that can be transferred, and the time allowed for the return of those resources to the original plan holder (AS 46.04.030(o)). The statute also requires the plan holders to "successfully demonstrate the ability to carry out the plan when required by [ADEC]" (AS 46.04.030(r)(2)(E)). ADEC regulations require that exercises (announced or unannounced) be conducted to test the adequacy and execution of the contingency plan. No more than two exercises are required annually, unless the plan proves inadequate. ADEC may, at its discretion, consider regularly scheduled training exercises as discharge exercises (18 AAC 75.485(a) and (d)).

d. Financial Responsibility

Holders of approved contingency plans must provide proof of financial ability to respond (AS 46.04.040). Financial responsibility may be demonstrated by one or a combination of 1) self-insurance; 2) insurance; 3) surety; 4) guarantee; 5) approved letter of credit; or 6) other ADEC-approved proof of financial responsibility (AS 46.04.040(e)). Operators must provide proof of financial responsibility acceptable to ADEC as follows:

- Crude oil terminals: $50,000,000 in damages per incident
- Non-crude oil terminals: $25 per incident for each barrel of total non-crude oil storage capacity at the terminal or $1,000,000, whichever is greater, with a maximum of $50,000,000
- Pipelines and offshore exploration or production facilities: $50,000,000 per incident.
- Onshore production facilities:
    - $20,000,000 per incident if the facility produces over 10,000 barrels per day of oil;
    - $10,000,000 per incident if the facility produces over 5,000 barrels per day of oil;
    - $5,000,000 per incident if the facility produces over 2,500 barrels per day but not more than 5,000 barrels per day of oil; and
    - $1,000,000 per incident if the facility produces 2,500 barrels per day or less of oil.
- Onshore exploration facilities: $1,000,000 per incident.
- Crude oil vessels and barges: $300 per incident, for each barrel of storage capacity or $100,000,000, whichever is greater
- Non-crude oil vessels and barges: $100 per barrel per incident or $1,000,000, whichever is greater, with a ceiling of $35,000,000
- The coverage amounts are adjusted every third year based on the Consumer Price Index. AS 46.04.045.

e. Government Contingency Plans

In accordance with AS 46.04.200, ADEC must prepare, annually review, and revise the statewide master oil and hazardous substance discharge prevention and contingency plan. The plan must identify and specify the responsibilities of state and federal agencies, municipalities, facility operators, and private parties whose property may be affected by an oil or hazardous substance discharge. The plan must incorporate the incident command system, identify actions to be taken to reduce the likelihood of occurrence of “catastrophic” oil discharges and “significant discharges of hazardous substances” (not oil), and designate the locations of storage depots for spill response material, equipment, and personnel.

ADEC must also prepare and annually review and revise a regional master oil and hazardous substance discharge prevention and contingency plan (AS 46.04.210). The regional master plans must contain the same elements and conditions as the state master plan but are applicable to a specific geographic area.

6. Mitigation Measures

Recognition of the difficulties of containment and clean up of oil spills has encouraged innovative and effective methods of preventing possible problems and handling them if they arise. Oil spill prevention, response, and cleanup and remediation techniques are continually being researched by state and federal agencies and the oil industry. Although the risk of impact from a spill cannot be reduced to zero, such risk can be minimized through preventive measures, monitoring, and rigorous response capability.

The following are summaries of some applicable mitigation measures and lessee advisories designed to mitigate potential impacts of spills. For a complete listing of mitigation measures and lessee advisories see Chapter Seven. Additional site-specific and project-specific mitigation measures may be imposed as necessary if exploration and development take place.

- Pipelines must utilize existing transportation corridors and must be designed to facilitate the containment and cleanup of spilled fluids. Onshore pipelines must be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion and other hazards.
- The siting of facilities will be prohibited within at least 500 feet of all fish-bearing waterbodies. Additionally, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers.
- Lessees must avoid siting facilities in sensitive habitats and important wetlands.
- The state discourages the use of continuous-fill causeways. Approved causeways must be designed, sited and constructed to prevent significant changes to nearshore oceanographic circulation patters and water quality characteristics. Causeways and docks must not be located in river mouths or deltas. Each proposed structure is reviewed on a case-by-case basis and may be permitted if the Director, in consultation with ADF&G, ADEC and the North Slope Borough, determines that the structure is necessary for field development and no practicable alternatives exist. A monitoring program may be required.
- Pursuant to regulations 18 AAC 75 administered by ADEC, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. Pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Containers with a total storage capacity of greater than 55 gallons that contain fuel or hazardous substances shall not be stored within 100 feet of a waterbody.
- Secondary containment is required for fuel or hazardous substance storage and containers with an aggregate capacity of greater than 55 gallons shall not be stored within 100 feet of a waterbody or within 1,500 feet of a current surface drinking water source.
- Store sites shall be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or using an impermeable liner or suitable mechanism.
- During fuel or hazardous substance transfer, secondary containment or a surface liner must be used. Appropriate spill response equipment, sufficient to respond to a spill of up to five gallons, must be on hand and trained personnel shall attend transfer operations at all times.
- Vehicle refueling shall not occur within the annual floodplain.
- A fresh water aquifer monitoring well, and quarterly water quality monitoring, is required down gradient of a permanent storage facility.

Chapter Seven: Mitigation Measures and Lessee Advisories

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Chapter Seven: Mitigation Measures and Lessee Advisories

AS 38.05.035(e) and the departmental delegation of authority provide the Director, Division of Oil and Gas (DO&G) ["Director"], with the authority to impose conditions or limitations, in addition to those imposed by statute, to ensure that a resource disposal is in the state's best interests. Consequently, to mitigate the potential adverse social and environmental effects of specific lease related activities, DO&G has developed mitigation measures and will condition plans of operation, exploration, or development and other permits based on these mitigation measures.

Lessees must obtain approval of a detailed plan of operations from the Director before conducting exploration, development, or production activities. A plan of operations must identify the sites for planned activities and the specific measures, design criteria, construction methods and operational standards to be employed to comply with the restrictions listed below. It must also address any potential geophysical hazards that may exist at the site.

These measures were developed after considering terms imposed in earlier competitive lease sales and comments and information submitted by the public, local governments, environmental organizations, and other federal, state, and local agencies. Additional measures will likely be imposed when lessees submit a proposed plan of operations.

Lessees must comply with all applicable local, state and federal codes, statutes and regulations, as amended, as well as all current or future ADNR area plans and recreation rivers plans; and ADF&G game refuge plans, critical habitat area plans, and sanctuary area plans within which a lease area is located. Lease activities must be consistent with the enforceable policies of the Alaska Coastal Management Program (ACMP), including statewide standards and the enforceable policies of an affected coastal district, as amended.

The Director may grant exceptions to these mitigation measures. Exceptions will only be granted upon a showing by the lessee that compliance with the mitigation measure is not practicable or that the lessee will undertake an equal or better alternative to satisfy the intent of the mitigation measure. Requests and justifications for exceptions must be included in the plan of operations. The decision whether to grant an exception will be made during the public review of the plan of operations.

Except as indicated, the mitigation measures do not apply to geophysical exploration on state lands; geophysical exploration activities are governed by 11 AAC 96.

Abbreviations mean: Alaska Department of Environmental Conservation (ADEC), Alaska Department of Fish and Game (ADF&G), Alaska Department of Labor and Workforce Development (ADLWD), Alaska Department of Natural Resources (ADNR), Alaska Oil and Gas Conservation Commission (AOGCC), ADNR Commissioner (Commissioner), Division of Mining, Land and Water (DMLW), Division of Oil and Gas (DO&G), Federal Aviation Administration (FAA), National Marine Fisheries Service (NMFS); North Slope Borough (NSB), North Slope Borough Municipal Code (NSBMC), Office of Habitat Management and Permitting (OHMP)[1], Office of Project Management and Permitting (OPMP); State Historic Preservation

[1] The Office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Division of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.

Officer (SHPO), U.S. Army Corps of Engineers (USCOE), U.S. Coast Guard (USCG), and U.S. Fish and Wildlife Service (USFWS), U.S. Bureau of Land Management (BLM), and National Park Service (NPS).

A. Mitigation Measures

1. Facilities and Operations

a. A plan of operations must be submitted and approved before conducting exploration, development or production activities, and must describe the lessee's efforts to minimize impacts on residential, commercial, and recreational areas, Native allotments and subsistence use areas. At the time of application, lessee must submit a copy of the proposed plan of operations to all surface owners whose property will be entered.

b. Facilities must be designed and operated to minimize sight and sound impacts in areas of high residential, commercial, recreational, and subsistence use and important wildlife habitat. Methods may include providing natural buffers and screening to conceal facilities, sound insulation of facilities, or by using alternative means approved by the Director, in consultation with ADF&G and the NSB.

c. To the extent practicable, the siting of facilities will be prohibited within 500 feet of all fish-bearing streams and waterbodies and 1,500 feet from all current surface drinking water sources. Additionally, to the extent practicable, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Kavik, Shaviovik, Kadleroshilik, Echooka, Ivishak, Kuparuk, Toolik, Anaktuvuk and Chandler Rivers. Facilities may be sited within these buffers if the lessee demonstrates to the satisfaction of the Director, in consultation with ADF&G, that site locations outside these buffers are not practicable or that a location inside the buffer is environmentally preferred. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses.

d. No facilities will be sited within one-half mile of identified Dolly Varden overwintering and/or spawning areas on the Canning, Shaviovik, and Kavik rivers. Notwithstanding the previous sentence, road and pipeline crossings may only be sited within these buffers if the lessee demonstrates to the satisfaction of the Director and ADF&G in the course of obtaining their respective permits, that either (1) the scientific data indicate the proposed crossing is not within an overwintering and/or spawning area; or (2) the proposed road or pipeline crossing will have no significant adverse impact to Dolly Varden overwintering and/or spawning habitat.

e. Impacts to important wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas. Further, all activities within wetlands require permission from the US Army Corps of Engineers (see Lessee Advisories).

f. Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the Director determines that no practicable alternative exists. Re-use of abandoned gravel structures may be permitted on a case-by-case basis by the Director, after consultation with the director, DMLW, and ADF&G. Approval for use of abandoned structures will depend on the extent and method of restoration needed to return these structures to a usable condition.

g. Pipelines must utilize existing transportation corridors where conditions permit. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Where practicable, onshore pipelines must be located on the upslope side of roadways and construction pads, unless the director, DMLW, determines that an alternative site is environmentally acceptable. Wherever possible, onshore pipelines must utilize existing transportation corridors and be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion and other hazards as determined on a case-by-case basis.

h. Pipelines shall be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At a minimum, above-ground pipelines shall be elevated 7 feet, as measured from the ground to the bottom of the pipe, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. Lessees shall consider increased snow depth in the sale area in relation to pipe elevation to ensure adequate clearance for wildlife. ADNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.

i. The state of Alaska discourages the use of continuous-fill causeways. Environmentally preferred alternatives for field development include use of buried pipelines, onshore directional drilling, or elevated structures. Approved causeways must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics (e.g., salinity, temperature, suspended sediments) that result in exceedances of water quality criteria, and must maintain free passage of marine and anadromous fish.

ii. Causeways and docks shall not be located in river mouths or deltas. Artificial gravel islands and bottom founded structures shall not be located in river mouths or active stream channels on river deltas, except as provided for in (iii).

iii. Each proposed structure will be reviewed on a case-by-case basis. Causeways, docks, artificial gravel islands and bottom founded structures may be permitted if the Director, in consultation with ADF&G, ADEC, and the NSB determines that a causeway or other structures are necessary for field development and that no practicable alternatives exist. A monitoring program may be required to address the objectives of water quality and free passage of fish, and mitigation shall be required where significant deviation from objectives occurs. (See also Lessee Advisories regarding U.S. Army Corps of Engineers requirements.)

j. Dismantlement, Removal and Rehabilitation (DR&R): Upon abandonment of material sites, drilling sites, roads, buildings or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the Director, unless the Director, in consultation with DMLW, ADF&G, ADEC, NSB, and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.

k. Gravel mining sites required for exploration and development activities will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where practicable, gravel sites must be designed and constructed to function as water reservoirs for future use. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless the director, DMLW, after consultation with ADF&G, determines that there is no practicable alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.

Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean, R. F. 1993, North Slope Gravel Pit Performance Guidelines, ADF&G Habitat and Restoration Division Technical Report 93-9, available from ADF&G.

2. Fish and Wildlife Habitat

a. Detonation of explosives within or in proximity to fish-bearing waters must not produce instantaneous pressure changes that exceed 2.7 pounds per square inch in the swim bladder of a fish. Detonation of explosives within or in close proximity to a fish spawning bed during the early stages of egg incubation must not produce a peak particle velocity greater than 0.5 inches per second. Blasting criteria have been developed by ADF&G and are available upon request from ADF&G. The location of known fish-bearing waters within the project area can also be obtained from ADF&G.

   The lessee will consult with the NSB prior to proposing the use of explosives for seismic surveys. The Director may approve the use of explosives for seismic surveys after consultation with the NSB.

b. Water intake pipes used to remove water from fish-bearing waterbodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Screen mesh size shall be no greater than 1 mm (0.04 inches), unless another size has been approved by ADF&G. The maximum water velocity at the surface of the screen enclosure may be no greater than 0.1 foot per second, unless an alternative velocity has been approved by ADF&G.

c. Removal of snow from fish-bearing rivers, streams and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fish-bearing waterbodies is prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice or snow bridges may be required.

d. Bears:

   i. Before commencement of any activities, lessees shall consult with ADF&G (907-459-7213) to identify the locations of known brown bear den sites that are occupied in the season of proposed activities. Exploration and production activities must not be conducted within one-half mile of occupied brown bear dens, unless alternative mitigation measures are approved by ADF&G. A lessee who encounters an occupied brown bear den not previously identified by ADF&G must report it to the Division of Wildlife Conservation, ADF&G, within 24 hours. Mobile activities shall avoid such discovered occupied dens by one-half mile unless alternative mitigation measures are approved by the Director, with concurrence from ADF&G. Non-mobile facilities will not be required to relocate.

   ii. Before commencement of any activities, lessees shall consult with the USFWS (907-786-3800) to identify the locations of known polar bear den sites. Operations must avoid known polar bear dens by 1 mile. A lessee who encounters an occupied polar bear den not previously identified by USFWS must report it to the USFWS within 24 hours and subsequently avoid the new den by 1 mile. If a polar bear should den within an existing development, off-site activities shall be restricted to minimize disturbance.

   iii. For projects in proximity to areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between bears and humans. The plan should include measures to:

      A. minimize attraction of bears to facility sites;
      B. organize layout of buildings and work areas to minimize interactions between humans and bears;
      C. warn personnel of bears near or on facilities and the proper actions to take;
      D. if authorized, deter bears from the drill site;

E. provide contingencies in the event bears do not leave the site;
F. discuss proper storage and disposal of materials that may be toxic to bears; and
G. provide a systematic record of bears on the site and in the immediate area.

e. Permanent, staffed facilities must be sited to the extent practicable outside identified brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas.

3. Subsistence, Commercial and Sport Harvest Activities

a. i. Exploration, development and production operations shall be conducted in a manner that prevents unreasonable conflicts between lease-related activities and subsistence activities. Lease-related use will be restricted when the Director determines it is necessary to prevent conflicts with local subsistence, commercial and sport harvest activities. In enforcing this term DO&G will consult with other agencies, the affected local borough(s) and the public to identify and avoid potential conflicts that are brought to the division's attention both in the planning and operational phases of lease-related activities. In order to avoid conflicts with subsistence, commercial and sport harvest activities, restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the Director.

ii. Prior to submitting a plan of operations for either onshore or offshore activities which have the potential to disrupt subsistence activities, the lessee shall consult with the potentially affected subsistence communities and the NSB (collectively "parties") to discuss the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts. The parties shall also discuss the reasonably foreseeable effect on subsistence activities of any other operations in the area that they know will occur during the lessee's proposed operations. Through this consultation, the lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests.

iii. A discussion of agreements reached or not reached during the consultation process and any plans for continued consultation shall be included in the plan of operations. The lessee shall identify who participated in the consultation and send copies of the plan to participating communities and the NSB when it is submitted to the division.

iv. If the parties cannot agree, then any of them may request the Commissioner of DNR or his/her designee to intercede. The commissioner may assemble the parties or take other measures to resolve conflicts among the parties.

v. The lessee shall notify the Director of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns.

b. Traditional and customary access to subsistence areas shall be maintained unless reasonable alternative access is provided to subsistence users. "Reasonable access" is access using means generally available to subsistence users. Lessees will consult the NSB, nearby communities, and native organizations for assistance in identifying and contacting local subsistence users.

4. Fuel, Hazardous Substances and Waste

a. Secondary containment shall be provided for the storage of fuel or hazardous substances.

b. Containers with an aggregate storage capacity of greater than 55 gallons which contain fuel or hazardous substances shall not be stored within 100 feet of a waterbody, or within 1,500 feet of a current surface drinking water source.

c. During equipment storage or maintenance, the site shall be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or by creating an area for storage or maintenance using an impermeable liner or other suitable containment mechanism.

d. During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to five gallons, must be on hand during any transfer or handling of fuel or hazardous substances. Trained personnel shall attend transfer operations at all times.

e. Vehicle refueling shall not occur within the annual floodplain, except as addressed and approved in the plan of operations. This measure does not apply to water-borne vessels.

f. All independent fuel and hazardous substance containers shall be marked with the contents and the lessee's or contractor's name using paint or a permanent label.

g. A fresh water aquifer monitoring well, and quarterly water quality monitoring, is required down gradient of a permanent storage facility, unless alternative acceptable technology is approved by ADEC.

h. Waste from operations must be reduced, reused, or recycled to the maximum extent practicable. Garbage and domestic combustibles must be incinerated whenever possible or disposed of at an approved site in accordance with 18 AAC 60. (See Lessee Advisories, ADEC.)

i. New solid waste disposal sites, other than for drilling waste, will not be approved or located on state property during the exploration phase of lease activities. Disposal sites may be provided for drilling waste if the facility complies with 18 AAC 60. (See Lessee Advisories, ADEC.)

j. The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers, or important wetlands. On pad temporary cuttings storage will be allowed as necessary to facilitate annular injection and/or backhaul operations. Impermeable lining and diking, or equivalent measures, will be required for reserve pits. Surface discharge of drilling muds and cuttings into reserve pits shall be allowed only when the Director, in consultation with ADF&G, determines that alternative disposal methods are not practicable. Injection of non-hazardous oilfield wastes is regulated by AOGCC through its Underground Injection Control (UIC) Program for oil and gas wells. See also Mitigation Measure 8.a.vi.

k. Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal. The primary method of garbage and putrescible waste is prompt, on-site incineration in compliance with state of Alaska air quality regulations. The secondary method of disposal is on-site frozen storage in animal-proof containers with backhaul to an approved waste disposal facility. The tertiary method of disposal is on-site non-frozen storage in animal proof containers with backhaul to an approved waste disposal facility. Daily backhauling of non-frozen waste must be achieved unless safety considerations prevent it.

5. Access

a. Except for approved off-road travel, exploration activities must be supported only by ice roads, winter trails, existing road systems or air service. Wintertime off-road travel across tundra and wetlands may be approved in areas where snow and frost depths are sufficient to protect the ground surface. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Exceptions may be granted by the director of the DMLW, and the Director, if an emergency condition exists; or, if it is determined, after consulting with ADF&G that travel can be accomplished without damaging vegetation or the ground surface. Exceptions, including the use of gravel, may also be granted on a site specific basis, if it is determined, after consulting with ADF&G and DMLW, that no practicable alternatives exist for constructing an exploration road or pad in the area south of the boundary described below and depicted in the map below:

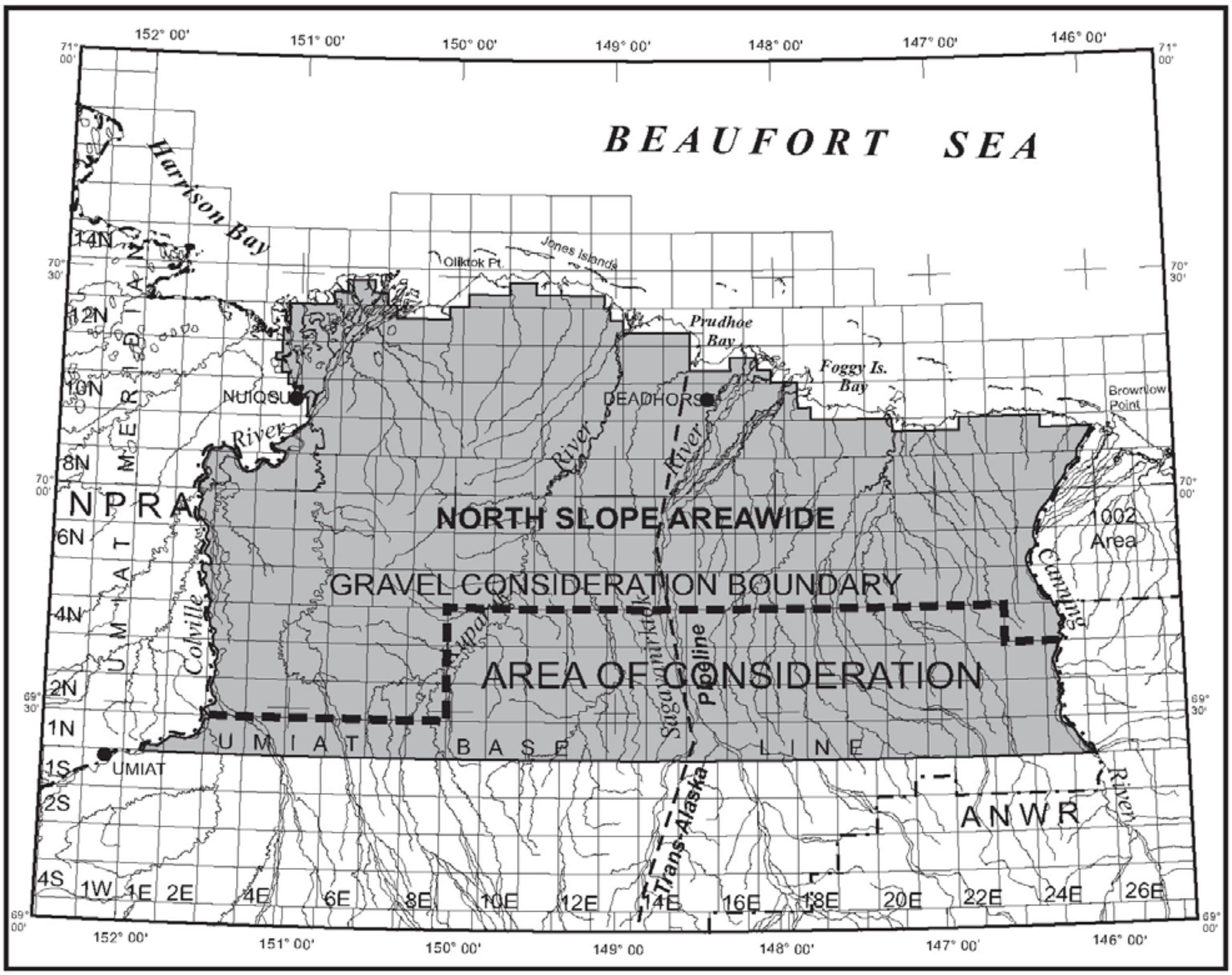

Figure 7.1: Gravel Consideration Boundary

Beginning at the NPR-A boundary, from the northeast corner of T 1N, R 2E,

- east to the northwest corner of T 1N, R 9E, then
- north to the northwest corner of T 4N, R 9E, then
- east to the northwest corner of T 4N, R 23E, then
- south to the southwest corner of T 4N, R 23E, and then
- east along the top of T 3N to the ANWR boundary.

b. Public access to, or use of, the lease area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related facilities. Areas of restricted access must be identified in the plan of operations. Lease facilities and operations shall not be located so as to block access to or along navigable or public waters as defined in AS 38.05.

6. Prehistoric, Historic, and Archeological Sites

a. Prior to the construction or placement of any structure, road, or facility resulting from exploration, development, or production activities, the lessee must conduct an inventory of prehistoric, historic, and archeological sites within the area affected by an activity. The inventory must include consideration of literature provided by the NSB, nearby communities, Native organizations, and local residents; documentation of oral history regarding prehistoric and historic uses of such sites; evidence of consultation with the Alaska Heritage Resources Survey and the National Register of Historic Places; and site surveys. The inventory must also include a detailed analysis of the effects that might result from the activity.

b. The inventory of prehistoric, historic, and archeological sites must be submitted to the Director, and to SHPO who will coordinate with the NSB for review and comment. If a prehistoric, historic, or archeological site or area could be adversely affected by a lease activity, the Director, after consultation with SHPO and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects.

c. If a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during lease operations, the lessee must report the discovery to the Director as soon as possible. The lessee must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the Director, after consultation with the SHPO and the NSB, has directed the lessee as to the course of action to take for its preservation.

7. Local Hire, Communication, and Training

a. Lessees are encouraged to employ local and Alaska residents and contractors, to the extent they are available and qualified, for work performed in the lease area. Lessees shall submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator’s plans for partnering with local communities to recruit, hire and train local and Alaska residents and contractors. The lessee is encouraged, in formulating this proposal, to coordinate with employment and training services offered by the State of Alaska and local communities to train and recruit employees from local communities.

b. A plan of operations application must describe the lessee’s past and prospective efforts to communicate with local communities and interested local community groups.

c. A plan of operations application must include a training program for all personnel including contractors and subcontractors. The program must be designed to inform each person working on the project of environmental, social, and cultural concerns that relate to that person’s job. The program must use methods to ensure that personnel understand and use techniques necessary to preserve geological, archeological, and biological resources. In addition, the program must be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating.

8. Definitions

a. In this document:

   i. "Facilities" means any structure, equipment, or improvement to the surface, whether temporary or permanent, including, but not limited to, roads, pads, pits, pipelines, power lines, generators, utilities, airstrips, wells, compressors, drill rigs, camps and buildings;
   ii. "Important wetlands" means those wetlands that are of high value to fish, waterfowl, and shorebirds because of their unique characteristics or scarcity in the region or that have been determined to function at a high level using the hydrogeomorphic approach;
   iii. "Minimize" means to reduce adverse impacts to the smallest amount, extent, duration, size, or degree reasonable in light of the environmental, social, or economic costs of further reduction;
   iv. "Plan of operations" means a lease Plan of operations under 11 AAC 83.158 and a unit Plan of operations under 11 AAC 83.346;
   v. "Practicable" means feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the standard;
   vi. "Secondary containment" means an impermeable diked area or portable impermeable containment structure capable of containing 110 percent of the volume of the largest independent container plus 12 inches of freeboard. Double walled tanks do not qualify as Secondary Containment unless an exception is granted for a particular tank.
   vii. "Temporary" means no more than 12 months.

B. Lessee Advisories

Lessees must comply with all applicable local, state, and federal codes, statutes, and regulations, as amended. Lessee Advisories alert lessees to additional restrictions that may be imposed at the permitting stage of a proposed project or activity where entities other than DO&G have permitting authority.

1. DNR/ADF&G

a. Under the provisions of Title 41 of the Alaska Statutes, the measures listed below may be imposed by ADF&G below the ordinary high water mark to protect designated anadromous fish-bearing lakes and streams and to ensure the free and efficient passage of fish in all fish-bearing water bodies. Exceptions to these requirements, including exceptions for the use of spill containment and recovery equipment, may be allowed on a case-by-case basis. Specific information on the location of anadromous water bodies in and near the area may be obtained from ADF&G.

   i. Alteration of riverbanks may be prohibited.
   ii. The operation of equipment, excluding boats, in open water areas of rivers and streams may be prohibited.
   iii. Bridges or non-bottom founded structures may be required for crossing fish spawning and important rearing habitats.
   iv. Culverts or other stream crossing structures must be designed, installed, and maintained to provide free and efficient passage of fish.

b. Removal of water from fish-bearing water bodies requires prior written approval by DMLW and ADF&G. Regulations for Appropriation and Use of Water are subject to the provisions of 11 AAC 93.035 - 11 AAC 93.147.

c. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important caribou or other large ungulate calving and wintering areas during the plan of operations approval stage.

d. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in and adjacent to important waterfowl and shorebird habitat during the plan of operations approval stage.

e. To minimize impacts on Dolly Varden (arctic char) overwintering areas, permanent, staffed facilities must be sited to the extent practicable outside identified Dolly Varden overwintering areas.

f. Lessees are advised that certain areas are especially valuable for their concentrations of marine birds, marine mammals, fishes, or other biological resources; cultural resources; and for their importance to subsistence harvest activities. The following areas of special biological and cultural sensitivity must be considered when developing plans of operation: the Canning River Delta; the Colville River Delta; and the Sagavanirktok River Delta.

g. Lessees are encouraged in planning and design activities to consider the recommendations of oil filed design and operations in the final report to the Alaska Caribou Steering Committee: Cronin, M. et al., 1994. “Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou.” LGL Alaska Research Associates, Inc., July.

h. Lessees must comply with the provision of Appendix B of the “Yellow-billed Loon Conservation Agreement,” dated July 31, 2006, between ADF&G, ADNR, USFWS, BLM, and NPS.

2. DNR/OPMP

a. Pursuant to Alaska Statutes, applicants for lease are required to comply with all policies and enforceable standards of the Alaska Coastal Management Program, including the District Coastal Management Plans.

3. ADEC

a. Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations. The plan must include a response action plan to describe how a spill response would occur, a prevention plan to describe the spill prevention measures taken at the facility, and supplemental information to provide background and verification information.

b. Air Pollution Emissions:

   i. Because of the state’s interest in clean air, lessees are encouraged to adopt conservation measures to reduce hydrocarbon vapor emissions, especially methane because it is a greenhouse gas. Wasting natural gas is contrary to state law implemented by the Alaska Oil and Gas Conservation Commission.
   ii. Lessees are advised that new processing facilities containing gas turbine engines may require an air permit under 18 AAC 50.302, including submitting a Best Available Control Technology (BACT) analysis for review under Part C of the Clean Air Act. Any BACT analysis submitted for gas turbine engines must include a full analysis of: 1) the installation of combined cycle turbines and / or use of co-generation applications; and 2) the potential treatment and use of produced water for water or steam injection into turbines to reduce formation of nitrogen oxides. Historical assumptions about the feasibility, economics, and energy impacts of these technologies are no

longer generally valid.

iii. The state has a growing interest in quantifying the emissions of greenhouse gases from any proposed oil and gas production facility. ADEC may require that emission calculations of greenhouse gases be provided at the same time as the calculations of traditionally regulated air pollutants when a lessee is applying for an Air Quality construction permit. Lessees are encouraged to adopt facility designs that minimize or eliminate greenhouse gas emissions.

iv. The state recognizes that in the long run sources of energy other than oil and gas will be needed. Lessee participation in conducting research on alternative energy sources is appreciated.

c. Wastewater disposal (per Clean Water Act, 33 U.S.C. 1251 *et seq*):

i. Unless authorized by NPDES or state permit, disposal of wastewater into freshwater bodies, including Class III, IV, VI and VIII wetlands, is prohibited.

ii. Unless authorized by an ADEC permit, surface discharge of reserve pit fluids and produced waters is prohibited.

iii. If authorized by ADEC and EPA, disposal of produced waters in upland areas, including wetlands, will be by subsurface disposal techniques. ADEC may permit alternate disposal methods if the lessee demonstrates that subsurface disposal is not practicable.

iv. Discharge of produced waters into open or ice-covered marine waters of less than ten meters in depth is prohibited. The commissioner, ADEC, may approve discharges into waters greater than ten meters in depth based on a case-by-case review of environmental factors and consistency with the conditions of a state certified development and production phase NPDES permit issued for the sale area.

4. ADLWD

a. The Lessee shall facilitate Alaska resident hire monitoring by reporting project wages on a quarterly basis for each individual employed by the Lessee in the lease area, through electronic unemployment insurance reporting, and by requiring the same of the lessee’s contractors and subcontractors.

5. USCOE

a. A USCOE permit is required when work is anticipated on, in, or affects navigable waters or involves wetland-related dredge or fill activities. A Section 10 Permit addresses activities that could obstruct navigation. Oil and gas activities requiring this type of permit include exploration drilling from a jackup drill rig, installation of a production platform, or construction of a causeway. A Section 404 Permit authorizes the discharge of dredged and fill material into waters and wetlands of the United States. The process and concerns are similar for both permits and, at times, both may be required.

6. USFWS

a. Lessees are advised that the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.) protects endangered and threatened species and candidate species for listing that may occur in the lease sale area. Lessees shall comply with the Recommended Protection Measures developed by the USFWS to ensure adequate protection for all endangered, threatened and candidate species.

Table 7.1: Endangered and Threatened Species That Occur in or Adjacent to the Lease Sale Area

Common Name	ESA Status
a. Bowhead whale	Endangered
b. Spectacled eider	Threatened
c. Steller’s eider (Alaska breeding population)	Threatened
d. Polar bear	Threatened

In order to ensure compliance with the MBTA, it is recommended that Lessees survey the project area prior to construction, vegetation clearing, excavation, discharging fill or other activities which create disturbance, and confirm there are no active migratory bird nests. It is recommended Lessees contact the U.S. Fish and Wildlife Service for assistance and guidance on survey needs, and other compliance issues under the Migratory Bird Treaty Act. While the Service can recommend methods (such as surveys and timing windows) to avoid unintentional take, responsibility for compliance with the MBTA rests with Lessees.

c. Lessees are advised that they must comply with the provisions of the Marine Mammal Protection Act of 1972, as amended (16 USC 1361-1407). USFWS shares authority for marine mammals with the NMFS.

d. Peregrine falcon nesting sites are known to occur in the sale area. Lessees are advised that disturbing a peregrine falcon nest violates federal law. Lessees are required to comply with the federal resource recovery plan for the arctic peregrine falcon.

7. NMFS

a. Lessees are advised that they must comply with the provisions of the Marine Mammal Protection Act of 1972, as amended (16 USC 1361-1407). NMFS shares authority for marine mammals with the USFWS.

8. NSB

a. Lessees are advised that the NSB Assembly has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes (AS 29.40.020-040). The NSB regulations require borough approval for all proposed uses, development and master plans. The (North Slope Borough Coastal Management Plan) NSBCMP policies are included as part of the NSB zoning regulations (Title 19) and all NSB permit approvals will require the proposal to be substantially consistent with these policies.

b. Access: Lessees are advised that restricting access to and use of fish camps and other subsistence use areas defined in the NSB Traditional Land Use Inventory, may violate NSBCMP and NSBMC subsistence harvest protection and land use regulations. Lessees are advised to consult with the NSB Planning Department and local communities during planning of operations.

c. Community Participation in Operations Planning: Lessees are encouraged to bring one or more residents of communities in the area of operations into their planning process. Local communities have a unique understanding of their environment and community activities. Involving local community residents in the earliest stages of the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams developing plans of operation, oil spill contingency plans, and other permit applications can help communities understand permitting obligations and help industry to understand community values and expectations for oil and gas operations being conducted in and around their area.

d. Aircraft Restrictions: In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle and vessel operations regulated by NSB Code ß19.70.050(I)(1) which codifies NSBCMP policy 2.4.4.(a). Lessees are encouraged to apply the following provisions governing aircraft operations in and near the sale area:

   i. From June 1 to August 31, aircraft overflights must avoid identified brant, white fronted goose, tundra swan, king eider, common eider, and yellow-billed loon nesting and brood rearing habitat, and from August 15 to September 15, the fall staging areas for geese, tundra swans, and shorebirds, by an altitude of 1,500 feet, or a lateral distance of 1 mile.
   ii. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 feet or a lateral distance of 1 mile, excluding takeoffs and landings, from caribou and muskoxen concentrations. A concentration means numbers of animals in excess of the general density of those animals found in the area.
   iii. Human safety will take precedence over flight restrictions.

Chapter Eight: Bidding Method and Lease Terms

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Chapter Eight: Bidding Method and Lease Terms

Under AS 38.05.180(f) and 11 AAC 83.100, the leasing of oil and gas resources must be by competitive bidding. The Alaska statutes provide a number of bidding methods to the department (AS 38.05.180(f)(3)).

(1) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease;
(2) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease and a fixed share of the net profit derived from the lease of not less than 30 percent reserved to the state;
(3) a fixed cash bonus with a royalty share reserved to the state as the bid variable but no less than 12.5 percent in amount or value of the production removed or sold from the lease;
(4) a fixed cash bonus with the share of the net profit derived from the lease reserved to the state as the bid variable;
(5) a fixed cash bonus with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease with the share of the net profit derived from the lease reserved to the state as the bid variable;
(6) a cash bonus bid with a fixed royalty share reserved to the state based on a sliding scale according to the volume of production or other factor but in no event less than 12.5 percent in amount or value of the production removed or sold from the lease;
(7) a fixed cash bonus with a royalty share reserved to the state based on a sliding scale according to the volume of production or other factor as the bid variable but not less than 12.5 percent in amount or value of the production removed or sold from the lease.

In selecting the bidding method for each North Slope Areawide Oil and Gas Lease Sale, ADNR considered and balanced the following state interests: protecting the state's ownership interest in hydrocarbon resources; promoting competition among individuals seeking to explore and develop the area; encouraging orderly and efficient exploration and development; and the need to generate revenues for the state.

The bidding method and lease terms for North Slope Areawide 2008 are:

- **Bidding Method**: Cash bonus bidding with a minimum bid of $10 per acre on all tracts.
- **Royalty Rate**: All tracts north of NS royalty line–a fixed royalty rate of sixteen and two-thirds percent (16.66667%). All tracts south of NS royalty line–a fixed royalty rate of twelve and one-half percent (12.5%) (See Figure 8.1).
- **Length of Lease**: All tracts north of NS royalty line–five (5) years. All tracts south of NS royalty line–seven (7) years.
- **Rental**: Annual rental on all tracts is $1.00 per acre for the first year, $1.50 per acre for the second year, $2.00 per acre for the third year, $2.50 per acre for the fourth year, and $3.00 per acre for the fifth and following years.

The bidding method and lease terms may change in subsequent sales over the 10-year life of this finding.

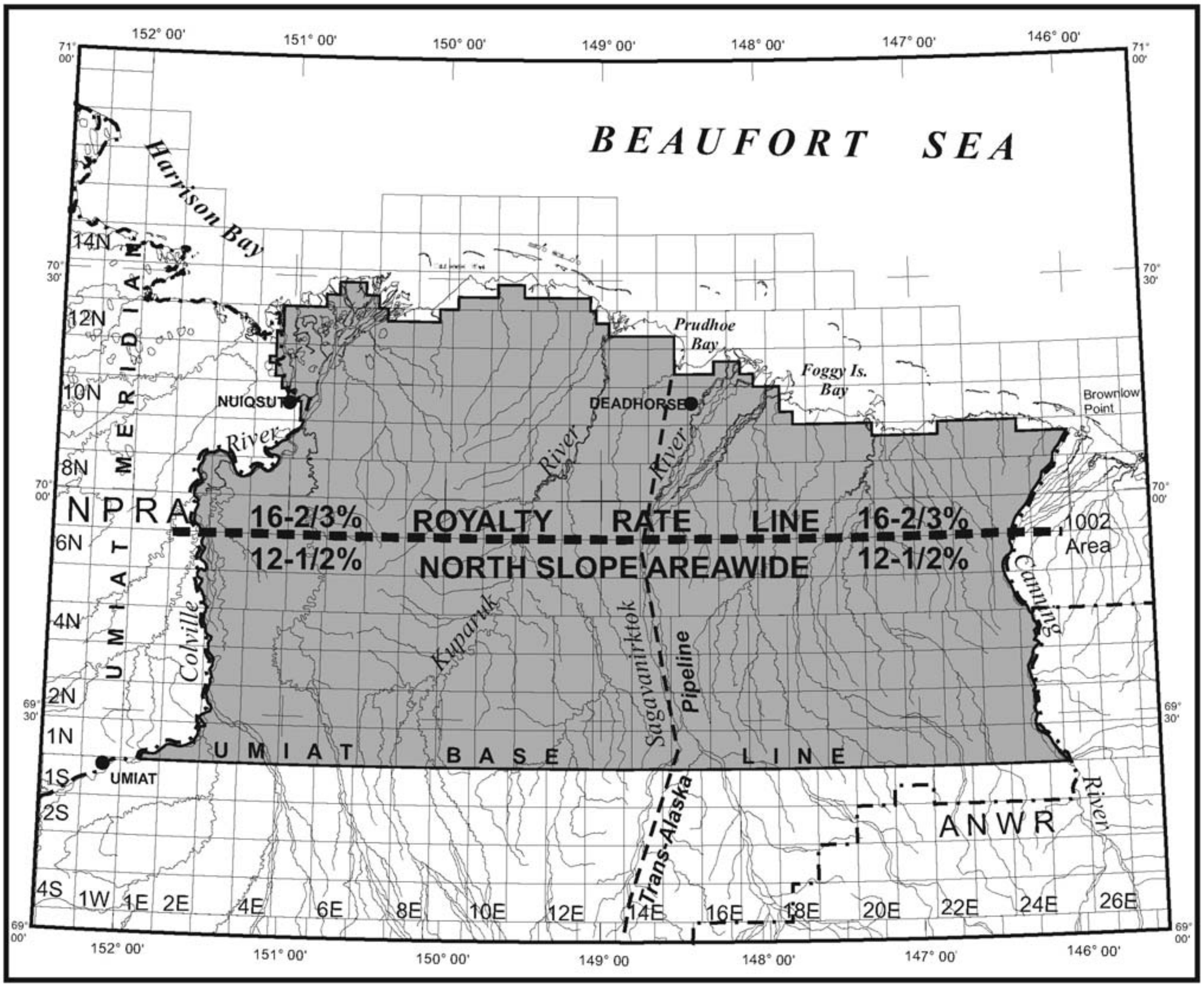

Figure 8.1 North Slope Royalty Line

Chapter Nine: Conclusion, Summary, and Signatures

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Chapter Nine: Conclusion, Summary, and Signatures

DO&G is required by AS 38.05.035(e) and (g), to determine whether an oil and gas lease sale serves the state's best interests. As the acting director of DO&G, my responsibility is to make that determination for the North Slope Areawide Oil and Gas Lease Sale. In making this decision, I balanced the reasonably foreseeable positive and negative effects to determine whether the potential benefits exceed the potential negative effects and whether holding this sale is in the best interests of the state.

In this final finding analysis, DO&G considered the reasonably foreseeable potential effects, both negative and positive, that this sale could have on fish, wildlife, and human users of these resources, on the local economy and well-being, and on state revenue. DO&G analyzed the available socioeconomic, environmental, geological and geophysical data and comments submitted by local, state and federal agencies. The division has also considered the cumulative effects of development in the area.

The discussion throughout this final finding reflects the analysis of these issues. Below is a summary of this analysis.

A. Statewide and Local Fiscal Effects

1. Statewide Fiscal Effects

Effects – Oil and gas revenues, the majority of which came from North Slope production, comprised approximately 87 percent of the state's general fund unrestricted revenues in FY 2007. North Slope fields hold the vast majority of the state's known oil and gas reserves; however, oil and gas reserves are finite resources and North Slope production is declining. Even if the price of crude oil remains at present levels, general fund receipts will continue to decline (see Chapter Five). Hopefully, discovery and development of smaller, but important fields will temper the anticipated decline in revenues to the state treasury.

Most revenues generated from oil and gas activities go into the state's general fund, while some are set aside for the state permanent fund. Statewide, Alaskans receive direct and indirect benefits derived from general fund spending. Many funds, including oil and gas property taxes, are passed directly to borough and municipal governments. Funds can be passed directly to local governments through programs, while others are authorized specifically by the state legislature. Additionally, the energy industry is Alaska's largest industry, spending over two billion dollars annually in the state. The energy industry accounts for 12 percent of private jobs and has the highest average wage in Alaska.

When tracts are leased, a one-time increase in state income from bonus payments and an annual increase from rental payments will occur. The potential for additional revenue from royalties and taxes is unpredictable and the overall petroleum potential for the sale area is low to moderate. As exploration and development take place, the sale would add jobs to the state, regional and local economies. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, transportation, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered, and whether projects to develop those resources are initiated. Additionally, industry investment in environmental and wildlife studies, planning and design activities, materials acquisition, facility construction, seismic surveys, drilling, transportation, and logistics contributes to the well being of both the state and local economies.

Mitigation Measures – The statewide fiscal effects are anticipated to be positive and no mitigation measures were developed for this topic.

B. Effects on Municipalities and Communities

Effects – As exploration and development take place, the sale would add jobs to the regional and local economies. These jobs would not be limited to the petroleum industry, but would be spread throughout the trade, transportation, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered, their location, and whether projects to develop those resources are initiated. Discovery and development of commercial quantities of petroleum or natural gas in the sale area would also bring direct economic benefits to the North Slope Borough in the form of local property tax revenue. Additionally, industry investment in environmental and wildlife studies, planning and design activities, materials acquisition, facility construction, seismic surveys, drilling, transportation, and logistics contributes to the well being of both the state and local economies.

Mitigation Measures – The local fiscal effects are anticipated to be positive and no mitigation measures were developed for this topic.

Effects – As the host of the production center for the state's oil and gas activities, the North Slope Borough is heavily influenced by the oil and gas industry. More than two thirds of all jobs in the borough are directly linked to the oil and gas industry or its support industries and the borough is a primary employer of residents in the communities. Non-residents, however, accounted for approximately 28 percent of the oil and gas industry's workforce in 2004.

Additionally, approximately 96 percent of local tax collections come from oil producers. The borough relies on these tax revenues to provide public services to all of its communities. Depletion of existing reservoirs has lowered the assessed value of the properties and resulted in a decline in tax revenue. Hopefully, discovery and development of smaller, but important fields will temper the decline in revenues to the borough's treasury.

Mitigation Measures – A plan of operations must describe efforts to minimize impacts on residential, commercial, Native allotments, subsistence use areas, and recreational areas and a copy of the proposed plan of operations must be submitted to all surface owners whose property will be entered. Facilities must be designed and operated to minimize sight and sound impacts in areas of high residential, commercial, recreational and subsistence use and important wildlife habitat. A plan of operations application must also describe the lessee's past and prospective efforts to communicate with local communities and interested local community groups. To the extent they are available and qualified, lessees are encouraged to employ local and Alaska residents and contractors. Lessees shall submit, as part of the plan of operations, a proposal detailing the means by which the lessees will comply with the measure. The proposal must include a description of the operator's plans for partnering with local communities to recruit and hire local and Alaska residents and contractors. The lessee is encouraged, in formulating this proposal, to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

Effects – The overall health of Alaska Natives, including the North Slope Inupiat, has improved significantly since 1950 due to the combination of improved socio-economic status, housing, sanitation, and health care and infection control efforts. Despite these improvements, significant disparities remain between Alaska Natives and the general U. S. population as cancer, diabetes, social pathology, and chronic diseases are rapidly increasing. At present, no evidence exists to conclusively link rates of any of these problems to oil and gas development. The Alaska Inter-Tribal Council and the NSB have received grants to perform Health Impact Assessments (HIAs).

Mitigation Measures – The state is currently developing a policy regarding HIAs for large resource extraction projects. ADNR will have the opportunity to consider health impacts and mitigation measures in a supplemental finding once the Alaska Inter-Tribal Council and NSB complete their HIAs, and the state finalizes its HIA policy.

C. Cumulative Effects and their Mitigation

1. Effects on Water

Effects – Water quality characteristics that may be altered by oil and gas activities include: pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential impacts that may alter surface water quality parameters include: accidental spills of fuel, lubricants, or chemicals; increases in erosion and sedimentation causing elevated turbidity and suspended solids concentrations; and oil spills.

Most drilling wastes are disposed of under ADEC's solid waste disposal program and re-injection is the preferred method of drilling fluid disposal. Most oilfield wastes are considered non-hazardous and waste fluids are recycled, filtered and treated before reinjection or disposal. The AOGCC insures proper and safe handling and disposal of drilling wastes.

Mitigation Measures – Exploration facilities must be constructed of ice. Impacts to important wetlands must be minimized and facilities must be sited in the least sensitive areas. Pipelines must utilize existing transportation corridors where conditions permit. The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. The removal of water from fish-bearing rivers, streams and natural lakes requires prior approval. Gravel mining within an active floodplain may be prohibited and mining of upland sites will be restricted to the minimum area necessary to develop the field. A fresh water aquifer monitoring well and quarterly water quality monitoring are required down gradient of a permanent storage facility. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers or important wetlands. The method of disposal of drilling mud and cuttings requires permit approval and re-injection is the preferred method of drilling fluid disposal. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

2. Effects on Air

Effects – Activities associated with oil and gas exploration, development and production that are likely to affect air quality are emissions from construction, drilling and production. Air pollutants include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter and volatile organic compounds (VOC). Trucks, heavy construction equipment and earth moving equipment would produce emissions, such as engine exhaust and dust. Sources of air emissions during drilling operations include rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, incinerators, and well test flaring equipment. Emissions would also be generated during installation of pipelines and utility lines, excavation and transportation of gravel, mobilization and demobilization of drill rigs, and during construction of gravel pads, roads, and support facilities. These elevated levels of airborne emissions would be temporary and would diminish after construction phases are complete. The probability of a gas blowout from a pad is estimated to be low; however accidental emissions could result from gas blowouts and evaporation of spilled oil, and burning of spilled oil.

Mitigation Measures – ADNR has not developed mitigation measures for air quality because they are adequately covered under existing statutes and regulations. All industry emissions must comply with the Clean

Air Act (42 U.S.C. §§ 7401-7642) and state air quality standards. AS 46.03 provides for environmental conservation, including water and air pollution control, radiation and hazardous waste protection. 18 AAC 50 provides for air quality control, including permit requirements, permit review criteria, and regulation compliance criteria. 18 AAC 50.316 establishes preconstruction review for construction or reconstruction of major source of hazardous air pollutants.

3. Effects on Fish and Wildlife Habitats, Populations and their Uses

Effects on Land Habitat – During oil and gas development and production, various activities could cause impacts to vegetation in the sale area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads. Single season ice roads melt in spring and leave little, if any, trace. Winter seismic surveys could affect tundra vegetation depending on snow depth, vehicle type, traffic pattern, and vegetation type. Overland moves and seismic surveys could alter the thermal balance, and increase the risk of thermokarsting. Effects of constructing production pads, roads, and pipelines include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. A secondary effect of construction activities includes dust deposition. After an oil field is abandoned, rehabilitation will be required to restore areas impacted by oil and gas activities. If a natural gas blowout occurs, plants in the immediate vicinity may be destroyed. Spilled oil will affect tundra depending on time of year, vegetation, and terrain. Oil spilled on the tundra will migrate both horizontally and vertically. Long-term impacts may include habitat improvement due to restoration and rehabilitation of impacted sites.

Mitigation Measures – Exploration facilities must be constructed of ice. Impacts to important wetlands must be minimized and facilities must be sited in the least sensitive areas. Pipelines must utilize existing transportation corridors where conditions permit. The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. Gravel mining is restricted to the minimum area necessary to develop the field. Drilling mud and cuttings cannot be discharged into lakes, streams, rivers or important wetlands. The method of disposal of drilling mud and cuttings requires permit approval and re-injection is the preferred method of drilling fluid disposal. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. All facilities must be removed and the site rehabilitated to the satisfaction of the Director.

Effects on Fish – Potential effects include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal, facility siting, and water removal; impediments to migration; and fish kills due to oil spills. Seismic activities are typically conducted during the winter months to minimize the effect on the environment. If a natural gas blowout occurs, some fish in the immediate vicinity might be killed. Oil spills are not be expected to have a measurable effect on freshwater or anadromous fish populations within and adjacent to the sale area. Long-term impacts may include habitat improvement due to restoration and rehabilitation of impacted sites.

Mitigation Measures – If ice thickness at a crossing is insufficient to protect the streambed and bank, lessees may be required to construct ice and/or snow bridges. Any removal of water from fishbearing waterways requires approval from the Alaska Department of Fish and Game (ADF&G) and lessees must use measures to avoid entrainment of fish. Lessees must locate, develop and rehabilitate gravel mine sites in accordance with ADF&G guidelines. Disposal of wastewater into fresh waterbodies is prohibited. The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. Continuous fill causeways are discouraged, and causeways, docks or other structures must maintain free passage of marine and anadromous fish. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Birds – Potential impacts to birds are more likely to occur after the exploration phase, as few resident species are present during winter when exploration occurs. Potential impacts include: habitat loss; barrier to movement; disturbance during nesting and brooding; change in food abundance and availability; and oil spills. Siting of onshore facilities, such as drill pads, roads, airfields, pipelines, housing, oil storage facilities, and other infrastructure, could eliminate or alter some preferred bird habitats, such as wetlands. Human activities such as air traffic and foot traffic near nesting waterfowl, shorebirds, and seabirds, could cause some species to temporarily abandon important nesting, feeding and staging areas. Impacts from an oil spill depend on the type of contact; direct contact with spilled oil by birds is usually fatal, ingestion from preening or consumption of oil-contaminated foods may reduce reproductive ability, and oil contamination of eggs by oiled feathers of parent birds significantly reduces egg hatching. In the remote event of a natural gas explosion and fire, birds in the immediate vicinity could be killed.

Mitigation Measures – Lessees must site permanent facilities outside of identified brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas. Permanent facilities must be sited minimum distances from stream and lakes. Lessees must comply with the USF&WS' recommended protection measures for Spectacled eiders (or any other endangered or threatened species in the area) during the nesting and brood rearing periods and are advised to consider identified sensitive bird habitats when planning operations. Lessees must comply with the provisions of the "Yellow-billed Loon Conservation Agreement," dated July 31, 2006 between the ADF&G, ADNR, USFWS, BLM and NPS that are applicable and appropriate to state lands. The North Slope Borough requires that vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where sensitive species are concentrated. Horizontal and vertical buffers will be required where appropriate under local code. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Caribou – Potential impacts can occur at all phases, but most are likely to occur during development and production. Potential effects to caribou populations from the sale include displacement from insect relief and calving areas due to construction and operations or from oil spills. During construction, small groups of caribou may be temporarily displaced; however, the disturbance reaction would diminish after construction is complete and construction would not take place over the entire sale area at the same time. Cow and calf groups are most sensitive to human disturbance just prior to calving and during the post calving period. Motor-vehicle and aircraft traffic can also disturb caribou and the response of caribou to potential disturbance is highly variable--from no reaction to violent escape reactions. Reactions depend on: distance from human activity; speed of approaching disturbance source (altitude of aircraft) and frequency of disturbance; sex, age and physical condition of the animals; size of caribou group; and season, terrain, and weather. Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Alternatively, dust settling along roads in the spring leads to earlier snow melt and green-up of vegetation that caribou feed on. Caribou also use roads and gravel pads and the shade of pipelines and buildings as insect relief areas.

Mitigation Measures – Pipelines must be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-ground pipelines must be elevated seven feet and ADNR, with consultation from ADF&G, may require additional mitigative measures. Ramps or pipeline burial may also be required to facilitate caribou movement. Lessees must avoid siting facilities in sensitive habitats and wetlands. Gravel mining must be limited to the minimum necessary to develop a field efficiently. The Director may also impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important caribou or other large ungulate calving and wintering areas during the plan of operations stage. Lessees are advised in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Muskoxen and Moose – Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Displacement from preferred habitat could have a negative effect on muskoxen populations. The magnitude of the effect is difficult to predict, but would likely be related to the magnitude and duration of the displacement. Very little moose habitat is expected to be lost as a result of post-sale activities because of mitigation measures. Primary sources of disturbance to muskoxen include seismic activity, vehicle traffic, and aircraft. Moose adapt readily and habituate to the presence of human activity and are not easily disturbed. An oil spill may result in oil contamination of individual animals in the immediate vicinity, contamination of habitats, and contamination of some local food sources. If a natural gas explosion and fire occurred on land or very near the coast, muskoxen or moose in the immediate vicinity could be killed or displaced.

Mitigation Measures – Pipelines must be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-ground pipelines must be elevated seven feet and ADNR, with consultation from ADF&G, may require additional mitigative measures. Additionally, lessees are advised that aircraft should avoid muskoxen concentrations. Alteration of river banks, except for approved permanent crossings, will be prohibited. Except for approved stream crossings, equipment must not be operated within willow stands (*Salix* spp.). To the extent practicable, facilities will not be sited within 1/2 mile of the banks of the Colville, Canning, Kavik, Shaviovik, Kadleroshilik, Sagavanirktok and Kuparuk Rivers. Gravel mining must be limited to the minimum necessary to develop a field efficiently. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Brown Bear – Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, housing and other infrastructure. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Seismic activity that occurs in winter may disturb denning bears. During exploration and development, human activity may attract foraging bears, especially to refuse disposal areas. The potential effects of oil spills on brown bears include contamination of individual animals, contamination of coastal habitats, and contamination of some local food sources. If a natural gas explosion and fire occurs on land or very near the coast, brown bear in the immediate vicinity could be killed or displaced.

Mitigation Measures – Lessees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting bears. Before commencement of any activities, lessees must consult with ADF&G to identify the locations of known brown bear den sites. Exploration and production activities must not be conducted within one-half mile of occupied brown bear dens. Gravel mining must be limited to the minimum necessary to develop a field efficiently. For projects in proximity to areas frequented by bears, lessees are required to prepare bear interaction plans designed to minimize interactions between humans and bears. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Furbearers – Activity during exploration and development may attract foraging foxes and wolves, especially to refuse disposal areas. Habitat destruction would primarily affect foxes through destruction of den sites; however, foxes have been known to use culverts and other construction materials for denning. Displacement of wolverines from local areas of development is unlikely. The potential effects of oil spills include contamination of individual animals, contamination of habitats, and contamination of some local food sources. If a natural gas explosion and fire occurs on land or very near the coast, animals in the immediate vicinity could be killed or displaced.

Mitigation Measures – Exploration facilities must be temporary and must utilize ice roads and pads. Lessees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting wolves, wolverines, and foxes. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Polar Bear – Potential impacts to polar bears include disruption of denning, attraction to areas of activity, ingestion of oil, oil contamination, and adverse interaction with humans. The primary sources of noise disturbance would come from air and marine traffic; however seismic activities and low-frequency noise from drilling operations would also be a source of noise. However, studies have shown that polar bears can tolerate high levels of noise and disturbance without measurable adverse effects. Some polar bears could be killed as a result of human-bear encounters near industrial sites and settlements associated with oil and gas development. The potential effects of oil spills include contamination of individual animals, contamination of habitats, and contamination of some local food sources. Modeling of hypothetical oil spills has shown a very low risk of polar bears contacting oil.

Mitigation Measures – Lessees should avoid use of aircraft over areas where species that are sensitive to noise and movement are concentrated. Lessees must use appropriate methods of garbage and putrescible waste disposal to minimize attracting bears. Before commencement of any activities, lessees must consult with USFWS to identify the locations of known polar bear den sites. Exploration and production activities must not be conducted within one mile of occupied polar bear dens. For projects in proximity to areas frequented by bears, lessees are required to prepare bear interaction plans designed to minimize interactions between humans and bears. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

Effects on Other Marine Mammals – Potential impacts to other marine mammals (ringed, spotted and bearded seals, and walrus) can occur during all phases. Some pinnipeds could be temporarily displaced by construction activities associated with causeway construction. Onshore development near the coast could also disturb a small number of pinnipeds. The primary sources of noise and disturbance of pinnipeds would come from marine traffic, air traffic, and geophysical surveys. A secondary source would be low frequency noises from drilling operations. Direct contact with spilled oil by pinnipeds may result in mortalities.

Mitigation Measures – Continuous fill causeways are discouraged. Causeways, docks or other structures must be designed, sited, and constructed so as to maintain free passage of marine and anadromous fish, and shall not cause significant changes to nearshore oceanographic circulation patterns and water quality characteristics. Causeways may not be located in river mouths or deltas. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

4. Effects on Subsistence Uses

Effects – Direct effects on subsistence uses may include: increased access and land use limitations; less privacy; immediate effects of oil spills; and potential increase in wage earning opportunities to supplant subsistence activities. Indirect effects include: the potential reduction in local fish and wildlife populations due to development; increased travel distance and hunting time required to harvest resources; potential reductions in harvest success rates; increased competition for nearby subsistence resources; improvements in community transportation, trade, and utilities infrastructure; and increased revenues to local government through petroleum revenue taxes. Alteration of the physical environment may affect migration, nesting, breeding, calving, denning and staging of animals that are sensitive to oil and gas development activities. As new discoveries are made, the number of development-related facilities will increase, and portions of the developed areas could be closed to public access, reducing the area available for subsistence activities. If subsistence hunters are displaced from traditional hunting areas, they might have to travel greater distances and spend more time harvesting resources. At the same time, increased public access to hunting, fishing, and trapping areas, due to construction of new roads, could increase competition between user groups for subsistence resources.

Mitigation Measures – Lease-related use will be restricted when the Director determines it is necessary to prevent conflicts with local subsistence activities. Restrictions may include alternative site selection, seasonal restrictions or other technologies deemed appropriate by the Director. Lessees must conduct an inventory of traditional use sites in the area for activity and ensure that archaeological resources are preserved. Lessees must include a program in any development plan to educate oil field workers about community values, customs, lifestyles, and laws protecting cultural resources in the sale area. Traditional and customary access to subsistence areas shall be maintained unless reasonable alternative access is provided. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Prior to submitting a plan of operations, lessees must consult with the potentially affected communities and the borough and make reasonable efforts to assure that activities are compatible with subsistence hunting and fishing activities. Lessees are advised to bring local residents into their operations planning process.

5. Effects on Cultural and Historic Resources

Effects – Potential impacts include disruption of culture and disturbance of historic and archeological sites. Damage to archaeological sites can include: direct breakage of cultural objects; damage to vegetation and thermal regime, leading to erosion and deterioration of organic sites; and shifting or mixing of components in sites resulting in loss of association between objects. Also, crews at archeological or historic sites could damage or destroy sites by collecting artifacts. Oil spills can have an indirect effect on archaeological sites by contaminating organic material. Disturbance to historical and archaeological sites might occur as a result of activity associated with accidents, such as an oil or gas well blowout or explosion. Cumulative effects on archaeological sites from oil and gas exploration, development, and production are expected to be low.

Mitigation Measures – Lessees are required to conduct training for all employees and contractors on environmental, social, and cultural concerns in the area of activity. Prior to ground disturbing activities, lessees must conduct an archaeological inventory. If any objects are discovered at any time, they must be reported and appropriate protective measures taken. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Lessees are advised to bring local residents into their operations planning process.

D. Specific Issues – Effects Related to Oil and Gas Exploration, Development, Production and Transportation

1. Geophysical Hazards

Effects – The primary geophysical hazards within the sale area include earthquakes, faulting, shore-ice movement, permafrost and frozen-ground phenomena, waves, coastal erosion, seasonal flooding, over-pressured sediments, and shallow gas deposits and hydrates. These geohazards could impose constraints to exploration, production, and transportation activities associated with possible petroleum development, and should be considered prior to the siting, design and construction of any facilities. Thick permafrost beneath most of the area may cause the earthquake response of sediments to be more like bedrock, which would limit amplification effects and would also tend to prevent earthquake-induced ground failure, such as liquefaction. Ice push has the potential to alter shorelines and nearshore bathymetry, which in the longer term may pose a threat to nearshore facilities with increased erosion. Ground settlement, due to thawing, occurs when tundra overlying permafrost is disturbed or when a heated structure is placed on the ground underlain by shallow, ice-rich permafrost, and the proper engineering measures are not taken to adequately support the structure and prevent the building heat from melting the ground ice. Seasonal flooding of lowlands and river channels is extensive along major rivers that drain into the sale area. Encountering over-pressured sediments while drilling can result in a blow-out or uncontrolled flow.

Mitigation Measures – It is standard industry practice that facility siting, design, and construction be preceded by site-specific, high-resolution, shallow seismic surveys that reveal the location of potentially hazardous geologic faults. All structures in the proposed sale area should be built to meet or exceed the Uniform Building Code requirements for seismic zone 1. Design parameters to mitigate the effects of ice push are similar to those employed to resist sea ice and coastal erosion forces. These include concrete armoring, berm construction, and coastal facility set-backs. Frozen-ground problems are successfully mitigated through siting, design, and construction; in addition, ADNR regulates winter travel across the tundra. Erosion rates, river bank and shoreline stability, and the potential impacts of waves and storm surge must all be considered in determining facility siting, design, construction, and operation. Pre-development planning should including hydrologic and hydraulic surveys, as well as flood-frequency analyses. Blow-out prevention equipment is required for all wells and surface and sub-surface safety valves are required to automatically shut-off flow to the surface.

The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. Continuous fill causeways are discouraged, and causeways, docks or other structures must not be located in river mouths or active stream channels on river deltas. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion, and other hazards. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

2. Likely Methods of Transportation

Effects – Elevated or buried flow, gathering, and common carrier pipelines would carry petroleum from wellheads to processing centers, and eventually into TAPS and a large gas pipeline, if constructed. Elevated pipelines can restrict caribou and other wildlife movements, especially if accompanied by a road with regular vehicle traffic. Buried pipelines have little impact on wildlife, but cannot be visually inspected and must be designed to avoid thawing of frozen soil.

Mitigation Measures – The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. Continuous fill causeways are discouraged, and causeways, docks or other structures must not be located in river mouths or active stream channels on river deltas. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion, and other hazards. Pipelines must be designed and constructed to avoid significant alteration of caribou and other large ungulate movement and migration patterns. At minimum, above-ground pipelines must be elevated seven feet and ADNR, with consultation from ADF&G, may require additional mitigation measures. Ramps or pipeline burial may also be required to facilitate caribou movement. Lessees must avoid siting facilities in sensitive habitats and wetlands. Lessees are advised in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

3. Oil Spill Risk, Prevention, and Response

Effects – The risk of a spill exists any time crude oil or petroleum products are handled. Oil spills associated with the exploration, development, production, storage and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels and other vehicles used in exploration and development activities.

Mitigation Measures – Each well has a blowout prevention program that is developed before the well is drilled. Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil from any pipeline which might be constructed in the sale area. Once a leak is detected, valves at both ends of the pipeline, as well as intermediate block valves, can be manually or remotely closed to limit the amount of discharge.

The siting of facilities is prohibited within 500 feet of all fish-bearing waterbodies, with an increased buffer along the banks of certain rivers. Continuous fill causeways are discouraged, and causeways, docks or other structures must not be located in river mouths or active stream channels on river deltas. All pipelines, including flow and gathering lines, must be designed, constructed and maintained to assure integrity against climatic conditions, geophysical hazards, corrosion, and other hazards. Pipelines must be designed to facilitate the containment and cleanup of spilled fluids. Secondary containment must be provided for the storage of fuel or hazardous substances. Storage sites must be protected from leaking or dripping fuel. During fuel or hazardous substance transfer, secondary containment or a surface liner must be used. Vehicle refueling cannot occur within the annual floodplain. A fresh water aquifer monitoring well and quarterly water quality monitoring is required down gradient of a permanent storage facility. Lessees are required to have an approved oil discharge prevention and contingency plan (C-Plan) prior to commencing operations and pipeline gravel pads must be designed to facilitate the containment and cleanup of spilled fluids.

E. Bidding Methods and Lease Terms

The selection of the bidding method, minimum bid, and term of the lease are based on the department's pre-sale analysis of economic, engineering, geological, and geophysical data. The bidding method selected best secures revenues for the state without creating disincentives to industry. The bidding methods and lease terms are described in Chapter Eight.

F. Summary and Signatures

No activity may occur without proper authorization from the appropriate permitting agencies. When specific activities are proposed, more detailed information such as site, type, and size of facilities will be known, in addition to the historical project data. Except for some very limited types of proprietary information, permit applications are public information and most permitting processes include public comment periods. DO&G will give public notice for plans of operation for exploration or development. Additional terms may be imposed in any subsequent permits when applied for if additional issues are identified at that time.

Developing the state's petroleum resources is vital to the state economy and the wellbeing of its citizens. With the mitigation measures presented in this final finding imposed on licenses and plans of operation, and additional project-specific and site-specific mitigation measures imposed in response to specific proposals, the petroleum resources of the sale area can most likely be explored and developed without significantly affecting fish and wildlife populations or traditional human uses. The state has sufficient authority from general constitutional, statutory and regulatory empowerments, the terms of the lease agreement, and plan of operations permit terms to ensure that lessees conduct their activities safely and in a manner that protects the integrity of the environment and maintains opportunities for subsistence uses.

On the basis of the facts and issues presented at this time, the foregoing findings, applicable laws and regulations, and the documents reviewed during preparation of this final finding, I conclude that the potential benefits of the North Slope Areawide Oil and Gas Lease Sale, as conditioned, outweigh the possible adverse impacts, and that the lease sale will best serve the interests of the state of Alaska.

A person affected by this decision who provided timely written comments may request reconsideration, in accordance with 11 AAC 02. Any reconsideration request must be received by August 4, 2008, and may be mailed or delivered to Thomas E. Irwin, Commissioner, Department of Natural Resources, 550 W. 7th Avenue, Suite 1400, Anchorage, Alaska 99501; faxed to 1-907-269-8918; or sent by electronic mail to dnr.appeals@alaska.gov. If reconsideration is not requested by that date or if the commissioner does not order reconsideration on his own motion, this decision goes into effect as a final order and decision on August 15, 2008. Failure of the commissioner to act on a request for reconsideration within 30 days after issuance of this decision is a denial of reconsideration and is a final administrative order and decision for purposes of an appeal to Superior Court. The decision may then be appealed to Superior Court within a further 30 days in accordance with the rules of the court, and to the extent permitted by applicable law. An eligible person must first request reconsideration of this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

Kevin R. Banks, Acting Director

July 15, 2008
Date

I concur with the director that the North Slope Areawide Oil and Gas Lease Sale 3 is in the best interests of the state.

Thomas E. Irwin, Commissioner

July 15, 2008
Date

Appendix A: Summary of Comments and Responses on the Preliminary Best Interest Finding Issued April 19, 2007

OFFICE OF HABITAT MANAGEMENT AND PERMITTING (OHMP),[1] J. WINTERS, JUNE 12, 2007
***Comment Summary**: OHMP submits edits to the Preliminary Best Interest Finding.* **DO&G Response:** DO&G incorporated most of these changes into the Final Finding.

ALASKA ESKIMO WHALING COMMISSION, H. BROWER, CHAIRMAN, JULY 19, 2007
***Comment Summary**: That the preliminary best interest finding should include a section on the effects of vessel traffic on bowhead whales. That these effects occur not just from vessel traffic in support of offshore development, but from vessel traffic in support of onshore development as well.* **DO&G Response:** Information on the effects of vessel traffic on bowhead whales has been added to Chapter Five. ***Comment Summary**: That the preliminary best interest finding should include a mitigation measure requiring all vessels supporting oil and gas development to be equipped with GPS tracking equipment. That without tracking of such vessels, it is difficult to identify a vessel that is contributing to driving the whales offshore.* **DO&G Response**: Vessel tracking is the responsibility of the U.S. Coast Guard, which is in the process of developing a nationwide Automatic Identification System (AIS) with a focus on improving maritime security, marine and navigational safety, search and rescue, and environmental protection services. Users will have access to archived vessel movement data to investigate maritime incidents, analyze risks, and improve vessel traffic patterns. An AIS system along the entire coastline of the United States is expected to be fully implemented by 2014. The Division of Oil and Gas (DO&G) will consider the benefits of requiring AIS on oil industry support vessels when it becomes available in the Beaufort Sea.

NORTH SLOPE BOROUGH (NSB), E. ITTA, MAYOR, JULY 19, 2007
***Comment Summary**: That the best interest finding is the first phase of a multi-phased review. That phasing is poor public policy because with each successive step toward development it becomes more challenging for the state, NSB, and other authorities to raise concerns related to potential cumulative adverse effects. That phasing is inconsistent with the provisions of AS 38.05.035(g), which requires a best interest finding to consider and discuss the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area including effects to subsistence users, fish and wildlife habitat, populations and their uses, historic and cultural resources, and communities.* **DO&G Response:** Under AS 38.05.035(e)(1)(C), the DO&G is allowed to review projects as

[1] The Office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Division of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.

“multiphased development.” Phased review recognizes that leasing of state land may result in future phases that cannot be predicted or planned with any certainty or specificity at the initial lease sale phase and future phases that will require public notice and the opportunity to comment before the next phase of the project may proceed. (See Chapter One).

Comment Summary*: That significant events have occurred since the initial North Slope best interest finding was issued in 1998: NPR-A was opened for leasing, the Northstar field was developed and the Alpine fields were extended, aging pipelines have caused major spills, and global climate change is having profound effects on the North Slope.*
DO&G Response: The Northstar and Alpine fields are discussed in Chapter Two as is global climate change. Oil spills and pipeline corrosion issues are discussed in Chapter Six.

Comment Summary*: The NSB requests consistency in mitigation measures across state and federal leases. The borough also requests that the state conduct a thorough analysis of its mitigation measures and BLM’s NPR-A mitigation measures and align all that can be aligned without sacrificing any protections. Further, the borough requests that the state adopt those mitigation measures that are the most stringent where alignment is not possible.*
DO&G Response: The DO&G is willing to consider alignment of state and federal mitigation measures but believes that the NSB, as the requesting agency, should conduct the analysis and present specific proposals to BLM and the division for consideration.

Comment Summary*: That the current preliminary best interest finding does not include a sufficient discussion of reasonably foreseeable effects of the sale: subsistence, occupational change, cultural change, and fiscal effects at the community level. That impacts to subsistence may increase hunger and food insecurity.*
DO&G Response: Under AS 38.05.035(e), the Alaska Department of Natural Resources (ADNR) is required to discuss the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources, the reasonably foreseeable fiscal effects of the lease sale and the subsequent activity on the state and affected municipalities and communities. This was done in Chapter Five. Additional information on fiscal effects at the community level has been added. ADNR believes the discussion is sufficient. The statement that impacts to subsistence may increase hunger and food insecurity is inconclusive. Impacts to subsistence can be minimized through the imposition of mitigation measures.

Comment Summary*: That the preliminary best interest finding does not address public health effects such as diabetes, cancer, alcohol abuse, drug abuse, suicide, domestic violence, and injury rates.*
DO&G Response: Research suggests that social pathology and other health problems may be related to the rapid cultural changes that have occurred in rural Alaska. However, it is difficult to attribute these changes directly to oil and gas development as they also occur in many rural parts of Alaska not exposed to oil and gas development. Health impacts are discussed in Chapter Five.

Comment Summary*: That road access to previously isolated communities results in illicit drug and alcohol trafficking. That the influx of oil personnel from outside the region could exacerbate racial tensions.*
DO&G Response: Lessees and their contractors are housed in work camps, not in local communities. Lessees and their contractors are prohibited from trafficking in illicit drugs and alcohol. ConocoPhillips checks all vehicles that use its roads and pass through its check points for drugs and alcohol. Under Mitigation Measure 7.c., a plan of operations application must include a training program for all lessee personnel including contractors and subcontractors. The program must be designed to help lessee personnel increase their sensitivity and understanding of community values, customs, and lifestyles in

areas where they will be operating.

***Comment Summary**: That health problems related to air pollution associated with oil and gas development cause respiratory illness and cardiac disease.*

DO&G Response: An ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999 as a State of Alaska permit condition for the Alpine field. Data collected indicate that air quality is in compliance with National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS). The effects of leasing and subsequent activity on air quality are discussed in Chapter Five.

***Comment Summary**: The NSB suggests the following mitigation measures to mitigate potential health impacts:*

1. *Establish a "Health Advisory Board."(HAB).*
2. *Lessee-designed and funded subsistence studies.*
3. *Lessee-funded construction of community freezers.*
4. *Lessee-instituted hunter assistance program.*
5. *Lessee-funded diabetes program and interventions to improve local diet.*
6. *Industry-funded baseline health studies.*
7. *Lessee-contaminant monitoring.*
8. *Lessee-funded police and emergency service personnel.*
9. *Lessee-funded health screening.*
10. *Lessee-funded sustainable development plan.*
11. *Lessee-funded plan to mitigate the health impacts of a large oil spill.*

DO&G Response: The State of Alaska is currently developing a coordinated policy for addressing health impacts on large resource extraction projects.

In 2007, the NSB was awarded a $1.67 million grant from NPR-A impact funds to perform a Health Impact Assessment. The goal of the assessment is to aid the borough in analyzing and understanding potential impacts of proposed development on the health of its communities and to design appropriate mitigation measures.

It is premature to develop and impose mitigation measures before the state's interagency process and the NSB's HIA have been completed. Mitigation measures are typically considered based on a "but for the project" criterion, i.e., there is a reasonable cause-effect relationship between the potential project activity and a subsequent effect (impact). ADNR believes that consideration of mitigation measures should follow the borough's HIA, not precede it. The effects of leasing and subsequent activity on public health are discussed in Chapter Five.

Each year the DO&G issues a call for comments requesting substantial new information that has become available since the most recent finding for that sale area was written. This request is sent to agencies and individuals on the division's mailing list and posted on the division's web site. Based on information received, the division determines whether it is necessary to supplement the finding. By this mechanism, health impacts may be considered when the state and the NSB have completed their respective processes.

***Comment Summary**: The NSB provides updated information on Dolly Varden, whitefish, snow geese, caribou and polar bears.*

DO&G Response: This information has been incorporated into the best interest finding.

BROOKS RANGE PETROLEUM CORPORATION, J. WINEGARNER, JULY 19, 2007
***Comment Summary**: That the citation that 40 hours of HAZWOPER training is required does not match the exemption cited in CFR 1910.120(e)(3)(iii) which requires a minimum of 24 hours of instruction.* **DO&G Response:** The best interest finding has been changed to a minimum of 24 hours of instruction.

Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

Alaska Statutes (AS) and Administrative Code (AAC) Sections

Alaska Department of Natural Resources (ADNR)	
AS 38.05.027	Management of legislatively designated state game refuges and critical habitat areas is joint responsibility of ADF&G (AS 16.20.050-060) and ADNR. Lessees are required to obtain permits from both ADNR and ADF&G.
AS 38.05.127	Provides for reservation of easements to ensure free access to navigable or public water.
AS 38.35.010 to AS 38.35.260	Right-of-way leasing for pipeline transportation of crude oil and natural gas is under control of commissioner of ADNR. Commissioner shall not delegate authority to execute leases.
11 AAC 51.045	Easements to and along navigable or public water.
11 AAC 83.158(a)	Plan of operations for all or part of leased area or area subject to oil and gas exploration license must be approved by ADNR commissioner before any operations may be undertaken on or in leased or licensed area.
11 AAC 96.010	Operations requiring permits, including use of explosives and explosive devices, except firearms.
11 AAC 96.025	Generally allowed land use activities are subject to general stipulations that will minimize surface damage or disturbance of drainage systems, vegetation, or fish and wildlife resources.
ADNR Division of Oil and Gas (DO&G)	
AS 38.05.035(a)(8)(C)	Requires geological and geophysical data to be kept confidential upon request of supplier.
AS 38.05.130	Allows DO&G director to approve oil and gas exploration and development activities in cases where surface estate is not held by state or is otherwise subject to third-party interests, provided director determines that adequate compensation has been made to surface estate holder for any damages that may be caused by lease activities.
AS 38.05.132	Establishes exploration licensing program.
AS 38.05.180	Establishes oil and gas leasing and gas only leasing programs to provide for orderly exploration for and development of petroleum resources belonging to state of Alaska.
11 AAC 96.010 to 11 AAC 96.145	Provides controls over activities on state lands in order to minimize adverse activities; applies to geophysical exploration permit
ADNR Division of Forestry	
AS 41.17.082	Alaska Forest Resources Practices Act. Requires that all forest clearing operations and silvicultural systems be designed to reduce likelihood of increased insect infestation and disease infections that threaten forest resources.
11 AAC 95.195	Describes approved methods of disposal or treatment of downed spruce trees to minimize spread of bark beetles and reduce risk of wildfire.
11 AAC 95.220	Requires lessee to file detailed plan of operations with state forester.

ADNR Division of Mining, Land and Water	
AS 38.05.075	Governs public auctions for leasing lands (including tidelands and submerged lands) — procedures, bidding qualifications, and competitive or noncompetitive bidding methods.
AS 38.05.850	Authorizes director to issue permits, rights-of-way, or easements on state land for recovery of minerals from adjacent land under valid lease.
11 AAC 80.005 to 11 AAC 80.085	Pipeline right-of-way leasing regulations.
11 AAC 93.040 to 11 AAC 93.130	Requires water rights permit for appropriation of state waters for beneficial uses.
11 AAC 93.210 to 11 AAC 93.220	Provides for temporary water use permits and application procedures.
11 AAC 96.010 to 11 AAC 96.110	Land use permit activities not permitted by multiple land use permit or lease operations approval.
ADNR Office of Habitat Management and Permitting[1]	
AS 41.14.840	Requires permit from ADNR (ADF&G after July 1, 2008) prior to obstruction of fish passage.
AS 41.14.870	Provides for protection of anadromous fish and game in connection with construction or work in beds of specified water bodies and calls for approval of plans by deputy commissioner, ADNR (ADF&G after July 1, 2008), for construction of hydraulic project or any use, diversion, obstruction, change, or pollution of these water bodies.
11 AAC 195.010	Atlas and catalog of waters important for spawning, rearing, or migration of anadromous fish. Permit application procedures.
ADNR Office of Project Management and Permitting	
11 AAC 110	Alaska Coastal Management Program Implementation
11 AAC 112.230	Requires that energy facilities in coastal areas be sited to extent feasible and prudent where development will necessitate minimal site clearing, dredging, and construction in productive habitats, to minimize risk of oil spills in or other contamination of productive or vulnerable habitats, and to allow for free passage and movement of fish and wildlife.
11 AAC 112.300	Requires that wetlands and tide flats be managed to assure adequate water flow and to avoid adverse effects on natural drainage patterns, destruction of important habitat, and discharge of toxic substances.

[1] The Office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Division of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.

Alaska Department of Fish and Game (ADF&G)	
AS 16.20	Management of legislatively designated game refuges, sanctuaries, and critical habitat areas.
AS 16.20.060, AS 16.20.094, and AS 16.20.530	Commissioner, ADF&G, may require submission and written approval of plans and specifications for anticipated use and construction work and plans for proper protection of fish and game (including birds) within legislatively designated game refuges, critical habitat areas, and sanctuaries.
AS 16.20.180 to AS 16.20.210	Require measures for continued conservation, protection, restoration, and propagation of endangered fish and wildlife.
Alaska Oil and Gas Conservation Commission (AOGCC)	
AS 31.05.005	Establishes and empowers AOGCC.
AS 31.05.030(d)(9)	Requires oil and gas operator to file and obtain approval of plan of development and operation.
AS 46.03.100	Standards and limitations for accumulation, storage, transportation, and disposal of solid or liquid waste.
AS 46.03.900(35)	Definition of waste.
20 AAC 25.005 to 20 AAC 25.570	Requires permit to drill, to help maintain regulatory control over drilling and completion activities in state.
20 AAC 25.140	Requires water-well authorization to allow abandoned oil and gas wells to be converted to freshwater wells and to assure freshwater source is not contaminated.
Alaska Department of Environmental Conservation	
AS 26.23.900(1)	Defines State Emergency Response Commission.
AS 46.03	Provides for environmental conservation including water and air pollution control and radiation and hazardous waste protection.
AS 46.03.100	Requires solid waste disposal permits.
AS 46.03.759	Establishes maximum liability for discharge of crude oil at $500 million.
AS 46.03.900(35)	Definition of waste.
AS 46.04.010 to AS 46.04.900	Oil and Hazardous Substance Pollution Control Act. Prohibits discharge of oil or any other hazardous substances unless specifically authorized by permit; requires those responsible for spills to undertake cleanup operations; and holds violators liable for unlimited cleanup costs and damages as well as civil and criminal penalties.
AS 46.04.030	Requires lessees to provide oil discharge prevention and contingency plans (C-plans). Also provides regulation of aboveground storage facilities that have capacities of greater than 5,000 bbl of crude oil or greater than 10,000 bbl of noncrude oil.
AS 46.04.050	Exemptions for aboveground storage facilities that have capacities of less than 5,000 bbl of crude oil or less than 10,000 bbl of noncrude oil.
18 AAC 50	Provides for air quality control, including permit requirements, permit review criteria, and regulation compliance criteria.

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18 AAC 60.200	Requires solid waste disposal permit to control or eliminate detrimental health, environmental, and nuisance effects of improper solid waste disposal practices and to operate solid waste disposal facility.
18 AAC 60.265	Requires proof of financial responsibility before permit for operation of hazardous waste disposal facility may be issued.
18 AAC 50.316	Preconstruction review for construction or reconstruction of major source of hazardous air pollutants.
18 AAC 60.430(a)(2)	General requirement for containment structures used for disposal of drilling wastes.
18 AAC 70	Requires Certificate of Reasonable Assurance (Water Quality Certification) in order to protect state waters from becoming polluted. Assures that issuance of federal permit will not conflict with Alaska's water quality standards.
18 AAC 72	Requires wastewater disposal permit in order to prevent water pollution (and public health problems) due to unsafe wastewater disposal systems and practices.
18 AAC 75.005 to 18 AAC 75.025	Requirements for oil storage facilities for oil pollution prevention.
18 AAC 75.065 to 18 AAC 75.075	Requirements for oil storage tanks and surge tanks.
18 AAC 75.080	Facility piping requirements for oil terminal, crude oil transmission pipeline, exploration, and production facilities.
18 AAC 75.305 to 18 AAC 75.395	Provides for oil and other hazardous substance pollution control, including oil discharge contingency plan.
North Slope Borough	
Title 19	North Slope Borough land management regulations, planning, and permitting powers.

Federal Laws and Regulations

[CFR, Code of Federal Regulations; USC, United States Code]

Clean Water Act

33 USC §§ 1251 to 1387 — Water pollution controls
33 USC § 1344 — Army Corps of Engineers permit required to excavate, fill, alter, or otherwise modify course or condition of navigable or U.S. coastal waters and to discharge dredge-and-fill material.

Environmental Protection Agency (EPA)-administered oil and other hazardous substance regulations

40 CFR § 109 — Criteria for oil removal contingency plans
40 CFR § 110 — Discharge of oil
40 CFR § 112 — Oil pollution prevention.
40 CFR § 112.7 — Guidelines for implementing spill prevention, control, and countermeasures plan
40 CFR § 113(A) — Liability limits for small onshore storage facilities (oil)
40 CFR § 116 — Designation of hazardous substances
40 CFR § 117 — Determination of reportable quantities for hazardous substances

Coast Guard, Department of Homeland Security-administered regulations relevant to oil spills in navigable waters

33 CFR §§ 153 to 158
33 CFR § 153 — Reporting oil spills to Coast Guard, Department of Homeland Security
33 CFR §§ 155 to 156 — Vessels in oil transfer operations

EPA-administered water quality regulations

40 CFR § 121 — State certification of activities requiring federal license or permit
40 CFR § 136 — Test procedures for analysis of pollutants

EPA-administered National Pollutant Discharge Elimination System regulations

40 CFR § 122 — NPDES permit regulations
40 CFR § 125 — Criteria and standards for NPDES permits
40 CFR § 129 — Toxic pollutant effluent standards
40 CFR § 401 — General provisions of effluent guidelines and standards
40 CFR § 435 — Offshore oil and gas extraction point-source category.

EPA-administered ocean dumping regulations

40 CFR §§ 220 to 225 and 227 to 228 — Ocean dumping regulations, permits, and criteria

EPA-administered materials discharge and disposal regulations

40 CFR § 230 — Discharge of dredged or fill material into navigable waters
40 CFR § 231 — Disposal site determination

Army Corps of Engineers-administered navigable waters regulations

33 CFR § 209—Navigable waters
33 CFR §§ 320 to 327 and 330 — Permit program regulations
33 CFR § 323 — Discharge of dredge and fill
33 CFR §§ 328 and 329 — Definitions of waters

Fish and Wildlife Coordination Act

Clean Water Act § 404 — Permit applications
16 USC § 662(a) Allows comments on permit applications by EPA, National Marine Fisheries Service, U.S. Fish and Wildlife Service (USF&WS), and state agency that administers wildlife resources.

Comprehensive Environmental Response, Compensation, and Liability Act

42 USC §§ 9601 to 9675 — Environmental laws

EPA-administered oil and other hazardous substance pollution regulations

40 CFR § 300 — National Oil and Hazardous Substances Pollution Contingency Plan

Safe Drinking Water Act

42 USC § 300 (f) to (h)

EPA-administered underground injection regulations

40 CFR § 144—Permit regulations for underground injection control program
40 CFR § 146—Criteria and standards for underground injection control program
40 CFR § 147—State underground injection control program

Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act

42 USC §§ 6901 to 6991

Clean Air Act

42 USC §§ 740l to 7661

Toxic Substances Control Act

15 USC §§ 2601 to 2655

National Environmental Policy Act (NEPA)

42 USC §§ 4321 to 4347

Council on Environmental Quality-administered NEPA-related regulations

40 CFR §§ 1500 to 1508 — Implement NEPA procedures

Endangered Species Act

16 USC §§ 1531 to 1543

USF&WS-administered threatened and endangered species regulations

50 CFR § 17 — Threatened and endangered wildlife and plant species
50 CFR § 402 — Interagency cooperation

Marine Protection, Research, and Sanctuaries Act

33 USC §§ 1401 to 1445

Marine Mammal Protection Act

16 USC §§ 1361 to 1407

Migratory Bird Treaty Act

16 USC §§ 703 to 712 and 715

National Historic Preservation Act

16 USC § 469 and 470

Leases and Permits on Restricted Properties

25 CFR § 162

Appendix C: Directional and Extended-Reach Drilling

Directional drilling is a drilling technique whereby a well is deliberately deviated from the vertical in order to reach a particular part of the reservoir. Directional drilling technology enables the driller to steer the drill stem and bit to a desired bottom hole location. Directional wells initially are drilled straight down to a predetermined depth and then gradually curved at one or more different points to penetrate one or more given target reservoirs. This specialized drilling usually is accomplished with the use of a fluid-driven downhole motor, which turns the drill bit (Gerding, 1986). Directional drilling also allows multiple production and injection wells to be drilled from a single surface location such as a gravel pad or offshore production platform, thus minimizing cost and the surface impact of oil and gas drilling, production, and transportation facilities (see Figure 5.3). It can be used to reach a target located beneath an environmentally sensitive area and may offer the most economical way to develop offshore oil fields from onshore facilities.

The limitations of directional drilling are primarily dependent upon maximum hole angle, rate of angle change, and torque or friction considerations. In directional drilling, it is now common for the horizontal displacement of the bottom hole location to be twice the total vertical depth (TVD) of the well. That is, a well with a vertical depth of 7,000 feet could have a bottom hole horizontal displacement of 14,000 feet from the drill site. However, in a shallower well, such as one in which a potential target is two miles away from the drill site but only one mile deep, directional drilling would be much more difficult, risky, and costly (Schmidt, 1994).

Direction drilling may be limited by the type of geology or rock through which drillers must drill in order to reach the desired target. Coal and shale deposits tend to expand or collapse the well bore and cause the drill string to get stuck. This is more likely to happen in wells that take longer to drill where the downhole formations are exposed to the drilling mud and drill string longer before well casing is cemented into the hole. Small subsurface faults are difficult to locate prior to drilling, and if the drill bit crosses a fault, the type of rock being drilled may suddenly change and a new geologic reference must be established. During this intermediate period in the drilling operation, the driller will not be sure if the desired geologic target is being drilled or could be intersected again (Schmidt, 1994). Stuck pipe can also occur in directional wells when the borehole becomes oval shaped from the drill pipe constantly laying on the downside part of the well bore. The pipe gets lodged in the groove cut on the bottom of the hole. The most common cause of hole collapse is the chemical difference between in-formation saltwater and the water in drilling mud. This is especially common when drilling through shale. Ions in the water in the mud have a tendency to transfer to the shale, the shale expands, and small sheets slough off into the hole, causing the pipe to get stuck (Gerding, 1986).

Subsurface collisions with neighboring wells can be problematic when drilling multiple boreholes from one surface location. A collision with a producing well could result in a dangerous situation. Anticollision planning begins with accurate surveys of the subject well and a complete set of plans for existing and proposed oil and gas wells (Schlumberger Anadrill, 1993).

Perhaps the greatest limitation on directional drilling is cost. For certain reservoirs, directional drilling technically may be possible but is not always economically feasible. Factors that may prohibit the use of directional drilling, such as the position of oil or gas deposits in the geologic structure relative to the drilling rig, the size and depth of the deposit, and the geology of the area, are all important elements that determine whether directional drilling is cost effective (Winfree, 1994). The environment and the cost of multiple pads or locations are also considerations in determining the cost-effectiveness of directional drilling.

Horizontal drilling, a more specialized type of directional drilling, allows a single well bore at the surface to penetrate oil- or gas-bearing reservoir strata at angles that parallel or nearly parallel the dip of the strata. The well bore is then open and in communication with the reservoir over much longer distances. In development wells, this can greatly increase production rates of oil and gas or volumes of injected fluids (Winfree, 1994). Horizontal drilling may involve underbalanced drilling, coiled tubing, bit steering, continuous logging, multilateral horizontals, and horizontal completions. Lateral step-outs are directional wells that branch off a main borehole to access more of the subsurface. Conditions for successful horizontal wells include adequate prespud planning, reservoir descriptions, drillable strata that will not collapse, and careful cost control (PTTC, 1996).

Extended-Reach Drilling (ERD) has evolved from simple directional drilling to horizontal, lateral, and multilateral step-outs (see Figure E.1). ERD employs both directional and horizontal drilling techniques and has the ability to achieve horizontal well departures and total vertical depth-to-deviation ratios beyond the conventional experience in a particular field (Gerding, 1986). ERD can be defined in terms of reach/TVD (total vertical depth) ratios (Judzis *et al.*, 1997). The definition of an ERD well depends on the results of existing drilling efforts in a particular oilfield (Gerding, 1986). Local ERD capability depends on the extent of experience within specific fields and with specific rigs and mud systems. “ERD wells drilled in specific fields and with specific rigs, equipment, personnel, project teams, etc. do not necessarily imply what may be readily achieved in other areas.” (Judzis *et al.*, 1997).

Possible challenges to successful ERD include problematic movement of downhole drillstring and well casing, applying sufficient weight to the drill bit, buckling of well casing or drillstring, and running casing successfully to the bottom of the well. Drillstring tension may be a primary concern in vertical wells, but in ERD, drillstring torsion may be the limiting factor. Running normal-weight drill pipe to apply weight to the bit in ERD can lead to buckling of the drill pipe and rapid fatigue failure. Conventional drilling tools are prone to twist-off because of unanticipated failure under high torsional and tensile loads of an extended-reach well (JPT, 1994). Torque can be significantly reduced with the use of nonrotating drill pipe protectors (Payne *et al.*, 1995). Advanced equipment for an ERD well may include wider diameter drill pipe, additional mud pumps, enhanced solids control, higher capacity top-drive motors, more generated power, and oil-based drilling fluids (Judzis *et al.*, 1997).

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ERD requires longer hole sections, which require longer drilling times; the result is increased exposure of destabilizing fluids to the well bore (JPT, 1994). Oil-based muds are superior to water-based muds in ERD (Payne *et al.*, 1995). Water-based muds may not provide the inhibition, lubrication or confining support of oil-based muds (JPT, 1994).

Figure C.1 Multilateral Wellbore

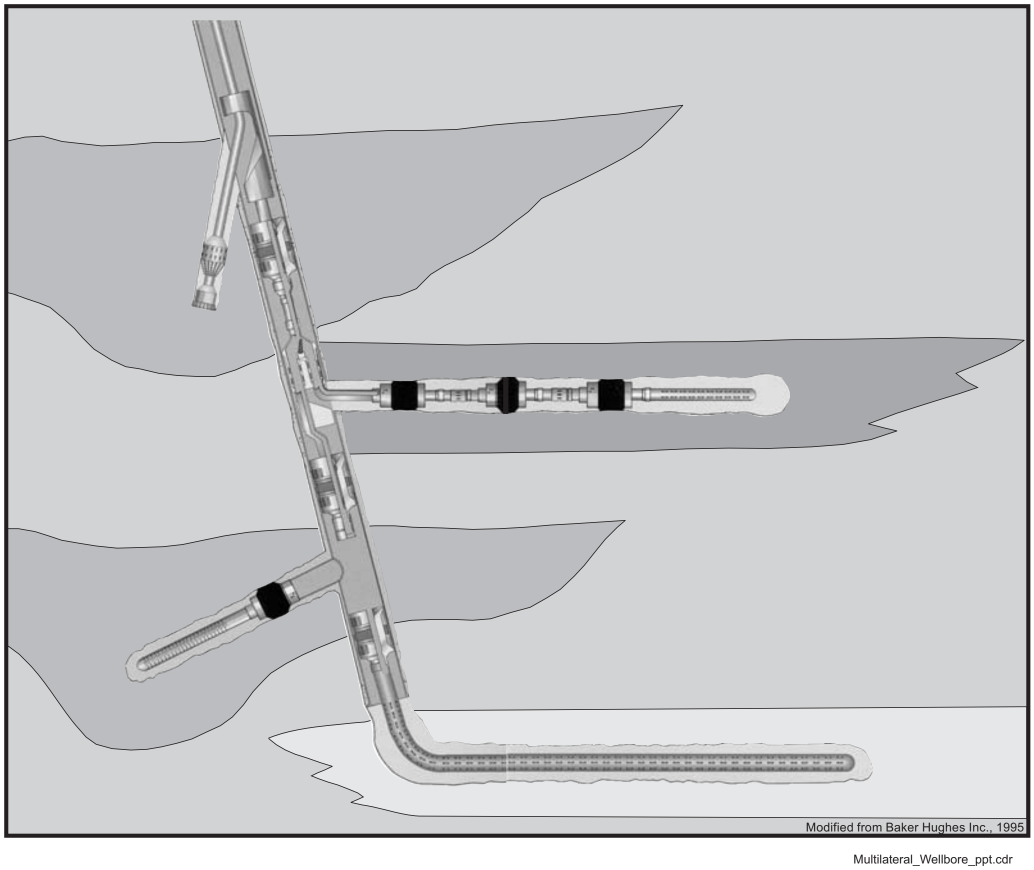
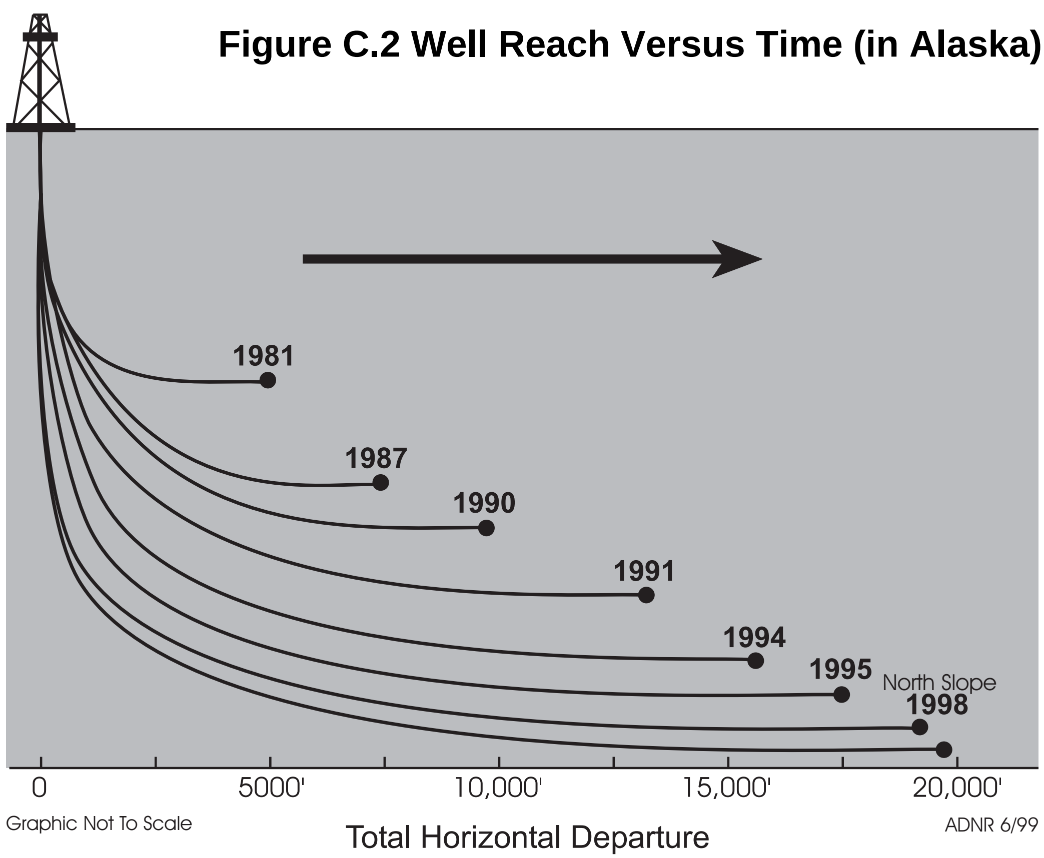


Figure C.2 Well Reach Versus Time (in Alaska)



Drillstring design for ERD involves: (1) determining expected loads; (2) selecting drillstring components; (3) verifying each component's condition; (4) setting operating limits for the rig team; and (5) monitoring condition during drilling. Economic and related issues in drillstring planning include cost, availability, and logistics. Rig and logistics issues include storage space, setback space, accuracy of load indicators, pump pressure and volume capacity, and top-drive output torque. Drill hole issues include hole cleaning, hole stability, hydraulics, casing wear, and directional objectives (Judzis *et al.*, 1997).

The working relationship between various components of a drill string must be analyzed carefully. Conventional drill stems are about 30 feet long and are made up of a bit, stabilizer, motor, a measurement-while-drilling (logging) tool, drill collars, more stabilizers, and jars. Typically there are more than 1,600 parts to a drill string in a 24,000-foot well. A modern drill string can be made up of hundreds of components from more than a dozen vendors. These components may not always perform as anticipated and may not meet operational demands of drilling an extended-reach well (JPT, 1994).

In a few cases, ERD technology has been used instead of platform installation off the coast of California, where wells are drilled from onshore locations to reach nearby offshore reserves. ERD has been instrumental in developing offshore reserves of the Sherwood reservoir under Poole Bay from shore at Wytch Farm, U.K. The original development plan called for the construction of a $260 million artificial island in the bay (JPT, 1994). ERD also has been used successfully in the North Sea, in the Gulf of Mexico, in the South China Sea, and in Alaska (Milne Point, Badami, Point McIntyre, Alpine, and Niakuk fields) (Judzis *et al.*, 1997).

Although a 6.6-mile horizontal displacement was accomplished in 1999 at Cullen Norte 1 well in Argentina (Halliburton, 1999), horizontal displacements (departure from vertical) of 0.5 to 2 miles are typical. In October 1998, BP set a long-reach record for horizontal directional wells in the U.S. with a displacement of 19,804 feet in the Niakuk field (see Figure E.2). Despite its $6 million price, the well represents a cost saving over the other drilling alternatives, such as construction of an offshore artificial gravel island (AJC, 1996).

Exploration wells within the license area may be directionally drilled because of a lack of suitable surface locations directly overlying exploration targets. However, until specific sites and development scenarios are advanced and the specific conditions of drill sites are known, the applicability of directional drilling for oil and gas within the license area is unknown. It is anticipated that most development wells will be directionally drilled because of the cost savings realized in pad construction and required facilities.

Many surface use conflicts can be avoided through directional drilling and ERD. However, some reservoirs are located or sized such that directional drilling cannot eliminate all possible conflicts.

Appendix D: Sample Competitive Oil and Gas Lease

Competitive Oil and Gas Lease
Form #DOG 200204 (rev. 10/2003)

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES

Competitive Oil and Gas Lease **ADL No.**

THIS LEASE is entered into , between the State of Alaska, "the state," and

"the lessee," whether one or more, whose sole address for purposes of notification is under Paragraph 25.

In consideration of the cash payment made by the lessee to the state, which payment includes the first year's rental and any required cash bonus, and subject to the provisions of this lease, including applicable stipulation(s) and mitigating measures attached to this lease and by this reference incorporated in this lease, the state and the lessee agree as follows:

1. GRANT. (a) Subject to the provisions in this lease, the state grants and leases to the lessee, without warranty, the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances in or under the following described tract of land:

containing approximately acres, more or less (referred to in this lease as the "leased area"); the nonexclusive right to conduct within the leased area geological and geophysical exploration for oil, gas, and associated substances; and the nonexclusive right to install pipelines and build structures on the leased area to find, produce, save, store, treat, process, transport, take care of, and market all oil, gas, and associated substances and to house and board employees in its operations on the leased area. The rights granted by this lease are to be exercised in a manner which will not unreasonably interfere with the rights of any permittee, lessee or grantee of the state consistent with the principle of reasonable concurrent uses as set out in Article VIII, Section 8 of the Alaska Constitution.

(b) For the purposes of this lease, the leased area contains the legal subdivisions as shown on the attached plat marked Exhibit A.

(c) If the leased area is described by protracted legal subdivisions and, after the effective date of this lease, the leased area is surveyed under the public land rectangular system, the boundaries of the leased area are those established by that survey, when approved, subject, however, to the provisions of applicable regulations relating to those surveys. If for any reason the leased area includes more acreage than the maximum permitted under applicable law (including the "rule of approximation" authorized in AS 38.05.145 and defined in AS 38.05.965 (18)), this lease is not void and the acreage included in the leased area must be reduced to the permitted maximum. If the state determines that the leased area exceeds the permitted acreage and notifies the lessee in writing of the amount of acreage that must be eliminated, the lessee has 60 days after that notice to surrender one or more legal subdivisions included in the leased area comprising at least the amount of acreage that must be eliminated. Any subdivision surrendered must be located on the perimeter of the leased area as originally described. If a surrender is not filed within 60 days, the state may terminate this lease as to the acreage that must be eliminated by mailing notice of the termination to the lessee describing the subdivision eliminated.

(d) If the State of Alaska's ownership interest in the oil, gas, and associated substances in the leased area is less than an entire and undivided interest, the grant under this lease is effective only as to the state's interest in that oil, gas, and associated substances, and the royalties and rentals provided in this lease must be paid to the state in the proportion that the state's interest bears to the entire undivided fee.

(e) The state makes no representations or warranties, express or implied, as to title, or access to, or quiet enjoyment of, the leased area. The state is not liable to the lessee for any deficiency in title to the leased area, nor is the lessee or any successor in interest to the lessee entitled to any refund due to deficiency in title for any rentals, bonuses, or royalties paid under this lease.

2. RESERVED RIGHTS. (a) The state, for itself and others, reserves all rights not expressly granted to the lessee by this lease. These reserved rights include, but are not limited to:

(1) the right to explore for oil, gas, and associated substances by geological and geophysical means;

(2) the right to explore for, develop, and remove natural resources other than oil, gas, and associated substances on or from the leased area;

(3) the right to establish or grant easements and rights-of-way for any lawful purpose, including without limitation for shafts and tunnels necessary or appropriate for the working of the leased area or other lands for natural resources other than oil, gas, and associated substances;

(4) the right to dispose of land within the leased area for well sites and well bores of wells drilled from or through the leased area to explore for or produce oil, gas, and associated substances in and from lands not within the leased area; and

(5) the right otherwise to manage and dispose of the surface of the leased area or interests in that land by grant, lease, permit, or otherwise to third parties.

(b) The rights reserved may be exercised by the state, or by any other person or entity acting under authority of the state, in any manner that does not unreasonably interfere with or endanger the lessee's operations under this lease.

3. TERM. This lease is issued for an initial primary term of 7 years from the effective date of this lease. The term may be extended as provided in Paragraph 4 below.

4. EXTENSION. (a) This lease will be extended automatically if and for so long as oil or gas is produced in paying quantities from the leased area.

(b) This lease will be extended automatically if it is committed to a unit agreement approved or prescribed by the state, and will remain in effect for so long as it remains committed to that unit agreement.

(c) (1) If the drilling of a well whose bottom hole location is in the leased area has commenced as of the date on which the lease otherwise would expire and is continued with reasonable diligence, this lease will continue in effect until 90 days after cessation of that drilling and for so long as oil or gas is produced in paying quantities from the leased area.

(2) If oil or gas in paying quantities is produced from the leased area, and if that production ceases at any time, this lease will not terminate if drilling or reworking operations are commenced on the leased area within six months after cessation of production and are prosecuted with reasonable diligence; if those drilling or reworking operations result in the production of oil or gas, this lease will remain in effect for so long as oil or gas is produced in paying quantities from the leased area.

(d) If there is a well capable of producing oil or gas in paying quantities on the leased area, this lease will not expire because the lessee fails to produce that oil or gas unless the state gives notice to the lessee, allowing a reasonable time, which will not be less than six months after notice, to place the well into production, and the lessee fails to do so. If production is established within the time allowed, this lease is extended only for so long as oil or gas is produced in paying quantities from the leased area.

(e) If the state directs or approves in writing a suspension of all operations on or production from the leased area (except for a suspension necessitated by the lessee's negligence), or if a suspension of all operations on or production from the leased area has been ordered under federal, state, or local law, the lessee's obligation to comply with any express or implied provision of this lease requiring operations or production will be suspended, but not voided, and the lessee shall not be liable for damages for failure to comply with that provision. If the suspension occurs before the expiration of the primary term, the primary term will be extended at the end of the period of the suspension by adding the period of time lost under the primary term because of the suspension. If the suspension occurs during an extension of the primary term under this paragraph, upon removal of that suspension, the lessee will have a reasonable time, which will not be less than six months after notice that the suspension has been removed, to resume operations or production. For the purposes of this subparagraph, any suspension of operations or production specifically required or imposed as a term of sale or by any stipulation made a part of this lease will not be considered a suspension ordered by law.

(f) If the state determines that the lessee has been prevented by force majeure, after efforts made in good faith, from performing any act that would extend the lease beyond the primary term, this lease will not expire during the period of force majeure. If the force majeure occurs before the expiration of the primary term, the primary term will be extended at the end of the period of force majeure by adding the period of time lost under the primary term because of the force majeure. If the force majeure occurs during an extension of the primary term under this paragraph, this lease will not expire during the period of force majeure plus a reasonable time after that period, which will not be less than 60 days, for the lessee to resume operations or production.

(g) Nothing in subparagraphs (e) or (f) suspends the obligation to pay royalties or other production or profit-based payments to the state from operations on the leased area that are not affected by any suspension or force majeure, or suspends the obligation to pay rentals.

5. RENTALS. (a) The lessee shall pay annual rental to the state in accordance with the following rental schedule:

(1) For the first year, $1.00 per acre or fraction of an acre;
(2) For the second year, $1.50 per acre or fraction of an acre;
(3) For the third year, $2.00 per acre or fraction of an acre;
(4) For the fourth year, $2.50 per acre or fraction of an acre;
(5) For the fifth year and following years, $3.00 per acre or fraction of an acre; provided that the state may increase the annual rental rate as provided by law upon extension of this lease beyond the primary term.

(b) Annual rental paid in advance is a credit on the royalty or net profit share due under this lease for that year.

(c) The lessee shall pay the annual rental to the State of Alaska (or any depository designated by the state with at least 60 days notice to the lessee) in advance, on or before the annual anniversary date of this lease. The state is not required to give notice that rentals are due by billing the lessee. If the state's (or depository's) office is not open for business on the annual anniversary date of this lease, the time for payment is extended to include the next day on which that office is open for business. If the annual rental is not paid timely, this lease automatically terminates as to both parties at 11:59 p.m., Alaska Standard Time, on the date by which the rental payment was to have been made.

6. RECORDS. The lessee shall keep and have in its possession books and records showing the development and production (including records of development and production expenses) and disposition (including records of sale prices, volumes, and purchasers) of all oil, gas, and associated substances produced from the leased area. The lessee shall permit the State of Alaska or its agents to examine these books and records at all reasonable times. Upon request by the state, the lessee's books and records shall be made available to the state at the state office designated by the state. These books and records of development, production, and disposition must employ methods and techniques that will ensure the most accurate figures reasonably available without requiring the lessee to provide separate tankage or meters for each well. The lessee shall use generally accepted accounting procedures consistently applied.

7. APPORTIONMENT OF ROYALTY FROM APPROVED UNIT. The landowners' royalty share of the unit production allocated to each separately owned tract shall be regarded as royalty to be distributed to and among, or the proceeds of it paid to, the landowners, free and clear of all unit expense and free of any lien for it. Under this provision, the state's royalty share of any unit production allocated to the leased area will be regarded as royalty to be distributed to, or the proceeds of it paid to, the state, free and clear of all unit expenses (and any portion of those expenses incurred away from the unit area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering,

saltwater disposal, and preparing oil, gas, or associated substances for transportation off the unit area, and free of any lien for them.

8. PAYMENTS. All payments to the State of Alaska under this lease must be made payable to the state in the manner directed by the state, and unless otherwise specified, must be tendered to the state at:

DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 1410
ANCHORAGE, ALASKA 99501-3561
ATTENTION: FINANCIAL SERVICES SECTION

or in person at either of the Department's Public Information Centers located at

550 W. 7th Ave., Suite 1260
Anchorage, Alaska

3700 Airport Way
Fairbanks, Alaska

or to any depository designated by the state with at least 60 days notice to the lessee.

9. PLAN OF OPERATIONS. (a) Except as provided in (b) of this section, a plan of operations for all or part of the leased area must be approved by the commissioner before any operations may be undertaken on or in the leased area.

(b) A plan of operations is not required for:

(1) activities that would not require a land use permit; or

(2) operations undertaken under an approved unit plan of operations.

(c) Before undertaking operations on or in the leased area, the lessee shall provide for full payment of all damages sustained by the owner of the surface estate as well as by the surface owner's lessees and permittees, by reason of entering the land.

(d) An application for approval of a plan of operations must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the commissioner to determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

(1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;

(2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;

(3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and

(4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas.

(e) In approving a lease plan of operations or an amendment of a plan, the commissioner will require amendments that the commissioner determines necessary to protect the state's interest. The commissioner will not require an amendment that would be inconsistent with the terms of sale under which the lease was obtained, or with the terms of the lease itself, or which would deprive the lessee of reasonable use of the leasehold interest.

(f) The lessee may, with the approval of the commissioner, amend an approved plan of operations.

(g) Upon completion of operations, the lessee shall inspect the area of operations and submit a report indicating the completion date of operations and stating any noncompliance of which the lessee knows, or should reasonably know, with requirements imposed as a condition of approval of the plan.

(h) In submitting a proposed plan of operations for approval, the lessee shall provide ten copies of the plan if activities proposed are within the coastal zone, and five copies if activities proposed are not within the coastal zone.

10. PLAN OF DEVELOPMENT. (a) Except as provided in subparagraph (d) below, within 12 months after certification of a well capable of producing oil, gas, or associated substances in paying quantities, the lessee shall file two copies of an application for approval by the state of an initial plan of development that must describe the lessee's plans for developing the leased area. No development of the leased area may occur until a plan of development has been approved by the state.

(b) The plan of development must be revised, updated, and submitted to the state for approval annually before or on the anniversary date of the previously approved plan. If no changes from an approved plan are contemplated for the following year, a statement to that effect must be filed for approval in lieu of the required revision and update.

(c) The lessee may, with the approval of the state, subsequently modify an approved plan of development.

(d) If the leased area is included in an approved unit, the lessee will not be required to submit a separate lease plan of development for unit activities.

11. INFORMATION ACQUIRED FROM OPERATIONS. (a) The lessee shall submit to the state all geological, geophysical and engineering data and analyses obtained from the lease within 30 days following the completion of a well. The lessee shall submit to the state data and analyses acquired subsequent to well completion within 30 days following acquisition of that data. The state may waive receipt of operational data from some development, service or injection wells. The state will inform the operator of the waiver prior to well completion. The lessee shall submit the data and analyses to the Division of Oil and Gas, Department of Natural Resources, at the location specified in paragraph 25 of this lease. The data and analyses shall include the following:

(1) a copy of the completion report (AOGCC form 10-407) with an attached well summary, including daily drilling reports, formation tops encountered, a full synopsis of drillstem and formation testing data, an identification of zones of abnormal pressure, oil and gas shows and cored intervals;

(2) latitudinal and longitudinal coordinates for the <u>completed</u> surface and bottom hole locations;

(3) a copy of the permit to drill (AOGCC form 10-401 only, additional documentation not required) and the survey plat of the well location;

(4) a paper copy (no sepia copies) of all final 2-inch open hole and cased hole logs, including measured depth and true-vertical depth versions, specialty logs (such as Schlumberger's cyberlook, formation microscanners and dipmeter logs), composite mud or lithology log and report, measured-while-drilling (MWD) and logged-while-drilling (LWD) logs, velocity and directional surveys;

(5) a digital version of well logs in LAS, LIS or ASCII format on IBM format floppy disks, a digital version of velocity surveys in SEG Y format, a digital version of directional surveys in ASCII format (other formats may be acceptable upon agreement with the Division of Oil and Gas); and

(6) a paper copy of all available well analyses, including geochemical analyses, core analyses (porosity, permeability, capillary pressure, photos, and descriptions), paleontologic and palynologic analyses, thermal maturation analyses, pressure build up analyses, and fluid PVT analyses (an ASCII format digital version of the above information shall also be submitted, if available). The state may require the lessee to submit additional information in accordance with the applicable statutes and regulations in effect at the time of the completion date of the well.

(b) Any information submitted to the state by the lessee in connection with this lease will be available at all times for use by the state and its agents. The state will keep information confidential as provided in AS 38.05.035(a)(9) and its applicable regulations. In accordance with AS 38.05.035(a)(9)(C), in order for geological, geophysical and engineering information submitted under paragraph 11(a) of this lease to be held confidential, the lessee must request confidentiality at the time the information is submitted. The information must be marked **CONFIDENTIAL.**

12. DIRECTIONAL DRILLING. This lease may be maintained in effect by directional wells whose bottom hole location is on the leased area but that are drilled from locations on other lands not covered by this lease. In those circumstances, drilling will be considered to have commenced on the leased area when actual drilling is commenced on those other lands for the purpose of directionally drilling into the leased area. Production of oil or gas from the leased area through any directional well surfaced on those other lands, or drilling or reworking of that directional well, will be considered production or drilling or reworking operations on the leased area for all purposes of this lease. Nothing contained in this paragraph is intended or will be construed as granting to the lessee any interest, license, easement, or other right in or with respect to those lands in addition to any interest, license, easement, or other right that the lessee may have lawfully acquired from the state or from others.

13. DILIGENCE AND PREVENTION OF WASTE. (a) The lessee shall exercise reasonable diligence in drilling, producing, and operating wells on the leased area unless consent to suspend operations temporarily is granted by the state.

(b) Upon discovery of oil or gas on the leased area in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geologic structure at another location with a reasonable profit to the operator, the lessee must drill those wells as a reasonable and prudent operator would drill, having due regard for the interest of the state as well as the interest of the lessee.

(c) The lessee shall perform all operations under this lease in a good and workmanlike manner in accordance with the methods and practices set out in the approved plan of operations and plan of development, with due regard for the prevention of waste of oil, gas, and associated substances and the entrance of water to the oil and gas-bearing sands or strata to the destruction or injury of those sands or strata, and to the preservation and conservation of the property for future productive operations. The lessee shall carry out at the lessee's expense all orders and requirements of the State of Alaska relative to the prevention of waste and to the preservation of the leased area. If the lessee fails to carry out these orders, the state will have the right, together with any other available legal recourse, to enter the leased area to repair damage or prevent waste at the lessee's expense.

(d) The lessee shall securely plug in an approved manner any well before abandoning it.

14. OFFSET WELLS. The lessee shall drill such wells as a reasonable and prudent operator would drill to protect the state from loss by reason of drainage resulting from production on other land. Without limiting the generality of the foregoing sentence, if oil or gas is produced in a well on other land not owned by the State of Alaska or on which the State of Alaska receives a lower rate of royalty than under this lease, and that well is within 500 feet in the case of an oil well or 1,500 feet in the case of a gas well of lands then subject to this lease, and that well produces oil or gas for a period of 30 consecutive days in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geological structure at an offset location with a reasonable profit to the operator, and if, after notice to the lessee and an opportunity to be heard, the state finds that production from that well is draining lands then subject to this lease, the lessee shall within 30 days after written demand by the state begin in good faith and diligently prosecute drilling operations for an offset well on the leased area. In lieu of drilling any well required by this paragraph, the lessee may, with the state's consent, compensate the state in full each month for the estimated loss of royalty through drainage in the amount determined by the state.

15. UNITIZATION. (a) The lessee may unite with others, jointly or separately, in collectively adopting and operating under a cooperative or unit agreement for the exploration, development, or operation of the pool, field, or like area or part of the pool, field, or like area that includes or underlies the leased area or any part of the leased area whenever the state determines and certifies that the cooperative or unit agreement is in the public interest.

(b) The lessee agrees, within six months after demand by the state, to subscribe to a reasonable cooperative or unit agreement that will adequately protect all parties in interest, including the state. The state reserves the right to prescribe such an agreement.

(c) With the consent of the lessee, and if the leased area is committed to a unit agreement approved by the state, the state may establish, alter, change, or revoke drilling, producing, and royalty requirements of this lease as the state determines necessary or proper to secure the proper protection of the public interest.

(d) Except as otherwise provided in this subparagraph, where only a portion of the leased area is committed to a unit agreement approved or prescribed by the state, that commitment constitutes a severance of this lease as to the unitized and nonunitized portions of the leased area. The portion of the leased area not committed to the unit will be treated as a separate and distinct lease having the same effective date and term as this lease and may be maintained only in accordance with the terms and conditions of this lease, statutes, and regulations. Any portion of the leased area not committed to the unit agreement will not be affected by the unitization or pooling of any other portion of the leased area, by operations in the unit, or by suspension approved or ordered for the unit. If the leased area has a well certified as capable of production in paying quantities on it before commitment to a unit agreement, this lease will not be severed. If any portion of this lease is included in a participating area formed under a unit agreement, the entire leased area will remain committed to the unit and this lease will not be severed.

16. INSPECTION. The lessee shall keep open at all reasonable times, for inspection by any duly authorized representative of the State of Alaska, the leased area, all wells, improvements, machinery, and fixtures on the leased area, and all reports and records relative to operations and surveys or investigations on or with regard to the leased area or under this lease. Upon request, the lessee shall furnish the State of Alaska with copies of and extracts from any such reports and records.

17. SUSPENSION. The state may from time to time direct or approve in writing suspension of production or other operations under this lease.

18. ASSIGNMENT, PARTITION, AND CONVERSION. This lease, or an interest in this lease, may, with the approval of the state, be assigned, subleased, or otherwise transferred to any person or persons qualified to hold a lease. No assignment, sublease, or other transfer of an interest in this lease, including assignments of working or royalty interests and operating agreements and subleases, will be binding upon the state unless approved by the state. The

lessee shall remain liable for all obligations under this lease accruing prior to the approval by the state of any assignment, sublease, or other transfer of an interest in this lease. All provisions of this lease will extend to and be binding upon the heirs, administrators, successors, and assigns of the state and the lessee. Applications for approval of an assignment, sublease, or other transfer must comply with all applicable regulations and must be filed within 90 days after the date of final execution of the instrument of transfer. The state will approve a transfer of an undivided interest in this lease unless the transfer would adversely affect the interests of Alaska or the application does not comply with applicable regulations. The state will disapprove a transfer of a divided interest in this lease if the transfer covers only a portion of the lease or a separate and distinct zone or geological horizon unless the lessee demonstrates that the proposed transfer of a divided interest is reasonably necessary to accomplish exploration or development of the lease, the lease is committed to an approved unit agreement, the lease is allocated production within an approved participating area, or the lease has a well certified as capable of production in paying quantities. The state will make a written finding stating the reasons for disapproval of a transfer of a divided interest. Where an assignment, sublease, or other transfer is made of all or a part of the lessee's interest in a portion of the leased area, this lease may, at the option of the state or upon request of the transferee and with the approval of the state, be severed, and a separate and distinct lease will be issued to the transferee having the same effective date and terms as this lease.

19. SURRENDER. The lessee at any time may file with the state a written surrender of all rights under this lease or any portion of the leased area comprising one or more legal subdivisions or, with the consent of the state, any separate and distinct zone or geological horizon underlying the leased area or one or more legal subdivisions of the leased area. That surrender will be effective as of the date of filing, subject to the continued obligations of the lessee and its surety to make payment of all accrued royalties and to place all wells and surface facilities on the surrendered land or in the surrendered zones or horizons in condition satisfactory to the state for suspension or abandonment. After that, the lessee will be released from all obligations under this lease with respect to the surrendered lands, zones, or horizons.

20. DEFAULT AND TERMINATION; CANCELLATION. (a) The failure of the lessee to perform timely its obligations under this lease, or the failure of the lessee otherwise to abide by all express and implied provisions of this lease, is a default of the lessee's obligations under this lease. Whenever the lessee fails to comply with any of the provisions of this lease (other than a provision which, by its terms, provides for automatic termination), and fails within 60 days after written notice of that default to begin and diligently prosecute operations to remedy that default, the state may terminate this lease if at the time of termination there is no well on the leased area capable of producing oil or gas in paying quantities. If there is a well on the leased area capable of producing oil or gas in paying quantities, this lease may be terminated by an appropriate judicial proceeding. In the event of any termination under this subparagraph, the lessee shall have the right to retain under this lease any and all drilling or producing wells for which no default exists, together with a parcel of land surrounding each well or wells and rights-of-way through the leased area that are reasonably necessary to enable the lessee to drill, operate, and transport oil or gas from the retained well or wells.

(b) The state may cancel this lease at any time if the state determines, after the lessee has been given notice and a reasonable opportunity to be heard, that:

(1) continued operations pursuant to this lease probably will cause serious harm or damage to biological resources, to property, to mineral resources, or to the environment (including the human environment);

(2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and

(3) the advantages of cancellation outweigh the advantages of continuing this lease in effect. Any cancellation under this subparagraph will not occur unless and until operations under this lease have been under suspension or temporary prohibition by the state, with due extension of the term of this lease, continuously for a period of five years or for a lesser period upon request of the lessee.

(c) Any cancellation under subparagraph (b) will entitle the lessee to receive compensation as the lessee demonstrates to the state is equal to the lesser of:

(1) the value of the cancelled rights as of the date of cancellation, with due consideration being given to both anticipated revenues from this lease and anticipated costs, including costs of compliance with all applicable regulations and stipulations, liability for clean-up costs or damages, or both, in the case of an oil spill, and all other costs reasonably anticipated under this lease; or

(2) the excess, if any, over the lessee's revenues from this lease (plus interest on the excess from the date of receipt to date of reimbursement) of all consideration paid for this lease and all direct expenditures made by the lessee after the effective date of this lease and in connection with exploration or development, or both, under this lease, plus interest on that consideration and those expenditures from the date of payment to the date of reimbursement.

21. RIGHTS UPON TERMINATION. Upon the expiration or earlier termination of this lease as to all or any portion of the leased area, the lessee will be directed in writing by the state and will have the right at any time within a period of one year after the termination, or any extension of that period as may be granted by the state, to remove from the leased area or portion of the leased area all machinery, equipment, tools, and materials. Upon the expiration of that period or extension of that period and at the option of the state, any machinery, equipment, tools, and materials that the lessee has not removed from the leased area or portion of the leased area become the property of the state or may be removed by the state at the lessee's expense. At the option of the state, all improvements such as roads, pads, and wells must either be abandoned and the sites rehabilitated by the lessee to the satisfaction of the state, or be left intact and the lessee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. Subject to the above conditions, the lessee shall deliver up the leased area or those portions of the leased area in good condition.

22. DAMAGES AND INDEMNIFICATION. (a) No rights under the AS 38.05.125 reservation may be exercised by the lessee until the lessee has provided to pay the owner of the land, his lessees and permittees, upon which the AS 38.05.125 reserved rights are sought to be exercised, full payment for all damage sustained by the owner by reason of entering the land. If the owner for any reason does not settle the damages, the lessee may enter the land after posting a surety bond determined by the state, after notice and an opportunity to be heard, to be sufficient as to form, amount, and security to secure to the owner, his lessees and permittees, payment for damages, and may institute legal proceedings in a court of competent jurisdiction where the land is located to determine the damages which the owner of the land may suffer. The lessee agrees to pay for any damages that may become payable under AS 38.05.130 and to indemnify the state and hold it harmless from and against any claims, demands, liabilities, and expenses arising from or in connection with such damages. The furnishing of a bond in compliance with this paragraph will be regarded by the state as sufficient provision for the payment of all damages that may become payable under AS 38.05.130 by virtue of this lease.

(b) The lessee shall indemnify the state for, and hold it harmless from, any claim, including claims for loss or damage to property or injury to any person caused by or resulting from any act or omission committed under this lease by or on behalf of the lessee. The lessee is not responsible to the state under this subparagraph for any loss, damage, or injury caused by or resulting from the sole negligence of the state.

(c) The lessee expressly waives any defense to an action for breach of a provision of this lease or for damages resulting from an oil spill or other harm to the environment that is based on an act or omission committed by an independent contractor in the lessee's employ. The lessee expressly agrees to assume responsibility for all actions of its independent contractors.

23. BONDS. (a) If required by the state, the lessee shall furnish a bond prior to the issuance of this lease in an amount equal to at least $5 per acre or fraction of an acre contained in the leased area, but no less than $10,000, and must maintain that bond as long as required by the state.

(b) The lessee may, in lieu of the bond required under (a) above, furnish and maintain a statewide bond in accordance with applicable regulations.

(c) The state may, after notice to the lessee and a reasonable opportunity to be heard, require a bond in a reasonable amount greater than the amount specified in (a) above where a greater amount is justified by the nature of the surface and its uses and the degree of risk involved in the types of operations being or to be carried out under this lease. A statewide bond will not satisfy any requirement of a bond imposed under this subparagraph, but will be considered by the state in determining the need for and the amount of any additional bond under this subparagraph.

(d) If the leased area is committed in whole or in part to a cooperative or unit agreement approved or prescribed by the state, and the unit operator furnishes a statewide bond, the lessee need not maintain any bond with respect to the portion of the leased area committed to the cooperative or unit agreement.

24. AUTHORIZED REPRESENTATIVES. The Director of the Division of Oil and Gas, Department of Natural Resources, State of Alaska, and the person executing this lease on behalf of the lessee shall be authorized representatives for their respective principals for the purposes of administering this lease. The state or the lessee may change the designation of its authorized representative or the address to which notices to that representative are to be sent by a notice given in accordance with Paragraph 25 below. Where activities pursuant to a plan of operations are underway, the lessee shall also designate, pursuant to a notice under Paragraph 25 below, by name, job title, and address, an agent who will be present in the state during all lease activities.

25. NOTICES; PROTEST. (a) Any notices required or permitted under this lease must be by electronic media producing a permanent record or in writing and must be given personally or by registered or certified mail, return receipt requested, addressed as follows:

TO THE STATE:

DIRECTOR, DIVISION OF OIL AND GAS
DEPARTMENT OF NATURAL RESOURCES
550 WEST 7TH AVENUE, SUITE 800
ANCHORAGE, ALASKA 99501-3560

TO THE LESSEE:

(b) Any notice given under this paragraph will be effective when delivered to the above authorized representative.

(c) A lessee who wishes to protest the amount of money due the state under the lease or any action of the state regarding a provision of this lease must file a written protest with the Division of Oil and Gas within 30 days after the mailing date of the state's notice or bill. A lessee who fails to file a protest within the required time waives any further right to protest. The state will establish the administrative appeal procedure to be followed and will inform the lessee of the procedure no later than 30 days after the filing of the written protest.

26. STATUTES AND REGULATIONS. This lease is subject to all applicable state and federal statutes and regulations in effect on the effective date of this lease, and insofar as is constitutionally permissible, to all statutes and regulations placed in effect after the effective date of this lease. A reference to a statute or regulation in this lease includes any change in that statute or regulation whether by amendment, repeal and replacement, or other means. This lease does not limit the power of the State of Alaska or the United States of America to enact and enforce legislation or to promulgate and enforce regulations affecting, directly or indirectly, the activities of the lessee or its agents in connection with this lease or the value of the interest held under this lease. In case of conflicting provisions, statutes and regulations take precedence over this lease.

27. INTERPRETATION. This lease is to be interpreted in accordance with the rules applicable to the interpretation of contracts made in the State of Alaska. The paragraph headings are not part of this lease and are inserted only for convenience. The state and the lessee expressly agree that the law of the State of Alaska will apply in any judicial proceeding affecting this lease.

28. INTEREST IN REAL PROPERTY. It is the intention of the parties that the rights granted to the lessee by this lease constitute an interest in real property in the leased area.

29. WAIVER OF CONDITIONS. The state reserves the right to waive any breach of a provision of this lease, but any such waiver extends only to the particular breach so waived and does not limit the rights of the state with respect to any future breach; nor will the waiver of a particular breach prevent cancellation of this lease for any other cause or for the same cause occurring at another time. Notwithstanding the foregoing, the state will not be deemed to have waived a provision of this lease unless it does so in writing.

30. SEVERABILITY. If it is finally determined in any judicial proceeding that any provision of this lease is invalid, the state and the lessee may jointly agree by a written amendment to this lease that, in consideration of the provisions in that written amendment, the invalid portion will be treated as severed from this lease and that the remainder of this lease, as amended, will remain in effect.

31. LOCAL HIRE. The lessee is encouraged to hire and employ local and Alaska residents and companies, to the extent they are available and qualified, for work performed on the leased area. Lessees shall submit, with the plans of operations, a proposal detailing the means by which the lessee will comply with this measure. The lessee is encouraged, in formulating this proposal, to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

32. CONDITIONAL LEASE. If all or a part of the leased area is land that has been selected by the state under laws of the United States granting lands to the state, but the land has not been patented to the state by the United States, then this lease is a conditional lease as provided by law until the patent becomes effective. If for any reason the

selection is not finally approved, or the patent does not become effective, any rental, royalty, or other production or profit-based payments made to the state under this lease will not be refunded.

33. NONDISCRIMINATION. The lessee and the lessee's contractors and subcontractors may not discriminate against any employee or applicant because of race, religion, marital status, change in marital status, pregnancy, parenthood, physical handicap, color, sex, age, or national origin as set out in AS 18.80.220. The lessee and its contractors and subcontractors must, on beginning any operations under this lease, post in a conspicuous place notices setting out this nondiscrimination provision.

34. DEFINITIONS. All words and phrases used in this lease are to be interpreted where possible in the manner required in respect to the interpretation of statutes by AS 01.10.040. However, the following words have the following meanings unless the context unavoidably requires otherwise:

(1) "oil" means crude petroleum oil and other hydrocarbons, regardless of gravity, that are produced in liquid form by ordinary production methods, including liquid hydrocarbons known as distillate or condensate recovered by separation from gas other than at a gas processing plant;

(2) "gas" means all natural gas (except helium gas) and all other hydrocarbons produced that are not defined in this lease as oil;

(3) "associated substances" means all substances except helium produced as an incident of production of oil or gas by ordinary production methods and not defined in this lease as oil or gas;

(4) "drilling" means the act of boring a hole to reach a proposed bottom hole location through which oil or gas may be produced if encountered in paying quantities, and includes redrilling, sidetracking, deepening, or other means necessary to reach the proposed bottom hole location, testing, logging, plugging, and other operations necessary and incidental to the actual boring of the hole;

(5) "reworking operations" means all operations designed to secure, restore, or improve production through some use of a hole previously drilled, including, but not limited to, mechanical or chemical treatment of any horizon, plugging back to test higher strata, etc.;

(6) "paying quantities" means quantities sufficient to yield a return in excess of operating costs, even if drilling and equipment costs may never be repaid and the undertaking considered as a whole may ultimately result in a loss; quantities are insufficient to yield a return in excess of operating costs unless those quantities, not considering the costs of transportation and marketing, will produce sufficient revenue to induce a prudent operator to produce those quantities; and

(7) "force majeure" means war, riots, acts of God, unusually severe weather, or any other cause beyond the lessee's reasonable ability to foresee or control and includes operational failure of existing transportation facilities and delays caused by judicial decisions or lack of them.

35. ROYALTY ON PRODUCTION. Except for oil, gas, and associated substances used on the leased area for development and production or unavoidably lost, the lessee shall pay to the state as a royalty 12.50 percent in amount or value of the oil, gas, and associated substances saved, removed, or sold from the leased area and of the gas from the leased area used on the leased area for extraction of natural gasoline or other products.

36. VALUE. (a) For the purposes of computing royalties due under this lease, the value of royalty oil, gas, or associated substances shall not be less than the highest of:

(1) the field price received by the lessee for the oil, gas, or associated substances;

(2) the volume-weighted average of the three highest field prices received by other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices reported by other producers, the volume-weighted average will be calculated using the lesser number of prices received by other producers in the field or area;

(3) the lessee's posted price in the field or area for the oil, gas, or associated substances; or

(4) the volume-weighted average of the three highest posted prices in the same field or area of the other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices posted by other producers, the volume-weighted average will be calculated using the lesser number of prices posted by other producers in the field or area.

(b) If oil, gas, or associated substances are sold away from the leased or unit area, the term "field price" in subparagraph (a) above will be the cash value of all consideration received by the lessee or other producer from the purchaser of the oil, gas, or associated substances, less the lessee's actual and reasonable costs of transportation away from the leased or unit area to the point of sale. The "actual and reasonable costs of transportation" for marine transportation are as defined in 11 AAC 83.229(a), (b)(2), and (c) - l.

(c) In the event the lessee does not sell in an arm's-length transaction the oil, gas, or associated substances, the term "field price" in subparagraphs (a) and (b) above will mean the price the lessee would expect to receive for the oil, gas, or associated substances if the lessee did sell the oil, gas, or associated substances in an arm's-length transaction, minus reasonable costs of transportation away from the leased or unit area to the point of sale or other disposition. The lessee must determine this price in a consistent and logical manner using information available to the lessee and report that price to the state.

(d) The state may establish minimum values for the purposes of computing royalties on oil, gas, or associated substances obtained from this lease, with consideration being given to the price actually received by the lessee, to the price or prices paid in the same field or area for production of like quality, to posted prices, to prices received by the lessee and/or other producers from sales occurring away from the leased area, and/or to other relevant matters. In establishing minimum values, the state may use, but is not limited to, the methodology for determining "prevailing value" as defined in 11 AAC 83.227. Each minimum value determination will be made only after the lessee has been given notice and a reasonable opportunity to be heard. Under this provision, it is expressly agreed that the minimum value of royalty oil, gas, or associated substances under this lease may not necessarily equal, and may exceed, the price of the oil, gas, or associated substances.

37. ROYALTY IN VALUE. Except to the extent that the state elects to receive all or a portion of its royalty in kind as provided in Paragraph 38 below, the lessee shall pay to the state that value of all royalty oil, gas, and associated substances as determined under Paragraph 36 above. Royalty paid in value will be free and clear of all lease expenses (and any portion of those expenses that is incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area. All royalty that may become payable in money to the State of Alaska must be paid on or before the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances are produced. The amount of all royalty in value payments which are not paid when due under this lease or the amount which is subsequently determined to be due to the state or the lessee as the result of a redetermination will bear interest from the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances were produced, until the obligation is paid in full. Interest shall accrue at the rate provided in AS 38.05.135(d) or as may later be amended. Royalty payments must be accompanied by such information relating to valuation of royalty as the state may require which may include, but is not limited to, run tickets, evidence of sales, shipments, and amounts of gross oil, gas, and associated substances produced.

38. ROYALTY IN KIND. (a) At the state's option, which may be exercised from time to time upon not less than 90 days' notice to the lessee, the lessee shall deliver all or a portion of the state's royalty oil, gas, or associated substances produced from the leased area in kind. Delivery will be on the leased area, unit area, or at a place mutually agreed to by the state and the lessee, and must be delivered to the State of Alaska or to any individual, firm, or corporation designated by the state.

(b) Royalty oil, gas, or associated substances delivered in kind must be delivered in good and merchantable condition, of pipeline quality, and free and clear of all lease expenses (and any portion of those expenses incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area.

(c) After having given notice of its intention to take, or after having taken its royalty oil, gas, or associated substances in kind, the state, at its option and upon 90 days' notice to the lessee, may elect to receive a different portion or none of its royalty in kind. If, under federal regulations, the taking of royalty oil, gas, or associated substances in value by the state creates a supplier-purchaser relationship, the lessee hereby waives its right to continue to receive royalty oil, gas, or associated substances under that relationship, and further agrees that it will require any purchasers of the royalty oil, gas, or associated substances likewise to waive any supplier-purchaser rights.

(d) The lessee shall furnish storage for royalty oil, gas, and associated substances produced from the leased or unit area to the same extent that the lessee provides storage for the lessee's share of oil, gas, and associated substances. The lessee shall not be liable for the loss or destruction of stored royalty oil, gas and associated substances from causes beyond the lessee's ability to control.

(e) If a state royalty purchaser refuses or for any reason fails to take delivery of oil, gas, or associated substances, or in an emergency, and with as much notice to the lessee as is practical or reasonable under the circumstances, the state may elect without penalty to underlift for up to six months all or a portion of the state's royalty on oil, gas, or associated substances produced from the leased or unit area and taken in kind. The state's right to underlift is limited to the portion of royalty oil, gas, or associated substances that the royalty purchaser refused or failed to take delivery of, or the portion necessary to meet the emergency condition. Underlifted oil, gas, or associated substances may be recovered by the state at a daily rate not to exceed 10 percent of its royalty interest share of daily production at the time of the underlift recovery.

39. REDUCTION OF ROYALTY. Lessee may request a reduction of royalty in accordance with the applicable statutes and regulations in effect on the date of application for the reduction.

40. EFFECTIVE DATE. This lease takes effect on   .

BY SIGNING THIS LEASE, the state as lessor and the lessee agree to be bound by its provisions.

STATE OF ALASKA

By: ______________________________________
Mark D. Myers
Director, Division of Oil and Gas

STATE OF ALASKA)
) ss.
Third Judicial District)

On   , before me appeared Mark D. Myers of the Division of Oil and Gas of the State of Alaska, Department of Natural Resources, and who executed this lease and acknowledged voluntarily signing it on behalf of the State of Alaska as lessor.

____
Notary public in and for the State of Alaska
My commission expires September 28, 2007

LESSEE: ______________________________________

Signature: ______________________________________

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: ____

Signature: ____

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: ____

Signature: ____

Printed Name/Title: ________________________________

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

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[i] The office of Habitat Management and Permitting (OHMP) of the Alaska Department of Natural Resources became the Divison of Habitat, a part of the Alaska Department of Fish and Game (ADF&G), effective July 1, 2008, as a result of Executive Order 114.