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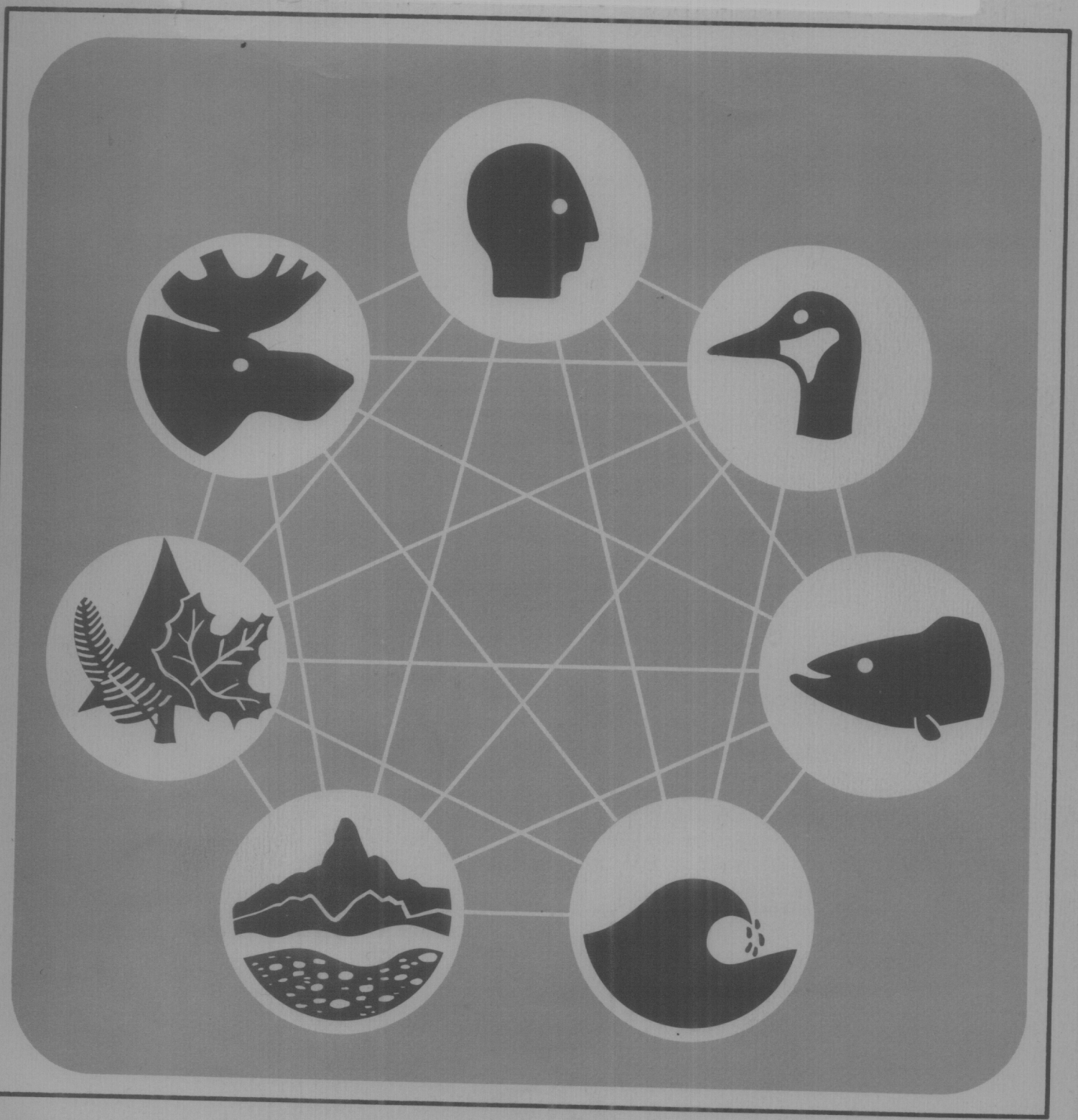
A COMPREHENSIVE STUDY OF PAST AND POTENTIAL LAND USE

IN AREA "A", PROPOSED TUKTOYAKTUK LAND FREEZE



A COMPREHENSIVE STUDY OF PAST AND POTENTIAL LAND USE IN AREA "A", PROPOSED TUKTOYAKTUK LAND FREEZE

Prepared for:

Department of Indian Affairs
and Northern Development
Ottawa, Ontario

Prepared by:

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This study comprises three volumes: a main study report, an appendix volume and a map supplement. The main study report presents our conclusions and recommendations for resolving traditional and industrial land use conflicts in Area "A", Proposed Tuktoyaktuk Land Freeze. The appendix volume contains much of the background information on biological characteristics and traditional land use used in developing the main study report. The maps described in the appendix volume are presented in the map supplement.

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SUMMARY

This report identifies eight areas regarded as critical in maintaining present use of Area "A" fish and wildlife resources, and an additional seven areas regarded as critical in maintaining potential resource harvest opportunities in Area "A".

Many potentials for adverse impact from oil and gas exploration and development activities within these areas are identified. For the most part, these impacts are regarded as mitigable through existing land-use regulations if appropriate operating conditions are applied to land-use permits and if enforcement of operating conditions is adequate.

We have identified operating conditions which should be applied to land use permits for activities in critical areas. These are mainly concerned with the timing of activities, methods used, and specific locations of activities. Certain exploration and development activities are regarded as incompatible, however, since no means for mitigating their impact is known. Generally, these include such things as water-based drilling programs and the configuration and site specific location of certain infrastructure components such as permanent roads, compressor stations, etc.

Two critical areas are highlighted as areas of particular concern, namely the upper and middle Eskimo Lakes and Cape Bathurst. The former is a favoured recreation area

for Tuktoyaktuk residents and we have recommended that no water-based exploration and development activities be permitted in these waters.

With respect to Cape Bathurst, we do not regard exploratory activities to be a particular concern in this area so long as appropriate operating conditions are applied to land use permits. We do, however, forsee the potential for adverse impacts on caribou should a producing field be discovered on Cape Bathurst and the necessary infrastructure (above-ground pipelines, permanent roads, etc.) be developed. The nature and extent of this impact would depend upon the precise location and configuration of the infrastructure, however, and this cannot be predicted at this time.

As a consequence, we conclude that exploration activity could only proceed in Cape Bathurst area at the peril of not being able to bring a proven field into production. That is, there would be a calculated risk for proponents of exploration activity in this area.

Even though we consider exploratory activity not to be damaging on Cape Bathurst, we do recognize that this area is held in special regard by some Tuktoyaktuk residents and consequently proposals to carry out any program there are likely to be regarded negatively as they have been in the past.

Much of Area "A" has not, on the basis of existing information, been classified as critical for present or potential use of Area "A" fish and widlife resources. We

forsee limited potential for adverse impacts on traditionally harvested fish and wildlife resources as a result of exploration and development activities in these areas. This of course presupposes that such activity is conducted in a manner consistent with sound land use practices as normally stipulated in operating conditions applied to land use permits.

We concluded that it was not necessary to identify operating conditions which should be applied to land use permits covering exploration and development activities in areas not regarded as critical. We also did not forsee the need to prohibit any of the types of exploration and development activities which might be anticipated within these areas.

Although attention in this study was focussed on potential adverse impacts of exploration and development activities on current harvest levels, we briefly aluded to the implications of local population growth on traditional resource harvesting activities. On the basis of the limited information available we concluded that local population growth, due both to natural population increase and in-migration, will probably give rise to increased harvest of renewable resources and could result in excessive pressure on local fish and wildlife populations within Area "A".

ACKNOWLEDGEMENTS

Many people from government, industry, and Tuktoyaktuk have been helpful in providing information and advice during the preparation of this report. We express appreciation and thanks to them all. Particularly we would like to acknowledge the biological and harvest information offered by Drs. J.G. Hunter and D.E. Sergeant of the Arctic Biological Station; R. Barnes (Inuvik) and D. Dowler (Yellowknife) of Fisheries and Marine Service; G. Williams (Inuvik) and V.D. Hawley (Edmonton) of the Canadian Wildlife Service; K. Davidge (Aklavik), Dr. G. Calef, B. Wong, R.B. Hall and R.B. Tinling (Yellowknife) all with the Northwest Territories Government; K.P. Whitten of the Alaska Department of Fish and Game; M. Fraker of F.F. Slaney and Co. Ltd; Gillian Earl (Calgary) of Gulf Oil Canada Limited; and Dr. R. Riewe of the University of Manitoba. Information on the present system of land use regulation was given by C.J. Cuddy, G.T. Glazier, and D. Longlitz (Yellowknife) and B. VendHoen (Inuvik), all with the Land Use Section of Indian Affairs and Northern Development; and J. Howell of Canadian Arctic Resources Committee. M. Ratuski of Gulf Oil Canada Limited in Calgary, and I. Bishko of Northern Geophysical Ltd. in Calgary were particularly helpful in providing insight to technical aspects of petroleum exploration and development. F. Schwartz, formerly with the Inuit Land Use and Occupancy Project, assisted in finding project

data at the Public Archives in Ottawa. Finally, and most importantly, we thank Jonah Carpenter, Bobby Chicksi, Charlie Gruben, and Alphonse Voudrack for their participation in an intensive review of our mapped information of animal distributions and traditional land use patterns. We would also like to thank all the residents of Tuktoyaktuk who took the time to review the background materials and discuss the study with us.

Interpretations of data and conclusions of this report are the sole responsibility of the authors.

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STUDY OBJECTIVES AND PROBLEM REVIEW

Study Objectives

The purpose of this study is to develop guidelines for controlling land use in Area "A", Proposed Tuktoyaktuk Land Freeze (Figure 1). Of particular concern is ensuring that existing and potential opportunities to practice traditional pursuits (hunting, trapping, fishing) are not impaired by oil and gas exploration and development activities.

Specific study objectives are:

1. to identify the extent to which portions of Area "A" are currently used for hunting, fishing and trapping (last 5 to 10 years); the extent of existing utilization (cash income, food supply) including consideration of the habitat needed to maintain the fish and wildlife resources used by man.

2. to identify the past, present and potential exploration and development activity in Area "A", and to identify potential conflicts between such activity and current hunting, trapping and fishing by local residents.

3. to identify areas within Area "A" where exploration and development could occur without detriment to traditional pursuits as currently practised. Acceptability must be determined by considering cumulative as well as immediate impact.

4. to identify specific conditions that might be used in permits regulating exploration and development activities in areas where a potential for conflict has been identified.

5. to identify areas in which no clear priority can be given to any single use and in which normal regulating procedures should be followed.

It is important to note at the outset that since several factors are not taken into account in this study, the findings presented here do not provide a complete basis for land use regulation in Area "A". First, this study restricts consideration to the living resources of Area "A". Although certain land use controls are required and can be instituted in Area "A" to ensure the integrity of fish and wildlife populations while they occupy the area, some species use lands outside the study area during critical life history phases. For example, most of the caribou which migrate through and calve in Area "A" winter outside the study area. Similarly certain goose populations which stage in the study area nest and winter outside the study area.

Second, only those species traditionally utilized by Inuit hunters, trappers and fishermen as a source of food and income are addressed in this study. Consequently the potential for impact on species not traditionally harvested, including rare and endangered species, was not considered.

Third, sites of historical and cultural significance, such as archaeological sites, burial grounds, and traditional camp sites, have not been considered.

Fourth, the reindeer herd was not considered since this herding enterprise does not fall under the definition of traditional use. For purposes of this study traditional

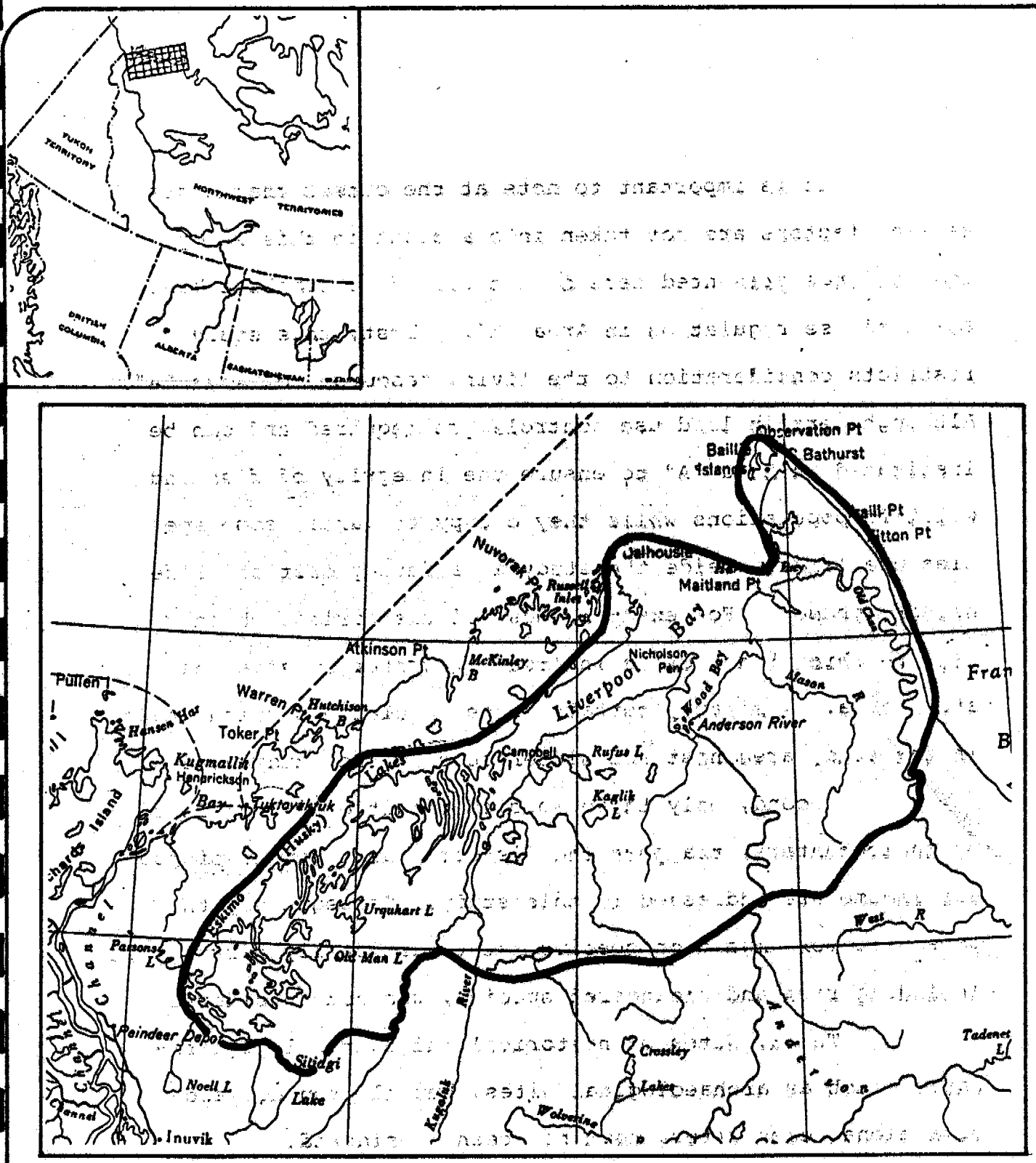

Fig. 1 LOCATION OF AREA "A" - PROPOSED TUKTOYAKTUK LAND FREEZE

use is defined as including hunting, trapping, and fishing activities that have been engaged in by local residents at least since the beginning of the fur trade era. For the most part, the objective of these traditional activities is to acquire food or cash income from the harvest of living resources. At times, however, these resources are used more for recreational purposes. Recreational use, where and when it occurs, is regarded as "traditional use" in this study.

Problem Review

Conflict in Area "A" came to the fore in April, 1972 when Elf Oil Exploration and Production Canada Ltd. applied for a land use permit to conduct a summer seismic program on Cape Bathurst. Concern was expressed by various member agencies of the Land Use Advisory Committee (LUAC), the Committee for Original People's Entitlement (COPE), and the Tuktoyaktuk Hamlet Council, that unacceptable damage to the environment could result from the proposed activity. It was felt that if this environmental damage occurred it could hinder or perhaps eliminate the livelihood of some Tuktoyaktuk residents. On these grounds the application was refused.

Elf Oil subsequently reapplied for permission to conduct a winter seismic program on Cape Bathurst from October to December, 1972; this application was approved by the Canadian Wildlife Service (CWS) and other member agencies of the LUAC. Some native people, however, still

perceived Elf's proposed winter program as a potential hazard. Fears expressed by the Inuit Tapirisat of Canada (ITC), COPE, and the Tuktoyaktuk Hamlet Council, persuaded the Minister of Indian Affairs and Northern Development (DIAND) to delay for one year a decision regarding this application and the permittee's obligations under their existing oil and gas permit for the area were postponed by an Order-in-Council.

At the same time, the Minister requested that a study be carried out to: examine the environmental concerns expressed by the Tuktoyaktuk residents and native organizations, apprise him of the state of knowledge on area wildlife resources, and recommend specific controls and guidelines which might be applied to regulate exploration and development activity in the Cape Bathurst area.

A "revised" report on the findings of that study, carried out by the Canadian Wildlife Service, was published in July 1975. In the interim, oil and gas permit obligations were postponed by annual Orders-in-Council. In essence, therefore, a moratorium on exploration and development activity has applied on Cape Bathurst since 1972.

During this period, native organizations had become increasingly active in pressing for a land claims settlement and had received a favourable judgement on an application to file a caveat on lands they were claiming. However, the judgement called for the filing of such a caveat only after all possible appeals from the judgement

had been completed or the time for launching them had expired. Government proceeded with an appeal and, as a result of this action, the native organizations asked the Minister what might be done to ensure that a measure of protection was provided for the lands identified in the various claims until such time as negotiations on land claims could be carried out. The Minister indicated that a total freeze on all lands being claimed was not acceptable but did suggest that there might well be some places of special significance to native people which should be given individual consideration. More specifically, the Minister conveyed the following message to the president of ITC, 28 November 1974. "I am referring to locations which may have particular cultural, historic, or local value for which special protection could be arranged so that disturbance would not occur without full prior consultation. I think that this approach, if you agree, could afford reasonable protection of individual parcels of land pending the outcome of any settlement."

In May 1975, in response to this initiative, COPE proposed three areas for individual attention and special protection. The largest of these was Area "A" - Proposed Tuktoyaktuk Land Freeze, an area of about 11,000 square miles in the Eskimo Lakes-Liverpool Bay and Cape Bathurst region. This proposal was endorsed by the Tuktoyaktuk Hamlet Council.

COPE asserted that the proposed land freeze area avoided all known high potential lands for oil and gas discovery, a view not shared by industry. The basic position

adopted was that all exploration and development activity be excluded from Area "A", and that it be preserved as a traditional hunting and trapping area. This position was in opposition to DIAND's policy of multiple land use and DIAND contended that environmental concerns could be adequately dealt with by the Territorial Land Use Regulations. Departmental officials further indicated that the intent of the Minister had not been to entertain proposals to freeze large blocks of land. Rather, it had been to consider small discrete parcels of land, such as burial grounds, for special protection. Both COPE and the ITC expressed their opposition to this position contending that Area "A", in its entirety, was valuable to the traditional pursuits of local people. DIAND's willingness to provide guarantees respecting such things as burial grounds were seen as marginal considerations compared to the value of the total area to native people. They further contended that the Land Use Regulations were inadequate as a tool for preserving this environment.

While the Minister did not accept the land freeze proposal, he did agree to extend the moratorium on Cape Bathurst to May 31, 1976, at which time he outlined proposals for the future. Generally, these proposals took the form of multiple land use in Area "A", with preference given to traditional use over industrial pursuits.

On October 1976, Atlantic Richfield applied for a land use permit in Area "A", followed by an application by Gulf Oil to conduct seismic work in the Eskimo Lakes area.

Tuktoyaktuk Hamlet Council and the Inuvik Town Council voiced no objection to the Gulf application. However, opposition to it was registered by COPE and the Tuktoyaktuk Hunters and Trappers Association, also via COPE. In response to this opposition, the Minister, in February 1977, endorsed a six-month land freeze in area "A", until such time as further studies could be done.

At present, a lack of unanimity of opinion appears to exist with regard to: (1) the adequacy of existing Land Use Regulations in controlling exploration and development, (2) the imputed value of Area "A" for traditional versus industrial pursuits, and (3) the designation of a responsible authority to represent local interests.

With respect to the adequacy of existing land use regulations, DIAND has steadfastly maintained that they are adequate for ensuring that exploration and development activity does not result in irreparable damage to the environment. Generally, local residents seem to agree that land use practices have improved greatly since land use regulations were first implemented. Nonetheless, earlier abuses and reckless land use practices are vivid memories for area residents. The land use regulations are not without their critics, however, but much of the criticism seems to focus not so much on the intent or adequacy of the regulations themselves as it does on the adequacy of their enforcement.

With respect to differences in opinion about the imputed value of Area "A" for traditional versus industrial pursuits, COPE, as stated earlier, contends that the lands within Area "A" do not possess high potential for gas and oil discovery. Industry does not share this view, and government geologists regard much of the area covered by the land freeze proposal as having moderate potential for oil and gas discovery.

When the boundaries of Area "A" were defined, many areas used by Tuktoyaktuk residents were not included. The core marten trapping area around Crossley Lakes, for example, was excluded from Area "A". The boundaries of Area "A" were clearly selected in an attempt to protect the watershed of Eskimo Lakes and the lands of Cape Bathurst. Over much of this area it is recognized and admitted locally that there is very little utilization of living resources.

Much of the controversy over the imputed value of traditional use seems to have centred on Eskimo Lakes. In part this may stem from confusion surrounding the nature and extent of the use in this area. There appears to be little question that the upper and middle Eskimo Lakes, and particularly the latter, are an important fishing area for Tuktoyaktuk residents. Fishing there is not so much for food as it is for recreation, however.

With respect to the problem of who represents local interests there is no clear answer. The elected Hamlet Council is obviously regarded as the representative authority within hamlet boundaries but their authority or

right to speak on behalf of Tuktoyaktuk residents concerning land use matters in the hinterland of the settlement has been challenged by the Hunters and Trappers Association. A review of miscellaneous pronouncements and transcripts of news media interviews with residents of Tuktoyaktuk also makes it abundantly clear that within particular local organizations opinion varies and changes from time to time. An understanding of "who represents whose interests" is further confounded by the periodic involvement and pronouncements of COPE and ITC, the regional and national Inuit organizations respectively. Both organizations at times purport to speak on behalf of local residents. Periodically, however, their right to do so or the accuracy of their pronouncements has been challenged locally.

With the recent establishment of an outpost camp at North Star Harbour, another group has to be reckoned with. We believe that most Tuktoyaktuk residents regard North Star Harbour residents as the legitimate or primary spokesmen regarding land use on Cape Bathurst.

In devising our study approach, we attempted to take account of these diverse views and interest groups.

STUDY APPROACH

Introduction

The approach adopted for this study first involved documenting, via maps and catalogue entries, traditional use of fish and wildlife resources (hunting, trapping, fishing), and biologically important areas (habitats), for traditionally harvested species, within Area "A". This information was subsequently verified with local residents.

A list of activities characterizing petroleum exploration and development was prepared and, within a matrix, potential effects of these different activities on traditionally harvested species were portrayed.

Areas considered critical in maintaining currently harvested fish and wildlife populations were delineated next and the potential short- and long-term impacts of moderate or high severity identified within the aforementioned matrix were addressed for each critical area. Finally, we identified exploration and development activities requiring special attention (controls) or which should be prohibited in each area critical to present use. This same procedure was repeated for areas considered biologically critical in maintaining fish and wildlife resources of potential value for use. In the case of potential use areas, concern was

confined to consideration of potential long-term impacts of moderate or high severity.

The above aspects of our approach and the underlying rationale are discussed more fully below.

Determination of Traditional Use

The Inuit Land Use and Occupancy Project information was used to develop an initial understanding of traditional use of Area "A" resources. This information for the Tuktoyaktuk area was compiled by GOPE on behalf of ITC, and, like all of the Inuit Land Use and Occupancy Project information, is deposited in the Public Archives, Ottawa. Only that information relating to more recent patterns of traditional use by Tuktoyaktuk residents (1955-1974) was used. The only source materials of use compiled by the Project not available for review were land use maps for individual Tuktoyaktuk residents. These maps, by agreement with respondents, are to remain confidential for five years.

The terms of reference for this study require that traditional use of Area "A" resources for the last 5 to 10 years be considered. Since the most recent information on traditional use compiled for the Inuit Land Use and Occupancy Project in the Tuktoyaktuk area is aggregated for a 20-year period, it was necessary to ascertain the change which may have occurred in use patterns during the last 10 years. This was accomplished via intensive review of our current land use maps with a small group of active hunters

and trappers, and more general discussions with a cross section of Tuktoyaktuk residents.

In addition to the above, harvest information was compiled from the available records maintained by the Northwest Territories Government for the period 1966-67 to 1975-76.

A detailed commentary on the history and status of traditional land use patterns and resource harvest, accompanied by supporting data in map, catalogue, and tabular format, is presented in the traditional land use and resource harvest data sections of the appendix volume to this report.

Documentation of Biological Characteristics of Traditionally Harvested Species

Biologically important areas for traditionally harvested species were identified from available literature, by personal communication with government resource workers, and through discussions with those who use the resources. Particular attention was focused on areas considered critical during various life history phases of traditionally harvested species, e.g. colonial nesting areas for waterfowl, caribou calving grounds, and areas critical to fish life histories.

Details on the biological characteristics of the study area for the species supporting traditional use are presented in maps and supporting catalogue entries in the appendix volume of this report.

Verification of Current Traditional Use and Biological Characteristics Information

Having reviewed and mapped all available information on the biological characteristics of the study area and patterns of traditional use, we verified this information with residents of both Tuktoyaktuk and North Star Harbour. The maps were given intensive scrutiny during a two-day review session with four area residents who are or have been active hunters and trappers. As a result of this review we were able to identify land use pattern changes during the last 10 years and to verify certain areas biologically important for harvested species.

Maps incorporating modifications made as a result of the above consultation were then placed on display in the Tuktoyaktuk community hall for three afternoons and two evenings. All interested residents were invited to visit the hall to have the study explained to them, and examine and comment on the maps. A particular effort was made to encourage active hunters and trappers to view the maps, but the general public was also urged to come and discuss our findings. About 25 to 30 residents viewed the maps and informally discussed the study.

Delineation of Critical Areas

Two types of areas regarded as critical for maintaining traditional use were delineated -- areas critical for present use and areas critical for potential use.

Areas regarded as critical in maintaining the populations and distribution patterns of currently harvested fish and wildlife populations were first delineated. These areas possess one or more of the following characteristics: the area is important for some particular life history phase of a species, large numbers of a particular species or group of species use the area during a particular life history phase, or species using the area are particularly vulnerable during the time they occupy the area. These areas are shown on a map (Figure 3) presented in Chapter 4 of this report. Detail on the critical areas is presented in catalogue entries accompanying the aforementioned map.

Areas regarded as critical for maintaining populations of traditionally harvested species, not currently used, were next delineated. These areas and associated populations are those considered significant for potential use. These critical areas are shown on a map (Figure 4) presented in Chapter 5 of this report. Additional detail is presented in accompanying catalogue entries.

Identification and Description of Exploration and Development Activities

The types of activities associated with each phase of exploration and development (seismic, exploratory drilling, production, transmission) were identified. This listing of activities was based on our own understanding of exploration and development as well as information provided to us by industry in response to our queries.

A brief description of each exploration and development activity was prepared. In all cases these descriptions attempt to specify the methods and timing of each activity, and they reflect what we understand to be "normal" practice. This information is contained in the appendix volume of this report.

Identification of Potential Exploration and Development Impacts

Since the potential of Area "A" for gas and oil discovery remains largely unproven, the ultimate nature, extent, and specific location of exploration and development activity is presently unknown. Consequently, we took the view that exploration and development activity could proceed from a preliminary seismic investigation through an exploration drilling program to the development of a producing field, with all its associated infrastructure, almost anywhere within the study area.

The potential for exploration and development activity to adversely affect species supporting traditional use was then addressed within a matrix. Exploration and development activities comprised the vertical axis of the matrix while the horizontal axis was comprised of sensitive life history phases of the species supporting traditional use. Within the matrix, only potential impacts of moderate and high severity are noted. Impacts are further differentiated as short- or long-term in duration. The matrix is also presented in the appendix volume of this report.

We considered an impact to be of moderate severity if it could result in a perceptible change in a population or distribution pattern. If a population is not being harvested heavily, however, an impact of moderate severity might not be reflected in total harvest, but greater effort might be required to attain a pre-impact level of harvest. On the other hand, if a resource is being harvested at or near capacity, an impact of moderate severity could result in decreased harvest.

We considered an impact to be of high severity if it could result in a readily noticeable change in a population or distribution pattern. This level of impact is likely to be reflected in total harvest. That is, not only would more effort have to be expended in an attempt to maintain a pre-impact level of harvest, but, even having expended the extra effort, there may well be a shortfall in harvest.

The differentiation made between a potential impact of moderate and high severity is a subjective one. The biological and use information available provides little or no basis for ascertaining whether or not any particular population is being harvested at or near capacity. For example, reliable census information (fish and wildlife numbers), populations dynamics studies, and harvest records (quantities harvested and time series) are not available.

With respect to impact duration, we regard a short-term impact as one where populations or distribution patterns will revert, in less than 3 years, to a pre-impact

condition. A long-term impact we therefore regarded as one whose effect persists for more than 3 years.

Both short- and long-term impacts of moderate and high severity were considered for populations currently utilized. For those populations not currently utilized but possessing good potential for expanded human use, only long-term impacts of moderate and high severity were considered.

CHAPTER 3

PAST, PRESENT, AND POTENTIAL LAND USE IN AREA "A"

This chapter provides a brief discussion of past, present and potential land-use in Area "A". This is discussed under two headings, traditional land use, which is concerned with the trapping, hunting and fishing activity of native peoples, and industrial land use, which is concerned with the exploration and development activities of industry, primarily the petroleum industry.

Traditional Land Use

Trapping, hunting, and fishing by Tuktoyaktuk and North Star Harbour residents occurs over much of Area "A". Arctic and coloured (red) fox are the major furbearers in Area "A" and are trapped over much of the area. Other major furbearers are polar bear, taken mainly in the Baillie Island-northern Cape Bathurst area; marten, taken south of the treeline in the Kugaluk and Anderson River areas; and muskrats, taken in the areas surrounding Eskimo Lakes. Wolves are taken throughout the area whenever encountered but they are relatively few in number.

Caribou are the major game species and are hunted over a large portion of the area from the Kugaluk River to northern Cape Bathurst. Moose are hunted in the Kugaluk,

Moose, Anderson, and Horton River valleys and around Sitigi Lake although very few are currently harvested. Seals are taken in Harrowby Bay but again harvests are relatively low. Geese and ducks are major game species and are hunted around Eskimo Lakes, in the Kugaluk, Moose, Smoke, and Mason River deltas and around Harrowby Bay.

Domestic and recreational fishing and occasionally commercial fishing occurs in Eskimo Lakes. Some domestic fishing occurs in the Kugaluk, Anderson, and Horton Rivers, in Wood Bay, and in several small inland lakes.

Details of trapping, hunting, and fishing areas are provided on the current land use maps in the supplement to the appendix volume of this report. Catalogue sheets accompanying these maps describe seasonality, intensity, and other aspects of land use.

We have mapped only land use within Area "A" although a much larger area is used by local residents. The total area of land currently used by local hunters and trappers is not significantly different from the area used by hunters and trappers living in the region before 1955. It extends east of Area "A" into Amundsen Gulf, south of Area "A" to the Crossley Lakes area, and west of Area "A" along the west coast of Mackenzie Bay. Usher (1976a) observes that, since the introduction of the snowmobile, Tuktoyaktuk people are now apparently covering traditional hunting areas as effectively from one settlement as they did many years ago from various camps.

We collected harvest data to determine the importance of hunting, trapping, and fishing to area residents

and to determine the relative distribution of harvest among the most active hunters and trappers. Harvest levels over the current 10-year period for many species (arctic and coloured (red) fox, polar bear, caribou, geese, ducks, and whales) are generally higher than, or as high as, harvest levels over the previous two 10-year periods, whereas harvest levels for marten, muskrats, moose, and seals have declined considerably. Individual harvest records indicate that a relatively small group of hunters-trappers account for a high percentage of moose, polar bear, caribou, marten, and muskrat harvest, whereas goose and duck hunting is a widespread activity which is practiced by a majority of local residents.

Every native resident must obtain a General Hunting License each year in order to be allowed to hunt or trap. Based on records, the number of General Hunting Licenses issued increased by 67% from 1966 to 1976 and 32% from 1971 to 1976. The corresponding increases in population during this period were 46% and 12% respectively, indicating that an increasing percentage of residents are obtaining licenses and thus are hunting or trapping. With increases in the population of Tuktoyaktuk in the future, we anticipate there will be corresponding increases in hunting and trapping and hence increased demand for fish and wildlife resources.

The degree to which increased harvest will be for satisfying basic food and income requirements, providing supplementary food and income, or deriving recreational

satisfaction cannot be predicted, however. Ultimately this will depend upon the nature and extent of alternative income opportunities available to local residents and their predisposition to a wage economy versus a traditional resource harvesting lifestyle.

We have estimated total cash and in-kind income for Tuktoyaktuk and North Star Harbour residents from fur and game harvest in 1976 as $275,900. However, this estimate is based on fur and game harvest records which have many significant sources of error. It also omits many sources of income including in-kind income from domestic fish harvest, in-kind income from game and fish used for dog food, in-kind income from animal products used for clothing, and cash income from local sales of handicrafts made from animal products. If these factors are considered, the total cash and in-kind income could be $100,000 or more greater than our estimate. Details of harvest data and income from fur and game harvest are presented in the appendix volume to this report.

Industrial Land Use

Between 1971 and the present, the main exploration and development activities in Area "A" have been seismic and exploratory drilling operations. Our calculations show that during this period about 9.88 square miles or 6323 acres of Area "A" were directly affected by seismic activity. This represents about 0.089 percent of the total study area which

encompasses an estimated 11,117 square miles or 7,114,880 acres. The location and relative intensity of activity since 1971 is shown in Fig. 2.

Records of exploration and development activity prior to 1971, when Land Use Regulations were first instituted, are incomplete and not readily available. Some older applications we reviewed and other information provided to us by industry indicate that considerable exploration activity, primarily seismic activity, was carried out in Area "A" prior to 1971. We regard as unlikely, however, the possibility that seismic activity in the area prior to 1971 exceeds that which has been carried out since 1971. At the present time, several land use applications for Area "A" are held in abeyance. According to information provided to us by DIAND, these include: Atlantic Richfield Canada Ltd.'s application for a permit (October 1976) to conduct a seismic program in the upper and middle Eskimo Lakes area, Gulf Oil Canada Limited's application to carry out a land-based seismic program within that portion of Area "A" lying south of the uppermost Eskimo Lake, Gulf Oil Canada Ltd's. application (April 1976) to carry out a seismic program north of Hans Bay, and Elf Oil Exploration and Production Canada Ltd.'s longstanding application (September 1972) to carry out a seismic program on Cape Bathurst.

The above applications are the best indication available of the general areas industry regards as having potential for oil and gas discovery. The only other

area of potential interest which might be added to the above is the area lying to the west of Anderson River and south of Liverpool Bay.

Generally, the oil and gas division of DIAND has rated the hydrocarbon potential of the study area as moderate except for that portion lying in the vicinity of the eastern Eskimo Lakes, including the fingers area, the Kugaluk River drainage, and the area south of upper Eskimo Lakes. These general areas are rated low potential hydrocarbon areas.

Given the very general nature of the available information on hydrocarbon potential, it is impossible to predict, with any confidence, the potential location and magnitude of future exploration and development activity in Area "A". As a consequence we have had to anticipate that exploration and development activity might proceed to the production phase almost anywhere within Area "A".

It is our understanding that no exploration or development activity of consequence, other than that associated with the petroleum industry, is anticipated within the study area. At the same time, we recognize that plans exist for construction of an all-weather road connecting Inuvik and Tuktoyaktuk. If the alignment of this road provides access to Eskimo Lakes, use of these waters by anglers from Inuvik is likely to increase, as is summer use by residents of Tuktoyaktuk.

Although it is impossible to accurately predict how much renewable resource use would increase as a result of enhanced access we would nonetheless suggest that, given

the generally low productivity of northern waters, and the alleged decline in trout catches which has already occurred at Eskimo Lakes, it is probable that the increased use, which would follow from improved access, would further deplete trout stocks.

We also recognize the presence of low grade coal resources in the study area. We are, however, not aware of any information which would suggest that development of these resources is likely in the foreseeable future.

If subsequent oil and gas exploration activity in the vicinity of Area "A" does reveal development potential, and if this potential is tapped, there will be a migration of personnel to the area to operate and maintain production facilities. For example, preliminary estimates for the Gulf Oil development at Parsons Lake suggest that a permanent work force of 65 to 130 persons might be anticipated there.

With increases in population due to the in-migration of personnel to operate oil and gas developments, there is likely to be an interest in harvesting local fish and game resources and this could result in excessive pressures on local fish and wildlife populations.

It is impossible to predict the potential implications of local population growth at this time, however, for the following reasons:

1. any prediction of the magnitude of local population growth which might be anticipated as a result of in-migration would be premature given the relatively poor understanding of area development potential.

2. the potential implications of oil and gas development in the area for resident employment opportunities is unknown,

3. the future propensity of local residents to harvest the fish and game resources of the area cannot be predicted, and

4. the magitude of the renewable resource base available for harvest and the degree to which the existing harvest approximates the maximum sustainable yield is unknown.

The above notwithstanding we suggest that if, at some future date, an increase in demand for and use of fish and wildlife resources of the area by in-migrants is regarded with alarm by the local native populations, it may be necessary for government to delineate fishing and hunting zones for native use exclusively. The native peoples themselves may be able to accomplish this, however, assuming that land claims are resolved and implemented in such a fashion that control of land use on lands "owned" by native residents rests with them.

CRITICAL AREAS FOR PRESENT USE OF AREA "A"

FISH AND WILDLIFE RESOURCES

In all, we have identified eight areas which we regard as critical for sustaining current traditional use in Area "A". Some of these are single discrete land or water units, some are comprised of several discrete land or water units where the same potential for impact exists, and one unit is divided into several sub-units on the basis of animal life-history phase implications.

The areas considered critical in supporting presently harvested fish and wildlife resources are shown on Figure 3. As indicated in the approach section of this report, these critical areas were identified, for the most part, on the basis of biological considerations. In focusing primarily on biological factors, we are suggesting that resource harvest will be largely unimpaired if effective land-use controls can be devised and implemented to ensure that fish and wildlife populations will remain relatively unaffected.

The most noteable exception to the above is the fishery at Eskimo Lakes. This appears to be primarily a recreational fishery for Tuktoyaktuk residents. From all reports, the annual spring trek to Eskimo Lakes, to "jiggle" for trout, is an event looked forward to with much antici-

pation by the people of Tuktoyaktuk. It heralds the coming of spring and is regarded as their holiday. There is therefore a strong and undeniable emotional attachment to this area similar to the attitude toward parks and favoured recreating areas that one might expect to find among residents of most southern Canadian communities.

For each area delineated on Figure 3, there follow catalogue sheets which summarize the biological description, resource harvest, potential impacts, data gaps, and conclusions. References indicated by reference numbers on the catalogue sheets are listed at the back of this volume.

The conclusion section for each critical area identifies those exploration and development activities regarded as potentially detrimental to fish and wildlife populations. Most of these impacts can be mitigated via existing land use regulations if appropriate operating conditions are specified and adequately enforced. Some activities, however, are regarded as totally incompatible and unmitigable; consequently, we recommend that they not be permitted.

Summary of Conclusions

Our conclusions regarding the compatibility of exploration and development activity and traditional use, as detailed in the accompanying catalogue sheets, may be briefly summarized as follows: few problems associated with oil and gas exploration and development programs are anticipated. The few exploration and test-drilling activities

regarded as potentially harmful can be controlled, for the most part, by existing regulations if appropriate operating conditions are attached to land use permits.

The most serious problems anticipated are those associated with water-based drilling programs, specifically blowouts, and with the infrastructure required to bring a proven field into production, process the product, and move it to an oil or gas trunk line for transmission to market.

We fully recognize that blowouts are regarded as low probability events and that the probability of an exploration and development program within any area being carried to its final conclusion - a producing field - is also low. Nonetheless, the possibility of these events and series of activities occuring cannot be disregarded, for each initiative taken in an exploration and development program is taken in the hope that positive results will be attained and activity may proceed through subsequent phases to development of a producing field.

Our conclusions and recommendations for the specific critical areas shown on Figure 3 are summarized below.

Area 1: Upper and Middle Eskimo Lakes. We forsee limited potential for exploration and development activites affecting the fish resources of these waterbodies assuming appropriate operating conditions are specified on land use permits and enforcement is adequate. The possible exceptions to the above are blowouts at water-based drilling sites and ruptures of underwater oil pipeline gathering

systems or oil pipelines at major tributary river crossings. Nonetheless, we recommend no exploration and development activity be permitted in these waterbodies because of their perceived importance to Tuktoyaktuk residents as a recreational resource. However, we do not regard Gulf Oil's proposed development of docking facilities on Hans Bay or the movement of limited barge traffic through Eskimo Lakes, assuming no dredging, in this category.

Area 2: Kugaluk Estuary. In this area we forsee potential for several adverse impacts upon traditionally used fish resources. In all instances, however, we feel these potential impacts can be controlled if operating conditions applied to land use permits are appropriately drafted and adequately enforced.

Area 3: Small Inland Lakes (noted for lake trout and whitefish). Several potential sources of impact are envisaged but are regarded as controllable if existing land use regulations are applied and effectively enforced. Certain water-based activities, namely exploratory drilling and explosive seismic operations, should not be permitted in these lakes, however.

Area 4: Smoke and Moose River Deltas, Campbell and Thumb Islands. A number of potential sources of impact are identified for this area. Of particular concern is the timing and specific location of activities which could result in a fouling of critical waterfowl nesting and molting habitat. Also of concern is the location of in-

frastructure relative to brant nesting colonies and project-related activity near these colonies when birds are present.

Area 5: Mason River Valley and Delta. As with Area 4 above, concerns here focus on the degradation of critical molting areas and disturbance or destruction of brant nesting colonies. Our conclusions for this area are essentially the same as those for Area 4.

Area 6: Old Horton River Channel and South Shore of Harrowby Bay. We are restricted in properly evaluating impacts for this area because of the lack of data on numbers and seasonal distribution of waterfowl. Nonetheless, the limited information available leads us to conclude that restrictions similar to those defined in Area 4 should be applied.

Areas 7A through E: Cape Bathurst and Most of Area "A" South of Eskimo Lakes, Liverpool Bay and East of Kugaluk River. This very extensive area encompasses a number of areas used by caribou during different life history phases, namely migration, calving, summer grazing, and wintering. Little impact on these life history phases is anticipated anywhere in the area from exploration and test drilling activity, assuming that these are winter operations and avoid any local areas where caribou are present. The potential for major impacts is seen to be more associated with development of a producing field. More particularly, concern centres on widespread activity and infrastructure development in areas regarded as critical for calving or post-calving aggregations and development of major infra-

structure elements, primarily collector lines and permanent roads, across areas used by caribou in migrating between calving and summering grounds on Cape Bathurst and winter ranges further south. A detailed appraisal of impact, especially in this area, would have to await detailed information on location and design of production and transmission infrastructure in the area. Since Cape Bathurst is a particularly important area for caribou and caribou are an important resource to area residents, it is perhaps appropriate to point out that, in our view, some residents of Tuktoyaktuk will remain opposed to any exploration and development activity on Cape Bathurst regardless of any assurances that all precautions will be taken to ensure that no environmental damage occurs.

Area 8, Harrowby Bay. Concern in this area centres on the probability of blowouts at water-based drilling operations. Concerns about other exploration and development activities displacing or killing seals can be mitigated through drafting and enforcing appropriate operating conditions respecting the timing of such activities.

An examination of Figure 3 reveals that no critical areas are identified for some traditionally harvested species. For example, no areas are identified for fox. The reason for this is that the only exploration and development activity considered potentially detrimental to fox is gravel extraction from land features where fox denning is concentrated. However, even this activity would probably have

only a relatively short-term impact on fox populations as long as alternative denning habitat is sufficiently abundant. Similarly, although whitefront and Canada goose nesting occurs within some critical areas, it was not the presence of this nesting activity which led to the critical designation and few concerns respecting the nesting of these species are enumerated since, unlike snow geese and brant which nest in colonies, whitefront and Canada goose nests are relatively dispersed.

CATALOGUE SHEETS FOR FIGURE 3

CRITICAL AREAS FOR PRESENT USE - FISH

AREA 1A & 1B: MIDDLE AND UPPER ESKIMO LAKES

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Lake trout	Spawning, feeding, overwintering	Moderate	All year
Whitefish	Spawning, feeding, overwintering	Moderate	All year

Notes:
- the major lake trout populations of the entire study are are in these lakes
- lake trout in Eskimo Lakes are largely confined to west of 132° 30' (the narrows southeast of Tuktoyaktuk).
- spawning areas of lake trout and whitefish are unidentified but are likely along shorelines and reefs.
- fish movements within and between lakes are not well understood.
- fish abundance is less here than in southern waters, but greater than in small inland lakes of the study area (64).

RESOURCE HARVEST

Type of Harvest: Domestic, recreational, commercial fishing

Season:
Domestic, recreational - spring, primarily Mid-April to late May (5,23,43)
Commercial - summer or early fall

Intensity:
Domestic, recreational - very high during the spring "jiggling" season
Commercial - very low and occasional

Notes:
Domestic, recreational - Eskimo Lakes are a very important spring "jiggling" area to almost all Tuktoyaktuk residents. Spring "jiggling", in association with camping and goose hunting, is seen as an important "holiday" by Tuktoyaktuk residents (16,43,93). Based on observed and recorded campsite locations (16,35,60,93), area 1A is more important than area 1B. Only the eastern part of 1B is important for spring "jiggling". (See Current Land Use - Fish, Area 1).

Commercial - One commercial fisherman from Inuvik occasionally fishes the upper lake (3), but catches have been low. Commerical quotas are established for 1976/77 (24).

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC				
Explosives	Fish-kills	Locally high	Short-term	Air-guns
EXPLORATORY DRILLING				
Site preparation	Siltation	Locally high	Short-term	Method, location
Drilling activity (blowouts)	Toxicity	High	Short-term	Present controls inadequate
PRODUCTION OPERATIONS				
Staging	Toxic spills	Moderate	Short-term	Location, contingency procedures
Permanent roads	Siltation	Moderate	Long-term	Location, design
Dredging	Siltation	Moderate	Short-term	Location, method
Gravel extraction	Siltation	Moderate	Short-term	Location, design
Dock construction	Siltation	Moderate	Short-term	Location, method
Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	High	Short-term	Present controls inadequate
Process wastewater	Toxic spills	Moderate	Long-term	Method
TRUNK LINES				
Staging	Toxic spills	Moderate	Short-term	Location, contingency procedures
Permanent roads	Siltation	Moderate	Long-term	Location, design
Dredging	Siltation	Moderate	Short-term	Location, method
Dock construction	Siltation	Moderate	Short-term	Location, method
Trenching	Siltation	Moderate to high	Long-term	Location, design
Gravel extraction	Siltation	Moderate	Short-term	Location, design

Discussion:

Industrial (petroleum) development could affect fish populations of the middle and upper Eskimo Lakes primarily by inducing siltation to sensitive fish habitat, because of well blowouts and line ruptures that allow toxic spills to water, and by use of explosives in water-based seismic operations.

Fish spawning sites are particularly vulnerable to siltation, and because these sites are now inadequately known, site-specific investigations should be made prior to project activities that could cause siltation. The objective of these investigations should be to identify spawning sites so they could be avoided by project activities.

Where avoidance of spawning sites is not possible, appropriate construction methods and project design will lessen siltation. Specifically this means considering methods other than dredged artifical islands for offshore drilling, and discharging channel and dock area dredging slurry to safe land areas. Permanent roads and trunkline rights-of-way, which can cause long-term siltation, should be located in non-erodible areas away from the lakes, and should be designed to limit and control siltation. Use of shoreline gravel for borrow material is potentially more damaging to fish habitat than the use of upland borrow sites.

Fish eggs, fry, and adult fish are all directly vulnerable to toxic materials in water, and fish are indirectly vulnerable through effects on fish food organisms. Adult fish are least vulnerable since they can swim away from the spill area. Well blowouts and line ruptures in water pose the most difficult problem since contingency procedures presently appear inadequate. This problem worsens with ice cover because access to the wellhead and underwater lines becomes virtually impossible.

Areas with significant potential for toxic spills are at major staging areas that would be used during construction of production facilities and trunk lines. These staging areas should not be located near sensitive fish areas, e.g. spawning or rearing areas. Staging sites should be located in areas without direct drainage to watercourses, and fuel storage should be properly dyked.

Contingency procedures for the containment and cleanup of toxic spills should be tested and in place before moving fuels or other toxic materials into the field (50). Damage to fish from the disposal of process wastewater can be controlled by injecting these wastes below the permafrost level, or by detoxifying the wastes before they enter natural waterbodies.

Fish-kills caused by explosive, water-based seismic can apparently be controlled by using air-guns rather than explosive energy (25). Under-ice use of air-guns should be prohibited until it can be shown non-harmful to fish.

MAJOR DATA GAPS

- lake trout and whitefish spawning and nursery areas
- general availability of gravel at upland locations
- effects of non-explosive seismic under ice cover

CONCLUSIONS

This is designated as a critical area because of traditional high recreational importance and use of the area. Spring "jiggling" in this area, in conjunction with camping and goose hunting, is viewed as an important "holiday" by Tuktoyaktuk residents.

With the possibility of a permanent road providing access to Eskimo Lakes in the future, this area may receive more recreational use in summer.

Fish productivity of these lakes is typical of northern waters; i.e. growth rates are much slower than in southern waters. Oil or gas exploration and development would affect fish in this area via explosive seismic, siltation, and toxic spills. Effects of openwater seismic can be controlled by using non-explosive energy sources, but under-ice seismic is not acceptable until it is shown safe to fish. Siltation from permanent road and trenched rights-of-way can be largely controlled by suitable location and adequate design. Siltation from channel dredging and dredging artifical islands could cause severe local impacts if it occurred at spawning areas. In-lake well blowouts and line ruptures represent the greatest danger to fish since contingency action to deal with this event is presently inadequate.

We can forsee no problems with barge traffic in Area 1 to service land-based exploration or development activities, providing no dredging takes place. We also forsee no problem with openwater seismic, providing non-explosive energy sources are used.

In our view, exploration drilling or development activities should not be permitted within the lake due to the high recreational importance of this area to residents of Tuktoyaktuk. Directional drilling from onshore areas would be acceptable if the applicant ensures that project activities will not interfere with traditional resource use and camping, and if adequate precautions were taken to ensure that blowouts would not contaminate the lake.

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CRITICAL AREAS FOR PRESENT USE-FISH

AREA 2: KUGALUK ESTUARY

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Whitefish	Feeding, overwintering, nursery	High	All year
Lake herring	Feeding, overwintering, nursery	Moderate to high	All year
Sea herring	Possible overwintering	More to north than south	Fall and winter
Northern pike	Spawning, feeding, overwintering	High in south	All year

Notes: - northern pike abundant in south end of area

- whitefish common throughout area, migration likely
- sea herring enter north end of area in September
- estuary situation

RESOURCE HARVEST

Type of Harvest: Domestic fishing

Season: Primarily fall and early winter, some spring fishing (43,23)

Intensity: Low

Notes: The Kugaluk is fished by trappers in fall and early winter to procure food supplies. There is probably some spring fishing associated with spring goose hunting. There are at least two campsites in this area which are currently used by hunters and trappers (43).

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC				
Explosives	Fish-kills	Locally high	Short-term	Air-guns
EXPLORATORY DRILLING				
Staging	Toxic spills	Moderate	Short-term	Location, contingency procedures
Site preparation	Siltation	Locally high	Short-term	Method, location
Drilling activity (blowouts)	Toxicity	High	Short-term	Present controls inadequate
PRODUCTION OPERATIONS				
Staging	Toxic spills	Moderate	Short-term	Location, contingency procedures
Permanent roads	Siltation/fish blockage	Moderate	Long-term	Location, design, method
Dredging	Siltation	Moderate	Short-term	Location, method
Dock construction	Siltation	Moderate	Short-term	Location, method
Process wastewater	Toxic spills	Moderate	Long-term	Method
Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	High	Short-term	Present contols inadequate
TRUNK LINE				
Staging	Toxic spills	Moderate	Short-term	Location, contingency procedures
Permanent roads	Siltation/fish blockage	Moderate	Long-term	Location, design, method
Dredging	Siltation	Moderate	Short-term	Location, method
Dock construction	Siltation	Moderate	Short-term	Location, method
Trenching	Siltation	Moderate	Long-term	Location, design

Discussion:

The main impacts to fish that may be caused by industrial petroleum development in this area are fish-kills resulting from explosive seismic; siltation of spawning areas caused by dredging, roads, and trenching; and toxic effects via process wastewater discharges, fuel spills from storage areas, well blowouts, and line ruptures.

Seismic caused fish-kills can apparently be controlled by use of non-explosive energy sources (e.g. air guns) for water-based seismic (25). Water-based seismic under ice-cover should be prohibited until it can be shown non-harmful to fish.

Siltation resulting from dredging for artificial islands, channel deepening, dock construction, permanent roads, and trenching could smother fish eggs and degrade spawning habitat. Because of the restricted size of this area, these effects could be severe. In this area, artificial islands should not be built, and dredging for channel deepening and dock area leveling should not be allowed in spawning areas. Location of these spawning areas will require site-specific investigations by development proponents. Permanent roads and buried pipeline rights-of-way should be located away from sensitive areas and should be designed to minimize erosion by locating the alignments in non-erosive areas, and should be designed to limit and control siltation.

Toxic spills can directly affect fish and fish eggs, and can indirectly affect fish by killing fish food organisms. Fuel storage and handling sites are the main potential source of toxic spills. These sites should be operated in accordance with operating conditions of land use permits and they should be located at least 450 m (approx. 500 yds) from waterbodies (37). Damage to fish from disposal of process wastewater can be controlled by injecting these wastes below the permafrost level or by detoxifying the wastes before they enter natural waterbodies. Restriction of water-based drilling would preclude underwater well blowouts and collector line ruptures, but land-based wells should be located so that blowouts could be controlled and contained before reaching the waterbody.

Blockage of fish movement resulting from a permanent road restricting water channels can be controlled by employing bridges for channel crossings, rather than causeways and culverts.

MAJOR DATA GAPS

- timing and extent of fish movements in this area
- location of fish spawning sites

CONCLUSIONS

The Kugaluk estuary is used by various fish species for overwintering, migration, feeding, spawning, and rearing. With controls that can be accommodated within the existing regulatory framework, petroleum exploration and development is acceptable in this area. Specifically, these controls are: prohibition of explosives for water-based seismic; appropriate location and design of road and pipeline rights-of-way and water-crossings to limit erosion and minimize siltation; avoidance of fish spawning areas by dredging; and allowing camps and fuel storage sites only in areas without direct drainage to waterbodies; and developing contingency systems for the cleanup of spills. Exploration and development activities should avoid sites which are important campsites for hunters and trappers.

In-water drilling activity is not acceptable because of the high potential for siltation resulting from construction of artifical islands and because of the severity and uncontrollable aspects of well blowouts and line ruptures in water. It is felt that directional drilling from land is a practical alternative to water-based drilling.

CRITICAL AREAS FOR PRESENT USE - FISH

AREA 3: SMALL INLAND LAKES

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Lake trout	Spawning, feeding, overwintering	Moderate to high	All year
Whitefish	Spawning, feeding, overwintering	Moderate to high	All year

Notes:
- lake trout are predominant in some lakes, whitefish in others
- lakes appear to function as somewhat independent systems
- easily overexploited or disrupted due to size of lakes

RESOURCE HARVEST

Type of Harvest: Domestic (commercial status applied for on three Cape Bathurst waterbodies)

Season: Primarily fall and early winter (43,23,19)

Intensity: Tuktoyaktuk trappers or North Star Harbour residents frequently fish these lakes.

Notes: See Current Land Use - Fish, Area 2,5.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC				
Explosives	Fish-kills	High	Potentially long-term	Air-guns
EXPLORATORY DRILLING				
Site preparation	Siltation	Moderate	Potentially long-term	Method, location
Drilling activity (blowouts)	Toxicity	High	Potentially long-term	Present controls inadequate
PRODUCTION OPERATIONS				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Camp operations	Effluent discharge	Moderate	Short-term	Location, method
Fuel storage	Toxic spills	High	Short-term	Location, contingency procedures
Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	High	Potentially long-term	Present controls inadequate
Process wastewater	Toxic spills	High	Long-term	Method
TRUNK LINE				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Trenching	Siltation	Moderate	Long-term	Location, design
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Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	High	Potentially long-term	Present controls inadequate
Process wastewater	Toxic spills	High	Long-term	Method
TRUNK LINE				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Trenching	Siltation	Moderate	Long-term	Location, design
Camp operations	Effluent discharge	Moderate	Short-term	Location, method
Fuel storage	Toxic spills	Moderate	Short-term	Location, contingency procedures

Discussion:

The main impacts to fish that may be caused by petroleum exploration and development at small inland lakes are: seismic-caused fish-kills; siltation of spawning habitat caused by construction of artifical islands, permanent roads, and trenching for a trunk line; and toxicity resulting from blowouts, and pipe ruptures in water, camp operations, leakage from fuel storage areas, and discharge of process wastewater.

The severity of many of these impacts will be greater in small inland lakes than in larger waterbodies because fish are confined to a small water volume, thus allowing concentration of pollutants and limiting escapement of fish. Lack of water currents in these lakes also impairs the flushing and cleansing ability of these waterbodies.

Fish-kills resulting from water-based seismic can apparently be controlled by using air-guns rather than explosives as an energy source (25). None the less, even air-guns should not be used under ice until it can be shown that this method is not harmful to fish.

The construction of artifical islands in these lakes could cause unacceptable siltation of spawning habitat. Potential long-term siltation from erosion of permanent road and pipeline rights-of-way can be controlled by locating these rights-of-way a suitable distance from these lakes (17) and in areas of nonerodible, stable soils. Design of these components should include adequate silt-control methods. Detailed geophysical investigation will be required for location of permanent road and pipeline right-of-way alignments.

Concern about blowouts of water-based wells is greatest if drilling is done from an ice platform, making access to the wellhead difficult. During production operations, ruptures of underwater collector lines would also be very difficult to repair under ice. Again because of the possible isolated biological nature of these lakes, recovery from impacts may take longer than three years. We therefore recommend that drilling in these lakes be prohibited. An acceptable alternative to in-lake drilling would be directional drilling under the lakes from land.

Discharge of sewage effluent and toxic materials from large camp sites could have a more damaging effect on fish in these small waterbodies than in larger waterbodies such as Selma Lakes or Liverpool Bay for the reasons mentioned previously. The same situation exists for other sources of toxic spills, i.e. fuel storage, and process wastewater. Toxic spills from camp operations are best controlled by locating camps away from these lakes and by employing adequate effluent treatment methods. Fuel storage sites should also be located a safe distance from these lakes, and adequate contingency procedures should be developed to contain and clean-up fuel spills before they enter the lakes.

MAJOR DATA GAPS

- independance of these lakes from other aquatic systems

CONCLUSIONS

Fish in small inland lakes are more vulnerable to impact because of the confined habitat. With controls that can be accomodated within the existing regulatory framework, petroleum exploration and development is acceptable within these lake drainages. Specifically, these controls are: prohibition of explosives for water-based seismic; appropriate location and design of road and pipeline rights-of-way to limit erosion and minimize siltation; and allowing camps and fuel storage sites only in areas without direct drainage to waterbodies; and developing contingency systems for the cleanup of spills.

In-lake drilling activity is not acceptable because of the high potential for siltation resulting from construction of artificial islands, and because of the severity and uncontrollable aspects of well blowouts and line ruptures in water.

CRITICAL AREAS FOR PRESENT USE - WATERFOWL

AREA 4: SMOKE AND MOOSE RIVER DELTAS AND CAMPBELL AND THUMB ISLANDS

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Brant	Nesting and broods	several thousand (43)	Late May - Mid Aug. (4)
	Molting	several thousand (43)	Mid July - Mid Aug. (4)
Whitefront	Nesting and molting	20,000 molting (9,2)	25 May - 15 Aug. (4)
Ducks	Molting (21,86)	Potential for 75,000 (86)	20 July - 25 Aug. (86)
Canada Goose	Nesting and broods	100 (5), 200 (2)	Mid May - Mid Aug. (42)
	Molting	20,000	1 July - Mid Aug. (42)

Notes: This is a critical nesting, molting, and brood-rearing area for geese from late May to mid September. The Smoke and Moose River deltas plus the east shore of Campbell Island are especially important to geese. Offshore areas are important for molting ducks, principally scaup and scoters, from mid July to late August. There is considerable movement and interchange among key waterfowl concentration areas in the Cape Bathurst - Liverpool Bay - Eskimo Lakes area. For example, some ducks and geese that breed near Anderson River may stage or molt near the Smoke and Moose River deltas. Along with the Anderson River delta, this appears to be the most important brant nesting area within the study region; local residents stated that thousands of brant nest on a small island south of Thumb Island.

RESOURCE HARVEST

Type of Harvest: Goose and duck hunting

Season: Mid May to June (43,93)

Intensity: The area from the Moose River northeast is an important hunting area (43,93). This area has increased in importance recently. It is an important area for spring goose-hunting camps (35,43).

Notes:

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Gravel extraction	Displacement of nesting brant and molting ducks and geese	Potential abandonment of brant colonies and local reduction of molting populations	Long-term for brant Short-term for geese and ducks	Do not locate gravel sites in or near brant colonies
Site development	Displacement of nesting brant; habitat degradation	Loss of nests and reduced production	Long-term	Do not locate sites in or near brant colonies
Camp operations	Displacement of nesting brant	Same as preceding	Short-term	Do not locate camps in or near colonies; schedule activities to minimize disturbance
Drilling activity (blowout)	Fouling or displacement of nesting brant, molting geese and ducks	Potential abandonment of brant colonies and large-scale losses of molting waterfowl	Long-term	Do not locate wells where blowouts will foul critical molting or nesting habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Long-term for brant Short-term for other waterfowl	Do not stage fuel where spills will foul critical molting or nesting habitats
PRODUCTION, TRUNK LINES				
Staging/fuel handling	Same as preceding	Same as preceding	Same as preceding	Same as preceding
Construction of: Pads, cluster facilities, camps, processing plants, roads	Displacement of nesting brant	Potential abandonment of colonies through habitat degradation	Long-term	Do not build roads or facilities in or near brant colonies
Operation and maintenance	Displacement of nesting brant and molting ducks and geese	Potential abandonment of brant colonies; reduced numbers of molting waterfowl	Long-term	Schedule activities to reduce disturbance
Cluster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of nesting brant and molting geese and ducks	Potential abandonment or destruction of brant colonies and large-scale losses of molting waterfowl	Long-term	Do not locate wells or pipelines where blowouts or ruptures will foul critical molting and nesting habitats
Camp operations	Displacement of nesting brant	Potential abandonment of brant colonies	Short-term	Do not locate camps in or near brant colonies
Aircraft	Displacement of nesting brant and molting ducks and geese	Potential abandonment of brant colonies and reduced numbers of molting birds	Short-term	Do not fly over nesting brant or molting waterfowl at low altitudes

Discussion: Main concerns are long-term disturbance and extensive pollution in sites used by molting brant, Canada, and white-fronted geese and ducks. Staging of fuel along banks of major drainage systems or on shorelines of Campbell Island and offshore or shoreline location of wells could result in large-scale mortality of waterfowl if spills or blowouts occur where ducks, geese, and swans gather during the molt. At such times, populations are concentrated in small areas and being flightless are less capable of avoiding slicks. In addition to causing direct mortality, major spills - primarily those from blowouts - could degrade waterfowl food sources for several years. Finally, spread of fuel or crude oil into brant colonies could destroy nests and adults cause birds to abandon the area.

Other activities involving intensive human activity, low and frequent passage of aircraft, and construction noise close to occupied molting areas could cause birds to move elsewhere. This could result in loss of birds through stress and depletion of energy reserves needed for successful migration. However, such activities are not likely to significantly reduce populations available for local harvest.

Placement of roads, gravel extraction, camps, cluster facilities, or processing plants within a brant colony will almost certainly cause birds to abandon the area. Activities associated with these developments, including aircraft disturbance, could result in nest abandonment if activities take place close to occupied colonies.

The construction and presence of permanent facilities such as clusters, processing plants, compressor stations, and airstrips at or near important campsites could displace hunters from preferred camping locations or affect the visual quality of the setting.

MAJOR DATA GAPS

- precise locations of key concentration sites of molting or nesting waterfowl in Area 4.
- confirmation on numbers of molting white-fronted and Canada geese

CONCLUSIONS

Area 4 supports large numbers of waterfowl of several species, all of which are hunted by residents of Tuktoyaktuk. The area is particularly important as a place where birds congregate in large flocks to molt or nest. This makes them vulnerable to disturbances, especially those that could result in permanent degradation of critical habitats.

Therefore, (a) no wells or fuel storage sites should be located on coastlines, river banks, or offshore areas where spills or blowouts will pollute brant colonies or waterfowl concentration areas, (b) no major construction activity should take place within 3.2 km (2 miles) of brant colonies or critical molting habitats during times of waterfowl use, (c) construction camps, compressor stations, processing plants, and other facilities should not be located within 3.2 km (2 miles) of brant colonies or critical molting habitats, (d) aircraft should not be operated within 3.2 km (2 miles) of, or lower than 610 m (2000 feet) over, colonies or critical molting habitats when waterfowl are present.

Other activities and structures associated with oil/gas exploration and development should not have any significant or long-lasting effect on waterfowl populations that inhabit the area. No seismic operations are expected to create major conflicts with waterfowl habitats or activities. Permanent facilities should be located to avoid important colonies.

CRITICAL AREAS FOR PRESENT USE - WATERFOWL

AREA 5: MASON RIVER VALLEY AND DELTA

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Snow Goose	Staging along the coast from Mason River to Baillie Island (86)	Potential for 200,000 (4,86)	20 May - 8 June (86) 20 Aug. - 10 Sept. (86)
Brant	Nesting (86)	Undetermined	25 May - 1 Sept. (86)
Whitefront	Nesting Molting	400± (2) 2500 (2)	Mid May - Mid Aug. Early July - Mid Aug. (4)
Ducks	Molting (86)	Undetermined	20 July - 25 Aug.
Canada Goose	Molting	1500	Early July - Mid Aug. (42)

Notes: This is a critical area because of the numbers of species present. Although waterfowl are present throughout the open-water season, the most important periods are in spring and fall, when large flocks of snow geese may stage in the area, and mid summer (mid July to late August), when rafts of molting ducks congregate in coastal and offshore habitats. Protected bays and quiet lagoons are especially important to staging and molting birds. As is the case with other parts of Liverpool Bay - Eskimo Lakes, there is a great deal of movement between Mason River and other nearby river deltas. Thus, events that affect populations at Mason River would be reflected to some extent in other areas.

RESOURCE HARVEST

Type of Harvest: Goose and duck hunting

Season: Mid May to June (23)

Intensity: Low

Notes: This is no longer an important area although it is still occasionally used (43,23).

AREA 6: OLD HORTON RIVER OUTLET AND SOUTH SHORE OF HARROWBY BAY

BIOLOGICAL DESCRIPTIONS

Species	Activity	Abundance	Season
Brant	Nesting and broods (86)	Undetermined	25 May - 15 Sept. (86)
Whitefront	Molting	700± (2,9)	1 June - 1 Sept.
Ducks	Molting	Large numbers (9)	20 July - 25 Aug. (86)
Eiders	Nesting	Undetermined	Early June - Late Sept. (86)
Snow Goose	Staging	Potential for 200,000 (4)	Mid May - Early June (4)
Canada Goose	Nesting (river islands)	Undetermined	Mid May - Mid July (42)

Notes: Despite the data gaps, this area is used by enough species to warrant "critical" status. Snow geese, which may stage here in spring and during molt migration, are of greatest concern because very large numbers of birds could be present at one time. This is particularly true in spring when 150,000 - 200,000 snow geese that breed on Banks Island may pass through and stop in the Cape Bathurst area. This part of Harrowby Bay is also important as a molting area for ducks, white-fronted and presumably for brant and Canada goose broods. The brant nesting area (near Ikpisugyuk Point) is of some concern with regard to possible oil/gas development activities; however, the number of birds involved has not been specified.

RESOURCE HARVEST

Type of Harvest: Goose and duck hunting

Season: Spring to Fall (May to September) (43)

Intensity: Important area for North Star Harbour residents (43)

CRITICAL AREAS FOR PRESENT USE - CARIBOU

AREA 7A: AROUND WOOD BAY BETWEEN ANDERSON AND MASON RIVERS
AREA 7B: ADJACENT TO AND SOUTH OF THE TREELINE, BETWEEN ANDERSON AND KUGALUK RIVERS

BIOLOGICAL DESCRIPTION

Species: Barren-ground caribou

Activity: Winter range (marginal to the main winter range) or migration route (See Critical Areas - Caribou, Area 7C) if caribou winter further south (32,33).

Abundance: No estimate available - depends on weather and other factors in different years. Most of the Bluenose herd winters south of the treeline, primarily south of Area "A" (17,32,33).

Season: October or November to late March or early April (depending on the year) (17,32,33).

Notes: The main winter range area is adjacent to or south of the treeline. Large numbers may winter to the south and southwest of the study area, but generally not as far south as Great Bear Lake (17,33). The extent of southerly movement and numbers of caribou wintering in Area "A" depends on the year. Only a small part of the Bluenose herd winters in or adjacent to the study area (17,33). In late November and early December 1969, when freeze up was late and snowfall limited, caribou were still concentrated on the barrens north of the tree line (32). Some caribou winter on Cape Bathurst, particularly in Area 7A (43). Small numbers of caribou are reported to winter outside these designated areas, including the southern side of the Eskimo Lakes and Liverpool Bay (43). During winter, caribou undertake considerable local movement (66,102,110).

By mid-April, most caribou have generally left wooded areas and are heading north to calving and summer ranges (17,32,33). (See Critical Areas - Caribou, Area 7C).

RESOURCE HARVEST

Type of Harvest: Caribou hunting

Season: Late fall and winter (43,23)

Intensity: Low to moderate in 7A and very low in 7B

Notes: 7A is a hunting area for trappers who have camps in the area and occasionally for North Star Harbour residents (43). Caribou are occasionally killed by trappers in parts of 7B (43). See Current Land Use - Caribou, Area 2,5.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC	None anticipated			
EXPLORATION DRILLING	None anticipated			
PRODUCTION OPERATIONS				
Permanent roads	Block local movements	Moderate	Long-term	Unknown
Gathering system	Block local movements	Moderate	Long-term	Unknown
TRUNK LINE				
Permanent roads	Block local movements	Moderate	Long-term	Unknown

Discussion: The effects of development-related obstacles on caribou movements are variable and have been incompletely researched. Although there are few data on the effects of permanent roads and gathering systems on local movements of caribou on winter ranges, observations on the effects of these features at other times of the year indicate that they may be serious impediments to free movement of caribou. Simulated "pipeline" structures as well as permanent roads in conjunction with the elevated Alyeska pipeline caused caribou, particularly pregnant cows and calves, to avoid these structures (14,15,98). There may be seasonal variation in reaction to these obstructions, however.

Caribou displayed greater uncertainty about crossing the Dempster Highway in forested regions than in open tundra where the road was clearly visible. Steep embankments were a physical barrier to movement only where deep snow banks or drifts were present. High-profile roads also present a visual barrier, and may cause avoidance reactions. Caribou were also reluctant to walk on the Dempster Highway, particularly if bare gravel was present (124). Other reports (7) indicate that caribou may winter near highways and readily travel across them.

Although caribou have been described as selecting certain seismic lines for winter movements due to the greater ease of travelling there (44,57), caribou on Banks Island were found to definitely avoid new seismic lines as well as snow drifts over 30 cm (1 foot) in height along roads. Caribou frequently paralleled these obstructions rather than cross them (92).

This indicates that aboveground gathering systems or high, bermed roads may present serious obstacles to movement of caribou on their winter ranges. Caribou normally undergo quite extensive movements on their winter ranges (46,66,102) and obstruction of such movements could result in loss of large areas of range with population consequences.

MAJOR DATA GAPS

The reaction of wintering caribou to permanent bermed roads and aboveground gathering systems is not adequately understood. Technological solutions to these problems require further development and testing, involving intensive research. There is a general absence of information on long-term effects of development activities on caribou (92,124).

CONCLUSIONS

At present we foresee no serious problem interactions between barren-ground caribou on their winter ranges and seismic operations and exploration drilling activities, provided that (a) accepted land-use practices are followed, (b) any areas where caribou concentrations are found are avoided, and (c) occupied winter ranges are kept free from development-related disturbance. However, certain activities associated with the production operation and trunk line phases of any development may be unacceptable in barren-ground caribou wintering areas.

If aboveground pipelines or high bermed roads alone or in conjunction with such pipelines pose a significant barrier to caribou movements as effective utilization of caribou winter ranges such developments are unacceptable. Present information on the reaction of wintering caribou to impediments such as high bermed roads and aboveground pipeline systems is inadequate. However, we feel that there is a high probability that the presence of these particular facilities will render any associated phases of development unacceptable due to obstruction of caribou movements, with attendant loss of critical winter range.

These facilities may become acceptable if it can be shown that they will not impede caribou movements. Similarly, development and installation of effective crossing structures at any points where caribou movements tend to be concentrated by topographic (or other) features (and never more than 8 km (5 mi) apart) will make these facilities conditionally acceptable on winter ranges. Should crossing structures closer than 8 km (5 mi) apart be necessary this would be a condition of acceptability.

CRITICAL AREAS FOR PRESENT USE-CARIBOU

AREA 7C: CAPE BATHURST AND SOUTH OF LIVERPOOL BAY AND ESKIMO LAKES AS FAR WEST AS THE MINER RIVER

BIOLOGICAL DESCRIPTION

Species: Barren-ground caribou

Activity: Seasonal migration routes (spring and fall)

Abundance: As many as 20,000 caribou have been recorded between the Miner and Kugaluk Rivers east of Inuvik (33), many of which would have crossed Area "A". Precise estimates of numbers are hard to get, and they vary in different years (17).

Season: Spring - March to June. Fall - August to November. By November, migration will have finished in all but the southern and southwestern portions of the study area adjacent to winter ranges (17,32,33).

Notes: Although routes used can be described in a general way, they are subject to some annual variability (32,33,34). Paths up to several metres wide are evident from the air, indicating the general orientation of migration, at least in spring (17).

Spring migration, although variable, tends to be north and northeast from between the Kugaluk and Horton Rivers. Most of the caribou are moving north onto the tundra by late March or early April. There is some movement from the eastern part of the western Bluenose component along the Smoking Hills (17,33). The timing of movement varies in different years, and for different sex and age classes (45). Fall migration tends to be primarily south and southwest, and carries them as far west as the Kugaluk and Miner Rivers (32,33).

During the pre-rut period (August-September) caribou gradually move south over the whole width of Cape Bathurst [illegible]. By October and November the entire body of the "herd" is moving toward treeline (32,33,34). With the recent expansion of the Bluenose herd, the use of more western areas (Kugaluk River area) is increasing as a migration route (17,32,33), and in some years large numbers of caribou are found almost as far west as Travaillant Lake (33) and adjacent to the Eskimo Lakes and Liverpool Bay (43).

RESOURCE HARVEST

Type of Harvest: Caribou hunting

Season: Late fall and early winter is the most important period. There is year-round hunting on Cape Bathurst by North Star Harbour residents (43,23).

Intensity: Northern Cape Bathurst and areas south of Liverpool and Wood Bays are important hunting areas. Most of the remainder of this area can be categorized as a low-intensity caribou hunting area. There is no recorded caribou hunting over much of the southern part of Area 7C.

Notes: See Current Land Use - Caribou, Area 1,2,3,5.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC	None anticipated			
EXPLORATION DRILLING	None anticipated			
PRODUCTION OPERATIONS				
Permanent roads	Block, delay or divert migration	High	Long-term	Unknown
Gathering system	Block, delay or divert migration	High	Long-term	Unknown
TRUNK LINE				
Permanent roads	Block, delay or divert migration	High	Long-term	Unknown

Discussion:

Reaction of barren-ground caribou to obstructions is somewhat variable and has been incompletely researched. The Alyeska pipeline and feeder roads (with associated construction activity) apparently inhibited the northward progression of female caribou and calves adjacent to the right-of-way (14,98). The extent to which this avoidance was caused by the physical presence of the right-of-way and not the associated construction activity is unclear (98).

Most caribou refused to cross simulated pipeline structures during summer at Prudhoe Bay (15). The extent to which this reaction was due to the methodology is unclear, as is the reaction of caribou to such obstacles during the course of migration.

Reindeer (and presumably caribou) may be unwilling to cross under newly-erected power lines (46). In woodland, migrating caribou were observed to be reluctant to leave traditional paths (58).

Barriers, particularly those perpindicular to migration routes, could halt migration at least temporarily, and necessitate delays while circumventing them. Subsequent effects on the timing and location of calving and behavior of the caribou during calving could be critical (58), although the location of calving by the Porcupine herd reportedly varies in accordance with the timing and ease of the spring migration (124). Impediments to caribou along the Alyeska pipeline may have resulted in a partition of the Central Arctic herd into two relatively discrete components (98).

Caribou displayed greater uncertainty about crossing the Dempster Highway in forested regions than in open tundra where the road was clearly visible. Steep embankments were a physical barrier to movement only where deep snow banks or drifts were present. High-profile roads also present a visual barrier, and may cause avoidance reactions. Caribou were also reluctant to walk on or cross the Dempster Highway, particularly if bare gravel was present (124). It has also been suggested that caribou avoid roads on Banks Island because they could detect a difference in "footing" (92).

Further research is required to accurately determine the effect of bermed roads, above-ground gathering systems, and overhead power lines on the behavior of migrating caribou. Similarly, research is required to develop and prove the effectiveness of techniques whereby caribou can successfully cross these barriers without undue expenditures of time and energy or deflection from migration routes. Without the development and implementation of the appropriate technology it is highly probable that such obstacles could result in loss of critical seasonal ranges and disruption of caribou behavior to such an extent that the viability of a major component of the Bluenose herd could be threatened.

MAJOR DATA GAPS

The reaction of migrating caribou to bermed, permanent roads, aboveground gathering systems, and overhead power lines is inadequately known. Technological solutions to these problems require further development and testing, requiring an intensive research effort. There is a general absence of information on long-term effects of development activities on caribou (92, 124).

Major migration corridors and critical points where the topography tends to funnel migrating caribou (e.g. stream crossings) require delineation, if in fact such points exist in this area.

CONCLUSIONS

At present we foresee no significant problem interactions between barren-ground caribou migration and winter seismic operations or any exploration drilling activities conducted in accordance with good land-use practices. However, certain activities associated with production operations and trunk line phases of any development may be unacceptable with respect to barren-ground caribou migration. If aboveground pipelines or high bermed roads, alone or especially in conjunction with such pipelines, pose a significant barrier to caribou migrations such facilities are unacceptable.

Present information on the reaction of migrating caribou to impediments such as high bermed roads and aboveground pipelines is inadequate. However, we feel there is a high probability that the presence of these particular facilities will render any associated phases of development unacceptable due to obstruction of caribou movements and diversion of caribou migrations by more than 8 km (5 mi) in order to circumvent them.

These facilities can become acceptable if it can be shown that caribou will not be required to undertake diversions of more than 8 km (5 mi), or when techniques can be developed, proven effective, and implemented such that caribou will be freely able to cross such impediments after diversions of no more than 8 km (5 mi), and at all points where migrating caribou are traditionally funnelled by topographic or other natural features.

AREA 7D: CAPE BATHURST, NORTH OF MASON RIVER MOUTH-- MACKENZIE LAKE AREA 7E: DISCRETE AREAS ON CAPE BATHURST

BIOLOGICAL DESCRIPTION

Species: Barren-ground caribou

Activity: Calving ground areas identified by Hawley - 7E (33) and general calving and post-calving ground identified by local residents - 7D (43).

Abundance: Potentially several thousand. Decker recorded 1000 on the northern end of Cape Bathurst in mid-April 1976, but this was probably an underestimate (17). Hawley estimated 4746 on Cape Bathurst in May 1974 (33), but numbers are expected to vary in different years (34).

Season: Approximately early June to early July (31,33) to expect adjacent areas to be used until August as post-calving and summer ranges.

Notes: Almost the entire western calving group of the Bluenose herd calved north of Harrowby Bay and the Old Horton Channel in 1976 and few calved in the highlands along the Smoking Hills (17). Areas used for calving may vary in different years, and more southerly areas of Cape Bathurst, possibly as far south of the West River (69° N), may be used (17,33,34). Indications are that productivity of the Bluenose herd is high (33). Caribou may be particularly sensitive to disturbance on their calving grounds. These areas may be considered the most critical part of caribou habitat, and maintenance of the integrity of such areas is essential to the future well-being of the herd (8,11).

RESOURCE HARVEST

Type of Harvest: Caribou hunting

Season: Fall and early winter are the most important seasons. There is some hunting year-round by North Star Harbour residents in Area 7D (43,23).

Intensity: 7D is an important area. Intensity is very low in the southern 7E areas.

Notes: North Star Harbour residents depend on caribou in Area 7D as a major food source. Caribou taken in the southern 7E areas are incidental kills by trappers. There is no recorded hunting in the southernmost 7E area. See Current Land Use - Caribou, Area 1,5.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC	None anticipated			
EXPLORATION DRILLING				
Aircraft	Disturbance	Moderate	Short-term	Concern on altitude and timing of flights and avoidance of critical areas can minimize aircraft effects
Equipment operation	Disturbance	Moderate	Short-term	These facilities should not be operated in calving ranges when occupied by caribou
Gravel extraction	Disturbance, Habitat destruction	Moderate	Long-term	Gravel extraction should not be undertaken in traditional calving grounds
Camp operations	Disturbance, Human presence	Moderate	Short-term	These facilities should not be located in caribou calving ranges when occupied by caribou
PRODUCTION OPERATIONS				
Permanent roads	Block movements	High	Long-term	Unknown
Road construction	Block movements, Disturbance	Moderate	Short-term	Roads should not be constructed on caribou calving ranges unless they are found to present no barrier to caribou movements. In such a case, no construction should occur when these ranges are occupied by caribou.
Gathering system	Block movements	High	Long-term	Unknown
Camp operations	Disturbance, Human presence	Moderate	Short-term	Camp facilities should not be located in caribou calving ranges when occupied by caribou
TRUNK LINE				
Permanent roads	Block movements	High	Long-term	Unknown
Aircraft	Disturbance	Moderate	Long-term	Controls on altitude and timing of flights in critical areas can minimize aircraft effects
Gravel extraction	Disturbance, Habitat destruction	Moderate	Long-term	Gravel extraction should not be undertaken in traditional calving grounds
Camp operations	Disturbance, Human presence	Moderate	Short-term	Camp facilities should not be located in caribou calving ranges when occupied by caribou

Discussion:

Reaction of barren-ground caribou to man-made obstacles is variable and has been incompletely researched. In general, caribou appear unwilling to go over or under such obstructions, although most research on the problem has involved either barriers intended to simulate elevated pipelines (15) or situations where the presence of bermed roads and aboveground pipelines was compounded by human presence or vehicular activity (14,98). Thus, although calves and pregnant females avoided areas adjacent to the Alyeska line and haul road, it was not possible to differentiate between the presence of the facilities per se and the associated activity as to the cause of the avoidance (14,98).

Both females and young were frequently observed to be reluctant to cross under any artifical, elevated structure (15). The separation of cow/calf pairs that often resulted, and the inhibition of free movement on the calving ground could seriously hamper normal use of traditional calving ranges and possibly result in behavioral abnormalities. Both of these possibilities would have deleterious effects on calf survival and recruitment to the herd.

During winter caribou displayed some reluctance to cross the Dempster Highway, particularly in forested areas, if deep snow was present or the road had a high profile (124). The extent to which these reactions can be extended to the calving ranges is unclear.

Further research is required to determine the effects of bermed roads and aboveground gathering systems as well as overhead power lines (46) on caribou calving and post-calving behavior. Similarly, research is required to develop and to demonstrate the effectiveness of techniques whereby caribou can successfully negotiate these barriers with no undue expenditure of time or energy and no significant behavioral changes.

Barren-ground caribou are sensitive to disturbance by noise and human presence on their calving grounds. Aircraft operation causes strong reactions, decreasing as altitude increases. Helicopters may be more disturbing than fixed-wing aircraft (57, 124), although some data do not substantiate this (13).

Some research has shown caribou to be more sensitive to the presence of humans and aircraft during the calving period than at other times (48,120,124), although other data do not support this (12). Given this controversy, we feel it is prudent to adopt a conservative approach, and suggest that all development-related disturbance between May and August could have deleterious effects on caribou during the calving and post-calving periods. Thus it is advisable that all aircraft maintain a minimum altitude of at least 300 m (1000 ft.) over calving and post-calving grounds. Although caribou may show only local avoidance of an area as a result of noise from a simulated compressor station on a calving ground (57), all forms of development-related disturbance on the calving and post-calving grounds should be avoided between April and August.

Because the calving grounds may be considered the most critical part of caribou habitat, maintaining the integrity of such areas is essential for the long-term well-being of a herd (8,11). Post-calving aggregations are believed to provide an opportunity for critical resocialization of the previous winter bands disrupted during spring migration (110), making avoidance of disturbance at this time of great importance.

MAJOR DATA GAPS

The reaction of barren-ground caribou to permanent bermed roads and aboveground gathering systems on their calving grounds is not adequately known. Feasible technological solutions to the problems posed by these obstructions require further development and testing, involving intensive research. There is a general absence of information on long-term effects of development activities on caribou (92,124).

Additional information is required as to the location of traditional caribou calving grounds in Area "A", the numbers of caribou using such areas, and the degree of fidelity of caribou to particular calving grounds. The collection of such data requires intensive, long-term research.

CONCLUSIONS

At present we foresee no significant problem interactions between barren-ground caribou calving and post-calving activities and associated areas and winter seismic and exploration drilling operations in Area "A", including Cape Bathurst. At the same time, certain activities associated with the exploration drilling, production operation , and trunk line phases of any development may be unacceptable with respect to barren-ground caribou calving and post-calving activities.

If permanent roads and/or aboveground pipeline systems pose any barriers to free movements of caribou on any portion of a calving or post-calving ground they are unacceptable. Similarly, operation of any facilities and aircraft or the presence of humans is unacceptable in any area if disturbance of caribou on calving or post-calving grounds results. We believe that compliance with these restrictions would effectively restrict any seismic and exploration drilling activities to winter (prior to April 1). Enforcement of these restrictions is considered critical in view of the importance attached to the maintenance of calving and post-calving grounds. Such restrictions on the timing of activity in calving and post-calving ranges can be accomodated by incorporating the requirements into the existing regulatory framework.

Present information on the reaction of caribou to impediments such as high, bermed roads and aboveground pipeline systems is inadequate. However, we feel that there is a high probability that the presence of these particular facilities will render any associated phases of development totally unacceptable on caribou calving and post-calving grounds.

These facilities could become acceptable (subject to the above restrictions on noise, human presence, and other disturbance) when such facilities can either be shown to have no inhibitory effect on caribou movements or behavioral patterns, or when techniques can be developed, proven effective, and implemented such that caribou movements and behavior will not be affected, even locally, by them.

CRITICAL AREAS FOR PRESENT USE- SEALS

AREA 8: HARROWBY BAY

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Ringed seal	All habitat functions (pupping, molting, feeding and over-wintering)	No estimate of population available	Apparently year round

Notes:

Ringed seals are widespread in the western arctic, including those landfast ice areas adjacent to Cape Bathurst (85,90). Immature seals tend to concentrate in unstable offshore ice between fall and spring (88,89,90,118). There are wide seasonal movements of certain age classes of seals, primarily in shear zones along the polar pack in the Beaufort Sea (82).

Winter lairs of mature seals as well as birth lairs are found primarily in snow drifts in the lee of pressure ridges in the extensive landfast ice areas, including the deeper bays (89,90,118). Recent data indicate that offshore areas of shifting but relatively stable ice are an important part of the breeding habitat (85). Young are born in March and April (85,90,118) and require over two months for weaning (118).

Between May and July, seals haul out onto the ice to bask and molt (90,114,118). During this time they lose much of their blubber reserves (84,118) despite an apparent continuation of some feeding activity during that period (84). This weight loss has been attributed to stress at that time, a problem to which hair (phocid) seals are commonly susceptible (103).

In summer many seals, particularly immature animals, are associated with the widespread areas of polar pack ice which are found at some distance from shore (88,91). Movement of mature seals is less extensive, and those in deep bays frequently remain in the general area all year round, including the open-water period (118). Ringed seals rarely move onto land at this or other times (123). There is a tendency for immature seals to move from unstable, offshore ice onto the fast ice at breakup, and a less pronounced movement in the same direction at freeze-up (118). As fast ice forms in fall, most young seals move out of inshore areas with the progressing ice edge, leaving the adults in their winter residence under the fast ice (118).

RESOURCE HARVEST

Type of Harvest: Seal hunting

Season: August, September (43)

Intensity: Low

Notes: Total harvest is relatively low, but Harrowby Bay is an important seal hunting area for North Star Harbour residents.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Drilling activity (blowouts)	Habitat loss, mortality, oiling	Moderate	Short-term	Offshore drilling should not be conducted in winter until the technology to control and clean up blowouts has been developed. In summer, oil must be contained and cleaned up immediately.
PRODUCTION OPERATION				
Cluster facilities and pipelines (blowouts and ruptures)	Habitat loss, mortality, oiling	Moderate	Short-term	Offshore drilling should not be conducted in winter until the technology to control and clean up blowouts has been developed. In summer, oil must be contained and cleaned up immediately.
TRUNK LINE	None anticipated			

CRITICAL AREAS FOR PRESENT USE - SEALS

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PRODUCTION OPERATION				
Cluster facilities and pipelines (blowouts and ruptures)	Habitat loss, mortality, oiling	Moderate	Short-term	Offshore drilling should not be conducted in winter until the technology to control and clean up blowouts has been developed. In summer, oil must be contained and cleaned up immediately.
TRUNK LINE	None anticipated			

Discussion:

The primary problems which could have significant impacts on seal populations are blowouts during offshore drilling as well as massive fuel spills. Short-term (24-hour) exposure to fresh crude oil caused transient eye problems, and minor kidney and possibly liver lesions, but no apparent permanent damage. The same exposure to oil following lower-term captivity (a high-stress situation) rapidly resulted in the death of the seals (84,103). Long-term exposure to oil (as of seals in fast ice areas) would likely result in permanent eye disorders.

The effects of a blowout would be particularly serious on stressed seals or those which are in poor nutritional condition (84,103). Pre-weaned seals inhabitat subnivean birth lairs (85,118) and these would be highly susceptible to fouling by oil (103). Although phocid (hair) seals are generally not susceptible to thermoregulative problems due to oiling, the effect on young in birth lairs could be greater (84,103,104). Increased stress as a result of oil spills or blowouts, particularly during the molting period, would conceivably result in greater mortality of seals, especially those in poor condition (84).

Although injestion of small quantities of oil may not be harmful to seals, their prey species could concentrate hydrocarbon metabolites to a level where they may be toxic to seals (84). At present, oil spill or blowout countermeasures are inadequate under most summer conditions in the Beaufort Sea, and would be almost totally ineffective under winter conditions, particulary in the transition and polar pack zones (50).

The reaction of basking seals to aircraft overflights apparently varies with the proximity of the airplane, the presence of cliffs (which echo aircraft noise) and the weather. Seals exhibited relatively minor responses to aircraft at 150 m (500 ft) during periods when weather was optimal for basking, although this effect was greater at other times (114).

Smith (119) found that 75% of the seals up to a distance of 400 m (0.25 miles) dived into the water after a plane passed at 12 - 30 m (40 - 100 ft) altitude. There are no data regarding the ultimate effects of such disturbance on seals. Ringed seals may be under the greatest physiological stress during the molting-basking period (103), and additional stresses should be avoided at this time.

Intensive marine seismic operations conducted within the limits of Alaskan regulations did not appreciably displace seals from landfast ice wintering areas during the seismic operations or the following spring melt (114).

MAJOR DATA GAPS

The number of seals using Harrowby Bay for critical life-cycle functions is unknown. Detailed responses of seals to development-related disturbance and the longer-term physiological and behavioral responses have not been adequately researched.

CONCLUSIONS

At present we foresee no serious conflicts between seismic activities or trunk line construction and operation and the seals utilizing Harrowby Bay. Although massive fuel spills could pose a problem, it is considered unlikely that any spills would be of such a magnitude as to have a serious effect on the seal population there. During the exploration drilling and production operations phases, however, the risk of underwater blowouts renders offshore drilling in Harrowby Bay unacceptable at any season for the foreseeable future, despite the apparently small probability of such a blowout actually occurring. Because present technology for cleaning up oil spills is inadequate for the Beaufort Sea particularly during winter, any major blowout could result in the loss of a major part of the seal habitat in Harrowby Bay. Because this area may be occupied primarily by the mature, breeding segment of the population, effects on the population could be relatively long-term.

Serious seal mortality could also result, especially if a blowout occurred during the molting period or when ice cover is present. This could have a significant effect on the local human population relying on this resource. Offshore drilling activities in this area could become acceptable if (a) adequate blowout and spill prevention and cleanup procedures are developed and implemented, and (b) industrial activity (aircraft, drilling operations, ships) does not cause disturbance or displacement of seals during the pupping and molting period (April to August). These timing restrictions can be accomodated by incorporating them into the existing regulatory framework.

CHAPTER 5

CRITICAL AREAS FOR POTENTIAL USE OF AREA A FISH AND WILDLIFE RESOURCES

We have identified seven areas which we regard as critical for potential use of Area A fish and wildlife resources; that is, areas supporting animal populations which are not presently utilized but nonetheless regarded as the most important sources of fish and wildlife for expanded human use. Many of these areas, or the fish and wildlife resources they support, were harvested in the past.

The areas identified as critical in supporting fish and wildlife resources of significance for potential harvest are shown on Figure 4. These areas were identified in a manner similar to that described in the preceding chapter for areas critical to present use in addressing exploration and development impact on areas regarded as critical for potential use, however only long-term impacts of moderate or high severity were considered.

For each area delineated on Figure 4, there follow catalogue sheets which summarize the biological description, resource harvest, potential impacts, data gaps and conclusions. References indicated by reference numbers on the catalogue sheets are listed at the back of this volume.

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Summary of Conclusions

Our general conclusions regarding the impact of exploration and development activity on the areas delineated as critical for potential use are essentially the same as those for the areas we identified as critical for present use. Few problems are anticipated with land-based exploration and test drilling phase activities; and those that are anticipated are, in our view, controllable via existing land use regulations.

The most serious problems anticipated are associated with water-based exploration and drilling programs, specifically blowouts with respect to the latter, and the configuration and location of the infrastructure required for a producing field and the human activity associated with its construction.

Our concerns and recommendations for the specific critical areas shown on Figure 4 are summarized below.

Area 1: Small inland lakes (noted for lake trout and whitefish). We foresee limited potential for land-based exploration and development activities affecting the fish resources of these waterbodies. This of course assumes that appropriate operating conditions are applied to land use permits and adequately enforced. We would, however, recommend that explosive seismic operations and water-based drilling programs not be permitted in these waterbodies.

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Area 2: "Fingers" Area of Eskimo Lakes. Land-based exploration and development activity in the "fingers" area is not regarded as detrimental to staging and molting waterfowl so long as appropriate operating conditions respecting location and timing of activity are applied to land use permits and adequately enforced. Water-based drilling programs should not be permitted, however.

Area 3: Anderson River Delta, Wood Bay, Nicholson Peninsula. Winter exploration and land-based test drilling operations in this area should not constitute any particular threat to nesting, staging and molting waterfowl. Major infrastructure development should not be permitted near nesting colonies, however, and certain activities would have to be curtailed when waterfowl are present. No water-based drilling operations should be permitted in Wood Bay.

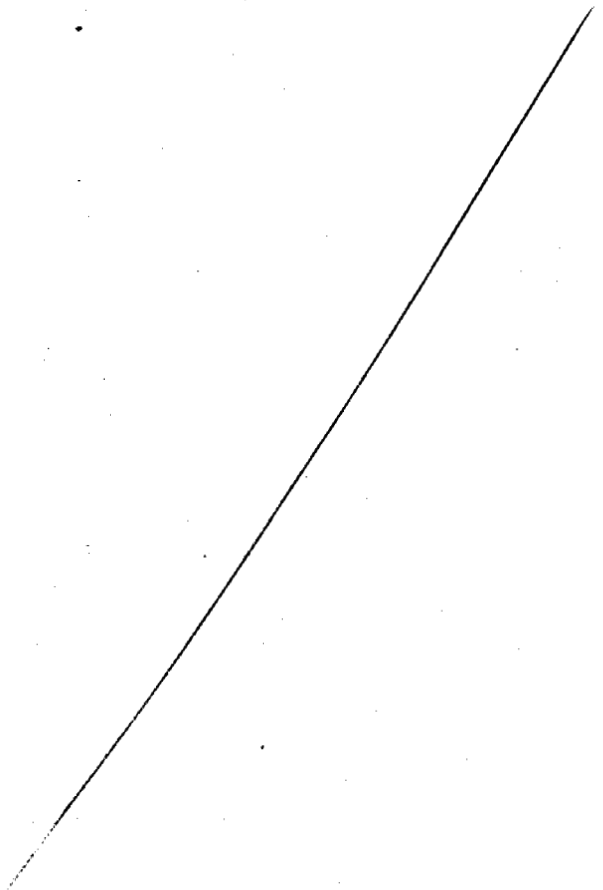
Area 4: Cape Dalhousie. In our view, exploration and development can be accomplished in this area with little disturbance to nesting, molting, and staging waterfowl. Certain restrictions on infrastructure siting should be applied in the area, however, and certain activities curtailed or carefully controlled when waterfowl are present.

Area 5: Baillie Island and Northern Cape Bathurst. With adequate controls to ensure that waterfowl staging and molting areas are not fouled by spills or blowouts, and that human activity is curtailed during periods when large numbers of waterfowl are present, no major problems are anticipated in this area. It should be noted, however, that the

Cape Bathurst portion of this area is located within Critical Area 7 for Present Use.

Area 6: Wood Bay. No major long-term impacts are anticipated in this area as a result of exploration and development activity if certain operating conditions are applied to ensure that fish habitat is not degraded.

Area 7: Mouth of Horton River. Water-based drilling operations and gathering systems should not be permitted in this area. With adequate controls, other activities could probably proceed in this area.



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CATALOGUE SHEETS FOR FIGURE 4

CATALOGUE SHEETS FOR FIGURE 4

CRITICAL AREAS FOR POTENTIAL USE-FISH

AREA 1: SMALL INLAND LAKES

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Lake trout	Spawning, feeding, overwintering	Moderate to High	All year
Whitefish	Spawning, feeding, overwintering	Moderate to high	All year

Notes:
- lake trout are predominant in some lakes, whitefish in others
- lakes appear to function as relatively independent systems
- easily overexploited or disrupted due to size of lakes
- there may be other lakes similar to these in the study area that are presently not identified

RESOURCE HARVEST

Type of Harvest: Potential domestic or limited commercial fishing

Season: Primarily fall and early winter

Notes: Many of these lakes were fished by trappers in the past when dogteams were used. They may become important in the future if there is an increase in trapping intensity in the study area or if there is a return to the use of dogteams.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC				
Explosives	Fish-kills	High	Potentially long-term	Air-guns
EXPLORATION DRILLING				
Drilling activity (blowouts)	Toxicity	High	Potentially long-term	Present controls inadequate
Site preparation	Siltation	Moderate	Potentially long-term	Method, location
PRODUCTION OPERATIONS				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Process wastewater	Toxic spills	Moderate	Long-term	Method
Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	High	Potentially long-term	Present controls inadequate
TRUNK LINE				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Trenching	Siltation	Moderate	Long-term	Location, design

Discussion: The main potential impacts to fish in these lakes are the same as the long-term impacts expressed for Area 3 in the catalogue sheets accompanying the Critical Areas for Present Use Map. These are fish-kills resulting from explosive water-based seismic, blowouts and pipe ruptures in water, siltation caused by erosion from permanent road and pipeline rights-of-way, and toxic spills from the discharge of process wastewater.

Explosive water-based seismic in these lakes is felt to have potential for long-term impact to fish because of the possible isolated nature of these populations. Lack of recruitment from nearby waterbodies may increase the recovery time of these fish populations to more than three years. This impact can apparently be controlled by using air-guns rather than explosives as an energy source (25). None the less, even air-guns should not be used under ice until this method is shown not to be harmful to fish.

Concern about blowouts of water-based wells is greatest if drilling is done from an ice platform, making access to the wellhead difficult. During production operations, ruptures of underwater collector lines would also be very difficult to repair under ice. Again because of the relatively isolated nature of these lakes, recovery from impact may take longer than three years. We therefore recommend that drilling in these lakes be prohibited. An acceptable alternative to in-lake drilling would be directional drilling from land.

Potential long-term impacts from siltation originating from erosion of permanent roads and pipeline rights-of-way can be controlled by locating these rights-of-way a suitable distance from lakes (37), and in areas of nonerodable, stable soils. Design of these project components should include adequate silt-control methods. Detailed geophysical investigation will be required for location of permanent road and pipeline rights-of-way.

Process wastewater could be a persistant source of toxic spills. These wastes can be injected below the permafrost layer or detoxified prior to release to natural waterbodies.

MAJOR DATA GAPS

- independence of these lakes from other aquatic systems

CONCLUSIONS

Fish in small inland lakes are more vulnerable to impact because of the confined habitat. With controls that can be accommodated within the existing regulatory framework, petroleum exploration and development is acceptable within these lake drainages. Specifically, these controls are: prohibition of explosives for water-based seismic; and appropriate location and design of road and pipeline rights-of-way to limit erosion and minimize siltation.

In-lake drilling activity is not acceptable because of the high potential for siltation resulting from construction of artificial islands, and because of the severity and uncontrollable aspects of well blowouts and line ruptures in water.

CRITICAL AREAS FOR POTENTIAL USE - WATERFOWL

AREA 2: ESKIMO LAKES FINGERS

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Ducks (scaup & scoters)	Staging and molting	Potential for about 75,000 (86)	Mid May -

Notes: The entire Eskimo Lakes - Liverpool Bay system is used by ducks, primarily scaup and two species of scoter, for molting and to a lesser extent for staging. Aside fr
some of the larger bays opening onto Liverpool Bay, the most heavily used molting
areas are in quiet waters between the "fingers" of Eskimo Lakes; where
more than 10,000 birds have been observed in a single day. The critical
From mid July to late August.

RESOURCE HARVEST

there is no record of duck hunting ever having occurred in this area. hunters primarily go goose hunting and kill ducks in goose hunting areas. Ducks that molt and stage in this area, however, may be hunted in other areas, either currently or in the future.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Drilling activity (blowouts)	Fouling or displacement of molting and staging ducks	Potential large-scale losses of molting and staging birds	Potentially long-term	Do not locate wells where blowouts will foul critical molting or staging habitats
Staging (fuel handling)	Fouling or displacement of molting ducks	Potential large-scale reduction of duck numbers	Potentially long-term	Do not stage fuel where spills will foul critical molting and staging habitats
PRODUCTION AND TRUNK LINES				
Cluster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of molting and staging ducks	Potential large-scale losses to molting and staging populations	Potentially long-term	Do not locate wells or pipelines where ruptures or blowouts will foul critical molting or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting or staging habitats

Discussion: The possibility of blowouts or large fuel spills poses the greatest threat to ducks staging or molting in the Eskimo Lakes "fingers". Ducks that become fouled with raw oil or freshly spilled fuel in most cases will not survive. Because birds usually gather in very large flocks during molting or staging, opportunities for large-scale die-offs caused by oil/fuel spills cannot be discounted.

Frequent passage of aircraft over flocks of ducks or over critical habitats during molting and fall staging periods could cause birds to avoid or abandon key feeding and resting habitats which in turn could jeopardize survival through winter. However, such conflicts should not have measurable effects on regional populations because intensive disturbance is anticipated only during construction phases, not during operation of production facilities, should any be located within this area.

MAJOR DATA GAPS

- description of specific habitats used by molting and staging ducks
- numbers and species of ducks during spring, mid-summer and fall concentration periods

CONCLUSIONS

Land-based oil/gas development within the Eskimo Lakes "fingers" areas can be accomplished with a minimum of disturbance to molting and staging ducks as long as measures are taken to protect birds and their habitat from pollution and persistent disturbance from aircraft and other construction-related activities.

To reduce the possibility of destructive impacts on molting and staging ducks, (a) no wells, trunk lines, or fuel storage sites should be located on coastlines, riverbanks, or in offshore areas where spills or blowouts will pollute duck concentration areas, and (b) aircraft should not be operated within 3.2 km (2 miles) of, or lower than 610 m (2000 feet) altitude over, critical habitats when waterfowl are present.

CRITICAL AREAS FOR POTENTIAL USE - WATERFOWL

AREA 3: ANDERSON RIVER DELTA, WOOD BAY, AND NICHOLSON PENINSULA

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Snow Goose	Nesting, brood rearing	4,000 - 8,000 (86,9)	Mid May - Early Sept.
	Pre-molt migration and staging (86)	Undetermined	Mid July - Mid Aug. (86)
	Spring staging (in bad weather) (86)	Potential for 200,000 (4,86)	Mid May - Early June
Brant	Nesting, brood rearing	2,000 - 3,000 (9,86)	Late May - Mid Aug. (4)
	Molting	3,000 (9)	Mid July - Mid Aug.
Whitefront	Staging	Undetermined	Mid May - Mid June (23)
	Nesting, brood rearing	2,000 (9)	Mid May - Mid Aug. (86,4)
	Molting	3,000 (9)	Early July - Mid Aug. (4)
Canada Goose	Molting	400[1] (9)	Early July - Mid Aug. (42)
Ducks	Nesting	Undetermined	Mid May - Early July (42,73)
	Molting	Potential for 75,000 (86)	20 July - 25 Aug. (86)
	Staging	Potential for 75,000	Mid May - Mid June
			Mid Aug. - Mid Sept.

Notes: The critical waterfowl use period is mid May to late August. Key issues in order of importance are: (a) spring staging by snow geese which could number 150,000 to 200,000; (b) nesting brant and snow geese, whose colonial breeding habits make them especially vulnerable to disturbance; and (c) molting ducks and geese which, being flightless, are less able to avoid major disturbances. Nesting whitefronts are not as likely to be adversely affected by oil/gas exploration and development activities owing to their dispersed pattern of distribution when breeding. In general, the Anderson Delta is a recognized "critical" waterfowl area; its importance to birds is reflected in the establishment of the Anderson River Migratory Bird Sanctuary.

RESOURCE HARVEST

Type of Harvest: Potential goose and duck hunting

Season: Spring to fall (May to September)

Notes: This used to be a good hunting area but is now part of the Sanctuary and no hunting has been allowed in the past few years. If hunting is once again allowed, this may become an important goose hunting area as some Tuktoyaktuk hunters-trappers currently have camps in the area (43).

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Gravel extraction	Habitat degradation and displacement of nesting snow geese and brant	Potential destruction or abandonment of nest colonies	Long-term	Do not locate gravel sites in or near brant or snow goose colonies
Drilling activity (blowout)	Fouling or displacement of (a) molting and staging ducks and geese, (b) nesting brant and snow geese	Potential (a) large-scale losses of molting/staging populations; (b) abandonment of brant and snow goose colonies	Potentially long-term	Do not locate wells where blowouts will foul critical molting, nesting, or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting, nesting or staging habitats
Site development	Habitat degradation and displacement of nesting brant and snow geese	Potential abandonment or destruction of colonies	Long-term	Do not locate sites in colonies
PRODUCTION, TRUNK LINES				
Cluster facilities and pipelines (blowouts or ruptures)	Fouling or displacement of (a) molting and staging ducks and geese, (b) nesting brant and snow geese	Potential (a) large-scale losses to molting/staging populations; (b) abandonment of brant and snow goose colonies	Potentially long-term	Do not locate wells or pipelines where blowouts or ruptures will foul critical molting, nesting, or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Same as preceding	Do not stage fuel where spills will foul critical molting, staging or nesting habitats
Construction of: pads, cluster facilities, camps, permanent road, processing plants	(a) Nesting brant and snow geese (b) molting geese and ducks, in order of concern	Potential destruction of colonies or reduction in numbers of breeding residents; reduced numbers of molting and staging waterfowl	Long-term (colonies) short-term (molting, staging)	Do not build facilities or roads in or near colonies
Permanent roads (traffic)	Displacement of nesting brant and snow geese	Loss of nests and production potential, abandonment of colonies	Potentially long-term	Do not build roads in or near colonies
Operation and maintenance	Displacement of molting and staging geese and ducks, and nesting brant and snow geese	Loss of nests and reduced production for snows and brant; reduced numbers of molting/staging waterfowl	Potentially long-term	Schedule activities to minimize disturbance
Aircraft	Displacement of nesting brant and snow geese	Loss of production in colonies; reduced numbers of molting/staging waterfowl	Potentially long-term	Do not fly directly over colonies or molting sites at low altitudes; schedule flights to avoid bird concentrations

Discussion:

Anderson River delta and Wood Bay are the most important centres of waterfowl production habitat within the study area. Delta and offshore habitats are used by flocks of staging and molting ducks and geese of several species. Both molting and staging flocks are particularly vulnerable to disturbance because at these times they tend to gather in very large, tightly grouped flocks.

The most serious potential problem is the presence of oil or fuel in offshore sites used by staging snow geese, molting ducks and geese, and staging ducks. As this is a critical waterfowl area in terms of numbers of species and individuals, extensive pollution could result in large-scale mortality in regional or flyway populations.

Frequent or long-term disturbance from people, construction activity, and production facilities within or near brant or snow goose colonies could result in large-scale production losses and possible abandonment of these colonies. Repeated disturbance from low-flying aircraft could drive nesting snows and brant off eggs or away from helpless young, leaving them open to cold weather or predators. Staging and molting ducks and geese may avoid traditional habitats if aircraft pass over often at low altitudes.

MAJOR DATA GAPS

- numbers of staging whitefronts and location of staging sites
- critical duck molting and staging sites
- description of snow goose pre-molt migration in terms of numbers and specific concentration sites

CONCLUSION

The impact of project activities on regional waterfowl populations, particularly those of snow geese and brant, could be severe and long-lasting enough to reduce their availability to residents of Tuktoyaktuk. If the present status and well-being of these populations is to be guaranteed, (a) no wells or fuel storage sites should be located where spills, ruptures, or blowouts will foul goose nesting colonies or waterfowl staging and molting habitats; (b) no major construction activity should take place within 3.2 km (2 miles) of nesting colonies or critical molting and staging habitats when birds are present; (c) pumps, compressor stations, processing plants and other facilities should not be located within 3.2 km (2 miles) of colonies or critical molting and staging areas; and (d) aircraft should not be operated within 3.2 km (2 miles) of or lower than 610 m (2000 feet) over goose colonies or critical molting and staging habitats when birds are present. Operations of winter seismic programs are not expected to have any measurable impact on regional populations.

CRITICAL AREAS FOR POTENTIAL USE - WATERFOWL

AREA 4: CAPE DALHOUSIE

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Snow Goose	Staging	Potential for 150-200,000 (4)	Mid May - Early June
Brant	Nesting (and brooding) (86)	Undetermined	Late May - Mid Aug.
Ducks	Molting (oldsquaw, scaup, scoters) Staging	Potential for 600,000 (9) Potential for 1-2 million (86)	20 July - 1 Aug. Spring and Fall

Notes: Snow geese migrating to Banks Island breeding grounds have been known to stop at Cape Dalhousie during bad weather. Thus, the main use period is mid May to early June. In fact Cape Dalhousie lies along the major migration flyway for most waterfowl that breed along the coast or farther north; this is especially true for oldsquaw and eiders which move along coastal and offshore areas in spring and fall in very large numbers.

RESOURCE HARVEST

Notes: There is no record of any duck or goose hunting in this area. This could be due to difficult accessibility of this area in spring. However, ducks and geese that stage and molt here are hunted in other areas.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Gravel extraction	Displacement of nesting brant; habitat degradation	Potential destruction and abandonment of colony	Long-term	Do not locate gravel sites in or near brant colony
Drilling activity (blowouts)	Fouling or displacement of molting and staging ducks and geese and nesting brant	Potential (a) large-scale losses of molting and staging birds and (b) abandonment of brant colony	Potentially long-term	Do not locate wells where blowouts will foul critical molting, nesting, or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Same as preceding	Do not stage fuel where spills will foul critical molting, nesting or staging habitats
Site development	Habitat degradation; displacement of nesting brant	Potential destruction and abandonment of colonies	Long-term	Do not locate sites in brant colonies
PRODUCTION AND TRUNK LINES				
Cluster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of molting and staging ducks, snows, and nesting brant	Potential (a) large-scale losses to molting and staging populations and (b) abandonment of brant colony	Potentially long-term	Do not locate wells or pipelines where ruptures or blowouts will foul critical molting, staging, or nesting habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting, nesting, and staging habitats
Construction of: Pads, cluster facilities, camps, permanent roads, processing plants	Habitat degradation, displacement of nesting brant and staging snows	Potential destruction of brant colony; reduced numbers of staging snows	Long-term (brant) Short-term (staging)	Do not build facilities or roads in or near colonies or critical staging sites
Permanent roads (traffic)	Disturbance of nesting brant, staging snow geese	Possible abandonment of brant colony; reduced numbers of staging snows	Potentially long-term	Do not build roads in or near colonies; schedule traffic flows to avoid staging snows
Operation and maintenance	Displacement of staging snows and nesting brant	Potential abandonment of brant colony; reduced numbers of staging snows	Potentially long-term	Schedule activities to reduce disturbance

Discussion: A large segment of the snow goose and diving duck population may use coastal and offshore habitats for staging and molting in any given year. Presence of fuel or oil during use periods could foul and kill thousands of birds. Potential effects of construction, human presence, or aircraft are of some concern but are not expected to threaten the long-term stability of regional populations. Although there is no information on the size of the brant colony, it seems likely that only a small number of birds nest in the area and these should be relatively easy to avoid.

MAJOR DATA GAPS

- Size and location of brant colony
- Specific sites used by snow geese and ducks
- Numbers and species composition of ducks

CONCLUSIONS

Oil/gas exploration and development in the Cape Dalhousie area can be accomplished with little or no disturbance to nesting, molting, and staging waterfowl populations as long as protective measures against pollution and disturbance effects are carefully followed. These measures include: (a) no wells or fuel storage sites should be located on coastlines, river banks, or offshore areas where spills, ruptures, or blowouts will invade waterfowl concentration areas, (b) no major construction activity should take place within 3.2 km (2 miles) of critical habitats during times of waterfowl use, (c) construction camps, compressor stations, processing plants, and other facilities should not be located within 3.2 km (2 miles) of critical habitats, (d) aircraft should not be operated within 3.2 km (2 miles) of, or lower than 610 m (2000 feet) over, critical habitats when waterfowl are present.

Gravel extraction	Displacement of nesting pearl habitat degradation	Potential destruction and abandonment of colony	long-term	Do not locate gravel sites in or near brant colony
Drilling activity (blowouts)	Fouling or displacement of molting and staging ducks and nesting brant	Potential (a) large-scale losses of molting and staging birds and (b) abandonment of brant colony	Potentially long-term	Do not locate wells where blowouts will foul critical molting, nesting, or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Same as preceding	Do not stage fuel where spills will foul critical molting, nesting or staging habitats
Site development	Habitat degradation; displacement of nesting brant	Potential destruction and abandonment of colonies	long-term	Do not locate sites in brant colonies
PRODUCTION AND TRUNK LINES				
Disaster facilities and pipeline (blowouts) and ruptures)	Fouling or displacement of molting and staging ducks, snows, and nesting brant	Potential (a) large-scale losses to molting and staging populations and (b) abandonment of brant colony	Potentially long-term	Do not locate wells or pipelines where ruptures or blowouts will foul critical molting, staging, or nesting habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting, nesting, and staging habitats
Construction of: roads, disaster facilities, camps, permanent roads, processing plants	Habitat degradation, displacement of nesting brant and staging snows	Potential destruction of brant colony; reduced numbers of staging snows	long-term (brant); short-term (snows)	Do not build facilities or roads in or near colonies or critical staging areas
Transport roads (traffic)	Disturbance of nesting brant, staging snow geese	Possible abandonment of brant colony; reduced numbers of staging snows	Potentially long-term	Do not build roads in or near colonies; schedule traffic flows to avoid staging snows
Operation and maintenance	Displacement of nesting brant and snows	Potential abandonment of brant colony; reduced numbers of staging snows	Potentially long-term	Schedule activities to reduce disturbance

Discussion: A large segment of the snow geese and diving duck population may use coastal and offshore habitats for staging and molting in any given year. Presence of fuel or oil during this period could foul and kill considerable numbers of birds. Potential effects of construction, human presence, or aircraft are of some concern but are not expected to present a long-term instability of regional populations. Although there is no information on the size of the brant colony, it seems likely that only a small number of nests exist in the area and these should be relatively easy to avoid.

Known Data Gaps

- Size and location of brant colony
- Specific sites used by snow geese and ducks
- Numbers and species composition of ducks

AREA 5: BAILLIE ISLAND AND NORTHERN CAPE BATHURST

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Snow Goose	Staging (86)	Potential for 200,000 (4)	20 May - 8 June 20 Aug. - 10 Sept.
Oldsquaw	Molting (16)	Part of a regional population of over 1 million	Mid July - Late Aug.
Ducks	Migration, staging (73,86)	Part of a regional population of over 1 million (86)	Late May - Mid June Mid Aug. - Mid Sept.

Notes: The area is a major migration pass for large numbers of sea ducks, many of which stage or molt in the vicinity of Baillie Island. They and the snow geese, which are part of the large Banks Island population, are present during spring and fall; however, snows frequently congregate on land whereas ducks tend to remain offshore. Of the two groups of waterfowl, the snow geese are potentially of greatest importance for human use.

RESOURCE HARVEST

Type of Harvest: Potential duck and goose hunting

Season: Mid May to Mid September

Notes: There used to be goose hunting on northern Cape Bathurst and duck hunting on Baillie Island when people lived in these areas.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
SEISMIC OPERATIONS	None anticipated			
EXPLORATION DRILLING				
Drilling activity (blowouts)	Fouling or displacement of molting and staging ducks and staging snows	Potential large-scale losses of molting and staging ducks and staging snow geese	Potentially long-term	Do not locate wells where blowouts will foul critical molting or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting or staging habitats
PRODUCTION AND TRUNK LINES				
Cluster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of molting and staging ducks and snows	Potential large-scale losses to molting and staging populations	Potentially long-term	Do not locate wells or pipelines where ruptures or blowouts will foul critical molting or staging habitats
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term	Do not stage fuel where spills will foul critical molting and staging habitats
Construction of: Pads, cluster facilities, camps, permanent roads, processing plants	Habitat degradation; displacement of staging snows	Reduced numbers of staging snows	Potentially long-term	Do not build facilities or roads in critical staging sites
Permanent roads (traffic)	Displacement of staging snow geese	Reduced numbers of staging snows	Potentially long-term	Schedule traffic flows to avoid staging snows
Operations and maintenance	Same as preceding	Same as preceding	Same as preceding	Schedule activities to avoid staging snows

Discussion:

Extensive pollution of critical offshore habitats used by staging or molting ducks is the most serious potential problem -- birds coming in contact with crude oil or large fuel spills would almost certainly die. Because of the large numbers of birds that pass through the area, losses could be great enough to noticeably reduce harvest by Tuktoyaktuk residents.

Snow geese, while extremely sensitive to disturbance when staging, are not likely to suffer large-scale losses to regional populations because of oil/gas development on Cape Bathurst. Compared to the Mackenzie Delta-Yukon coast areas, Cape Bathurst is not a critical fall staging area for snow geese arriving from Banks Island. Disturbance by aircraft or human activity would probably cause snows to leave this area for major staging sites to the west. Blowouts and fuel spills into coastal or wetland habitats used by snows could result in direct mortality; however, this is not likely to be as serious as in the case of ducks because staging snow geese typically congregate in upland areas.

Human activity and frequent passage of low-flying aircraft will disturb molting or staging ducks and could cause them to abandon traditionally used habitats. By forcing birds to avoid favourable feeding and resting areas and by repeatedly interrupting normal behavior, molting and staging flocks squander energy reserves needed for migration or breeding. This along with the increased stress brought about by disturbance could raise mortality rates. However, it is unlikely that any noticeable decrease in regional populations would result from such disturbance.

MAJOR DATA GAPS

- Numbers of ducks and snow geese present during any given year
- Specific concentration areas
- Season of use by ducks
- Species composition by season

CONCLUSIONS

Although Area 5 contains important molting and staging habitats for ducks and snow geese, oil and gas development can probably be carried out without causing major or long-term disturbance of birds during critical use periods. But it is essential that sensitive offshore habitats be protected from pollution and that aircraft stay away from waterfowl concentrations if development is to proceed. For recommended controls to be effective, it is also essential that more precise descriptions of waterfowl numbers, habitats, and use periods are obtained.

To prevent excessive disturbance of molting and staging waterfowl in the Baillie Island-Cape Bathurst area (a) no wells or fuel storage sites should be located on coastlines, river banks, or offshore areas where spills or blowouts will invade waterfowl concentration areas, (b) no major construction activity should take place within 3.2 km (2 miles) of critical habitats during times of waterfowl use, (c) construction camps, compressor stations, processing plants, and other facilities should not be located within 3.2 km (2 miles) of critical habitats, (d) aircraft should not be operated within 3.2 km (2 miles) of, or lower than 610 m (2000 feet) over, critical habitats when waterfowl are present.

Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term
Disaster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of molting and staging ducks and snows	Potential large-scale losses to molting and staging populations	Potentially long-term
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term
Construction of: Pads, disaster facilities, camps, permanent roads, processing plants	Habitat degradation; displacement of staging snows	Reduced numbers of staging snows	Potentially long-term
Permanent roads (traffic)	Displacement of staging snow geese	Reduced numbers of staging snows	Potentially long-term
Operations and maintenance	Same as preceding	Same as preceding	Same as preceding

Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term
Disaster facilities and pipelines (blowouts and ruptures)	Fouling or displacement of molting and staging ducks and snows	Potential large-scale losses to molting and staging populations	Potentially long-term
Staging (fuel handling)	Same as preceding	Same as preceding	Potentially long-term
Construction of: Pads, disaster facilities, camps, permanent roads, processing plants	Habitat degradation; displacement of staging snows	Reduced numbers of staging snows	Potentially long-term
Permanent roads (traffic)	Displacement of staging snow geese	Reduced numbers of staging snows	Potentially long-term
Operations and maintenance	Same as preceding	Same as preceding	Same as preceding

Do not stage fuel where spills will local critical molting or staging habitats

Do not locate wells or lines where blowouts or blowouts will foul critical molting or staging habitats

Do not stage fuel where spills will local critical molting and staging habitats

Do not build facilities or roads in critical staging areas

Schedule activities to avoid staging snows

Schedule traffic flows to avoid staging snows

Extensive pollution of critical offshore habitats used by staging or molting ducks is a most serious potential problem -- birds coming in contact with crude oil or large fuel spills would almost certainly die. Because of the large numbers of birds that pass through the area, losses could be great enough to noticeably reduce harvest by Inuvialuit hunters.

Snow geese, while extremely sensitive to disturbance when staging, are not likely to be large-scale losses to regional populations because of oil and gas development on Cape Bathurst. Compared to the Mackenzie Delta-Yukon coast area, Cape Bathurst is not a critical fall staging area for snow geese arriving from Banks Island. Disturbance by aircraft or other activity would probably cause snows to leave this area for major staging areas to the west. Blowouts and fuel spills into coastal or wetland habitats used by snows could result in direct mortality however, this is not likely to be as serious as in the case of ducks because staging snow geese typically congregate in upland areas.

Human activity and frequent passage of low-flying aircraft will disturb molting or staging ducks and could cause them to abandon traditionally used habitats. By forcing birds to avoid favourable feeding and resting areas and by repeatedly interrupting normal behavior, molting and staging flocks squander energy reserves needed for migration or breeding. Thus, long-term the increased stress caused by disturbance could cause mortality rates. However, it is unlikely that any noticeable decrease in regional populations would result from such disturbance.

DATA GAPS

- Numbers of ducks and snow geese present during any given year
- Specific concentration areas
- Season of use by ducks
- Migration completion by season

CRITICAL AREAS FOR POTENTIAL USE - FISH

AREA 6: WOOD BAY

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Whitefish	Spawning (?), feeding, overwintering	High	All year
Lake herring	Spawning (?), feeding, overwintering	High	All year

Notes: - excellent fishing potential for whitefish (broad, lake, and inconnu) and lake herring
- probably an important overwintering area
- spawning in Anderson River drainage

RESOURCE HARVEST

Type of Harvest: Domestic fishing - potential commercial fishing

Season: Primarily fall and winter (43) - possibly some spring fishing

Intensity: Low

Notes: There is some fishing in Wood Bay by trappers who have camps in the area (43) and possibly some fishing in conjunction with spring goose hunting in the Mason River delta area. Wood Bay is thought to have a good commercial fishing potential (23).

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC	No long-term concerns anticipated			
EXPLORATORY DRILLING	No long-term concerns anticipated			
PRODUCTION OPERATIONS				
Permanent roads	Siltation	Moderate	Long-term	Location, design
Process wastewater	Toxic spills	Moderate	Long-term	Location, method
TRUNK LINE				
Trenching	Siltation	Moderate	Long-term	Location, design
Permanent roads	Siltation	Moderate	Long-term	Location, design

Discussion: Because of the large size of this area and the circulation of water through the bay, fewer long-term impacts to fish caused by petroleum development are anticipated here. It is primarily because of the abundant fish population available for harvest that this area is considered critical for potential use.

Permanent roads and trenching are considered to be persistant sources of siltation. The most appropriate controls for these sources of siltation are to locate roads and pipelines away from the shoreline of Wood Bay and through areas that are not susceptible to erosion (37). In addition, adequate erosion control structures may be required in the design of these features.

Discharge of toxic process wastewater could cause impact to fish for the duration of operation of a gas or oil processing facility. The most effective control of this impact is to locate processing facilities away from Wood Bay, and dispose of process effluent by injection below the permafrost or detoxify the effluent before release into natural waterbodies.

MAJOR DATA GAPS

- importance of Wood Bay as an overwintering area
- timing and amount of fish movement between Wood Bay and the Anderson River

CONCLUSIONS

In considering only long-term impacts to fish, petroleum exploration and development activities are acceptable in and around Wood Bay if controls, that can be accommodated within the existing regulatory framework, are employed. Specifically, these controls are: appropriate location and design of road and pipeline rights-of-way to limit erosion and minimize siltation; and injecting process wastewater below the permafrost, or detoxifying before release into Wood Bay. Construction activities and permanent facilities should be located so that interference with resource use and traditional campsites is avoided.

CRITICAL AREAS FOR POTENTIAL USE- FISH

AREA 7: MOUTH OF HORTON RIVER

BIOLOGICAL DESCRIPTION

Species	Activity	Abundance	Season
Arctic char	Feeding, migration, upstream spawning.	High relative to Area A, low relative to other areas	Summer in estuary, all year upstream

Notes: - "best" char river in Area A

- fish passage essential to survival of population

RESOURCE HARVEST

Type of Harvest: Domestic fishing potential

Notes: There may be limited fishing in this area currently as the Horton River is reportedly fished to some extent by trappers in fall and early winter (43). It is not expected to become an important domestic fishing area due to its remoteness. It could, however, receive more use if trapping intensity in the Horton River area increases.

POTENTIAL IMPACTS

Project Activity	Major Concerns	Severity	Duration	Controls
LAND SEISMIC	None anticipated			
WATER-BASED SEISMIC	No long-term concerns anticipated			
EXPLORATORY DRILLING	No long-term concerns anticipated			
PRODUCTION OPERATIONS				
Permanent roads	Siltation/fish blockage	Moderate	Long-term	Location, design
Cluster facilities and pipelines (blowouts and ruptures)	Toxicity	Moderate	Long-term	Present controls inadequate
TRUNK LINE				
Permanent roads	Siltation/fish blockage	Moderate	Long-term	Location, design
Trenching	Siltation	Moderate	Long-term	Location, design

Discussion: Other harvestable fish are present in the Horton River, but only arctic char are considered here because this is the major identified arctic char river in the study area.

The major long-term concerns in this area are: the potential effects of siltation and fish blockage that may be caused by presence of a permanent road, siltation originating from trunkline trenching, and the possibility of blowouts or pipe ruptures in the estuary of the Horton River.

Siltation from roads and trenching can be controlled by locating these development features away from the river mouth. If a trunkline is to cross the river it should be upstream at a location of stable river banks, and adequate silt control structures should be employed on the right-of-way. The use of bridges for river crossings rather than causeways and culverts would minimize siltation from the crossing site, and would lessen the chance of blocking fish migrations.

Because of the importance of estuaries to anadromous arctic char life history (26), there is increased concern about the consequences of well blowouts and pipe ruptures in this area. Underwater blowouts or pipeline ruptures could cause long-term reduction of arctic char populations. Because control of this event is presently not practical, drilling and/or gathering systems are felt unacceptable in the Horton River estuary.

MAJOR DATA GAPS

- size of arctic char population
- soil and bank stability in this area

CONCLUSIONS

Use of the Horton River estuary is essential to the anadromous arctic char population of this river. With controls that can be accommodated within the existing regulatory framework, petroleum exploration and development is acceptable within this river drainage. Specifically, these controls are: appropriate location and design of road and pipeline rights-of-way to limit erosion and minimize siltation; and appropriate location and design of road and pipeline river crossings to avoid blockage of char migrations.

Petroleum exploration and development activities are not acceptable in the Horton River estuary because control of blowouts and ruptures is presently inadequate.

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