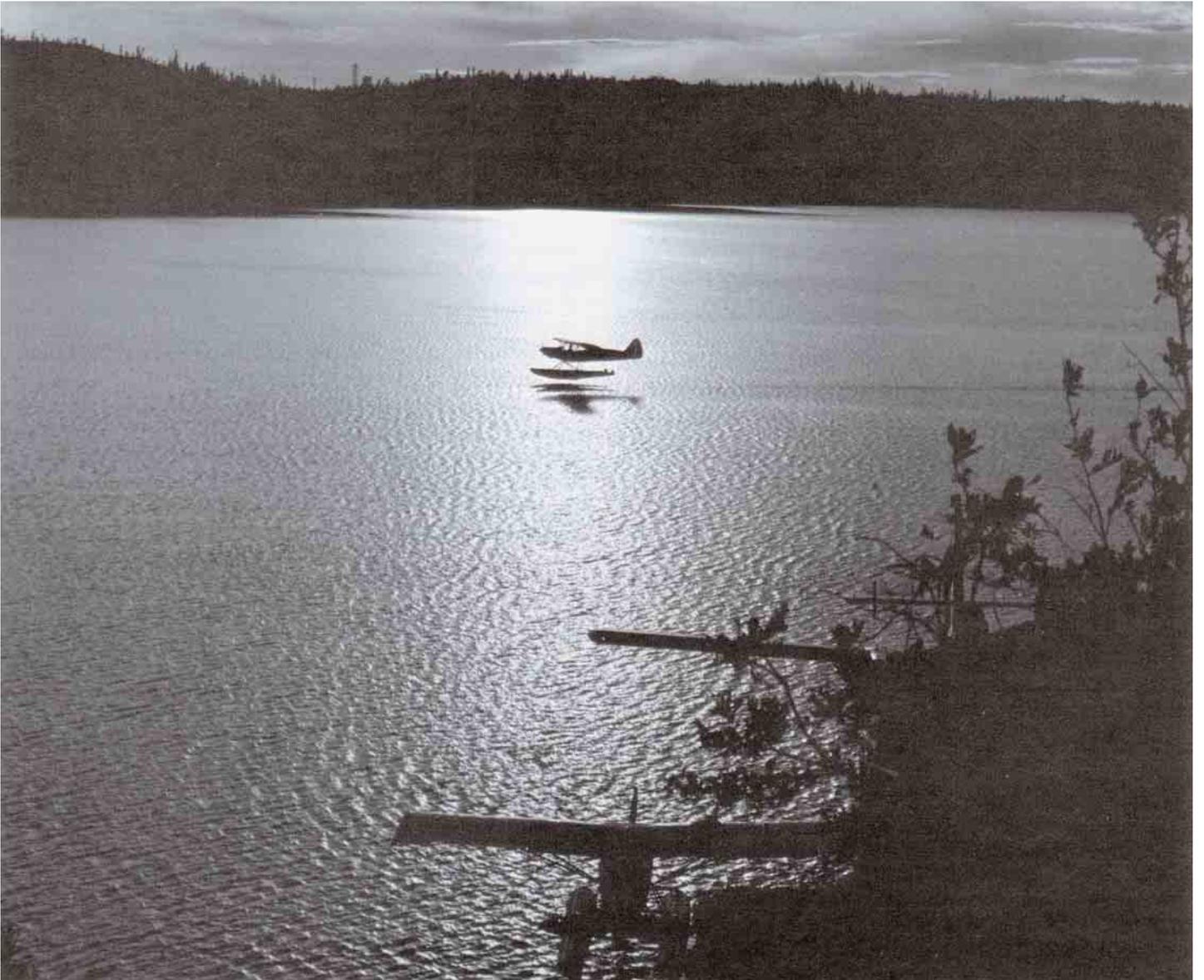


## PART TWO

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# Environment and Land





## 7

The Physical  
Environment

Many people assume that the vastness of the North and the sparseness of its human population preclude the possibility that its land, water and air could ever become polluted. This assumption, I believe, is false. Although large areas of the North still remain relatively pristine, there is ample evidence to suggest that they may not always remain unpolluted. Over the years, and especially during recent years, human activity has progressively extended disturbance from small, isolated centres to much larger areas. We can now see a marked contrast between the untouched wilderness on the one hand and, on the other hand, the lands and waters that surround the settlements and the extensive areas in the Mackenzie Valley and Mackenzie Delta that have been subjected to intensive exploration and development.

There is a tendency to underestimate the dimensional and cumulative aspects of human impacts on the northern landscape and to overestimate the capacity of the environment to absorb them. The concentration of polluting activities that follows projects of a linear nature, such as seismic lines, the proposed pipeline, highways, and transportation corridors in general, means that such impacts are not only becoming more extensive but also that they are becoming interlocking and interdependent. People and their polluting activities are generally found together, and the overlap and cumulative build-up of successive environmental changes they create tend to be longer lasting in the North than they are in more temperate regions. Our technological needs and capabilities are leading us to undertake very large-scale projects in the North, and these projects necessarily involve very large-scale environmental impacts and risks.

For these reasons, I do not believe that the vastness of the North and the relative sparseness of its population will be any protection from serious degradation of environmental quality. Furthermore, northern ecosystems are vulnerable because certain important species within them have critical habitats and critical life stages; thus, some human activities and some areas of wilderness will have to be excluded from industrial development, if we are sincere in our commitment to protect the northern environment. Some kinds of environmental

damage that are self-healing in the South, or are at least capable of rehabilitation, are, in the North, virtually permanent, and they therefore tend to be cumulative. It is this kind of cumulative effect, however slowly it may develop, that I see as the most serious threat to the northern environment in the long run.

*Environmental Priorities*

The evidence of hundreds of witnesses at the community hearings makes it quite clear that cumulative environmental impacts in the Mackenzie Valley and Mackenzie Delta have already reached a level that disturbs the people who live there. It is impossible for me to compare analytically past and probable future rates of accumulation of environmental impact. In the past, the rate was no doubt hastened by a general insensitivity to environmental concerns, and our ability to mitigate these effects was less advanced than it is today. In the future, the rate may be slowed by a greater corporate, governmental, and personal concern for the environment, but it might equally be intensified by our now greater technological ability to advance massive industrial developments.

Subject to the recommendations in this volume, I am convinced that a pipeline can be built in the Mackenzie Valley with an acceptable level of environmental impact. But we must bear in mind that any individual “acceptable” level of impact may be the beginning of a significant impact that will result from insignificant increments. How often and in how many locations can “acceptable” levels be tolerated before cumulative impact has produced an “unacceptable” level? This question is important. It seems to me that an “unacceptable” level is determined by, among other factors, both the absolute extent of the change involved and the public’s perception of the environmental quality base that is being changed. It may be that undamaged areas are likely to be regarded as worthy of protection from even minimal or “acceptable” damage. On the other hand, areas that have already been changed and that need protection to preserve

their remaining environmental qualities may not be considered worthy of such protection. Often a crisis situation has to develop before action in the form of ameliorative measures is thought necessary.

Environmental protection cannot be viewed in isolation from man's perception of what is right and proper. It involves decisions on which elements of the environment warrant protection for their own sake, which elements should be protected to meet man's needs for renewable resources or his desire for aesthetic enjoyment, sport or recreation, and how far protection should be relaxed to meet his priorities for industrial development. Thus, priorities for environmental protection depend upon individual attitudes, and they will differ among the various segments of any society.

*1. Priorities for environmental protection must reflect not only those of government and of the Company, but also those of native people and of other residents of the North, together with those of citizens of other parts of Canada. Of necessity, standards and measures for environmental protection must be developed and implemented. In practice, public officials will carry out this function, but interested segments of society must be permitted to have a voice in the formulation and the means of implementing controls. This is in recognition of the fact that, in the North, regulation of land use and protection of the environment are closely related. Environmental impact of an industrial development project will involve not only the project itself but it will also lead to changes in the renewable resources and lands and will therefore affect their ongoing use by others.*

I am aware that there are many codes, standards, and regulations that apply generally to the environmental questions raised here, and that there are guidelines and standards specifically designed to apply to pipelines in the North. It is not my intention, in this report, to supersede such existing standards and regulations; rather, my purpose is to place on record some of the insights gained during the Inquiry process. I hope that my comments will supplement and complement existing measures and that they will be useful in the drafting of an environmental code and guidelines for the pipeline. (See Project Regulation and Review.)

### *Environmental Atlas*

The interrelationships among the elements of an ecosystem are complex. Once one of the primary elements, such as land, water, vegetation, air or wildlife, is badly abused, it is difficult to prevent that damage from spreading to the other elements. Also, effects within an ecosystem are often felt in time and space far from the point of initial impact. For these reasons, damage to a highly visible element in the environment cannot be ignored or used as an excuse to avoid taking action that would prevent further degradation of that element. The northern environment must be viewed as an integrated entity.

Except in a very few localized situations, development in the North has not yet greatly abused the environment. Nevertheless, few large areas apart from the Northern Yukon can justify absolute protection measures solely on the basis of their wilderness condition. Most of the Mackenzie Valley and Western Arctic environment is in a state of early development and of sporadic impairment, a state that unfortunately evokes a somewhat apathetic response in any consideration of its environmental values. This apathy facilitates and serves to condone incremental damages that can, in the areas of critical habitat and life stages, quickly surmount the threshold of acceptability.

As an aid to understanding the wide range of environmental issues, I have been impressed with the usefulness of the environmental and wildlife maps prepared by the two pipeline companies and, in particular, by the atlas prepared by the Environment Protection Board and subsequently revised by Carson Templeton (Exhibits F135, F834 and F835). These documents present the various elements of the northern ecosystems, of present and projected land use, and related subjects in a visual format that is easily understood.

*2. I recommend that a large-scale, detailed, environmental atlas be prepared jointly by the Agency and the Company to show environmental sensitivity and land use priority for the use of all interested parties during design review, construction surveillance and project monitoring.*

### *Environmental Quality Index*

How much "acceptable" damage can be tolerated before the situation becomes "unacceptable"? This question, could be answered if we understood both the nature and extent of the accumulated damage and the public's perception of that total. I heard much evidence on the need for and the means of project and environmental monitoring, often of a subject-specific, species-specific or site-specific nature. However, I heard very little about how this valuable information could be used to appraise in a general way changes of broad environmental quality or changes over broad geographic areas.

Statistics bearing on changes in environmental quality already exist but they are frequently inaccessible, irregular in coverage and in time, or isolated from other related data. We need some measure of overall and cumulative environmental change to which the expert and layman alike can refer. In final argument, such a measure was proposed by Commission Counsel in his recommendation for environmental quality indices along the lines developed by Inhaber (1974) in Canada and by the Council on Environmental Quality in the United States (Thomas, 1972). Properly developed environmental quality indices would permit trends to be easily seen, would not hide assumptions, would be easily understood, and would be meaningful indicators of changes in, for example, air, water, land, and in biological and total environmental quality.

Air quality indices already exist for some metropolitan areas, for example Toronto, and the principle is firmly entrenched in our everyday lives by such well-known, continuously updated measurements as the gross national product (GNP) and the consumer price index.

Research by government and industry in the Mackenzie Valley has provided adequate environmental data to begin establishing indices for water, air quality, land and various biological components. Many measurements upon which such indices would be based are purely scientific. They are free from the cultural bias that the Committee on Original Peoples Entitlement stated, in its response to Commission Counsel's recommendations, would result from the imposition of non-native values on an index. Indices relating to things such as renewable resources could possibly be established that would take into account both the values of native people and their interaction with the environment.

Arctic Gas criticized severely the idea of indices, saying that it is "nothing but a futile attempt to portray in simple, meaningful ecological terms the complexity of ecosystems" (*Responses of Canadian Arctic Gas Pipeline Limited to Commission Counsel Submissions*, Vol. 1, p. 11-91). I think that response misses the point. An index is not an attempt to provide a model of a system; rather, it is designed to give a general overview of a complex situation without an immense volume of reports, studies or detailed statistics. It is one means, admittedly a general means, for experts to communicate with both their peers and the layman.

3. *The government should establish a system of environmental indices for the Mackenzie Valley and Western Arctic so that there will be a readily available and easily understood measure of the state of the regional environment and a baseline against which short- and long-term changes can be assessed.*

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## The Northern Landscape

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During pipeline construction and operation, large and widely distributed parts of the landscape will be subject to major disturbance. Compressor station sites will be the foci of activity, with associated wharves, gravel pits, landing strips, roads and other facilities affecting large areas around them. Permanent disturbance and sources of pollution will be introduced for the first time into areas where land, water and air are now virtually unimpaired. Large blocks of land, still in their natural state, will be split by the pipeline and held open by permanent access routes and sources of pollution.

We have been assured by the pipeline companies that deleterious environmental effects associated with short- and long-term disturbances of land and waterbodies, degradation of landscape values, and increases in air and noise pollution

levels will be held to "minimal" or "acceptable" levels. Nonetheless, I believe these effects will be significant.

Of course, some environmental damage is acceptable and some is unavoidable. However, this fact does not negate the need for protective measures; rather, it emphasizes such a need if we are not to foreclose other uses of the environment during the selection of land for a pipeline and the pipeline's use of it. Similarly, conflicts over land use can be exacerbated by environmentally inappropriate selection and use of land. Clearly there is a need for broad measures that will help mitigate these kinds of problems.

4. *As a general principle of environmental conservation, the areas of land and water used by any part of the project or physically disturbed by it should be kept to a minimum. Furthermore, the right-of-way, roads and sites for facilities should be selected so that their geographic distribution ensures minimal infringement upon other existing or potential uses of land. This principle of minimal pre-emption and disturbance applies to the routing, siting, design, construction, operation and, ultimately, the abandonment phases of the project.*

### Sensitive Terrain

In Volume One, I described the characteristics of northern terrain that make the Mackenzie Valley much more sensitive to engineering ventures than topography alone would suggest. The Valley was formerly flooded by extensive post glacial lakes, which means that much of the region is now underlain by silts and clays. These soils cause engineering problems that are made yet more difficult by the presence of permafrost, which increases northward in the Valley. Under permafrost conditions, fine-grained soils frequently contain excess ice. When such areas are disturbed, the thermal regime can be altered so that the ice melts and the soil loses its strength and stability, leading to subsidence, slope failure and erosion.

5. *For environmental as well as for purely technical reasons, the pipeline route and facilities should avoid, wherever practicable, areas of sensitive terrain and particularly areas in which terrain disturbance could adversely affect nearby waterbodies or lands important to wildlife.*

The importance of the insulating properties of the organic mat that overlies permafrost is well-known. Irreversible and progressive environmental damage is often the inevitable result of disturbance of this mat.

6. *In permafrost terrain, and particularly in areas of sensitive fine grained soils, disturbance of the organic mat and the vegetation that protects it should be minimized to avoid or reduce a wide range of environmental and engineering problems that could develop from permafrost degradation. (See Terrain Considerations: Ground Surface Preparation.)*

7. *Any organic mat and surface vegetation that has been disturbed should be restored, rehabilitated and stabilized. In*

*permafrost terrain with fine-grained soils, the progressive nature of thermokarst degradation, slope failure and erosion requires quick and efficient remedial measures.*

### *Importance of Valleys*

In Volume One, I noted the special importance of valleys in the landscape:

Although the valleys crossed by the corridor may constitute only a small proportion of the total landscape, they are the locations of disproportionately high land use and are of particular environmental, aesthetic and recreational values. They define essential fish and mammal habitat and the vegetation along them is more varied and abundant than elsewhere. Valleys have always been and still are the preferred areas for many native people. ... Valleys ... are the foci of the regional ecosystem. [pp. 78-79]

One of the most important elements of any valley, in environmental terms, is the bank of the river or stream. Here, the “edge effect” brings together for many species, including stream dwellers, their complex requirements of food, cover and water; it is a zone of very high biological productivity and diversity. The setting – the collective land-water contrast – is also a vital element of the scenery. From this perspective, shorelines can be considered to be environmentally sensitive areas that, if damaged by construction, will tend to broadcast the effect far out of proportion to the immediate and local circumstance.

*8. The potential for the pipeline project to cause land use conflicts, unacceptable damage to aesthetic values, or degradation of wilderness or areas important for recreation is particularly great in valleys and around waterbodies. The project should be adjusted to avoid or minimize impacts of this nature. Careful consideration must be given to the location of pipeline crossings, roads, water intakes, sewage and waste disposal sites, wharves, stockpile sites, work pads, camps, compressor stations and borrow areas where such facilities may impinge on valleys and waterbodies. Wherever possible, facilities (particularly groups of facilities) should be kept out of valleys and away from waterbodies and buffer strips should be left undisturbed. The land-water interface should be accorded special attention because of the special environmental values and geotechnical sensitivity associated with them. Water crossings should be kept to a minimum, and the pipeline route and roads should avoid closely paralleling watercourses.*

### *Wetlands*

Swamps, marshes and wetlands constitute a unique natural landscape. Although they are recognized by some as vital habitat with high values for wildlife and water conservation, they are more often treated as wastelands or nuisances – something to be drained or filled in.

Wetlands must not be regarded simply as wastelands. In this regard, I cite the following statement made by President

Carter to Congress on May 23, 1977, in a message about the environment:

The important ecological function of coastal and inland wetlands is well-known to natural scientists. The lasting benefits that society derives from these areas often far exceed the immediate advantage their owners might get from draining or filling them. Their destruction shifts economic and environmental costs to other citizens ... who have had no voice in the decision to alter them. ... We must now protect against the cumulative effects of reducing our total wetlands acreage. [p. 13]

*9. To protect the hydrologic and biologic values of wetlands, they should be accorded the same level of protection as other elements in the landscape and environment.*

### *Aesthetic Values*

In relation to the amount of direct evidence presented on aesthetic impacts of the project, the Inquiry heard a disproportionately large amount of cross-examination and discussion. This reflects the difficulty of coming to grips with such an abstract concept. The cross-examination was unsuccessful in demonstrating the existence of clear ameliorative measures, but it was useful in highlighting gaps in our knowledge and in delineating various aspects of the problem.

Arctic Gas stressed the subjective nature of aesthetic judgments, saying that perceptions vary so much from individual to individual that contradictory assessments can be made of the same situation. This extreme view tends to down play the importance of aesthetics. I agree that aesthetic judgment has a strong subjective component and that, as appeared in cross-examination, we know little of the influence of culture on aesthetics, particularly with regard to native people. However, whatever subjectivity and cultural influence there may be in aesthetic judgment, I believe there is a general consensus on what is pleasing and displeasing, on what is good practice, and on unacceptable aesthetic design. Although difficult to quantify or to protect, aesthetic values are an important component of environmental quality, and they must be viewed in this way in all aspects of the project.

*10. All aspects of the pipeline project should be designed and the right-of-way and facilities should be located to protect the natural aesthetic attributes of landscapes and waterbodies. All installations (and not simply those in areas of high sensitivity or visibility) should be constructed so that, as far as possible, the surrounding area is left in its natural state.*

### *Cumulative Effects of Development*

Although the Mackenzie Valley covers a vast area, it will not be long before conflicts over land use within it intensify. The wildlife of the region has certain requirements. The native people will continue to need extensive lands for their own purposes. Industrial developers will need land, and still other areas may be designated for conservation and recreation. Each

designated use will diminish the availability of uncommitted land, and competition for such land will increase.

The environmental effect of industrial development will often preclude or inhibit the ongoing use of the land by others. This problem is exacerbated by a tendency to view and assess each industrial development as a single and exclusive event. In considering the effect of a project like the pipeline, not only its direct and immediate impact but also the effect of all ancillary and spin-off activities, and the effect of other developments that can be reasonably anticipated over the life of the project, must be taken into account.

*11. The pipeline project should be designed and located so that its effects on the ongoing use of the region by others, such as the native people, are kept to a minimum. In so doing, the cumulative effects of all construction, operation and abandonment activities shall be considered, along with the effects of other developments that can be reasonably anticipated in the region over the life of the project.*

Two particular aspects of the pipeline project that are related to cumulative environmental impact warrant special mention. The first deals with the operation of the project after construction. It is established engineering practice to minimize long-term costs by judicious allocation of costs between initial capital construction costs and annual maintenance and repair costs. An essentially maintenance-free project is generally not feasible. In many locations, however, environmental considerations may render maintenance and repair activities too unacceptable to allow standard economic trade-offs to be employed. If the environmental protection of sensitive areas is to be taken seriously, there must be a shift in the ratio that normally exists between capital costs and annual maintenance costs to reflect more firmly the impact of maintenance activities on the environment.

Let me cite one example. Pipeline maintenance and repair, particularly in summer when the active layer is unfrozen and the ground surface is soft and when waterfowl or fish may be concentrated nearby, could be much more damaging and disturbing than the original construction activity.

*12. The Company should locate, design and construct the pipeline and related facilities so that maintenance and repair activities that could damage the landscape and disturb wildlife over the life of the project are kept to a minimum. In permafrost and other sensitive terrain, the Company's designs may, as a result, have to be significantly more conservative than is usual in established pipeline engineering practice.*

The second aspect related to cumulative environmental impact is of broader concern. It refers to both the current use of local resources by others and the possible future demand on those resources by further development. It is likely that there will be sections along any route where water, gravel and other resources that are essential to virtually all developments will be in short

supply, or where they will be regionally depleted before there is a comprehensive plan to share a scarce resource among present and future users.

*13. The use of resources such as gravel and water by the pipeline project shall be compatible with the demand made on such resources by local activities and by developments that can be reasonably anticipated in the future. In particular, the pipeline Company shall employ designs and construction practices that minimize the use of limited local natural resources so far as practicable.*

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## Water

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Water, as an element of the physical environment, has innumerable domestic, commercial and industrial uses; as an element of the landscape, it is the essential element of marshes, ponds, lakes, streams, rivers and springs. In both of these functions, the quality of water is a prime consideration and it is this aspect that I develop in this section.

Much of what I have to say about other aspects of water is contained in other parts of this report. In the chapters on Fish and Wildlife, I deal with the biological aspects of waterbodies. Elsewhere I recommend measures to protect the land-water interface – the shorelines, the river banks and the stream edges – measures that would indirectly protect the waterbodies themselves.

Just as I recommend that the pipeline should avoid wilderness areas and specific, important natural areas to protect their intrinsic values, I also recommend that:

*14. Wherever possible, lakes should be avoided, and the crossings of watercourses should be minimized to protect water resources. For example, the pipeline route should be adjusted where practicable so that meandering rivers are crossed only once.*

Fluctuations in flow and water levels are natural, and certain plants and animals find their habitat in intertidal zones, floodplains, intermittent stream channels or sloughs that result from such changes. On the other hand, drastic changes in water levels, either natural or man-induced can cause destructive environmental changes. Although aquatic vegetation, furbearers, waterfowl and fish can tolerate a certain range of natural or seasonal fluctuations in water level, untimely changes may cause effects ranging from significant to severe. After a severe disruption, populations depending on such an environment may take generations to attain previous stable levels. It would be prudent, therefore, to eliminate or to minimize large-scale, man-induced effects of this kind. Such man-induced changes could occur if streams were overused as water sources, particularly in winter when flow is low, or if surface and subsurface drainage were impeded by the construction and operation of a chilled gas pipeline.

*15. Site-specific review of water withdrawal proposals shall be required to ensure that any drawdown of water that exposes shorelines, shrinks channel flow or depletes stream pools does not cause unacceptable vegetative or faunal changes. (See Water Withdrawals.) Similarly, designs or construction activities that result in ponding or flooding shall be deemed unacceptable practice, and they shall require modification to mitigate these adverse impacts. (See Terrain Considerations: Drainage and Erosion.)*

It is the pristine quality of water in the North that gives the waterbodies their great value. To the extent that southern Canadians have some idea of an undefiled northern landscape, it is probably based on their impression of pure lakes and streams rather than on unspoiled tracts of land. But the waterbodies in the North are highly susceptible to industrial pollutants. Permafrost restricts downward filtration so that spilled contaminants move laterally into surface waters rather than into deep soils and bedrock, where self-cleansing might take place. Permafrost also restricts groundwater movement so that many waterbodies are separate and isolated, rather than forming parts of a connected system, as they would in a region lacking permafrost. The cold temperatures also greatly inhibit biodegradation of pollutants, so they persist longer and often have a more devastating effect in northern waters than they would in the South.

Our experience with water pollution, competing demands, and conflicting interests over water resources in southern Canada should provide the motivation necessary to avoid these problems in the North. In southern Canada, we are now learning the great environmental, social and economic cost of water pollution and the difficulty of trying to restore the surface water to an acceptable quality. In the North, except for a few isolated localities, the surface waters have not yet been badly polluted. In allowing development to proceed, we have an obligation to maintain the high quality of water where it now exists. We must emphasize that here we would be maintaining the relative purity of northern water, a contrast with the current emphasis on water pollution control programs in southern Canada. Such a maintenance program must have two parts. The first is to control what goes into the water. My recommendations in this regard are found under Waste Management and, to a lesser extent, in other chapters such as Management of Fuels and Hazardous Substances. The second involves monitoring the quality of the receiving waters.

Following waste management procedures and adhering to effluent standards will not in themselves guarantee that the quality of receiving waters will be maintained. The treatment of effluent is limited by current technology, and it relies to some extent on the natural assimilative capacity of the receiving waters. Effluent standards are only one part of the administrative mechanisms directed at environmental (and public health) protection. They are not an end in themselves.

Each waterbody in its natural state has its own unique chemistry – its own unique quality. The development and use of effluent standards require judgment to determine how effluent can be released without adverse impact. Watercourse and effluent volume, flow or exchange rate, method and timing of effluent discharge, downstream water use and, of course, receiving water quality must all be considered.

I have not found a fully satisfactory compilation of the limits within which receiving water quality parameters must be kept, but Commission Counsel has examined a number of sources and combined the findings of three excellent and authoritative works: *Water Quality Criteria, 1972*, U.S. National Academy of Sciences and National Academy of Engineering; *Surface Water Quality Criteria, Province of Alberta*, Government of Alberta; and *Standards Methods for the Examination of Water and Wastewater*, American Public Health Association. Commission Counsel's compilation is included below as standards for the Agency and the Company.

Many of the streams and waterbodies that will be selected to receive effluent discharges are likely to be used for this purpose far into the future. There is no reason to believe that either the period of pipeline construction or the life of the project itself will terminate effluent discharges into them. Only by long-term monitoring will it be possible to make rational decisions that will maintain ambient water quality.

*16. To ensure that receiving waters maintain the water quality standards imposed by the Agency, a program to monitor the streams and waterbodies into which effluents are discharged shall be established. Both the Company and the Agency should take into account the information made available by the Department of the Environment's Water Resources Document Reference Centre (WATDOC) and the National Water Quality Data Bank (NAQUADAT). These two computerized services shall be supplied with all relevant new information that is assembled during the design, construction and operation of the pipeline project.*

### *Water Quality Standards*

*17. Unless otherwise specifically approved by the Agency, wherever effluent is released into a waterbody the Company shall adhere to the following limits for water quality:*

*a) Bacteria: at least 90 percent of the samples (not less than five samples in any consecutive 30-day period) shall have a total coliform density of less than 5000 / 100 ml and a fecal coliform density of less than 1000 / 100 ml. These standards are the upper limits; in certain cases, they may have to be substantially altered to guarantee that public health is protected. (See Waste Management.)*

*b) Dissolved oxygen: shall not go below 6.0 mg / l. If natural conditions are below 6.0 mg / l, effluent shall not be released into the waterbody unless the Company can demonstrate that discharge will not adversely deplete the oxygen level.*

c) pH: shall not be altered by more than 0.5 and shall be maintained in the 6.5-8.5 range.

d) Temperature: shall not be altered by more than 3°C.

e) Odour: shall not exceed the threshold odour number 8 at 20°C (see American Public Health Association, op. cit., p. 252).

f) Colour: shall not be increased more than 30 colour units above background.

g) Turbidity: see Fish.

h) Phenolics: shall not exceed 0.005 parts per million. Fish flesh shall not have any detectable change in taste or odour as determined by a government agency taste panel.

i) Oils and greases: no visible iridescent sheen shall be present.

j) Inorganic chemicals: shall not exceed the following levels expressed in mg / l

Boron	0.5	Nitrogen	1.0
Copper	0.02	Phosphorus	0.15
Fluoride	1.5	Sodium	30-75
Iron	0.3	Sulphide	0.05
Manganese	0.05	Zinc	0.05

k) Pesticides: only air fogging pesticides shall be permitted. No persistent chemicals shall be used.

l) Toxic chemicals: shall not exceed the following levels expressed in mg / l:

Arsenic	0.01	Lead	0.015
Barium	1.0	Mercury	0.001
Cadmium	0.01	Selenium	0.01
Chromium	0.05	Silver	0.05
Cyanide	0.01		

18. Samples for the water quality criteria shall be taken at points determined by the method outlined in Fish. Dissolved oxygen shall be measured in stream pools and locations in lakes where depleted oxygen levels could be expected because of organic loading.

19. Testing for the parameters listed above shall be carried out according to the methods outlined in Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 1974.

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## Air

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There can be little doubt that, from a global perspective, there is little man-made air pollution in the North. However, the contrast between localized areas of human activity and the large intervening wilderness areas illustrates the high potential that exists for problems related to air quality, even with limited human activity. These problems range from the

emissions of certain industries, to ice fog in communities and dust problems along the gravel highways. While the pipeline project would cause many problems that would have to be dealt with by the Agency, my principal concern here is the environmental effect of major sources of pollution at given points, such as compressor stations. Unless we formulate comprehensive standards for such permanent emissions now, we will be faced in the future, after successive industrial developments, with the problems and costs of trying to clean up these emissions.

Most of us do not think about problems of air quality when we have clean air, but quickly become obsessed by the sight and smell of pollution when, apparently from nowhere, the reward of our negligence is inflicted upon us. It is not surprising, therefore, that pure air is taken for granted throughout most of the Mackenzie Valley, whereas the residents of Toronto keep an anxious eye on their air quality index, and the citizens of Fairbanks and Inuvik suffer through the inconvenience and hazards of ice fog.

We can sometimes conceal or walk away from lands and waters that have been degraded, but we cannot walk away from air pollution. It envelops and pervades all aspects of our lives. No doubt that is one reason why, during the growth of environmental awareness in the 1960s, air quality was among the first aspects of the physical environment to receive widespread attention. Air quality is an issue that is personal, regional, national and international in scope.

### *Air Quality Objectives*

The Department of the Environment has established National Ambient Air Quality Objectives for a number of common air contaminants. These objectives are divided into three levels – maximum tolerable, maximum acceptable and maximum desirable – with standards applicable for various periods of discharge. The most stringent standard, the maximum desirable level, is meant to “define the long term goal for air quality and provide a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology” (*The Canada Gazette*, Part 1, August 7, 1976, p. 3898).

In uninhabited areas, where there is no foreseeable threat of air quality degradation, an anti-degradation policy means little. If an anti-degradation policy is to be implemented anywhere, it should, I think, be applicable in the Mackenzie Valley and Western Arctic where the present air quality is high but is threatened by industrial development. The following recommendation therefore seems to me to be in keeping with stated government policy.

20. Emissions from pipeline development shall be controlled in the Mackenzie Valley so that ambient air quality figures do not exceed “maximum desirable levels” as defined in the Clean Air Act: Ambient Air Quality Objectives (*The Canada Gazette*, Part II, Vol. 108, No. 11, and Vol. 109, No. 3).

But is this control practicable under normal conditions? Temperature inversions must be regarded as normal, for this condition prevails from one-half to two-thirds of the time in winter in the Mackenzie Valley. During a temperature inversion, pollutants are discharged into the air as though into a closed container, the lid of which is removed only when the weather changes. As a result, under inversion conditions, emissions often accumulate for days at a time, and ice fog forms spontaneously if the temperature drops below  $-40^{\circ}\text{C}$ .

*21. Constraints placed on the pipeline project to maintain air quality must reflect northern conditions, such as temperature inversions, which inhibit dilution and dispersal of atmospheric pollutants. (See Facilities Complexes and Equipment Operations.)*

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## Noise

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The control of noise is as much a part of environmental conservation as the maintenance of water quality and of natural landscapes. The only redeeming features of noise pollution are that it is often of short duration, and that it usually leaves no visible scars when it stops. Nevertheless, intermittent or sustained noise has an overwhelming influence on overall environmental values from both a human and a wildlife perspective. Noise cannot be ignored because its effects, although not necessarily the sound itself, can and do linger on in the form of abandoned wildlife ranges, staging areas and nesting sites, and a general lessening of the usefulness of the region. In yet another sense, and one that I do not discuss here because it is adequately dealt with in existing codes, noise can be an occupational hazard for health and safety reasons.

### *Environmental Aspects of Noise*

Noise is measured in decibels (dBA) on a scale that is not linear, but is based on doubling the apparent loudness of noise to the human ear with every additional seven to 10 dBA. Zero dBA, the lower end of the scale, is at the threshold of hearing. The level of conversation is about 65 dBA, and 120-140 dBA is at the threshold of pain. To place environmental noise levels in context, in a tundra environment under calm conditions, natural noise levels are less than 15 dBA (Dr. George Thiessen, National Research Council, Ottawa, personal communication, August 1977); in an open alpine meadow, with the rustling of grasses and brush and the distant sound of tree movement, Dailey and Redman reported the background level to be about 30 dBA under low wind conditions of three to five miles per hour, but to increase to about 35 dBA in a mature coniferous forest under the same conditions (*Guidelines for Roadless Area Campsite Spacing to Minimize Impact of Human Related Noises*, 1973, p. 12). They also pointed out that noise must be reduced to 15 dBA less than the background level of

the setting before it is muffled by background noise (p. 16). Generally, noise levels decrease by six dBA for each doubling of the distance from its source. This figure may be increased or decreased by topography, vegetation and meteorological conditions.

In recent years, environmental noise pollution has received increased attention from the public and law-makers, a fact attested by the proliferation of articles and studies on the subject and by noise control legislation at all levels of government. The sound emission standards for construction equipment recently passed by the Province of Ontario, (Ontario Ministry of the Environment, Publication NPC-115 in Schedule 1 of *Model Municipal Noise Control By-Law*, Revised May 1976), are a good example of an approach that aims at maintaining environmental, and not simply occupational, quality. This trend toward noise abatement as part of the maintenance of overall environmental quality is directly applicable in the North and to the pipeline project in particular. Despite the present use of planes, trucks, snowmobiles, outboard motors and diesel motors in many communities, the North is still a relatively quiet place. This silence is a vital aspect of the habitat for many species of wildlife and is also one of its main attractions for both residents and visitors.

I shall not discuss here the complexities of the production, propagation, attenuation and measurement of sound and the enforcement of its control. But central to all these problems is the fact that sound is both a physical phenomenon and a perceived sensation. The first is objective, scientific, measurable; the latter is highly subjective and personal.

The recommendations I make, here and elsewhere in this report, require compliance with certain standards – in this case, with noise levels measured in decibels. It is a quantitative approach, such as regulatory agencies have traditionally felt bound to use for public health. The approach is not as satisfactory as a protection of environmental quality, but I nevertheless advocate its continued use for that purpose.

This approach, however useful it may be to quantify the problem, is quite inadequate to solve it. It seems to me that the crucial difference is the perceived difference between sound and noise. The distinction should not be made on the basis of intensity or of a decibel reading on a sound meter. The distinction should be made on the basis of acceptability or non-acceptability – on the basis of pleasantness or disagreeableness, of annoyance or disturbance – however difficult it may be to assess these qualities.

Low intensity sounds – lower than noise standards are ever likely to be set – can still be perceived as noise, and they can therefore be considered a disturbance. Disturbance to wildlife need not be manifested in fright or flight reactions to be real and harmful.

Subjective judgment must therefore be added to the quantitative approach to noise control. In attempting this change, we shall have to follow the advice of wildlife experts and to accommodate the feelings of the public. A solely

quantitative approach to noise is limited in its application by the very fact that response to it is subjective according to species.

### *The Environment and Project Noise*

It is clear that pipeline construction and operation in the Mackenzie Valley, which will have noise levels in the range of 90 to 140 dBA, will often produce noise that may be considered environmental pollution over an area several miles from its source. Noise will pervade a greater area than any other form of pollution generated by the project. The commonly held impression that transportation by pipeline is quiet is no doubt based on the public's experience with gas mains, water mains and sewage systems in urban areas. But such an analogy is wrong. The pipeline will be a noisy business, both in its construction and in its operation.

Of course, I cannot recommend that pipeline construction and operations should be silent: that is patently impossible. No technology exists (and it may never exist) that would eliminate the variety of noises associated with the construction and operation of industrial developments. But technologies do exist to reduce noise levels. Although noise is increasingly attenuated in the interests of public health and worker safety, we must begin to consider the importance of attenuating noise as a means of mitigating environmental pollution.

When compressor stations are operating, the gas turbine engines, which are comparable to jet aircraft engines, will emit constant noise of very high intensity. Maintenance blowdown (depressurizing the pipeline), with its intermittent but startlingly loud noise, will be confined mainly to compressor station sites, but similar noises will be generated elsewhere along the line, for example during purging. My recommendations on pipeline operations noise are dealt with more fully in the chapter Facilities Complexes and Equipment Operations. As a general principle however:

*22. The pipeline project should be designed in accordance with good noise abatement practice to minimize environmental disturbance, particularly at times and at locations that are critical to wildlife populations and to traditional land use by local people.*

Pipeline construction will employ thousands of pieces of heavy equipment, machinery and vehicles that have the potential for environmental disturbance by making noise. Crawler-type tractors, earth-moving and ditching equipment, air compressors and drills, to name only the most familiar machines, generate noise in the 85-115 dBA range. These noise levels will be generated at wharf sites on the Mackenzie River, at borrow pits, which are scattered over a wide area, and along the right-of-way. Only slightly lower intensities will be generated by road construction and haulage activities.

There seems to be no justification to diminish environmental quality through noise pollution because noise reduction

technology is available. Sound emission standards for construction equipment are common in the South, and new standards have been developed for 1980 (Ontario Ministry of the Environment, op. cit.), so there is ample and practicable precedent for standards of noise attenuation in construction activities.

*23. Environmental standards for noise associated with the operation of construction equipment should be developed by the Agency in keeping with the best practicable technology. Special noise abatement practices should be developed for activities in sensitive areas for wildlife. (See Wildlife.)*

Construction noise will be accompanied by noise from associated transportation activities. The movement of supplies and personnel will increase barge, vehicular, helicopter and fixed-wing aircraft traffic, and commercial air traffic will also increase greatly. These sources of noise are discussed further under Facilities Complexes and Equipment Operations and under Wildlife. Blasting, another construction related noise, is separately discussed under Terrain Considerations: Blasting.

Monitoring and maintenance activities, which will be carried out mainly by aircraft, will produce most of the transportation noise during the post-construction period. The major concerns about this form of continued disturbance are discussed at some length in the chapters entitled Wildlife and Aircraft Control.

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## Archaeological Sites

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Archaeological sites are one aspect of the physical environment that we often overlook. In Volume One, I referred to the prehistory of the North as it is known through archaeological discoveries that have so far been made in, for example, the Old Crow Flats, but I said nothing about the impact of the pipeline upon the part of our national heritage that is represented by as yet undiscovered sites.

Archaeological sites constitute not only an irreplaceable element of our national heritage, they are also an integral part of the history of northern native peoples. The little that we know of the prehistory of the Mackenzie Valley and the Western Arctic suggests that sites there may be rare and small. Their smallness makes them hard to find and particularly susceptible to destruction. As J.V. Wright wrote in his article, "The Destruction of Canada's Prehistory," "Any human or natural force that alters, buries, or floods the earth can be regarded as being potentially destructive to archaeological data" (p. 5). Obviously, such forces include pipeline construction and associated activity. Preliminary studies in the Mackenzie Valley and elsewhere have shown that some disturbance and destruction of archaeological sites is inevitable in a project the size of the proposed pipeline.

Paradoxically, the very process of disturbing the northern

landscape is often the means of finding an archaeological site. The numerous borrow pits, the ditch excavation, and the excavations for other facilities involved in the pipeline project will provide unprecedented opportunities for archaeological and paleoecological studies that would further our knowledge as much as, if not more than, the disturbances would hinder it. This is an opportunity not to be taken lightly. Sites are difficult to find in the boreal forest and logistics are often complex and expensive. Moreover, the density of human population may always have been quite low so that archaeological sites may, in fact, be relatively scarce. We must, therefore, take advantage of any opportunity to provide future generations with a more complete record of past human occupation and environmental evolution in the North.

Existing legislation clearly stipulates that archaeological sites should be protected from both wilful and negligent destruction. The Territorial Land Use Regulations prohibit industrial excavations or other land use operations within 100 feet of a known archaeological site, and whenever an operation encounters a previously unknown site, the operator is instructed to suspend his work and notify the engineer or an inspector of the location and nature of the occurrence.

Embodied in the Yukon Act and the Northwest Territories Act are Archaeological Sites Regulations that stipulate that all archaeological investigations must be conducted under permission of the Minister of Indian Affairs and Northern Development.

It appears that existing law provides a legal framework for the protection of archaeological resources from construction projects, but on a large-scale venture such as the pipeline only the organization of an adequate archaeological project can ensure that this will be done. It is certainly in keeping with this position that the pipeline companies have proposed archaeological work as a complement to the pipeline project.

*25. An archaeological program shall be established to identify, protect, excavate and investigate archaeological sites and associated paleoecological materials on or adjacent to lands used by or for the pipeline project. This archaeological program should be funded by the Company and organized under an arrangement between the Company and the Agency with the especial involvement of the Archaeological Survey of Canada, National Museum of Man. The program should be in operation from the time field operations of the Company begin until the pipeline is commissioned and all archaeological field studies and reports are completed.*

# 8

## Wildlife

A number of the principal environmental concerns identified in Volume One of my report will be alleviated by implementation of the major environmental recommendations in that volume. My recommendations that no pipeline be built and no energy corridor be established across the Northern Yukon, and that a wilderness park be created in that area, are designed to protect this unique wilderness region. This region includes vital habitat for wildlife and migratory birds on the Arctic Coastal Plain and Old Crow Flats, and, in particular, the critically important calving and summer range of the Porcupine caribou herd.

My recommendations that no pipeline be built and no energy corridor be established across the Mackenzie Delta, together with the recommendations for the white whale sanctuary and bird sanctuaries in the outer Delta area, are designed to protect the unique land-and-water ecosystems that characterize the Delta and the littoral of the Beaufort Sea. Only in this way will it be possible to safeguard the critical life stages of the migratory birds, whales, and other mammals and fish that depend upon this fertile and productive area. In addition, the bird sanctuaries that I proposed along the Mackenzie Valley are designed to protect major populations of migrating and nesting birds at critical localities.

Beyond these recommendations, there must be a wide range of specific measures designed to avoid or to mitigate the adverse effects of construction and operation of a pipeline on mammals, birds and fish. In this chapter and the following chapter on fish, I present the criteria, approaches and standards that I consider appropriate for the protection of these valuable but vulnerable resources.

Of course, the pipeline project will inevitably have some environmental impacts that cannot be mitigated. So I emphasize the importance of minimizing disturbance and of maintaining land, water and air, insofar as possible, in their natural state. With regard to mammals, birds and fish, I focus my concern on critical habitats and critical life stages – on the tracts of land and water of limited size that are vital to the survival of whole populations of certain species at certain times of the year. The recommendations I made regarding

withdrawals of land for a wilderness park, a whale sanctuary and bird sanctuaries offer the firmest protection to such habitat, but further measures are needed. My recommendations for the protection of birds relate to their migration routes and their nesting, moulting and staging areas; those for mammals concentrate on calving, lambing or den sites, on winter habitats, and on travel routes. I emphasize protection for species that are harvested by local people, as well as rare species, such as the peregrine falcon, the survival of which is of national or international concern.

The great challenge we face in the Mackenzie Valley is to maintain its living resources, a challenge that demands the same resolve with which we plan the development of northern energy and transportation systems.

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### Mammals

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#### *Caribou and Reindeer*

In Volume One, I discussed in some detail the importance and vulnerability of the Porcupine caribou herd and why I was convinced that a gas pipeline should not be built across the Northern Yukon. My major recommendations that no pipeline be built across that area, but that a wilderness park be established there, were designed to offer the firmest protection for the habitat of this herd. I also mentioned the Bluenose and Bathurst caribou herds, which winter close to the Mackenzie Valley; the woodland caribou, which are year-round Valley residents; and the semi-domesticated reindeer, which live in the Tuktoyaktuk peninsula.

According to testimony before the Inquiry, the Bluenose herd once wintered in the Mackenzie Delta and ranged west across to the foothills. In recent years, this herd has been reoccupying winter range near the Delta, and it is possible that gas production facilities and the pipeline may disturb the herd in that region. The herd's apparent increase in numbers and its expansion of range is and will continue to be an important feature in the renewable resource economy of the

people of the Mackenzie Delta and of the lower Mackenzie Valley.

The large-scale movements of migratory caribou herds allow them to use a wide range of habitat and environmental conditions. Nevertheless, the loss of any particular portion of a herd's total range may reduce its vitality and potential population.

The construction of a gas pipeline, the completion of the Mackenzie Highway, other developments, and increased access along the east bank of the Mackenzie River may, in my opinion, halt the continued westward expansion of this herd. The reduction of territory into which this herd might expand is, of course, significant, but it does not have the same serious implications for the future of the herd that the Dempster Highway and a pipeline along it would have on the Porcupine herd.

#### DEMPSTER HIGHWAY

In my discussion of the Porcupine caribou herd in Volume One (pp. 42-43), I drew attention to the impacts on the herd during migration and on its winter range caused by the existence of the Dempster Highway, by traffic on the highway, and by increased hunting related to the highway. These concerns have now been reinforced by the National Energy Board's decision to favour the possibility of a gas pipeline along a Dempster Route as well as by recent experience on the Dempster Highway.

The Dempster Highway and any pipeline along it would dissect the herd's winter range and might cut the herd off from a substantial part of that range. Although the Dempster Highway is not yet complete, there is evidence that the access it now provides to the herd's winter range and migration routes has greatly increased both subsistence and sport hunting in the region. Canadian Arctic Resources Committee, the Yukon Conservation Society and others, including Ronald Jakimchuk, a biologist who has spent years studying this herd, believe that the Dempster Highway poses a threat to its well being. The threat comes from uncontrolled harvesting and from the obstruction to herd movements that the highway itself and traffic along it represents.

The whole point about the Dempster from an environmental point of view is that the decision to build the highway was made without adequate environmental assessment. But the highway is in place now. It is virtually complete, so we shall have to devise measures to cope with it. The highway must be our principal concern so far as protection of the Porcupine caribou herd's winter range is concerned.

I consider that measures are needed now to protect the Porcupine herd on its wintering range near the Dempster Highway. If we can devise measures to cope with the highway, we may, in due course, be able to cope with a pipeline along the same route if it comes. I deal with these measures in detail in the section

on Wildlife Management and Research, but I think this recommendation is appropriate here.

*1. A restricted hunting zone should be established that extends two miles on either side of the Dempster Highway and of all connecting access roads and seismic lines within the winter range of the herd, but with provisions made for continued traditional use of this land by native people. All vehicle traffic and construction activity on the Dempster Highway should be controlled during the caribou herd's seasonal migrations through the region.*

The Alaska Highway Pipeline Inquiry, in its report, made this statement on our present knowledge of the environment along the Dempster Highway:

First, there is not sufficient information, nor has there been adequate study, of the Dempster Highway as a pipeline route. Further environmental, economic, and social research is necessary before this route may be seriously considered as an alternative to a pipeline along the Mackenzie Valley. There is an urgent need for detailed and extensive studies on the Porcupine caribou herd, and for studies of the probable impact on the herd of increased human activity along the Dempster Highway. Time is essential to permit adequate study of these subjects.

Apart from the Porcupine caribou herd, there are other environmental consequences of a pipeline along the Dempster Highway that must be studied. No doubt much may be learned by the experience of constructing a pipeline across the southern Yukon, but, until we know much more about the Dempster Highway route, we cannot make an informed comparison of the advantages and disadvantages of that route and the one along the Mackenzie Valley. We therefore recommend that at least five years be given to studies of this nature. [p. 130]

I cite this recommendation because it is fundamental to the protection of the caribou herd and to the pending decisions regarding a pipeline along the Dempster Highway.

*2. Before a pipeline along the Dempster Highway is given further consideration, the recommendation of the Alaska Highway Pipeline Inquiry should be implemented and a thorough comparison should be made of the alternative routes.*

#### BARRIERS AND DIRECT MORTALITY

The possible effects of roads and other obstacles as barriers to caribou herds vary from minor diversions in the line of travel to delay in herd movement, increased exposure to hunters or to predators in unsuitable habitat, and abandonment of part or all of a traditional range. It has been demonstrated in Scandinavia and Alaska that highways and railways do not in and of themselves cause reindeer or caribou to abandon their ranges. However, in conjunction with heavy traffic and with hunting, which is of special concern (*See Wildlife: Wildlife Management and Research*), the herds are likely to abandon their ranges, with the result that a herd's population declines – perhaps drastically.

During construction, it should be possible to avoid most contact with the migrating caribou by the careful scheduling

of work, including contingency planning, and by continuously monitoring the progress of the migration. Despite wide annual and seasonal variations in the use of ranges and of travel routes, the traditional use of certain locations, such as river crossings, allows observers to make some predictions about migration.

A number of activities related to pipeline construction could constitute both a physical barrier and a direct threat to caribou. An operating spread, complete with open ditch, strung pipe and operating equipment, or a well-travelled highway or haul road could present a formidable hazard to a migrating herd or to individual animals. Snow fences in unbroken lines perpendicular to a migration path, deep-drifted snow associated with roads or fences, steep road embankments, and elevated portions of the pipeline and feeder lines could also be serious barriers to caribou movements.

The main concern, as I emphasized in Volume One, is the Porcupine caribou herd. There is no similar large migrating herd in the Mackenzie Valley, although the fact that the Bluenose caribou herd winters not far east of the proposed route and part of the herd winters in the vicinity of the route, suggests the possibility of some impact on it. Woodland caribou in the Mackenzie Valley could also be affected, but their low density and relatively local migrations should keep the impact on a minor scale.

*3. The Company shall schedule construction and all other activities associated with the project so that barriers to groups of caribou during migration or on their winter range are minimized. The Company shall, therefore, prepare detailed schedules, including contingency plans, to handle annual variations in the patterns of migration and occupation of wintering grounds. These schedules shall be approved by the Agency before the Company proceeds with construction.*

*4. Before and during construction, a monitoring program shall be maintained to define the seasonal distribution and day-to-day movements of caribou during critical periods. This monitoring program will form the basis of the Company's contingency plans to safeguard the well-being of caribou.*

*5. The Company shall submit to the Agency for approval, measures that will prevent caribou from being obstructed or entrapped by project-related activities. These measures may include but are not limited to the scheduling of construction to minimize the time lapse between trenching and backfilling; the construction of earthen plugs in open trenches to permit the animals to pass across or to escape from the trench; and the skewing or stacking of pipe strung out along the right-of-way to enable the animals to move freely.*

*6. The Company shall submit for approval by the Agency steps that will be taken to minimize any disturbance of, or interference with, the movement of concentrations of caribou that approach a construction site. These measures may*

*include, but are not limited to, backfilling parts of the trench, moving pipe strung out along the right-of-way, and shutting down operations.*

*7. The Agency should ensure that the design and maintenance proposals for any of the project's rights-of-way guarantee free and easy passage to the caribou. In particular, the Company shall design and maintain roads to ensure free and easy passage of caribou. Snow shall be controlled and cleared so that caribou movements are not impeded by long, unbroken stretches of snow fence or of deep drifts or snowbanks caused by snow fences or by road clearing. Snow fences shall be removed in spring before the caribou arrive.*

*8. To keep to a minimum the number of caribou killed as a direct result of increased hunting in the project area, the Agency, in cooperation with the Company and the relevant government departments, should restrict access to the pipeline right-of-way and related facilities to personnel directly associated with the project. (See Wildlife: Wildlife Management and Research.)*

*9. To avoid disturbance and mortality to caribou, a highway traffic management plan should be developed by the appropriate authorities for areas in which there are concentrations of caribou. Such measures as speed limits, convoying and staggered scheduling of traffic, and periodic closures of highways should be considered.*

## HABITAT AND DISTURBANCE

In the Mackenzie Delta and Mackenzie Valley, the construction of gas plants, feeder lines, compressor stations and the main pipeline will not pre-empt any significant portion of the range of the woodland caribou, the Bluenose caribou herd or the reindeer. There are, however, some overall concerns about habitat that are related to fire and to emissions from facilities, especially because the production facilities and the pipeline are concentrated in the Delta, where a major part of the reindeer range and part of the Bluenose caribou herd's range is located.

The destruction of critical winter range by wildfires must be considered, although such fires will not necessarily be caused by activities associated with the pipeline project. There is some disagreement over what use caribou can make of recently burned areas, but it is evident that the animals avoid areas that have recently burned. The regeneration and growth of the lichens that are a major part of the caribou diet is very slow in the North, and for many years burned areas are unsuitable for pasturage. Although the number of fires may increase because of activity associated with the pipeline, better communications and improved access may help to reduce the total acreage burned.

*10. The Company shall develop contingency plans for the suppression of fires and give high priority to fire prevention and control in areas of important caribou habitat. (See Terrain Considerations: Forest Fire Prevention and Suppression.)*

Disturbance from a number of pipeline-related sources, including aircraft flights, machinery, human presence and compressor station noise, is potentially one of the most serious impacts on birds and mammals and is particularly significant for caribou. Although construction is scheduled for winter, a time when most animal species are widely dispersed, it is a time when the food supply is low and the animals' energy reserves are becoming depleted. The effects of disturbance can be severe.

Uncontrolled aircraft flights are probably the most serious form of disturbance. I deal with this in detail in the chapter on Aircraft Control, and make only one general recommendation here.

*11. To minimize aircraft disturbance to caribou, the Company shall control the flying heights and the frequency of project-related air traffic over occupied caribou range.*

Hunting and the increased presence of humans, which follows from easier access to a region, are other major forms of disturbance, both of which I discuss in more detail in *Wildlife: Wildlife Management and Research*.

If disturbance of wildlife is to be kept within acceptable levels, a number of regulations will have to be imposed. Many of my recommendations on this subject apply equally to birds and fish, and they may be found in relevant sections. Others that are related to project activities are contained in the appropriate chapters of Part Three: The Project.

### *White Whales*

In Volume One, I dealt extensively with white whales and recommended that a whale sanctuary be established in the west Mackenzie Bay area and that no pipeline be built across Shallow Bay. These measures are necessary if we are to protect the calving areas of the Beaufort Sea population of white whales, but they will not totally protect the whales. The sanctuary is, in itself, a compromise between the needs of the oil and gas industry and the necessity for preserving critical habitat of the whales. Thus, my concern for the well-being of these marine mammals does not end with those measures. As I explained in Volume One, there is a great deal of gas and oil exploration going on in the Delta and offshore in the Beaufort Sea. This activity will not cease, even if a gas pipeline is delayed or is not allowed to cross Shallow Bay. Exploration and other activities, which will extend well into the future, continue to pose a danger to the white whales of the Beaufort Sea through increased disturbance from water and air traffic and because of the risk of oil pollution.

Investigations to date have not been detailed enough to draw firm conclusions about the effects of disturbance on white whales. In *The 1975 White Whale Study*, Slaney and Company summarized their four years of investigations on the impact of construction of offshore drilling islands and of barge traffic on the whales in this way:

Boat traffic has, in some instances, resulted in short-term

changes in whale distribution. Reaction of whales to boats is variable, probably due to the interaction of a complex of factors. ...

The possibility of adverse effects on whales and whale hunting as a result of current levels of industrial activity does exist, however, there is no evidence suggesting that the overall pattern of whale movement and/or hunting has been affected. [p. 41]

Dr. David Sergeant and Wybrand Hoek, in their testimony before the Inquiry, suggested that more detailed studies of the effects of waterborne noise on whales are required. They cited evidence from Churchill, Manitoba, where whales, because of increasing and continued disturbance, are believed to have abandoned their traditional calving area in favour of another area where they are not disturbed. The evidence stated that the white whales were most sensitive to waterborne disturbance during calving and were somewhat less sensitive to airborne disturbance.

Many aspects of the white whale's life cycle are not yet well understood. My concern is that whales outside of the proposed sanctuary may be adversely affected by the host of activities that are, and will be, impinging upon the white whale habitat in the Beaufort Sea as a consequence of oil and gas exploration, development, production and transportation.

Although existing levels of activity are producing only short-term effects, increased activity could result in long-term changes in the whale's pattern of behaviour, with consequences that could lead to a decline in the Beaufort Sea population of the species. Such changes could, of course, have a serious effect on the economy of native people who harvest white whales.

*12. Shipping corridors should be established in the waters adjoining the outer Mackenzie Delta to avoid disturbing white whales, particularly during their calving season.*

*13. The Company, the Agency and the responsible government departments shall protect the white whales from disturbance by prohibiting harassment by low flying aircraft and water craft. Also, because information on the effect of air cushion vehicles on white whales is lacking, these vehicles should not be operated near the whales during their critical seasons.*

Oil spills, whether from a blowout or from a tanker accident, are another potential threat to the whales. Although most adult whales could probably avoid an oil slick, females that are calving or nursing might be reluctant to move from the warm estuarine waters. And, if they did move, probably many newborn calves would lose body heat and die in the cold oceanic waters. An oil spill could also taint the whales' food.

*14. Oil spill contingency plans prepared by government and industry shall outline measures to protect and clean up areas used by white whales for calving. (See Management of Fuels and Hazardous Substances.)*

15. *The design and construction of feeder lines that connect offshore wells to the onshore pipeline shall avoid the areas and seasons that are of critical importance to the white whale population of the Beaufort Sea.*

### *Moose*

Throughout the Mackenzie Valley, moose are an important species in the native economy. Moose range widely and are found throughout the forested region and, occasionally, above the tree line. The greatest cause for concern is that improved access will lead to increased moose hunting during and after pipeline construction. According to Dr. Peter Lent, a biologist with the University of Alaska, this has already happened in Alaska.

16. *To help control access and hunting, the Company, the Agency, and the relevant government departments should restrict access to the right-of-way and to related facilities to personnel performing work on the project. (See Wildlife: Wildlife Management and Research.)*

During winter, when the movement of moose is impeded by deep snow, weather and limited habitat, they gather in areas such as river valleys that provide shelter and food. Moose are sensitive to disturbance at this time, when, like the caribou, they are in a negative energy situation. Additional stress caused by disturbance would be detrimental to their well-being.

17. *Wherever practicable, the pipeline right-of-way and facilities, such as haul roads and compressor stations, shall be located to minimize disturbance to critical moose wintering areas and, in particular, to class 1 moose habitat (as defined by Watson et al., 1973.)*

18. *The Company shall minimize disturbance to moose by instituting measures such as those recommended in the section on Caribou and Reindeer above and in the chapter on Aircraft Control.*

### *Foxes and Wolves*

Many witnesses from northern communities explained their fears of hydrocarbon developments in general and of oil spills in particular by describing what might happen to the arctic food chain. I dealt with this subject at some length in Volume One, but foxes and wolves are good cases in point. Arctic foxes are known to scavenge the seal kills of polar bears. Seals could be regionally depleted as a result of an oil spill, so although not directly involved, the arctic fox could certainly be affected in a serious way by activities associated with industrial development. Similarly, the decline of any of the ungulate populations, especially the barren-ground caribou herds, would affect the wolf population. We have to view foxes and wolves – indeed all animals – in the overall context of the food chain, but my discussion of them here will be limited to the species themselves.

The pipeline project will affect only local populations of arctic foxes, coloured foxes and wolves. The concerns for these species arise mainly in two areas: the disturbance of the animals and their habitat; and the attraction of these animals to waste disposal sites.

All three of these species den in high, well-drained soils – soils that frequently provide prime borrow materials for construction. Because the pipeline will be constructed during the winter, disturbance during the denning period may not be a problem since these species occupy their dens in the spring. However, the danger remains that denning sites may be altered physically or destroyed by the alignment of the right-of-way or by their exploitation for borrow material. This could be significant because all three species tend to use the same den sites year after year.

Many of the reported arctic fox dens are on the Yukon Coastal Plain. My recommendation for a wilderness park there should protect the habitat of that species as well as of the wolf population. Throughout the Mackenzie Valley and Western Arctic the dens of arctic fox, together with those of the coloured fox and wolf, will need protection.

19. *During final design, the Company shall identify all arctic fox, coloured fox and wolf dens within one-half mile of the right-of-way and other pipeline facilities so that the project can be designed, located and scheduled to avoid prime denning areas. Unless authorized by the Agency, construction shall avoid such areas by a distance of at least 100 yards.*

The habituation of foxes and wolves to waste disposal sites and other camp facilities has always been a problem in the North and it was of concern during the construction of the Alyeska pipeline. Concentrations of these animals around campsites may become a nuisance, and could cause problems associated with rabies.

20. *Every effort shall be made to prevent foxes and wolves from becoming a nuisance around campsites. To this end:*

*The feeding of foxes and wolves shall be prohibited.*

*The Company shall manage all domestic and other waste in a manner that will minimize the attraction of foxes and wolves to construction sites and facilities. Fencing shall be installed around all incinerator, food storage and domestic waste handling areas. (See Waste Management.)*

### *Bears*

Grizzly, polar and black bears inhabit the Mackenzie Valley and Mackenzie Delta in varying densities. The grizzly bear of the Delta and central Arctic, referred to as the barren-ground grizzly, may be taxonomically distinct from the grizzly bear of the Yukon. If this is the case, the barren-ground grizzly bear would be considered endangered. Its special relation to the tundra environment gives the species evolutionary interest and significance, and every effort should be made to maintain a healthy population.

Interactions between men and bears are usually viewed as threats to human safety, and bears are therefore usually eliminated from areas in which there is human activity. As is the case with foxes, the concerns for bears arise mainly in two areas: the attraction of waste disposal sites and disturbance of the animals and of their denning habitat.

Because of ineffective waste management practices in the North, bears have been attracted to areas of human activity and many of them have been destroyed in the name of human safety. This is a problem that can be solved only by improved techniques of waste disposal. Except when human safety is immediately threatened, only an authorized government representative may dispatch the animal as the last resort after all other possibilities have been exhausted.

*21. The Company shall collect, store and dispose of all domestic waste in a manner that will minimize the attraction of bears to construction sites and facilities. (See Waste Management.)*

*22. The feeding of bears should be regarded as an act that threatens human life. Any person feeding bears should be immediately dismissed, reported to the Agency, and then returned to point of hire. Persons or companies who, through negligence or otherwise, provide bears with an opportunity to become habituated to waste materials should be prosecuted.*

*23. The Company shall ensure that each working unit (survey crew, right-of-way clearing crew, etc.) likely to encounter bears is equipped and familiar with the use of approved devices to scare bears away from centres of human activity. Each working unit shall be equipped with only one sealed firearm for use only when there is a real and immediate threat to human safety. Each firing of this firearm should be reported, and it must be resealed without delay by an authorized representative of the Agency.*

*24. The Company shall immediately report to the Agency any bear that may be considered a nuisance or that threatens human safety.*

Although construction of the pipeline will alter bear habitat only minimally, certain critical habitats must be protected. Denning sites are found on high, well-drained slopes, which are also good locations for borrow material. Bears occupy their dens during winter, and any occupied dens must be protected from disturbance. If a bear is disturbed and forced to abandon a den in winter, the lack of food, inability to dig a new den in the frozen soil, and the cold would certainly lead to the bear's death. At other times of the year, extended harassment might deplete stored reserves of energy or cause death by physical exhaustion or overheating.

*25. During final design, the Company shall identify bear dens within one-half mile of the right-of-way and other pipeline facilities so that the project can be designed, located and scheduled to avoid these sites. To prevent disturbance to denning bears, construction activities, especially blasting, shall*

*avoid occupied dens by a distance of at least 500 yards, or as otherwise approved by the Agency.*

*26. The Company shall institute measures to ensure that there is no harassment of bears by aircraft and vehicles and that encounters or conflicts between men and bears are minimized. (See Facilities Complexes and Equipment Operations, and Aircraft Control.)*

All three species of bears are hunted for food and sport, but the polar bear and grizzly bear are regarded as prize trophies. The harvest of polar bears is controlled by a quota system, whereas the harvest of grizzly and black bears is controlled by Territorial Game Regulations. Improved access, increased numbers of people and better facilities could have an adverse impact on the grizzly bear population.

*27. To prevent overharvesting, the government should review existing game regulations respecting grizzly bears. Particular consideration should be given to suggestions made by Pearson (1976) regarding new game regulations that might reduce overharvesting and permit bear populations to be maintained.*

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## Birds

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It may be difficult for many Canadians to understand why it is necessary to make recommendations to preserve birds and their habitat. There has been a tendency to downplay the concerns expressed about northern bird populations by biologists and by others for whom birds are important. In most cases, I think this dismissive attitude is based on a misunderstanding of what is now at stake in northern Canada. The distribution of birds in the North is very different from what most of us have seen in southern Canada.

As I explained in Volume One, the Mackenzie Valley and, to a lesser extent, the shores of the Beaufort Sea, are major flyways for millions of geese, swans, ducks, gulls, terns and the many other species that converge on this region every summer to nest and raise their young. During these critical periods of their life cycles, these international bird populations rely on the habitat provided by the Mackenzie Valley, the Mackenzie Delta and the Beaufort Sea coast. Nature, political boundaries and treaties have made these populations a Canadian responsibility.

At least 230 species in 41 families of birds are nesters, migrants or casual visitors in the Western Arctic. Many of these species are continental in their distribution, so the proportion of their total population that might be affected by pipeline-related activities is small. Some species, however, are vulnerable to pipeline construction and operation either because a total population is relatively small or because a significant proportion of a total population gathers within the project area at some vital stage of its life cycle. For some

species, a significant proportion of their critical habitat lies within the proposed project area.

Every species of bird that is found in the area is an integral part of both northern and continental ecosystems. A rational approach to the problem of protecting these birds requires us to define exactly what is at stake and then to devise a practical means of ensuring that what must be protected is protected. No amount of research and certainly no recommendations that I can offer will afford complete protection to all of the birds everywhere in the region. Our objective, therefore, is to permit both international migratory populations and local populations to continue to use this region year after year without having their numbers progressively diminished.

With this in mind, I turn now to the critical habitats and critical life stages of northern birds, to those tracts of land and water that are vital to the survival of whole populations of birds at certain times of the year.

There are three major groups of birds that must be protected and, if measures are taken to ensure their protection, many other species will also be protected. The first group comprises the rare or endangered species, such as the peregrine falcon, the whooping crane and the Eskimo curlew, that are of national or international concern. Raptors and, in particular, the peregrine falcon, gyrfalcon, bald eagle, golden eagle and osprey make up the second group. Finally, there are the waterfowl, especially the species that nest in colonies or form large, vulnerable congregations during moulting and staging.

### *Areas Important to Birds*

In Volume One, I made recommendations to protect critical habitats and life stages of birds by specially designating certain land areas that are vital to them. It was, in part, the very heavy avian use of the Northern Yukon that led me to recommend the creation there of a wilderness park. I also recommended that human use of certain areas be strictly regulated to protect important waterfowl and falcon habitats and I proposed the outer Mackenzie Delta, the International Biological Programme sites at Campbell Hills-Dolomite Lake, Willow (Brackett) Lake and Mills Lake as bird sanctuaries. I also noted that many islands in the Mackenzie River are important to migratory waterfowl and, I suggested that, at some time, some of them should be designated as bird sanctuaries.

The designation of lands on which industrial activity should be prohibited or appropriately controlled is only one way of protecting birds. When we have in view a specific project, such as a pipeline, a second method – that of specific regulations – is also appropriate. In my opinion, the protection of birds and their habitat can be achieved in three ways. First, the pipeline route and the location of its associated facilities can be adjusted. Second, engineering designs that minimize impact can be used: noise attenuation devices fall

into this category. Third, the timing of construction activities can be scheduled so that birds would not be disturbed during their seasonally critical life stages.

*28. Birds and their habitat shall be protected from adverse effects associated with surveying, construction, operation and maintenance of the pipeline. Before construction begins, the Agency shall identify important and restricted areas and periods for birds, particularly for raptors, and waterfowl, and shall devise whatever restrictions may be necessary on project location, engineering design, project scheduling, access and aircraft activities in these areas and during these periods.*

### PROTECTION FROM SPILLS

Spills of oil, fuel and other hazardous substances are one of the greatest threats to birds and their habitat. Biologists spoke at length at the Inquiry about the devastating impact of oil spills on birds and emphasized that we are not able to rehabilitate birds that come into contact with oil, even in temperate climates. Waterfowl in particular are threatened by such spills. If extensive areas of waterfowl habitat or small areas used by large numbers of individual birds are affected by a spill, the effect could be catastrophic.

I dealt with the problem of spills at some length in Chapter Six of Volume One and I make specific recommendations elsewhere in this volume on the means of minimizing the chances of a spill. But because our ability to handle large spills is rudimentary and because the effects could be so severe, I make the following recommendation with specific reference to birds.

*29. The Company's plans for the transportation, handling, storage and disposal of fuels, lubricants and other toxic materials shall demonstrate that bird habitat, and particularly waterfowl habitat, will be avoided or in some other way protected from the risks of spills. Contingency plans shall demonstrate that the Company has fully considered and has the technical, logistical and financial ability to protect critical waterfowl habitat. (See Management of Fuels and Other Hazardous Substances.)*

### PHYSICAL DISTURBANCE OF LAND AREAS

Other general issues related to bird habitat warrant mention. The bars and islands of the Mackenzie River constitute important mating and resting areas for migrating birds in the spring. Physical alteration of these areas may affect the birds' chances of breeding success and survival during the summer. I have already recommended in Volume One that these islands be designated as bird sanctuaries.

Specific activities related to the project will affect various aspects of terrain and water that are important for birds, particularly waterfowl, which tend to congregate in large numbers at various times in their life cycle. For example, trenching and other activities in wetland areas may lead to the draining or drowning of waterfowl nesting and feeding habitat, and excess siltation from stream crossings could

affect waterfowl food supply. The mouths of the tributaries of the Mackenzie River are particularly important habitat.

*30. Degradation of important bird habitat such as the river islands of the Mackenzie River; the beach bars of the Arctic Coast, wetlands and the riparian vegetation of streams and lakes shall be avoided, wherever possible, and shall otherwise be kept to a minimum. Critical habitat that has been degraded shall be restored following the construction period.*

#### DISTURBANCE FROM NOISE AND PEOPLE

There is much more to the disturbance of birds than simply startling them. If that were the only problem, the birds would probably fly from the area, alight elsewhere and carry on as normal. The problems of disturbance are far more complex. The disturbance of birds during critical life stages or in critical areas may lead to abandonment of nesting sites and death. Take the case of the snow geese: because they nest in colonies, any continuous disturbance of them during their nesting season could cause the loss of one year's brood through exposure of the eggs or young to the weather or predation; similarly, if snow geese were harassed on their fall staging grounds and were, therefore, not able to store up enough energy, large numbers of them could die on their southward migration.

Most construction activity will take place in winter when there are few birds in the area. Nonetheless, during the summers of the construction period, there will be movements of aircraft and barges, activities at stockpile sites, compressor sites and airfields, and perhaps operations at gravel pits and other activities along the pipeline route. During the operation of the pipeline, there will be noise from compressors and from pipe blowdowns, aircraft and barge movements, vehicles, and repair and maintenance work. I make specific recommendations on many of these activities in Part Three: The Project, but it is worthwhile to review here the scope of the problem in its ornithological context and to make appropriate recommendations to mitigate the adverse effects.

*31. As far as practicable, construction and maintenance activities shall be scheduled for winter or for other times of the year when birds are not present. Activities undertaken when birds are in the area shall be strictly controlled to limit the extent and level of disturbance.*

There will be substantial numbers of people working at wharf, stockpile and compressor station sites during the summer. The amount of disturbance to the bird populations near any given facility will depend on the type and frequency of the disturbance emanating from the site, its effects on surrounding vegetation and topography, and the sensitivity of particular species to disturbance.

The location of pipeline facilities and of ground-based activities will be critical to the well-being of raptors and colonial nesting birds. Any source of disturbance that is immediately adjacent to the nesting areas of these birds could

have a serious effect on them. Both groups are particularly sensitive to human presence when they are nesting and rearing their broods. Unrestricted human access to their nesting areas could lead to reduced reproduction of these species.

Compressor stations located near sensitive wildlife areas are of particular concern. I note that the National Energy Board has accepted Foothills' undertaking to keep noise from compressor stations down to 60 decibels (dBA) at the fence line. However, research commissioned by the pipeline companies has suggested that even that level of noise can have significant effects on bird populations. Staging snow geese vacated an area within 1.5 miles of a compressor-station-sound simulator that had a noise level of 50 dBA at 1,000 feet, and it was suggested that a level of 56 dBA at 1,000 feet would cause geese to vacate an area within a 2.5-mile radius. Extensive observations of geese during the drilling of Imperial Oil's gas well at Taglu suggested that staging geese would vacate an area within a 5- to 10-mile radius around a compressor station, depending on the amount of aircraft disturbance associated with the site.

*32. The Company shall locate all facilities and design all devices associated with those facilities to minimize disturbance to birds. In particular, noise attenuation devices shall be installed on all appropriate equipment to reduce noise to the lowest practicable level. In certain locations and at certain times that are deemed to be sensitive for birds, the Agency may require special noise attenuation equipment and procedures. (See Facilities Complexes and Equipment Operations.)*

*33. Upon request, the Company shall provide the Agency with all data used to assess the cost-effectiveness of various levels of attenuation and to assess the impact of various levels of noise on birds at any construction site.*

Of all the forms of disturbance to birds that may be caused by industrial development in the North, uncontrolled movement of aircraft is potentially one of the most serious. The degree of susceptibility to such disturbance will vary among the species, depending on the season, weather and location.

Ornithological studies submitted to Arctic Gas have suggested that aircraft disturbance may cause gyrfalcons to abandon their nests and that staging snow geese may be disturbed within nine miles by a light aircraft flown at an altitude of 10,500 feet. The results of many of these studies are inconsistent, and firm conclusions based on them are not possible. However, because aircraft will be a major means of transportation during construction and operation of the pipeline, some form of control will have to be exercised to regulate the altitudes and frequencies of aircraft flights.

The protection of birds through the regulation of aircraft is such an important issue that I discuss it in a separate chapter entitled Aircraft Control. There I make proposals for flight corridors and the regulation of flight ceilings and schedules so

that critical locations and life stages of the bird populations that are susceptible to disturbance may be avoided.

Increases in river traffic during the construction and operation of the pipeline and related facilities are also a source of disturbance for birds. The Mackenzie Valley is one of North America's most important flyways. In spring, the northward migrating birds generally pass through before the barging season on the river begins. But in years when waterfowl, especially geese and swans, may not have stored up enough energy for their flight south, the islands and bars in the Mackenzie River become extremely important to them as resting and feeding areas. Barge traffic at this time might so disturb the birds that many of them would fail to complete their flights south. Increased barge traffic may also disturb ducks in the Beaver and Mills Lakes areas, but it is in the Mackenzie Delta that disturbance from such traffic would be most serious. There waterfowl use the river islands and channels for moulting and staging sites from July to September.

*34. The routing and scheduling' of water traffic shall be regulated to minimize the impact on birds and their habitats during sensitive periods in the Mackenzie Delta and elsewhere along the Mackenzie River. Water traffic shall avoid areas identified as critical to bird populations. Similarly, docking and other shoreline facilities shall be located to avoid the disturbance of such areas. (See Facilities Complexes and Equipment Operations.)*

### *Rare or Endangered Species*

At present in Canada, there is no official federal recognition of any rare or endangered species, and because there is no national policy or legislation for dealing with such species, the designation of a species as rare or endangered may be highly subjective. Under these circumstances, it is difficult to ascertain the relative significance of the designation of a species as rare, uncommon or endangered.

During the Inquiry, mention was made of many species, the majority of which are birds, that biologists consider to be rare or endangered. The peregrine falcon, whooping crane and Eskimo curlew are the best known of this group, which also includes the Hudsonian godwit, buff-breasted sandpiper and Thule white-footed goose. Except for the peregrine falcon, little attention was focused on any of these species, perhaps because our knowledge of them is limited. My concern for the peregrine falcon is dealt with below in my recommendations on raptors. The breeding habitat of the whooping crane is already protected, and it is unlikely to be affected by the present alignment of the pipeline. So little is known of the ecology of the other rare and endangered birds that it is impossible at present to make recommendations to protect them. Continuing research will reveal more information about these birds, but in the meantime recommendations to protect other species will hopefully protect rare species.

We have an obligation to do all we can to ensure the survival of species of birds that may be in danger of extinction, especially if that danger is caused by human disturbance.

*35. The government should develop a national policy and should draw up legislation to provide for the protection of rare and endangered species of birds.*

Of course, the problem of rare and endangered species goes well beyond bird species. The bowhead whale inhabits the offshore waters of the Beaufort Sea and is listed by the International Whaling Commission as being endangered. The barren-ground grizzly bear that I mention in *Wildlife: Mammals* may also be considered rare or endangered.

### *Raptors*

The raptors (birds of prey), that nest in the Western Arctic constitute a significant proportion of the remaining North American populations of these species. There are nesting sites all along the Mackenzie Valley and, in particular, in the Campbell Hills and Franklin Mountains.

Raptors such as the falcons, bald eagles, golden eagles and ospreys are fairly common in the North, although their populations elsewhere in North America are low. It is necessary to give northern populations of all raptors attention, but it is the peregrine falcon that requires particular protection. Here is what Finney and Lang said in a report prepared for Foothills Pipe Lines Ltd.:

The population [of the peregrine falcon] is at a dangerously low level and there is no indication that recovery is imminent. Due to the sensitivity of the peregrine population, developers have to face the fact that the destruction of a single nest site or interference with nesting in a single year is a serious and unacceptable impact. These constraints apply to no other bird species regularly nesting along the proposed pipeline corridor. [Finney and Lang, 1975, *Biological Field Program Report: 1975*, Vol. VI Section 4, p. 32]

The recommendations I make for raptors therefore apply primarily to the peregrine falcon.

The maintenance of wilderness within critical distances of the nest sites is of paramount importance because raptors are extremely sensitive to disturbance by men, machinery and aircraft. Such disturbance could cause direct destruction of the eggs or young by exposure, predation or accidental ejection of the eggs or chicks from the nest, or it could reduce the wilderness seclusion of the area around the nest so that it was no longer acceptable to the breeding pair. Low-intensity, repeated disturbance over a period of time frequently has a cumulative effect that leads to permanent desertion of the nest. We can best protect raptors by isolating their habitats from the disturbances caused by the project.

*36. The pipeline and its related facilities shall be located, designed, constructed and operated in a manner that avoids disturbance to raptors and their habitat.*

37. For purposes of project review and control, the Agency shall designate Raptor Protection Zones around regularly and irregularly occupied raptor nest sites that are considered to be threatened by project activities. Such zones should be applicable to peregrine falcons in particular but may also apply to other raptors. These zones should be approximately two miles in radius or of the size that is required to protect the nest site. Access to these zones shall be prohibited unless authorized by permit.

Applications for an access permit to Raptor Protection Zones shall be accompanied by sound biological evidence that the proposed activity will not jeopardize the raptors during their nesting period and will not adversely affect the nest site itself.

Because of the need to provide complete protection for raptors and their habitat, the Company must understand that there may be lengthy delays if it plans to undertake activities in a Raptor Protection Zone.

38. To limit disturbance to raptors, barging operations and other movements of pipeline material that infringe on any Raptor Protection Zone during the periods of occupancy shall be subject to site specific limitations imposed by the permit.

39. The frequency and altitude of aircraft flights over Raptor Protection Zones shall be controlled by the Flight Control Group. (See Aircraft Control.) In general, aircraft shall maintain an altitude of at least 3,000 feet above ground level over any Raptor Protection Zone during a sensitive period. Flights at lower levels shall be diverted around the zone. Airstrips and heliports shall be located so that approaches and take-offs avoid Raptor Protection Zones. Pipeline surveillance flights at less than 3,000 feet above ground level, helicopter landings and motorized terrestrial access for maintenance or repair shall be prohibited within a Raptor Protection Zone during the period of occupancy, except as specifically authorized by the Agency.

### *Waterfowl*

The Beaufort Sea coast, particularly the Blow River Shallow Bay area and, to a lesser extent, the coastal plain out to Herschel Island, provides important nesting habitat for whistling swans. Brant, many species of ducks, loons, gulls, and other species use the coastal lagoons, beaches and islands of the Beaufort Sea as resting, nesting and moulting areas. From June through August, the tundra lakes of the Yukon Coastal Plain are important nesting, feeding, brood rearing and moulting areas for many species of swans, geese, ducks, loons and shorebirds. At any one time in the late summer and autumn, between 300,000 and 500,000 geese, swans and ducks gather on the Yukon Coastal Plain and Shallow Bay for a period of concentrated feeding to build up their energy reserves for the long southward migration. Snow geese are most numerous during this period and, on any one day in late August, almost the entire Western Arctic population of this

species might be gathered on the coastal plain between Bathurst Peninsula and the Canning River in Alaska. Old Crow Flats, in the Yukon interior, are second only to the Mackenzie Delta as a critical waterfowl production area in northwestern Canada.

In Volume One, I recommended that no pipeline be built and no energy corridor be established across the Northern Yukon and that a wilderness park be created in that area. This recommendation was intended, in part, to protect vital habitat for waterfowl there.

The Mackenzie Delta is also an important waterfowl production area and it has breeding populations of several hundred thousand ducks and geese. Of particular concern are the snow geese at Kendall Island, where there is a colony of 1,200 to 8,000 breeding birds; approximately 20,000 whistling swans nesting in the Eskimo Lakes-Liverpool Bay area; and the rare trumpeter swan, which has been reported nesting near Moose Channel. Many parts of the Delta are critical for moulting ducks, swans and geese during summer. For example, in any given year the Delta may be as vital as the Yukon Coastal Plain to the snow geese. Normally, the majority of the snow geese stage on the Yukon coast, but, in 1975, when the geese arrived in early September it was covered with snow and most of the geese moved into the Shallow Bay area of the Delta. The peak number of geese there, at that time, was an estimated 325,000 out of the region's total population of 375,000. Snow geese are easily disturbed by aircraft movements of the kind that would be associated with the construction and operation of a pipeline and production facilities.

In Volume One, I recommended that a bird sanctuary should extend across the outer part of the Mackenzie Delta, thereby giving the Canadian Wildlife Service jurisdiction to regulate industrial activity in the area.

The Mackenzie Valley, one of North America's major flyways, is used by many species of birds that breed in the Western Arctic and sub-Arctic. In May and early June, large numbers of migrating waterfowl find the only available open water around islands in the Mackenzie River between Camsell Bend and the Mackenzie Delta and in some of the lakes near the river. At this time, these areas of open water are heavily used for mating, nesting and feeding. As many as 100,000 northbound geese and swans may be concentrated on sandbars, spits and island fringes. These same areas also provide resting areas vital during the fall migration in years when young birds have been unable, for any reason, to store adequate reserves of energy to complete their long southward migration. With so short a season, the waterfowl cannot be delayed, and disturbance of them must be kept to a minimum.

Large numbers of ducks, some Canada geese, sandhill cranes, loons and various other species, nest in the forest and forest-tundra habitats of the Mackenzie Valley. The Ramparts River, Mackay Creek, Willow (Brackett) Lake, Mills Lake and Beaver Lake areas are the most important nesting, brood-

rearing, moulting and staging areas for water-oriented birds in the Mackenzie Valley between Great Slave Lake and the Mackenzie Delta.

In Volume One, I recommended that Willow Lake (Brackett Lake) and Mills Lake, which were identified under the International Biological Programme as sites important to waterfowl, be designated as bird sanctuaries.

In addition to the designation of sanctuaries, regulations will have to be developed to control the adverse effects on waterfowl of activities associated with pipeline construction. Disturbance to populations of waterfowl could increase stress and alter normal behaviour patterns during critical life stages, such as spring migration, nesting, moulting and staging for fall migration. Disturbance could also decrease reproduction success and cause birds to desert traditional areas, such as nesting sites for which there may be no suitable alternative. The impact of disturbance on a particular species is a function of the type and intensity of the disturbance, as well as of the time of year, location, distribution of the species, and its sensitivity to disturbance and its ability to avoid the sources of disturbance. These variables become more important farther north, where shorter summers impose even tighter limits on the hatching and raising of healthy young in time for the fall migration.

*40. The Company shall control, restrict and otherwise alter its terrestrial and airborne activities and those of all its contractors and subcontractors to avoid disturbance to waterfowl and their habitat and to comply with restrictions of access and activity in important waterfowl areas, as defined by the Agency. Such measures should include the designation of corridors for air traffic and the designation and regulation of flight altitudes. (See Aircraft Control.)*

*a) Habitat critical during the spring migration throughout the Mackenzie Valley, including islands, deltas of tributaries, and adjacent marshes. Within these critical habitat areas, concentrations of birds should be protected from disturbance by a two-mile-wide buffer-zone. The period of restriction would generally be from May 1 to May 31. In addition, if these areas are used in the fall by migrating geese and swans, contingency plans should provide for the adequate protection of the birds and this habitat during such periods.*

*b) Areas in the Mackenzie Delta where there are concentrations of migrating, nesting, rearing, moulting and staging geese and other waterfowl. In general, construction activities should be minimized and personnel should be restricted to their immediate work areas from May 5 to October 5.*

*c) Areas critical for snow geese. All construction and other activity likely to cause disturbance and all human access should be strictly controlled within two miles of occupied areas from about August 15 to October 15.*

*d) Waterfowl habitat in the Mackenzie Valley forest areas between Great Slave Lake and the Mackenzie Delta.*

*41. Because of the extensive disturbance created by air cushion vehicles to waterfowl while they are nesting, rearing their young and staging, these vehicles shall be prohibited within the critical waterfowl areas described above, while birds are concentrated in them.*

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## Wildlife Management and Research

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It became evident during the Inquiry that, although the North has abundant wildlife resources, relatively little scientific information is available about wildlife populations. In this respect the North is still very much a frontier area. Much of the information that is available has been gathered as a result of gas and oil exploration and the proposal for a gas pipeline. As I stated in Volume One, much more information is needed if the populations of northern birds and mammals are to be managed scientifically for the benefit of northerners and conserved for all Canadians.

At present, five separate agencies are responsible for the management of northern wildlife resources. The Yukon Game Branch and the Northwest Territories Fish and Wildlife Service are responsible for the management of mammals and non-migratory birds, including raptors, within their respective territories. The Department of Indian Affairs and Northern Development is responsible for land management within the Yukon Territory and the Northwest Territories. The Canadian Wildlife Service, Department of the Environment, is responsible for the management of migratory birds, and the Fisheries and Marine Service, also part of the Department of the Environment, is responsible for the management of marine mammals.

During the Inquiry, I heard from representatives of all of these government agencies. The general conclusion was that, without more intensive wildlife management, a gas pipeline could have severe and long-term effects on many wildlife populations. Although there has been industrial development of various kinds in the North for some time, the pipeline is regarded by many as the first in a series of large-scale industrial developments there. I concur with this view; as I stated in Volume One, construction of a gas pipeline will

trigger a series of other activities, and the pipeline should not be viewed in isolation. Without effective wildlife management programs many of the now abundant populations will decline.

### *Northern Wildlife Management*

The essence of wildlife management is the manipulation of an animal population or its habitat for the benefit of man. The territorial government's wildlife management programs are, for the most part, directed towards the benefit of native people. Dr. Norman Simmons, Director of its Fish and Wildlife Service, described territorial policy to the Inquiry: "The management programs of the Fish and Wildlife Service are designed primarily to satisfy the food and psychological requirements of [the] indigenous people." (F20898) Whereas management policy may have these objectives at present, that has not always been the case. Commission Counsel summed up what I think has been, and is still, an essential fact about wildlife in the North:

The recent history of the North is replete with examples of the ability of mechanized man to decimate animal populations. These include not only the well-known nineteenth and early twentieth century examples, such as fur seal, sea otter, baleen whales, muskoxen, and caribou, but also more modern instances of wildlife depletion by northern residents, witnessed by the wildlife vacuums surrounding all northern centres of habitation. Where abundant wildlife populations still exist in the North, it is generally due in large part to limited human access. This isolated position of large areas in the North is rapidly being reduced. Without corresponding large-scale increases in wildlife management efforts in the North, this loss of isolation will be accompanied by rapid depletions in many animal populations. [Commission Counsel, 1976, "Wildlife Protection: Wildlife Management and Monitoring," p. 1]

In the previous sections that describe individual species, I repeatedly mentioned the two most important causes of impact: disturbance and increased access. These causes may have long-term effects and may cover a much larger area than the actual right-of-way of a pipeline. Having already discussed this problem as it relates to individual species, I shall discuss later the measures necessary to mitigate disturbance from specific aspects of this project.

Increased use of many areas that are still virtually wilderness areas will be a direct result of the greater numbers of people and of better and more facilities in the North. This threat to many wildlife populations is recognized by, and accepted to be, the responsibility of the wildlife management agencies. The success of a game management policy, whatever it may be, depends to a considerable degree on the staff and the funds that are made available. Even today, these agencies do not have adequate resources to meet their full range of responsibilities.

If northern wildlife is to be preserved, funds for management and research are required, whether or not a pipeline is built tomorrow or ten years from now. Not only will the

wildlife aspect of the Agency have to function during the construction of the pipeline, but the management functions of the various wildlife departments will have to be increased to meet a broad range of demands stimulated by the pipeline development. Because these increases will in part be directly attributable to the pipeline construction, it is logical that at least some of these costs should be borne by the Company. This is not a new concept: the development of the James Bay hydro-electric project has involved Hydro-Québec financially in the surveys of native harvests now going forward.

42. *In addition to funding the Agency so that it may undertake its functions related to wildlife, the government should ensure that the funding of various other agencies and organizations before, during and after pipeline construction is sufficient for them to meet increased responsibilities related to wildlife management and research in the face of a major industrial development. In so doing, the government should ensure the meaningful involvement of native organizations in all aspects of wildlife management in the region and should specify the extent and nature of the financial and professional involvement that will be required of the Company during the life of the pipeline.*

In Volume One, I indicated that certain areas should be excluded from industrial development and that certain other areas, such as bird sanctuaries, should be closely managed by the responsible government agency. The wilderness park in Northern Yukon and the whale sanctuary in the Beaufort Sea come into the first category, whereas the expansion of the Kendall Island Bird Sanctuary and the designation of the Mills Lake and Brackett Lake sites as sanctuaries come into the second. So far, in this volume, I have recommended that protection zones be set up around raptor nest sites, especially those of the peregrine falcon; that a game preserve be established along both sides of the right-of-way and around all pipeline facilities; and that a similar game preserve be established along both sides of the Dempster and Mackenzie highways. These areas of excluded or restricted access that I have identified are a major tool of wildlife management. There are, however, a variety of other means to effective management that must be used to protect wildlife populations so that they may continue to be used as renewable resources. I shall deal more explicitly with these other means in the following paragraphs. Because aircraft are considered a major source of impact, I have dealt with this subject in a separate chapter entitled Aircraft Control.

### *Wildlife Management and Pipeline Regulation*

During the Inquiry, it became apparent that, at all stages of the pipeline project, programs dealing with the enforcement and adaptation of regulations, the rehabilitation of habitats, and contingency plans are central to ongoing comprehensive wildlife

management. For example, advice from wildlife specialists will be needed to review designs and to approve schedules, the location and relocation of facilities, and equipment.

The inspection and enforcement of regulations governing pipeline construction activities will be very difficult tasks, especially since they may lead to delays or work stoppages. Field inspection staff will have to be given pragmatic training and the authority to carry out their duties effectively. If they do not have that authority, there will be needless delays, frustration and non-compliance. The greatest emphasis must be placed on having knowledgeable and experienced people in the field while construction is underway.

During the construction phase it will be necessary to document changes in the numbers and the movements of animals, damage to habitat, success of mitigative measures, and so on. Without collection and assessment of this type of information, the impact of the pipeline would not be apparent nor would mitigative techniques and methods be progressively improved.

*43. To ensure that the concerns for wildlife that have been expressed are considered and incorporated during all stages of design and that regulations concerning wildlife are enforced during the construction of the proposed pipeline, the Agency staff shall include specialists and high-level administrators to review and approve designs, to inspect and to enforce regulations, to design mitigative measures, and to collect and evaluate data on both the project and wildlife activities. These activities must be done in close coordination with the appropriate wildlife management agencies of government and must involve consultation with and input from native organizations.*

The regulation of the pipeline operation will involve protection of mammals and birds from the noise and disturbance involved in starting up the pipeline, in the routine operation of compressor stations and other facilities, in routine maintenance and repairs, and in contingency repairs. I assume that the Agency will be terminated soon after construction of the pipeline is completed and, therefore, that the regulatory tasks necessary during operation of the pipeline will become the responsibility of the permanent wildlife regulatory bodies under whatever arrangements may apply after the settlement of native claims.

*44. Before the Agency is disbanded at the end of the construction period, the roles of ongoing wildlife agencies and the responsibilities of the Company should be established. Consideration should be given to factors such as who will assume specific Agency functions during the operation and abandonment phases of the pipeline, and the funding and staff requirements necessary to maintain a comprehensive monitoring and management program.*

### *Hunting and Access*

One of the major concerns that I have mentioned throughout this chapter and in Volume One is that the construction of this pipeline will afford easier access to areas that have, until now, been relatively inaccessible to man. This improved access, together with the increasing number of residents and tourists in the North, will undoubtedly increase stress on many wildlife populations through direct mortality (hunting), by increased disturbance, and by habitat loss or alteration.

Both Foothills and Arctic Gas have stated that movement of pipeline personnel will be restricted and that they will not be allowed to hunt on company property. The pipeline companies will similarly restrict access to the right-of-way and to the pipeline facilities to company personnel. However, in view of the large number of people that will be attracted to a major project of this sort, it will be difficult for the Company alone to enforce these good intentions. Therefore, to protect the wildlife populations and the traditional harvest of them, a number of measures are required that will go beyond the Company's jurisdiction.

It will be necessary to control in some manner access to the right-of-way and to all access roads, wharves and other pipeline facilities. Otherwise many wildlife populations will decline or they will abandon certain areas.

One particularly important aspect of game management is the need to protect the Porcupine caribou herd in the vicinity of the Dempster Highway, both from the adverse effects of the highway and its traffic and from increased hunting pressure that has followed the highway. In Volume One, I quoted Ronald Jakimchuk on this subject. After publication of Volume One and of the National Energy Board report, he wrote to me about his observations along the Dempster Highway this spring. He said, "The herd is in existing and continuing jeopardy from the Dempster Highway." He urged "a commitment by government to implement timely regulations ... to ensure free and unimpeded movement of migrations and to monitor and regulate the kill," and he added, "The proposed wildlife range does not solve these problems as it does not encompass the Dempster" (Jakimchuk, personal communication, June 17, 1977).

In view of the continued work on the Dempster Highway and the undoubted increase in traffic and hunters on it when it has been completed and particularly in view of the endorsement that the National Energy Board has given to the idea of a pipeline along the Dempster Highway, I consider that it is of great importance for government to institute measures as soon as possible to protect the herd when it is near the Dempster Highway and to reinforce these measures whether or not a pipeline is built along the highway.

*45. A two-mile restricted hunting zone should be established along both sides of the pipeline right-of-way and all access roads and around all pipeline facilities. A similar restricted*

*hunting zone should be established along the Dempster and Mackenzie highways and all access roads that are within the winter range of the Porcupine caribou herd. Within this game preserve, traditional native harvesting would be allowed to continue, provided that the wildlife populations can support such harvesting.*

*46. The government should develop a traffic management plan for the Dempster Highway and other rights-of-way in areas that are important to caribou. When caribou are present in such areas, regulations such as slower speed limits, convoying or the staggered scheduling of highway traffic, and periodic closures of sections of the highway that may be the locations of large-scale caribou crossings should be instituted.*

*47. During construction the Company shall limit access to its facilities to only those persons who, in the course of their employment, need to be there. All haul and access roads, the right-of-way, and all airstrips and helipads built and operated by the Company shall be closed to public access, except in emergency situations or as approved by the Agency.*

*48. After pipeline construction is completed, the Company shall remove or otherwise make unusable (in an approved manner) all access facilities and structures that are not necessary to the continued operation of the pipeline.*

*49. To help control hunting during and after pipeline construction, revisions to the hunting regulations should be contemplated. Measures such as increasing the length of the residency requirement to obtain a hunting licence and restricting hunting areas and seasons, should be actively pursued. (See Renewable Resources.)*

### *Wildlife Research and Monitoring*

In Volume One, I drew attention to our lack of knowledge about northern birds and mammals, which, according to the biologists who gave evidence before the Inquiry, has hampered them in predicting the impacts of pipeline development. This lack of knowledge will also hamper the development of measures for the protection and management of wildlife during construction and operation of the pipeline.

*50. Wildlife studies should be undertaken before, during and after pipeline construction to gauge the nature of populations, to develop comprehensive mitigative responses and to assess the effectiveness of ameliorative measures on both a short- and long-term basis.*

### MONITORING

The monitoring of animal populations involves repeated checks or surveys of the populations to determine whether or not there are changes in the health, demography or distribution of a population. Monitoring is also used to document the movements of migrating animals. Should a migrating population come into contact with development activities, the knowledge gained from monitoring permits appropriate

precautions to be taken. Both short-term and long-term monitoring programs are necessary in any management plan to protect wildlife.

Obviously it is not possible, at this time, to specify which mammal or bird populations will have to be monitored, or where and when the monitoring will have to be done. These matters will have to be worked out by the relevant wildlife management bodies, the Agency and the Company.

*51. Because a wildlife monitoring program is vital to any successful plan to observe and to mitigate impacts on wildlife resources, a comprehensive short term monitoring program shall be an integral part of the work of the Agency. This program shall be designed to locate migrating mammals or birds and sites of concentrated wildlife activity and, on the basis of this information, to alter pipeline project activities that may cause unacceptable impact. This monitoring should also be used to assess the effectiveness and improve remedial measures.*

*52. The long-term monitoring program associated with continuing wildlife management in the region should be the responsibility of ongoing wildlife management agencies. Such a program should start before construction and continue through the life of the project and afterwards, to determine the health of populations and to develop comprehensive management programs that relate to all aspects of the wildlife resources in the region. This, of course, must include a harvest monitoring research component. (See Renewable Resources.)*

### WILDLIFE RESEARCH

The Inquiry was presented with a variety of proposals regarding the research that is needed to understand the impact of pipeline development on mammals and birds and to serve as the basis for programs of wildlife management and protection. Such proposals can be found in material presented by Canadian Arctic Resources Committee, Committee on Original Peoples Entitlement, Environment Protection Board and Commission Counsel, in the evidence of witnesses, in exhibits filed with the Inquiry, and in the final arguments before the Inquiry. For example, Canadian Arctic Resources Committee's "Final Arguments and Recommendations" contains a multitude of recommendations for wildlife studies, including 39 separate research proposals related to caribou.

The studies that have been proposed differ greatly in urgency, practicality and utility for wildlife management as it relates to pipeline development. But it is clear that there are important gaps in the knowledge that is required for effective wildlife management and that a great deal of field research is needed to fill these gaps.

*53. Concrete plans for research that is essential to wildlife management in relation to pipeline development should be prepared by the agencies that regulate wildlife. The government should make funds available for this purpose so that*

*independent government research may be started well ahead of the commencement of construction of the pipeline.*

To those charged with planning this research, I particularly commend Commission Counsel's proposal for disturbance studies (Commission Counsel, 1976, "Wildlife Protection: Wildlife Management and Monitoring," p. 7).

*54. The effects of various forms of disturbance, such as aircraft, noise from fixed facilities, blasting, ground transport and watercraft, on wildlife populations should be studied in some detail*

*to allow more precise prediction of these effects. The following groups of animals and birds are pointed out as species that deserve particular attention in these studies: all species of geese, swans and eider-ducks, especially at their moulting and spring and fall staging sites; all species of raptors, but particularly peregrine falcons, because more precise definition of the zone of protection for them and the degree to which raptors may adopt to various disturbances is required; and caribou, including behavioural and physiological reaction to various disturbances.*



# 9 Fish

The problem of fish and fish resources is complex because the aquatic data are incomplete for areas that are of critical importance to fish. We also tend to view the problem too narrowly: we are inclined to concentrate on fish rather than on the ecosystems of which they are part. A species-specific approach is undoubtedly necessary but we must not forget that a broader view of the aquatic ecosystem will lead to more effective identification of problem areas, and development of protective measures.

My principal concern for fish is similar to my principal concern for wildlife: we cannot protect every fish, but we must safeguard those areas where fish concentrate and we must avoid fish populations when they are sensitive to disturbance.

*1. To ensure that the fish resources of the Mackenzie Valley and Mackenzie Delta are maintained, measures shall be employed to preserve aquatic habitat and to avoid disturbance of fish during critical life stages.*

The evidence I have heard tends to fall into three categories: fish protection, monitoring of the aquatic environment, and fisheries management. I shall deal with each of these topics, but first we need to know the characteristics of northern fish if we are to understand the significance of the measures that are necessary to protect them from the impacts of development.

## *Characteristics of Northern Fish*

Because of their specific life cycles and biological characteristics, the species of fish present in the Mackenzie Valley and the Mackenzie Delta are particularly sensitive to man-made disruptions of their aquatic habitat. Northern fish typically have slow growth rates, are large for their species, and reach sexual maturity at a late stage in their development. These factors mean that in most areas there is a large standing stock of the fish, but a low rate of productivity to maintain that stock.

Most northern fish have specific migration routes and limited spawning, overwintering, nursery and feeding areas.

Northern fish can spend their lives entirely in fresh water or in salt water, or move between the two during various stages of their life cycles. Populations of some species, such as the arctic char, spend their lives in fresh water, whereas other populations of the same species migrate to sea. Throughout much of the Arctic, many populations of whitefish and lake trout use productive lakes as substitutes for the sea.

The Mackenzie River, because it originates in warmer latitudes, is more productive and therefore supports more fish species – 34 species have been found there – than most arctic rivers. The Mackenzie Delta and adjacent coastal estuary and lagoons are particularly important to fish: nineteen freshwater and four marine species are known to use these areas extensively.

Fish can be classified as either spring spawners or fall spawners. The eggs of fall spawners have to survive the rigors of the winter environment; they lie in the gravel from October until break-up the following May or June, when the fry hatch and move to nursery areas. Spring spawners deposit their eggs at break-up and the young emerge within a few weeks. Consequently, there is an important difference in the length of time the eggs of the two groups are vulnerable to environmental disruption.

In the Mackenzie River, fall spawners constitute 62 percent of the fish population, and spring spawners constitute 35 percent. The burbot, or freshwater cod, is the winter spawner in the system. Major spring spawning species are arctic grayling, yellow walleye, northern pike, longnose sucker and flathead chub. The arctic grayling, which is distributed throughout the system, is probably the most sensitive species of spring spawner.

Fall spawners in the Mackenzie system are dominated by the Coreonid (whitefish) class, the humpback, broad and round whitefish, arctic and least cisco, and the inconnu. With the exception of the more extensive lakes, these species have larger populations in the north end of the Mackenzie drainage. Well-defined spawning migrations of the whitefish family take place in the Mackenzie Delta channels and the Arctic Red, Peel, Great Bear and Mountain rivers. Arctic and

least cisco live in the sea during much of their lives. Populations of all of these species use the Delta channels and brackish Mackenzie estuary as feeding, nursery, and overwintering areas.

Lake trout occur in significant numbers in the deep lakes of the Mackenzie tributaries and the Delta. They do not appear to be a major species in the flowing waters of the system.

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## Fish Protection

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### *Principles of Protection*

The basis of all fish protection is to safeguard critical aquatic habitat and life stages. In Part Three of this report, I deal with many of the specifics of protection as they relate to the pipeline project, but here I want to define biologically appropriate terms and conditions, and emphasize the two fundamental principles.

*2. Measures to protect fish should focus on important fish populations rather than on scattered individuals.*

*3. Fish protection should be designed to minimize disturbances where and when fish are most sensitive and most numerous, particularly in spawning grounds and overwintering areas, and along migration routes.*

Spawning and rearing areas, overwintering sites and migration routes are probably the most critical habitats for fish in the North. In addition to the physical sites, suitable water quality and food sources are also essential. Habitat areas and parameters are particularly important in the Arctic because of the generally limited ability of fish populations to recover their original levels after a severe environmental disruption has reduced their numbers.

Most northern fish species need spawning grounds that have the correct substrate – usually gravel or cobble – and suitable water temperatures. The gravel must be free of silt so that water can percolate around deposited fish eggs and permit gas exchange with the surrounding water. Clean gravel also provides good substrate for juvenile fish food, and suitable living space. A pipeline project could disrupt spawning and rearing areas by removing the gravel used for spawning or rearing; by changing the water temperature or chemistry conditions in a way that would be harmful to fish; by causing suspended sediment loads in streams to increase, which would induce silt to settle out on spawning beds and to smother eggs; or by polluting streams with toxic fuels or chemicals.

To survive the severe conditions of the Arctic winter, fish must stay in waters that are sufficiently deep that they will not freeze to the bottom. The flow of water into these areas must be monitored and that water must have tolerable

chemistry, dissolved oxygen levels and silt loads and must be free of toxicants. The eggs of fall spawning fish must be in clean, well-oxygenated water during their incubation time. Fish or egg overwintering areas could be damaged by the same pipeline activities that could damage spawning and rearing areas, and by ditching or water removal that could cut off the intragravel flow into the overwintering areas.

Any disturbance of river beds that prevents or delays fish from migrating to normal life cycle areas can affect survival. Some species do not feed en route to spawning areas, and any significant delay in the migrating time might leave them with insufficient body energy to move to these areas. Project activities that could disrupt migration routes by creating barriers in rivers and streams include the installation of culverts, river diversion structures or ice bridges, and the lowering of water levels.

Northern fish also have a limited tolerance to changes in water chemistry – that is, to changes in temperature, in the levels of suspended solids, dissolved oxygen, and pH, and in salt content. They also have a limited tolerance to toxic substances, such as methanol, fuels and pipe-coating materials. Increased levels of suspended solids, for example, could be abrasive to fish gill membranes, and could be toxic to some invertebrate fish food and to fish eggs; and increased water temperatures could make important habitat areas unsuitable. And changes in all of these parameters could result from pipeline activities.

Some changes in aquatic environments may not affect the survival of the fish but they may leave the fish either unpalatable or unsafe to eat. A pipeline project could disrupt sport, commercial and domestic fisheries by introducing persistent materials, such as pesticides, PCB's, or heavy metals, into watercourses, where they could be picked up by fish directly or through the food chains, and accumulate in body tissue.

The ecological balance in a particular aquatic system can also be disrupted by reducing certain species, by removing food sources through chemical contamination or siltation, or by introducing a new species into a watershed in which it is not native. Because there are relatively few species in the North, and because food chains are short and the relationships between species are simple, northern populations are particularly susceptible to disruptions of this kind.

Different fish species vary in their ability to tolerate disturbance. Arctic grayling, arctic char, pacific salmon, lake trout, inconnu, humpback and broad whitefish, and arctic and least cisco, because of their relatively low tolerance to siltation, particularly during spawning, appear to have the least resistance to disturbance. Slow growth and narrow age classes delay recovery. Economically, however, these are the most important species in the domestic, commercial and sport fisheries. Northern pike, walleyes, longnose and white suckers, flathead, chub and burbot have a broad habitat tolerance and relatively wide distribution, and they are,

therefore, probably more resistant to the effects of environmental disturbance. The piscivorous or fish-eating species, such as pike, char, inconnu and burbot, would be most susceptible to chemical contamination because many biological contaminants pass up the food chain and concentrate in such predator species.

*4. Pipeline construction and other activities should not be allowed at sensitive times near areas used by fish for spawning, rearing, overwintering and migration.*

*Spawning and rearing areas should be protected from siltation, gravel removal, fuel spills, and from changes in water temperature, water chemistry, and levels of dissolved oxygen.*

*During the winter, overwintering areas should be protected from any decrease in water level and now caused by construction or water intake. They should also be protected from excess siltation, chemical pollution, changes in water temperature and decreases in dissolved oxygen levels.*

*Migration routes and times should not be disrupted by any blockage or diversion of flow, lowering of water level, significant increases in suspended sediment, or spills of fuels or toxic chemicals.*

#### THE USE OF NUMERICAL STANDARDS

Much of the evidence I have heard suggests that it is not enough to state the principles of fish protection: it is often difficult to translate them into specific and workable measures. Numerical standards, it seems, are needed as a guide for all who are concerned with the design, review, construction and operation of the pipeline. However, Arctic Gas and, to a lesser extent, Foothills do not agree. They argued that a competent biologist should make site-specific decisions. I agree in principle with their argument, but I do not think it is practicable for a project of this size. Indeed, a protection program founded entirely on such individual judgments may result in unnecessary delays, and unwarranted confusion and, most important, may fail to protect the fish.

It requires a certain academic naïveté to believe that thousands of site-specific design and construction situations can be evaluated satisfactorily by competent biologists. The principle of numerical standards should, therefore, be vigorously promoted. Such standards will inform design engineers of the criteria they must meet; they will show construction personnel the permissible levels for environmental disruption; and they will indicate to operational personnel the operating specifications that must be followed.

I recognize that, in isolated situations, it may be impractical, and perhaps even harmful to the environment, to comply with the numerical standards. If the Company can demonstrate to the Agency that certain numerical standards should not be expected in a particular situation, the Agency may grant an exception. Nevertheless, the principle of numerical

standards should, I believe, provide the cornerstone of a sound fish protection program.

#### *Suspended Sediment*

The construction of the pipeline will cause increased siltation of waterbodies through the direct disruption of the waterbody, or through increased run-off from adjacent land areas. Although concentrations of suspended solids must be extremely high before they cause direct, short-term damage to fish, finely divided material may settle to the bottom and blanket out normal fish food organisms, or they may spoil spawning beds by decreasing the percolation of water through the substrate. If siltation damage to spawning beds or fish food occurs in only one year, recovery of the stream bed can be expected in successive seasons, and the overall damage to fish populations would probably not be great.

To predict the impact of suspended sediment on the aquatic ecosystem requires an awareness of the seasonal variation of sediment loads; what may be tolerable in spring, when natural sediment loads are high, may be unacceptable in the winter, when most northern rivers are relatively clear. Winter construction of a pipeline may, therefore, cause special suspended sediment problems in watercourses.

*5. The construction and operation practices of the Company shall be such as to minimize the release of silt into waterbodies frequented by fish. In areas that are important to fish and where silt loads from project activities can be expected to be significant, the Company shall institute silt control measures before construction activities start.*

*6. Specific standards shall be established by the Agency to measure the natural silt load in watercourses, and to set upper limits for increased silt loads. If silt loads exceed the upper limits, erosion and silt control measures shall be put in place, or existing ones shall be improved to ensure that the critical habitats and life stages of aquatic resources are protected.*

#### GUIDELINES FOR SUSPENDED SEDIMENT STANDARDS

In his final submission, Commission Counsel proposed a turbidity and macroinvertebrate standard for estimating the increase in finely-divided solids in waterbodies and for assessing the effects of any increase on bottom macroinvertebrates in a stream. These standards and the rationale behind them are given extensive treatment in the submission (Commission Counsel, 1976, – Fish Protection: Suspended Sediment Standards”). I endorse the standards proposed by Commission Counsel and I recommend that experts in the Agency and in the Company refer to that document to appreciate the approach I have adopted below. I must emphasize at the outset that these standards and methods of measurement need further refinement. In particular, they have yet to be tested under winter conditions in the North.

*7. The standards for suspended sediment should be tested by the Company and the Agency under field conditions in the*

*pipeline areas and should be refined so that acceptable and practicable suspended sediment criteria for monitoring the pipeline project can be developed. If other standards are considered, they should have the following characteristics. They should be quantitative and objective; they should be practical enough to be used and to be enforced in the kinds of conditions that will be encountered by the pipeline project; they should be routinely workable by a small staff that is not highly skilled in scientific sediment load assessment practices; and they should measure both short-term and long-term increases in sediment load.*

A standard that sets limits on changes in suspended sediment is necessary to prevent widespread or continued damage to aquatic life. Because it is fairly easy to determine in the field and because the results are known immediately, Commission Counsel recommended that a turbidity standard be adopted.

Before the turbidity standard can be implemented, the following problems may have to be resolved. First, results may vary across the width of a stream river, or from day to day because of wind on lakes. The standards are intended to apply at any point that is the recommended distance from operations. Secondly, the collection of samples will be difficult in winter; it will require well-designed equipment for penetrating the ice and retrieving samples. Finally, if turbidity exceeds the standards, it will be an indication that construction practice is not satisfactory. This situation will be difficult to correct quickly because of the lingering effects of the causes of siltation.

A macroinvertebrate standard assesses the biological effects of an increase in sediment. Because the status of the resident macroinvertebrate community reflects conditions over previous weeks or months, it serves as a continuing, cumulative monitor, and to a large extent it will reflect any problems that are not detected by the infrequent turbidity measurements. Since the diversity of the aquatic community also monitors environmental effects other than siltation, the Agency could use the biological evaluation as an overall check. In questionable cases, findings of the biological survey should take precedence over the physical and chemical surveys.

There are many ways of interpreting ecological data, and Commission Counsel recommended that the Shannon Diversity Index be used because we have experience with it and because it is sensitive, reliable and conducive to use by both professionals and laymen alike. However, two problems may be encountered when implementing the macroinvertebrate standard: it may be difficult to take samples of benthic invertebrates during periods of high discharge in rivers, and it may be difficult to separate benthic invertebrates into individual species.

*8. The frequency and locations for suspended sediment sampling in rivers, streams, lakes and ponds shall be as*

*defined by the Agency. The direction of the sampling site from the construction activity shall be that of maximum effect, depending upon currents and wind. A control sample shall be taken in an unaffected part of the same waterbody or, if that is not possible, in a similar, nearby waterbody.*

*Samples shall be taken frequently enough to provide adequate assessments of the amounts of finely-divided solids generated by construction both during the construction phase and immediately afterwards. In particular, turbidity shall be measured at the time of peak activity and during changing discharge.*

*9. Turbidity shall be measured in nephelometric turbidity units (NTU), using any reliable, commercially available meter. Procedure for measurement shall follow part 214A of Standard Methods for the Examination of Water and Wastewater, prepared by American Public Health Association et al.*

*10. The following standard should be used to determine allowable levels of finely-divided solids in water: at the specified distance from operations, turbidity of the water shall not average more than 27 times the natural level during any 8-hour period, or more than 9 times the natural level during any 96-hour period, or more than 3 times the natural level during any 30-day period. (For rationale see Commission Counsel, 1976, "Fish Protection: Suspended Sediment Standards.")*

*11. Benthic macroinvertebrate samples should be taken in stream riffles using a reliable quantitative device, such as the Surber sampler. The same apparatus shall be used to take both control samples and test samples, and because macroinvertebrate communities may vary seasonally, the samples shall be taken at the same time. The test and control sampling areas must be as similar as possible, particularly with regard to bottom type and velocity of water.*

*12. The following standard should be used to determine ecological damage: at the specified distance from operations, the Shannon Diversity Index for bottom-living aquatic macroinvertebrates shall not be changed more than 25 percent from the natural value as a result of the addition of finely-divided solids. (For rationale see Commission Counsel, 1976, "Fish Protection: Suspended Sediment Standards.")*

*13. The suspended sediment standards shall apply during construction activities, and for two years after they have ceased.*

*14. In the year that starts 12 months after completion of a construction activity, turbidity should not exceed one-half of the levels recommended above and diversity shall not be changed more than the 25 percent recommended above.*

### *Barriers to Fish*

During construction and operation of the pipeline, a variety of structures that could become barriers to the normal movement of fish will be placed in watercourses. There will be culverts beneath temporary and permanent roads, dykes and coffer-dams to divert river flows, and ice bridges, wharves and work pads at river crossing sites. These kinds of installations, which are a vital part of any construction program, could prevent or delay fish migrations by constricting the channel and thereby increasing the water velocity, by altering the river regime, or by physically obstructing the migration routes.

*15. Installations and activities in waters that are inhabited by fish shall avoid fish-sensitive areas, and shall be designed and scheduled to provide for uninterrupted movement and safe passage of fish. Any structure or stream channel change that may cause blockage to fish, or that may create velocity barriers to fish movements, shall be provided with a fish passage structure or facility approved by the Agency.*

*16. The Company shall submit to the Agency, for design review, complete plans for dredging, trenching, diversion structures, or road crossings of waterbodies. The plans shall include such matters as: schedules for activities; amounts of spoil material to be removed or placed; designs and methods of construction; data on present flow regime or bathymetry of the waterbody in which work will be done; data on the fish resources that are present in the waterbody at all times of the year; information on how flow regimes or bathymetry of the waterbody will be altered by construction; and an assessment of how the fish species that are present in the system will be affected.*

### DESIGN GUIDELINES: BARRIERS TO FISH

*17. On fish migration routes, bridges with large spans across watercourses shall be used, wherever practicable, instead of culverts.*

*18. Culverts in watercourses that contain fish shall be of such a size and gradient that the peak water velocity and minimum water depth will not inhibit the passage of migrating fish. The lower ends of culverts in stream beds will be so placed as to eliminate any drop. The applicable standards for fish passage requirements and culvert design shall be as outlined in Guidelines for the Protection of the Fish Resources of the Northwest Territories During Highway Construction and Operation by Dryden and Stein.*

*19. Subject to the approval of the Agency, designed fords may be used for temporary stream crossings.*

*20. Winter road ice bridges shall be removed from small watercourses before break-up.*

*21. Construction and use of temporary coffer-dams, berms and diversion dykes in any watercourse that is frequented by fish shall be done in stages or shall be time-staggered to ensure*

*that water velocity does not prevent fish passage. Abandoned water diversion structures shall be plugged and stabilized to avoid trapping or stranding fish.*

*22. If borrow material sites are approved adjacent to or in waterbodies, the Company shall provide levees, berms or other structures to protect fish and fish passage, and to prevent siltation of such waterbodies.*

*23. Water intakes shall be installed and screened in such a way that the intake will not harm fish. (See Water Withdrawals.)*

### *Underwater Blasting*

Some underwater blasting will be necessary in the course of pipeline work. Throughout the hearings, there was frequent comment, particularly in the communities, on the detrimental effects of underwater blasting on fish, muskrat and beaver. Although I am concerned here only with fish, my observations may also apply to aquatic mammals. (I discuss terrestrial blasting operations in the chapter on Terrain Considerations.)

The effects of blasting on fish include direct consequences from the blast, and siltation from the blasted material. Blasting affects the swimbladder, an organ present in most freshwater fish to aid in swimming: the shock waves rupture the bladder, often bursting blood vessels and damaging tissue organs near the bladder. Furthermore, it has been suggested that chemicals present in the water immediately after the explosion may also be detrimental to fish and could disrupt fish migrations.

Factors that determine the extent of damage to fish include water depth, distance from the blast, strength of charge and position, and type of bed. The most serious damage occurs close to a blast site, in gravel-bottom or rock-bottom streams. Silty or muddy stream beds absorb some of the shock waves that are generated by a blast, whereas hard stream beds reflect the shock. Detonations under ice are more damaging to fish than those in open water because ice tends to contain the shock waves.

Blasting could significantly reduce fish populations if it took place in breeding or overwintering areas at times of high fish concentrations. Simultaneous activity in a watercourse could increase the damage to fish populations because it would reduce the number of areas that fish could move to during a blasting operation.

*24. Blasting in waterbodies should be avoided near fish-sensitive areas. Where blasting must be carried out, every effort should be made to schedule the activity so that fish concentrations are avoided, especially at critical stages of their life cycle.*

*25. Blasting shall not be permitted in waterbodies within 1,000 feet of areas in which concentrations of fish eggs are present in the bed, fish are spawning in restricted areas, fish*

are overwintering in restricted areas, or fish are migrating in concentrated schools.

26. *Where a requirement for blasting in a waterbody is identified during design and planning, the Company shall submit to the Agency an application for permission to blast, together with the information needed to assess the potential impact on fish, and a statement of measures to protect the fish during blasting.*

*Where a requirement for blasting in a waterbody is identified during construction activities, the Company's blasting proposal, its potential impact, and fish protection measures shall be subject to approval by the Agency in the field.*

27. *Blasting shall be permitted in water that is frequented by fish only if effective measures are taken to protect the fish. Such measures could include adjusting the time of the blast, moving fish and keeping them out of the blast area by means of nets, using blast deflectors (sand bags) or absorbers (air curtains), using charges of minimum size, and detonating charges in sequence with sufficient delay between firings to permit dissipation of the shock wave.*

28. *Underwater blasting shall conform to the same siltation standards as other in-water pipeline activities. (See Fish: Suspended Sediment.)*

29. *Underwater blasting shall be prohibited within one mile of fishing sites that are being used by local people and local fishermen.*

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## Monitoring of the Aquatic Environment

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In the chapter on Wildlife, I stated that a monitoring program is essential to ensure both the maintenance of populations, and the effectiveness of any protective measures that may be adopted as part of a pipeline project. Monitoring of the aquatic environment is particularly important: the aquatic environment is less accessible to observation, and problems are often not evident until they reach intolerable levels. In some cases, postconstruction monitoring will be particularly important. The monitoring of siltation levels, for example, is probably more important after construction than at any other time. Such monitoring may be necessary for several years after construction ends.

30. *During the construction and operation of the pipeline the aquatic environment shall be monitored. The Agency, in cooperation with the government agencies responsible for ongoing fish protection, should develop the monitoring program and establish what the responsibilities of the Company will be before, during and after construction.*

I recognize that the development of a monitoring program will require a detailed knowledge of local conditions and

project activities. Although I cannot say what form such a program would take, I can suggest aspects of monitoring that may be necessary and appropriate. I have based my guidelines on those contained in Commission Counsel's final submission (Commission Counsel, 1976, "Fish Protection: Monitoring of Aquatic Environment").

### Monitoring Guidelines

31. *An aquatic environment monitoring program should be divided into three phases – preconstruction, construction and postconstruction – and should incorporate the following observations and factors:*

*Turbidity should be used to compare postconstruction levels of suspended sediment with preconstruction levels. During construction, turbidity levels downstream from construction should be compared with turbidity levels upstream.*

*Dissolved oxygen levels should be monitored to ensure adequate oxygen levels in water where fish resources are present. These levels, which are most critical in winter, should be measured in waters that may be disturbed by construction or operation of the project.*

*Water levels and flows should be monitored where and when water quantities are limited, to ensure that adequate quantities are maintained for fish*

*Nutrient levels should be monitored in waste disposal areas to prevent overenrichment of fish habitat or high biological oxygen demand.*

*Fish and bottom sediment contaminant levels should be monitored as a baseline measure that will warn of any contamination of a fishery resource.*

*Water temperature should be monitored to ensure that tolerable limits for aquatic resources are maintained, and that water temperature is low enough to maintain adequate oxygen levels.*

*Gravel removal sites should be inspected before, during and after construction to determine the suitability of the site for removal of material, and to assess conformity with extraction plans, adequacy of restoration of site, and return of site to a stable state.*

*Chemical water quality parameters should be monitored in locations where pipeline-related activity might create chemical changes in water quality that could adversely affect fish.*

*Water velocities through culverts and some diversion structures should be monitored to ensure that velocities do not exceed the capabilities of fish migrating upstream.*

*Use of explosives in water should be checked visually to ensure that local fish populations are not affected by shock waves from blasts.*

*Pipeline crossing site inspections should involve visual*

checks to ensure that erosion control devices are working, and that disturbed areas do return to a stable state.

In addition to general monitoring, a few comprehensive studies may be necessary in certain aquatic environments that are sensitive to environmental disruption, or to the extensive use of resources by man. For example, it may be necessary to establish parameters such as benthos productivity and diversity, and the population dynamics of a domestic fishery resource, and to monitor the abundance of rare species.

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## Fisheries Management

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### *Man's Use of Fish*

In the North, the domestic, commercial and sport fisheries overlap in some areas as each fishery competes for the same species. This overlap will probably increase in the future.

The government's management programs are, for the most part, directed towards the benefit of native people. Accordingly, the harvesting of fish for, domestic purposes has precedence over commercial or sport fishery development.

The domestic fishery is traditionally an important source of protein in the Mackenzie Valley and Mackenzie Delta. Native people depend on fish for part of their dietary requirements, and as food for their dogs. The domestic fishery has declined somewhat since the snowmobile replaced dogs in many areas, but the catch is still important as a supplement to other wildlife sources of food.

Since its start in 1945 on Great Slave Lake, commercial fishing has continued uninterrupted in the Mackenzie drainage. Whitefish is the most important species harvested. At the present time the only other commercial operation outside the southern lakes of the system is a small, experimental commercial fishery on the East Channel of the Mackenzie Delta.

Sport fishery for arctic grayling throughout the Mackenzie drainage, and for char and lake trout in the Mackenzie Delta, represents a great tourist potential.

### *Fisheries and the Pipeline Project*

Pipeline construction will make accessible many domestic, commercial and sport fishing locations that were previously isolated. Access will be provided by new roads, the location of construction and operating personnel in remote areas, and an increase in air and water traffic along the route. The increase in sport and commercial fishing activity could affect the ongoing domestic harvest. River traffic, fishing by construction personnel, spills, the location of facilities such as stockpile sites and wharf sites, and the general consequences of constructing the project on fish biology will all have a significant effect on fishing activities.

As I explained earlier, northern fish populations have a

limited capacity to recover from unnatural losses. If fishing by pipeline personnel is not regulated, short-term reductions in fish populations along the route may occur. Long-term reductions could result if permanent access routes are opened up, and if fishing is not adequately controlled.

*32. Construction and operation of the pipeline and associated activities shall not interfere with ongoing domestic, commercial or sport fishing activities of the region. Pipeline activities shall not disturb fishing areas or cause changes to water, with the result that fish avoid certain fishing areas. Protection shall be afforded first and foremost to domestic fishing activities and domestic fish resources.*

*33. Unless otherwise approved by the Agency, pipeline-related facilities and activities shall be located at least 1,000 yards from any existing, well-defined domestic, sport or commercial fishery. Where pipeline activities or facilities are within one mile of such a site, the Company shall provide the local people with a description of its planned activities in the area. Any modifications requested by the local people shall be worked out in consultation with representatives from the local people, the Company, and the Agency.*

*34. Where local people and government authorities agree that project access roads are beneficial to local fisheries, they should be left intact when pipeline construction is completed. All other project access shall be blocked and the disturbed areas shall be restored when pipeline use of the access route has ended.*

Throughout the Inquiry, biologists told me that there are insufficient data on fish, particularly the domestic fishery, to develop a comprehensive management program. In my opinion, both the proponent of a major frontier development and the government have an obligation to ensure the continuation of fisheries in the region. The pipeline company has an obligation to show that it has properly researched the impacts of its project on resource harvesting activities.

In order to draw up workable and detailed plans for protecting fishing activities during pipeline construction, specific information is necessary.

*35. To plan for the protection of fisheries, the Company, in cooperation with all agencies responsible for fisheries management and the native organizations, shall compile a catalogue of fishing areas and fishing activities along the route. (See Renewable Resources.) This catalogue should provide a complete listing of all fish species caught in the domestic, commercial and sport fisheries, as well as information on the numbers of fish caught, the time of year and location of catches, the fishing methods used, an approximate estimate of catch per unit of fishing effort, the way fish are used after being caught, and the numbers of people involved in each fishery and the locations of fishing camps.*

*36. Before pipeline activity begins, the Agency shall establish regulations to control the level of fishing activity by Company*

*personnel during construction, and shall develop programs to monitor changes in fishing activity that result directly or indirectly from the pipeline project.*

*37. During the pipeline construction period, no sport fishing shall be permitted from pipeline structures or within the pipeline right-of-way. Personnel engaged in pipeline construction, operation or maintenance shall not fish within 1,000 yards of any*

*domestic or commercial fishery, or any area, such as a well-defined fish overwintering region, that is vulnerable to overfishing. Maps and descriptions of prohibited areas shall be posted in pipeline camps, and explained to personnel in worker-orientation programs.*

*38. The Company shall ensure that all fishery regulations are observed by all persons working on the pipeline project.*

# 10 Northern Conservation Areas

## A Northern Conservation Strategy

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With the rejection of the Arctic Gas pipeline proposal, there is now an opportunity to plan for land use in the Mackenzie Valley and the Western Arctic without the pressure of imminent, large-scale industrial development. This opportunity should not be lost. Clearly, comprehensive land use planning can only emerge from a negotiated settlement of native claims - indeed, a settlement of native claims is the keystone of land use planning in the North. At the same time, significant natural and cultural resources can be protected by conserving areas of various types. And areas can be conserved in a manner that does not prejudice native claims. In fact, as I explain below, some withdrawals of land may be necessary if claims are not to be prejudiced by industrial development.

Conservation areas should not be selected only from those lands that are of no value to industry. Conservation is itself an important land use and areas should be identified and set aside while the options are still open. In Volume One, I recommended the establishment of a number of conservation areas, including a wilderness park in the Northern Yukon, a whale sanctuary in west Mackenzie Bay and bird sanctuaries in the Mackenzie Delta and the Mackenzie Valley. Planning for these and other conservation areas can and should proceed now.

In the last century, at a time when western lands were wholly under federal jurisdiction, the Government of Canada established the great national parks in the Rocky Mountains. An act to establish Banff National Park was passed by the House of Commons in 1887, during the administration of Sir John A. Macdonald. In the North today, we have the same opportunity to set aside conservation areas in perpetuity.

The possibility of an energy corridor across the Northern Yukon and along the Mackenzie Valley has focused attention on this region and I have recommended that specific areas be set aside to protect the Porcupine caribou herd, the white whales of the Beaufort Sea, migratory waterfowl and raptors.

While I attach great importance to these specific recommendations, I am anxious that there should be adequate planning for all northern conservation areas before proposals for new large-scale frontier projects are advanced.

Evidence presented to the Inquiry indicates the need for a northern conservation strategy – a strategy that recognizes the claims of northern native people, as well as the constitutional situation in the North and the special characteristics of the northern environment. Such a strategy would include not only the setting aside of land and water for scenic, scientific and recreational purposes, but the protection of critical habitat for fish and wildlife, which are essential to the welfare of native people of the North.

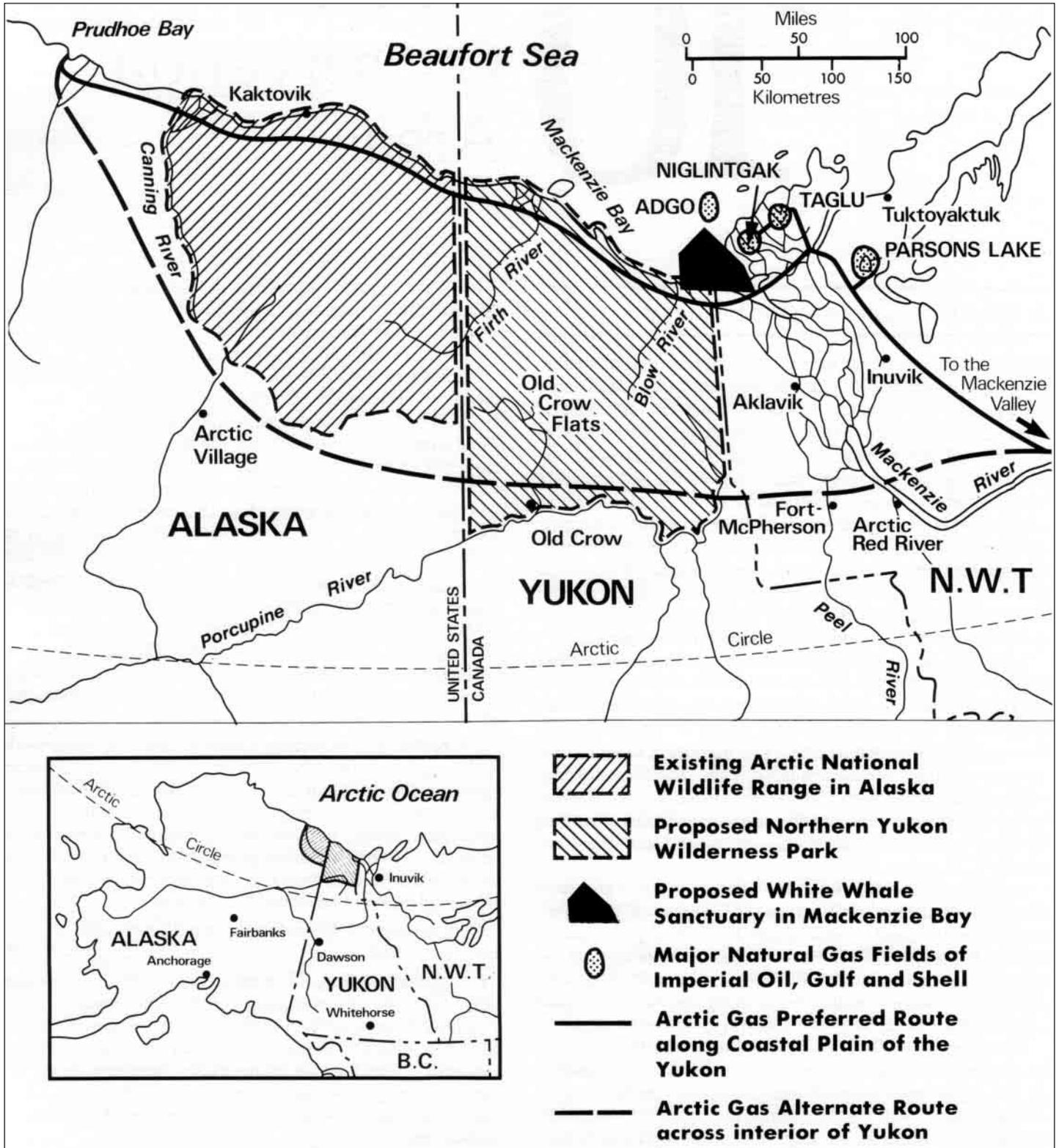
*1. As part of comprehensive planning in Canada's North, the federal government should develop a northern conservation strategy to protect areas of natural or cultural significance. This strategy should comprise inventories of natural and cultural resources, identification of unique and representative areas, and withdrawal and protection of such areas under appropriate legislation.*

*2. A northern conservation strategy should be implemented by distinguishing the different types of conservation areas and matching the degree of protection to the nature and importance of the resource. Such conservation areas may include wilderness parks, notional parks, national marine parks, national landmarks, wildlife areas, wild rivers, historic water routes, historic land trails, ecological reserves, recreation areas, and archaeological and historic sites.*

*3. There should be full consultation with native people before lands are withdrawn for any conservation area in the North.*

*4. As far as possible, the pipeline route shall avoid all areas identified as having natural or cultural significance whether they have been formally withdrawn or not. Where such areas cannot be avoided, the Company shall prepare, for Agency approval, plans for special protection measures to be used during construction, operation and abandonment of the pipeline so that the natural or cultural values of the areas are maintained.*

Major Environmental Recommendations (Volume One)



## Proposals Made by the United States in Alaska

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Since Volume One was released in May of this year, the Government of the United States has made certain proposals for the conservation of lands in Alaska. These proposals give an enhanced timeliness both to the recommendations I made in Volume One for the establishment of conservation areas such as a wilderness park in the Northern Yukon, and to the recommendations I make in this chapter.

In September 1977, the Carter Administration proposed amendments to Bill H.R.39, called the Alaska National Interest Lands Conservation Act. Those amendments call for some 90 million acres in Alaska to be set aside as conservation lands. This is in addition to the nearly 30 million acres in Alaska that are already dedicated as national parks and wildlife refuges. The President's proposals include designating 2.5 million acres as wild rivers, 45 million acres as new wildlife refuges or expansions to existing wildlife refuges, and 42 million acres as new national parks or expansions to existing national parks. The area to be devoted to conservation lands in Alaska will total 120 million acres – almost one third of the entire state.

In the United States, wilderness is a designation overlaid or superimposed upon those existing conservation areas, such as national parks, wildlife refuges and national forests, that qualify under the Wilderness Act. The Carter Administration has recommended that 43 million acres of existing and proposed conservation lands in Alaska be designated immediately as wilderness. This includes the Arctic National Wildlife Range, which lies entirely in Alaska. The Administration also proposed a non-wilderness addition to the Range that would double its size to about 17 million acres. The proposed Yukon Flats National Wildlife Refuge (in Alaska) some 8.5 million acres – would be contiguous with the Range on the south. One hundred miles of the Porcupine River west and downstream from the Yukon-Alaska border is also proposed for inclusion in the Wild and Scenic River System.

I cite the United States' initiative in Alaska to illustrate the appropriate dimensions, timeliness and feasibility of a wilderness park in the Northern Yukon and of a broadly based conservation and land reserve program in the Canadian North. In Volume One, I proposed that we should not only establish a wilderness park in the Northern Yukon, but that we should seek to establish an International Wilderness Park, comprising the Northern Yukon and the contiguous area of northeastern Alaska, that is, the Arctic National Wildlife Range. Given the United States' proposal to designate the Arctic National Wildlife Range as wilderness, the establishment of an international park lies within our reach.

## Wilderness Protection

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Wilderness is a non-renewable resource. If we are to preserve wilderness areas in the Canadian North, we must do so now: the areas available will diminish with each new industrial development on the frontier. Wilderness areas, if they are to be preserved, must be withdrawn from any form of industrial development. That principle must not be compromised.

I have already stated in Volume One the case for the establishment of a wilderness park in the Northern Yukon a case based upon the most authoritative and exhaustive examination of environmental protection in any region of Canada. But the wilderness does not stop at the boundary between Alaska and the Yukon. In fact, the calving grounds of the Porcupine caribou herd extend well into Alaska, along the coastal plain as far as Camden Bay, 100 miles to the west of the international boundary; the area of concentrated use by staging snow geese and by nesting and moulting waterfowl also extends far into Alaska. So we must cooperate with the Government of the United States. That is why I urged in Volume One:

If a decision should be made in favour of a pipeline along the Alaska Highway Route, or over any other southerly route across the Yukon Territory, I recommend that any agreement in this regard between Canada and the United States should include provisions to protect the Porcupine caribou herd and the wilderness of the Northern Yukon and Northeastern Alaska. By this agreement, Canada should undertake to establish a wilderness park in the Northern Yukon and the United States should agree to accord wilderness status to its Arctic National Wildlife Range, thus creating a unique international wilderness park in the Arctic. It would be an important symbol of the dedication of our two countries to environmental as well as industrial goals. [p. 50]

An agreement has been reached between our two countries to build a pipeline along the Alaska Highway Route. Now we should work toward an agreement for the establishment of an international wilderness park.

It may be said that means already exist to protect wilderness areas such as the Northern Yukon under the National Parks Act and under the Canada Wildlife Act. Without doubt, these statutes are useful, but they have weaknesses that could undermine the wilderness concept. Under the National Parks Act, permission, leases and permits may be granted for a wide range of activities, many of which are incompatible with the wilderness concept and wilderness values. Within national parks, the area used for intensive visitor activities is normally quite small and most of the park area is reserved in its natural state. But zoning of national park lands can be changed without consulting Parliament.

A cooperative wildlife sanctuary established under the Canada Wildlife Act would also have fundamental limitations with regard to protection of the wilderness. The Act does not

provide for exclusion of development. At the discretion of the Minister, permits for various industrial activities may be granted. Furthermore, no conditions attached to a permit could protect the wilderness values of a wildlife sanctuary – the Canada Wildlife Act was never intended for that.

Wilderness and wilderness values are too important to be offered anything less than the protection that only Parliament can confer or withdraw. Our present legislation is not adequate, so our National Parks Act should be amended to provide for a new statutory creation: the wilderness park.

Wilderness protection should be granted to the whale sanctuary in west Mackenzie Bay that I proposed in Volume One. Like the Porcupine caribou herd, the white whales of the Beaufort Sea are an international resource, and the establishment of a whale sanctuary in which development is excluded is the only means to protect the population that calves in Mackenzie Bay. In Volume One, I discussed this proposal at length and I found it possible to limit the boundaries of the proposed sanctuary to waters where no discoveries of gas or oil have yet been made. Thus, if present trends continue, a whale sanctuary can be set aside, and oil and gas activity can be forbidden there without impairing industry's ability to tap the principal sources of petroleum in the Mackenzie Delta and beneath the Beaufort Sea.

The wilderness concept has the potential for wider application in the North; other, as yet undisturbed, areas may also merit such strong legislative protection from the activities of industrial man. The identification and protection of other wilderness areas should be a significant component of the northern conservation strategy that I have recommended.

*5. Lands for the wilderness park in the Northern Yukon should be withdrawn immediately under section 19(c) of the Territorial Lands Act and accorded strict legislative protection through an appropriate amendment to the National Parks Act. Agreement should be sought with the United States regarding the establishment of an international wilderness park in the Northern Yukon and northeastern Alaska.*

*6. Wilderness protection should be afforded the area of west Mackenzie Bay that I proposed be set aside to protect the calving grounds of the white whales.*

*7. In the future, wilderness protection should be provided for appropriate conservation lands in the North, following consultation in this regard with northern governments and northern peoples.*

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## National Parks

National parks are intended to protect areas that are representative of a broad natural region, including geological, physiographical, geographical, oceanographical and biological features.

Parks Canada has identified 39 terrestrial and nine marine natural regions across Canada and the long-range goal is to identify and protect in national parks at least one area within each of these natural regions. In a policy statement issued in 1972 under the authority of the then Minister, Jean Chrétien, the Department of Indian Affairs and Northern Development said: "At least 30 more National Parks are needed [across Canada] to preserve that which is best in our natural environment" (Byways and Special Places, p. 44). The extension of the national parks system to the North should be an essential part of a northern conservation strategy.

Pre-emption by industrial development is a very real threat and may prove an almost insurmountable impediment. It may mean that only smaller or second best areas will be available for park purposes. And it may mean years of effort and negotiation before agreement can be reached. Such land use conflicts have already been encountered in the North: with mining interests in negotiations for Kluane National Park in the Yukon and with hydro-electric development in negotiations for Nahanni National Park, Northwest Territories.

National parks have a valuable role to play in preserving representative natural areas. Some of the natural regions in the North are now represented in three existing national parks – Kluane, Nahanni and Auyuittuq – and other natural areas of Canadian significance are being studied,

*8. As part of a northern conservation strategy, national parks should be established so that each of the major terrestrial and marine natural regions of the North is represented and protected in Canada's system of national parks.*

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## Other Conservation Areas

### *National Heritage Areas*

Parks Canada has a mandate to establish types of conservation lands other than national parks. In 1972, Jean Chrétien announced the Byways and Special Places Program, which set out new initiatives to preserve our national heritage. Particularly relevant to the Mackenzie Valley and Western Arctic were proposals for national landmarks, wild rivers, historic waterways and historic land trails. Although considerable planning has taken place, no conservation areas of these types have been established that were not in existence

prior to 1972. The Mackenzie Valley and the Western Arctic offer many possibilities for implementing these new initiatives.

National landmarks are intended to protect small, unique natural features. After ten years of deliberation and negotiations, it appears that Canada's first national landmark may be established among the pingos east of the Mackenzie Delta on the Tuktoyaktuk Peninsula. Other unique natural sites should be given appropriate protection as soon as possible before land use conflicts arise.

Parks Canada has made a preliminary survey of 65 wild rivers across Canada, including 22 in the Yukon and Northwest Territories. It is unfortunate, in my view, that this inventory has not been used as a basis for creating a system of protected wild rivers in Canada, similar to the United States National Wild and Scenic Rivers System. Certain proposed national parks may contain outstanding rivers, but in the absence of specific means of protection, important natural waterways may be altered or obstructed without due consideration of their value. The best opportunity to set aside unspoiled rivers in Canada today is in the North.

### *Conservation Areas of International Importance*

Canada is a participant in major cooperative programs – the International Biological Programme (IBP) and its successor, the Man and the Biosphere (MAB) Program – to preserve genetic and biological resources and to study man's relationship to his environment, including measuring the impact of major development projects. Basic to these programs is the establishment of natural conservation areas that can serve both to protect important ecological features and as permanent outdoor laboratories for baseline and comparative studies. For example, under the IBP, which terminated in 1974, a large number of candidate ecological reserves were identified in the Mackenzie Valley and Western Arctic. In 1975, the Minister of Indian Affairs and Northern Development gave his support in principle to the concept of ecological sites in the North, but no sites have yet been established. Action to protect areas identified by the IBP and the MAB Program should be an essential part of a northern conservation strategy.

### *Wildlife Areas*

Provisions for wildlife protection and wildlife sanctuaries are vital to any comprehensive conservation strategy in the North. The idea of sanctuaries is not new: Constance Hunt, in "The Development and Decline of Northern Conservation Reserves," traces the history of the public reserve system and game regulations in the Northwest Territories since 1877.

Today, formerly inaccessible wildlife populations and critical habitat are subject to disturbance and are threatened by the advance of a wide range of frontier developments. The Environmental-Social Program's Wildlife Habitat Inventory

and the Biological Report Series prepared for Arctic Gas provide a new foundation on which to build; and there is new legislation, the Canada Wildlife Act. This Act reflects new knowledge about the sensitivity of wildlife to disturbance and the critical role of habitat and life stages. It offers the protection that I said must be afforded the bird sanctuaries I recommended be established in the Mackenzie Delta and Mackenzie Valley. That is, the Canadian Wildlife Service, through the Canada Wildlife Act, can control activities even when the birds are absent, so that the habitat, not just the birds, is protected. Let me add that withdrawal under this legislation will not result in the exclusion of exploration and development; rather, the Act controls activities so that they are compatible with wildlife protection.

Many of the populations of birds and wildlife in the North are international in range. The Canadian Wildlife Service has the mandate and the means under the Migratory Birds Convention Act and the Canada Wildlife Act to fulfil its national and international responsibilities. The Yukon and Northwest Territories are also responsible for preserving game under Territorial Ordinances.

As part of a northern conservation strategy the federal and territorial governments should identify and set aside wildlife conservation areas.

### *Recreation Areas*

Outdoor recreation by local people and tourists is an essential ingredient of northern life, and one that will increase substantially in the future. Development activities in general will assuredly lead to a sharp increase in outdoor recreation in the Mackenzie Valley. With increased access, a growing population and a wider knowledge of the region, will come a need for recreational facilities, such as roadside parks and camping areas. These recreation lands should be identified now before the choice becomes further limited.

### *Archaeological, Cultural and Historic Sites*

A strategy for northern conservation should also include historical, cultural and archaeological sites. Places of cultural significance to the native people are being identified in their claims and, through a negotiated settlement, such places can be protected. It is important, nonetheless, that Parks Canada's program for commemorating persons, places and events of national historic significance should give greater recognition to native history.

## Native Claims Aspects

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To what extent will a northern conservation strategy bear on native claims? I dealt with this question in Volume One in relation to the proposal to dedicate the Northern Yukon as a wilderness park. I said that such action would not prejudice native claims because preservation of the wilderness and of the caribou herd is plainly in keeping with the desires of the native people. The rights that the native people would enjoy throughout the area covered by the park would have to be negotiated between themselves and the Government of Canada as part of a comprehensive settlement of native claims. These rights would include a core of essential conditions such as hunting, trapping and fishing rights within the park. The people of Old Crow, who live within the boundaries of the proposed park, have already announced their support for the park. So what will the strategy mean elsewhere as far as native claims are concerned?

I do not think withdrawal of conservation lands will prejudice native claims. It is not the withdrawal of conservation lands but rather the activities on these lands under existing or future permits, that prejudices native claims. Withdrawal would protect these lands from incompatible exploratory and industrial activities until a settlement of native claims is reached. The government cannot have a double standard; it cannot refuse to withdraw lands on the grounds that that would prejudice claims, while at the same time grant land use and exploration permits and allow consuming uses of land – alienations that clearly prejudice not only the claims of the native people, but the interest of all Canadians in the preservation of northern lands.

The national parks already established in the North were withdrawn under Section 19 of the Territorial Lands Act, and were later established as reserves for national parks pending the settlement of native claims. They are also subject to native hunting, trapping and fishing rights. This is clearly spelled out in Section 11 of the National Parks Act.

Native people must be guaranteed their hunting, fishing and trapping rights in all conservation lands in the North. As I said, the full extent of their rights to the lands in question must be negotiated between the Government of Canada and the native people; but I go further. I think a northern conservation strategy offers an opportunity to involve native people in the whole conservation lands program in the North.

This involvement should be formalized through a claims settlement, but there is an opportunity for immediate involvement in fish and game management, in compiling inventories of environmental and recreational resources, and in management of wilderness parks, and wildlife and other conservation areas. This would offer native people employment, training in skills that are relevant to the preservation of their northern homeland, and in a livelihood that would allow them to remain in their own communities and regions. There is no reason why management of northern conservation areas by native people should not be an objective of the Parks Canada Program and other conservation lands programs.

*9. When government withdraws conservation lands, it should formally guarantee to the native people that such withdrawals will not prejudice their claims and that no final disposition of these lands will be made until there is a settlement of claims.*

*10. Government agencies that have mandates relative to conservation lands must offer guarantees of traditional hunting, trapping and fishing rights within conservation areas.*

*11. A principal objective of claims negotiations should be the development of joint programs between the Government of Canada and native people for the management of conservation lands and of renewable resources.*

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## Conclusion

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In this chapter, I have urged that the federal government adopt a northern conservation strategy. In so doing, I am simply pulling together federal policy in a number of areas. The policy I have enunciated is not my policy: it is the Government of Canada's policy – and it is opportune to implement that policy in the Mackenzie Valley and the Western Arctic now, before new proposals for industrial development on the frontier come once more to the fore. A northern conservation strategy will not prejudice a settlement of native claims; rather it can, for the reasons I have given, enhance it.

Finally, although a range of proposals are made in this chapter, the area of land they encompass is small when measured against the vastness of the Canadian North, or even when it is measured against comparable proposals made by the Carter Administration for Alaska.