Federal Environmental Assessment and Review Process

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Federal Environmental
Assessment Review Office

Alaska Highway Gas Pipeline

Technical Hearings
(June 7-12, 1982)

Final Report of
the Environmental
Assessment Panel

Canada

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Federal Environmental Assessment
Review Office
13th Floor, Fontaine Building
Hull, Quebec K1A OH3

The Honourable John Roberts, P.C., M.P.
Minister of the Environment
Ottawa, Ontario
K1A OH3

Dear Minister:

In accordance with the Federal Enviromental Assessment and Review Process, the Environmental Assessment Panel on the Alaska Highway Gas Pipeline Project has concluded its review of the proposal by Foothills Pipe Lines (South Yukon) Limited to construct the Yukon section of a large-diameter gas pipeline from the Alaska north slope to the lower 48 states of the U.S.A. Recently the project sponsors announced a two-year delay in the project, with a new start-up date in late 1989.

The Panel convened technical hearings in Whitehorse in June to receive briefs and comments on Foothills' technical documents constituting 1982 addenda to an Environmental Impact Statement reviewed in 1979. After a thorough examination of the information presented at the hearings, the Panel has concluded that the preliminary environmental planning on the project is generally adequate. The Panel's report however, contains recommendations on several specific concerns. The Panel suggests that the additional two-year delay in the project now offers a more satisfactory time frame in which to address the recommendations contained in this report. Most of these recommendations are directed to the Northern Pipeline Agency which has the primary responsibility for project regulation and surveillance.

Yours sincerely,

Raymond M. Robinson
Chairman
Alaska Highway Gas Pipeline Project
Enviromental Assessment Panel

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EXECUTIVE SUMMARY

The Alaska Highway Gas Pipeline Environmental Assessment Panel has reviewed the technical submissions of Foothills Pipe Lines (South Yukon) Limited to plan, construct and operate a large-diameter, buried, gas transmission pipeline and ancillary structures in southern Yukon. The pipeline would be part of a larger system carrying natural gas from Alaska to the lower 48 states. The proposed route in Yukon is 818 km long, reaching from Beaver Creek in the west to Watson Lake in the east. On May 30, 1982 the project sponsors announced a two-year delay in the project with operations scheduled to begin in late 1989.

Foothills provided technical documents in March, 1982 as addenda to an Environmental Impact Statement (EIS) which was reviewed in 1979. This information was transmitted through the Northern Pipeline Agency and served as the body of information for the Panel's review of the project.

The Panel received written briefs on the Foothills submissions from the public and from technical reviewers. In June, 1982 the Panel held technical hearings at Whitehorse, Yukon and thereby received further information and comment. After careful review the Panel arrived at its conclusions and made several recommendations which are given in this report.

The Panel has concluded that the preliminary environmental planning on the project is adequate. Foothills, the Northern Pipeline Agency and government review agencies now have a good grasp of the main physical and biological problems and the options for solutions to those problems. However, there are several recommendations aimed at mitigation of potential negative impacts.

In general, the geotechnical difficulties associated with frost heave and thaw settlement are better understood than at the time of the 1979 review and design options have been developed which may overcome the problems. This applies to hydrology and revegetation issues as well. There remain a number of unresolved difficulties which will require full attention by Foothills and the Northern Pipeline Agency.

On the three remaining pipeline route alternative questions, the Panel agrees with Foothills preferred solutions. The problems which do exist are solvable given good engineering practice and diligence in environmental impact mitigation during construction. A fourth routing question, the Ibex/Whitehorse route, was reviewed in the spring of 1981 and was the subject of a panel report issued in August, 198 1.

Fisheries and wildlife resource values can be protected following measures recommended by Foothills and government review agencies, including scheduling of construction operations and the use of appropriate construction techniques.

The potential detrimental effects of the location of pipeline facilities (compressors, construction camps, storage yards, and borrow pit) can be mitigated with sufficient lead time for planning.

Problems of handling fuels and hazardous materials and the disposal of project wastes can be solved with proper foresight and good planning.

Other issues are noise impacts, aesthetic considerations, and the avoidance of disturbance to campground and recreation areas, for which Foothills has shown an adequate understanding to achieve the necessary impact mitigation. The Panel is confident that good planning and regulation will form the basis for environmentally acceptable construction measures and pipeline operation.

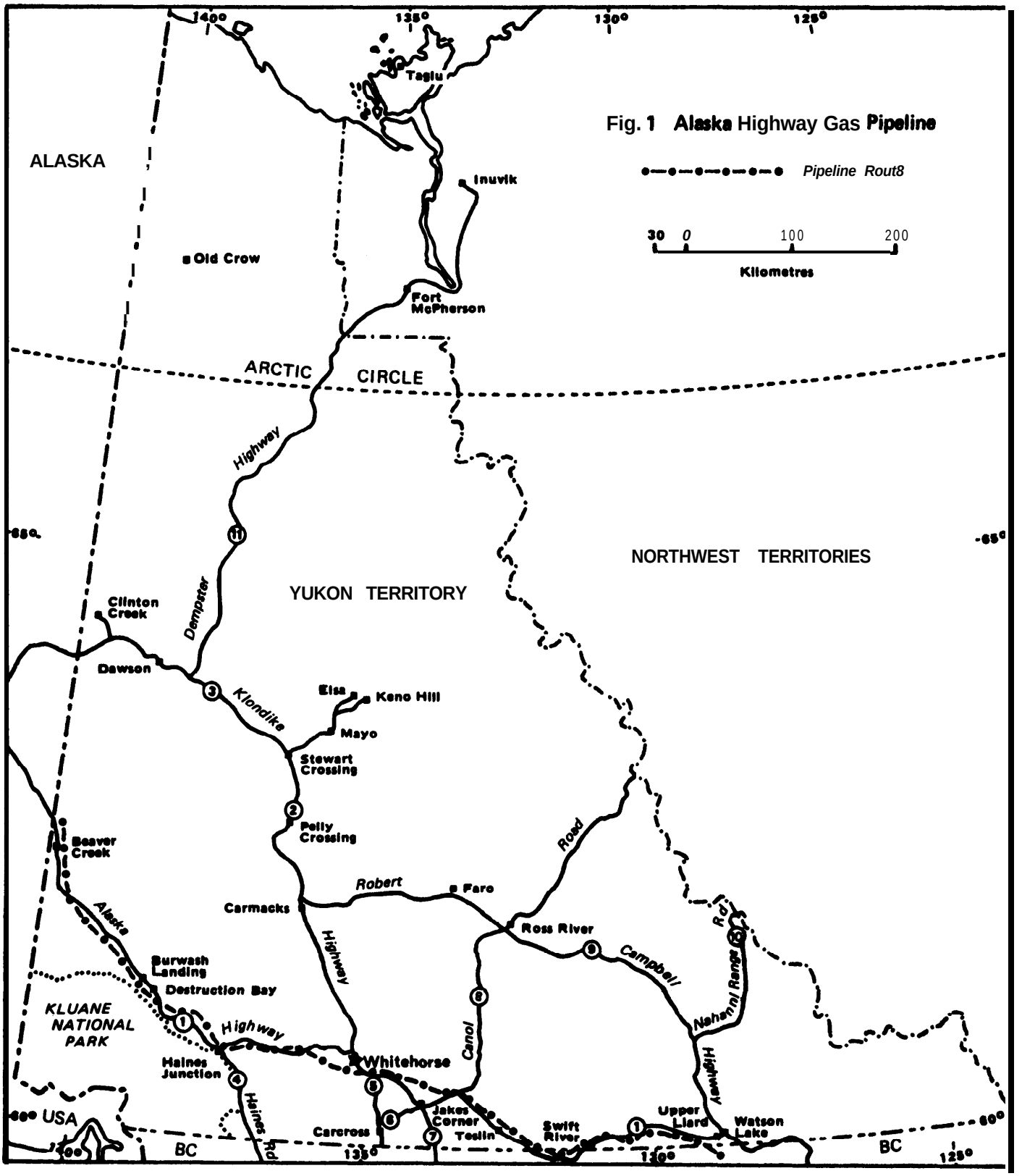


Fig. 1 Alaska Highway Gas Pipeline
Pipeline Rout8
30 0 100 200
Kilometres
ALASKA
Taglu
Inuvik
Old Crow
Fort McPherson
ARCTIC CIRCLE
NORTHWEST TERRITORIES
YUKON TERRITORY
Clinton Creek
Dempster Highway
Dawson
Klondike
Elsa
Keno Hill
Mayo
Stewart Crossing
Silver Trail
Beaver Creek
Alaska Highway
Robert Campbell Highway
Faro
Carmacks
Ross River
Campbell Road
Nahanni Range Rd
Burwash Landing
Destruction Bay
KLUANE NATIONAL PARK
Haines Junction
Haines Rd
Whitehorse
Canol Road
Jakes Corner
Teslin
Swift River
Upper Liard
Watson Lake
Cassiar
USA
BC
BC

1. INTRODUCTION

This report conveys the conclusions and recommendations of the Environmental Assessment Panel following the review of additional information required by the Panel and submitted by Foothills Pipe Lines (South Yukon) Limited as addenda to the 1979 Environmental Impact Statement for the Alaska Highway Gas Pipeline.

THE PROJECT PROPOSAL

The Yukon section of the Alaska Highway Gas Pipeline Project is a proposal by Foothills Pipe Lines (South Yukon) Limited. It involves the construction of a large-diameter, buried, gas transmission pipeline and ancillary structures in southern Yukon. The pipeline is a part of a larger system intended to carry natural gas from Alaska to the lower 48 States. The Canadian portion of the system would pass through Yukon, British Columbia, Alberta and Saskatchewan. The proposed route in Yukon is approximately 818 km long and parallels the Alaska Highway from Beaver Creek (Yukon-Alaska border) in the north, to Watson Lake (Yukon-British Columbia border) in the south (Figure 1).

Major departures from the Alaska Highway were proposed for the Kluane Lake area, the Ibex Pass near Whitehorse, the Marsh Lake—Squanga area and in the Swift River-Rancheria River Valley Region. From the Alaska border to approximately Whitehorse (375 km), the pipe will have an outside diameter of 1219 mm (48 inches). For the remainder of the route, the pipe will have an outside diameter of 1422 mm (56 inches) to eventually accommodate a planned tie-in with a proposed gas pipeline from the Mackenzie Delta (the "Dempster Lateral Pipeline").

From Alaska the gas will enter the Yukon and move 215 km at temperatures below 0°C to the second Yukon compressor station which is on the west side of Kluane Lake. Current plans call for the gas temperature to rise and remain above 0°C downstream from this compressor station.

On August 30, 1976, Foothills Pipe Lines (Yukon) Limited applied to the National Energy Board for a Certificate of Public Convenience and Necessity to construct the pipeline system as described. The Board studied the application and the route as well as the proposed Mackenzie Valley Pipeline routes and issued its report on July 4, 1977. It approved the Foothills proposal conditional upon the filing of an application by July 1, 1979 for a Dempster Lateral Pipeline to transport Mackenzie Delta gas to the Alaska Highway Gas Pipeline, connecting near Whitehorse.

Also on August 30, 1976, Foothills Pipe Lines (Yukon) Limited applied to the Minister of Indian Affairs and Northern Development for a grant of interests in lands in Yukon for a right-of-way on which to build the proposed Alaska Highway Gas Pipeline.

THE ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS

The Yukon portion of the proposed route passes through federal lands which, under the Territorial Lands Act, are administered by the Minister of Indian Affairs and Northern Development. Because the project requires the granting of a right-of-way through federally administered lands, and because there is potential for significant environmental impact, the project was referred to the Minister of the Environment by the Minister of Indian Affairs and Northern Development on March 2 1, 1977 for review under the Environmental Assessment and Review Process. An Environmental Assessment Panel was then established under the chairmanship of Dr. H.M. Hill.

Because of major decisions facing government on competing pipeline proposals in the fall of 1977, the Panel was not able to undertake a normal review of the environmental implications of the project at that time. Instead, the Panel reviewed existing data, sought public and professional opinion through hearings held in Yukon, and then submitted an interim Report on July 27, 1977. It was understood that, if the Alaska Highway Gas Pipeline Project was still a contender after decisions on competing proposals were made, the formal environmental assessment and review procedure would apply.

In its Interim Report, the Panel concluded that "the proposed pipeline can be constructed and operated in an environmentally acceptable manner" subject to certain specified conditions related to environmental planning, routing around sensitive areas, and development of mitigative measures to solve environmental problems associated with ice-rich permafrost. It was noted that an elevated mode, which was not addressed at the hearings, might provide an alternative to burying a pipeline in ice-rich permafrost areas. Furthermore, the Panel recommended that an Environmental Impact Statement (EIS) for the proposed Yukon pipeline route be completed based upon guidelines to be issued by the Panel.

In September, 1977, the Governments of Canada and the United States of America decided to proceed with the project. Following this decision by government to authorize construction of the pipeline, the Panel issued Guidelines for the Preparation of an Environmental Impact Statement to Foothills in December, 1977. The Guidelines specified that the organization, content and completeness of the EIS are the responsibility of Foothills. Furthermore, in preparing the EIS, Foothills was required to take into consideration the information deficiencies Identified during the hearings and in the 1977 Interim Report to the Minister of the Environment.

In late 1978, the Initiating Department role for the project was transferred from the Department of Indian Affairs and Northern Development to the Northern Pipeline Agency as a result of the transfer of regulatory responsibilities. In January, 1979, the EIS was submitted to the Environmental Assessment Panel.

In March and April of 1979, public hearings were held in Yukon communities, including Whitehorse, under the chairmanship of Mr. Fern Hurtubise. On April 28, 1979 the Panel concluded that Foothills had not provided sufficient information on certain aspects of the project, to enable the Panel to complete its environmental review at that time. The Panel prepared a second report requiring that Foothills complete its assessment of the project. This report was transmitted to the Minister of the Environment and released in September, 1979.

In 1980, it was necessary for the Panel to clarify the requirements in the 1979 report and this was done in two meetings attended by Foothills and the Northern Pipeline Agency. Following these meetings, the Panel issued a letter of clarification which detailed the explanations of requirements made at the 1980 meetings (Appendix 1).

In March 1981, Foothills submitted the first "Addendum to the Environmental Impact Statement for the Yukon Section of the Alaska Highway Gas Pipeline with Respect to Alternative Routes: Submissions 3-1 and 3-2" relating to the Whitehorse/Ibex Region. This covered one of the information requirements in the 1979 Panel Report. Technical hearings were held in Whitehorse in June 1981, under the chairmanship of Mr. Ewan Cotterill. The Panel recommended in a July, 1981 Report that the Ibex Pass route be rejected in favor of an alternative which more closely follows the Alaska Highway and that action be taken to preserve the wildlife and environmental values in the Ibex Valley.

In March, 1982 Foothills submitted an additional series of addenda to the Environmental Impact Statement, providing information called for in the 1979 Panel Report. The addenda are divided into seven sets of submissions dealing with the following subject areas:

1. Introduction to Addenda Submissions.
2. Project Description and Update for Addenda Submissions.
3. Alternative Routes.
4. Geotechnical, Hydrological, Design Mode and Revegetation Issues.
5. Fisheries, Wildlife and Scheduling Issues.
6. Issues Related to Pipeline Facilities.
7. Other Issues.

In April 1982, the Panel Chairman announced that technical hearings would reconvene in Whitehorse in the period June 7-12 in order for the Panel to complete the review.

The Panel is comprised of the following:

Mr. Raymond M. Robinson, Chairman, Ottawa.
Dr. Owen Hughes, Calgary.
Mr. William Klassen, Whitehorse.
Dr. Douglas Lacate, Vancouver.
Mr. Richard Spencer, Whitehorse.
Mr. Colin Wykes, Vice-Chairman, Whitehorse.

Panel biographies are given in Appendix 2.

On May 30, 1982 the Canadian and American project sponsors announced a two-year delay in the project. A new schedule and pre-construction budget is being developed on the estimate that operations will begin in late 1989, while keeping open the possibility of advancing that date by one year. It is understood that one year after the entire pipeline is completed, the Northern Pipeline Agency responsibilities on the project including monitoring will be taken over by Federal and Territorial Government agencies.

PANEL PROCEDURES

Review of the Documentation Submitted by Foothills.

The "Addendum to The Environmental Impact Statement for the Yukon Section of The Alaska Highway Gas Pipeline" was received in March, 1982. The Panel and technical advisors then commenced a detailed review of the documentation. Concurrently, copies of the documents were mailed to the public, government agencies and other interested parties through the following distribution program:

Public libraries — Communities along the Alaska Highway in Yukon,
— Whitehorse, Vancouver,
— Library of Parliament, Ottawa.
University Libraries — Saskatoon, Edmonton, Calgary.
Offices of Foothills — Whitehorse, Calgary, Ottawa.
Offices of the Northern Pipeline Agency — Whitehorse, Calgary, Ottawa.
Technical Intervenors — Federal Government Departments.
— Yukon Territorial Government, Whitehorse.
Public Interest Groups and Individuals which expressed an interest in receiving documentation.

The Panel retained a number of professional specialists to provide advice on the technical subject matter addressed in the addenda to the EIS. The advisors were also available at the technical hearings to respond to questions and to provide advice to hearings participants.

PUBLIC HEARINGS

Technical hearings were held at Whitehorse from June 7-12, 1982. For these sessions, a scheduled agenda was mailed, circulated and advertised before the hearings (Appendix 3). This permitted technical intervenors to be present at the time that specific issues were discussed.

2. GENERAL FINDINGS

During the technical review of the 1982 Foothills documents and during the hearings at Whitehorse, the Panel found that there is an improved information base for sound preliminary environmental planning of the pipeline project. All major subject areas have been considered although some concerns remain. The Panel would have preferred responses to its information requirements to appear directly in the reports submitted by Foothills. However, the Panel did conclude that the report, supplemented by information verbally presented by Foothills at the hearings, was sufficient to allow for recommendations to be made.

Information on the Ibex/Whitehorse routing alternatives filed in 1981, and in the 1982 documentation indicates that Foothills and government agencies now have a better grasp of the main physical and biological problems and the'options for solutions to those problems.

In general, the geotechnical difficulties associated with frost heave and thaw settlement are better understood than in 1979 and design options have been developed which may overcome the problems. The same situation applies to hydrology and revegetation issues. There remain a number of unresolved difficulties which will require priority attention by Foothills and the Northern Pipeline Agency.

The route alternatives proposed by Foothills do present some problems, but they are solvable given good engineering practice and diligence in impact mitigation during construction. The Panel agrees with three of the preferred route alternatives proposed by Foothills, i.e. the Kluane Crossing Alternative, the rerouting of the Mount Michie—Squanga Lake section to a line next to the Alaska Highway, and the revised routing in the Rancheria River Valley in eastern Yukon. The case of the Ibex/Whitehorse route alternatives was reviewed in the spring of 198 1 and was the subject of a Panel report issued in August, 1981. As indicated above, the Panel rejected the preferred Ibex Pass routing in favor of an alternative route which more closely follows the Alaska Highway.

On fisheries and wildlife, the Panel is satisfied that Foothills has demonstrated the ability to design the project in a manner that will avoid major environmental impacts and will give protection to fishery and wildlife resource values along the pipeline route. This can be accomplished by scheduling construction to avoid sensitive time periods for fish and wildlife and employing established construction techniques to minimize impacts at stream crossings and in critical wildlife habitats.

Problems associated with the location of pipeline facilities have been thoroughly reviewed and solutions have been identified. With sufficient lead time, detrimental effects of compressor station, construction camp, storage yard, and borrow pit location and operations can be successfully mitigated.

The handling of fuels and hazardous materials and the disposal of project wastes will present problems, all of which can be solved with proper foresight and good planning.

On the issues of noise impacts, aesthetic considerations, and the avoidance of disturbance to campground and recreational areas, Foothills has shown an adequate understanding of the necessary impact mitigation. Continuing committment to good planning and regulation will insure acceptable construction measures and operation of the pipeline.

The Panel has concluded that the preliminary environmental planning on the project is adequate. This presupposes that the engineering design is valid and that engineers and environmental managers can jointly work out the impact mitigation problems. However, certain engineering aspects, principally geotechnical questions, require further study and research towards satisfactory engineering designs. There are recommendations to be made on several specific concerns, which should be dealt with during the delay period to ensure the mitigation of several potentially serious negative impacts. These recommendations are directed to the Northern Pipeline Agency, which has the primary responsibility for project regulation and surveillance.

3. SPECIFIC RECOMMENDATIONS

PHYSICAL AND ENGINEERING CONCERNS

GEOTECHNICAL ASPECTS AND PIPELINE INTEGRITY

Permafrost

In the 1979 report, the Panel required *"a statement of procedures for permafrost surveying and the results of a survey program over the entire route . . ."*. The Foothills response was the production of a geotechnical atlas from which potentially ice-rich soil conditions could be inferred. In addition, preliminary engineering designs for different pipeline modes have been tentatively recommended for known permafrost terrain and for potentially ice-rich areas.

The Panel requested information *"on the operation of any previous or existing pipeline in permafrost". . .and "the feasibility of large diameter pipelines* **in permafrost". At the hearings exam**ples were drawn from the small diameter Pointed Mountain gas pipeline in south-eastern Yukon and northern British Columbia, as well as from northern U.S.S.R. Although lines have been built in these places, the available information is not directly relevant to the proposed Foothills gas pipeline.

Recommendation 1: Foothills needs to pursue actively engineering and environmental information on new and existing large diameter pipelines in permafrost areas and incorporate the results into the pipeline design In critical areas.

In 1979, the Panel required that *"the Proponent submit a description of the proposed geotechnical study program aimed at solving the complex problems of frost heave and thaw settlement of the pipe".* Since 1979, there has been considerable construction and development of field testing facilities both by Foothills and its American counterpart. Information given in the 1982 documents is quite limited but it is clear that detailed observations are being made of the ground thermal regime and pipe behavior in various design configurations. Major experiments have also been made on questions of uplift resistance and its effect on pipe stress. Very little information on the observations has been made available in the documents, partly because the information is regarded as proprietary and partly, it may be assumed, because a longer time is required before results become meaningful.

Secondary frost heave is a phenomenon of heave in already-frozen ground and therefore has potential to move pipe which is laid in permafrost bodies. This concern extends to frozen ground formed by the chilled pipe in initially unfrozen ground. The Panel learned of a wide range of engineering and environmental concerns on secondary frost heave. Foothills maintained, based on their experiments, that the rate of heave from this phenomenon is not significant and does not therefore require a design response. However, Foothills did undertake to look at any new evidence that is available on the subject, in case design changes are warranted.

Recommendation 2: Secondary frost heave should be further researched and assessed for its risk to the project in permafrost zones and where the pipe is chilled.

In 1979, the Panel required information *"on the extent of available terrain information and detailed examples of solutions for specific problem sections to be identified by the Proponent ..."*.

The Panel also specifically required *"detailed information on terrain types and typical design concepts and construction practices for a number of problem areas along the alignment identified by Foothills but including segments which cover numerous transitions from frozen to unfrozen ground".* This information was provided in the geotechnical atlas and in the 1982 documents describing the preliminary engineering designs and design modes.

Frost Heave and Thaw Settlement

In its 1979 Report, the Panel required information on:

"Details on the insulation and other techniques to be used to restrict frost heave or thaw settlement of the pipe".

Information on the mechanical and thermal properties of the insulation was given briefly at the technical hearings. This information was not sufficient to assure the Panel that the insulation would continue to function as intended. The required dimensions of insulation remain tentative because of uncertainties in the geothermal calculations.

"Information is required on the relative lengths of pipe for which different techniques or modes are used as well as their dimensional variations. The designs should be presented in both cross and longitudinal sections".

This information was provided by Foothills in the submissions and at the technical hearings.

"The Panel will require information on the distances over which the *specified* **amount of differential heave is** *tolerable. The Panel will also require a description of the acceptable maximum curvature of the pipe acceptable for either settlement or heave,* especially in relation to the metallurgical *properties* of the *pipe".*

"Convincing documentation with regard to the integrity of the pipe when exposed to deformation and the associated stresses *and* show that frost heave will *not overstress the pipe".*

The 1982 Foothills submissions cover pipe stress and this aspect of the work has been extended considerably since 1979. However virtually no information has been made available on the all-important question of the analysis of those stresses arising from differential frost heave. In particular, such analysis requires information on creep properties of frozen ground which is not widely available and largely not yet established. Studies since 1979 have shown that the amounts of heave that could be tolerated by the pipe are less than previously stated. Thus the geotechnical designs for control of heave become more complex.

Recommendation 3: Research and development on pipe behavior under differential frost heave or thaw settlement and resulting design modifications should be given a high priority to insure the integrity of the pipe in terrain where potential for frost heave or thaw

settlement exists and to avoid environmental impacts that might arise along the right-of-way.

In 1979 the Panel required, *"the results of an error analysis conducted with respect to the geothermal calculations".*

No such analysis was submitted by Foothills. It is essential that detailed studies be made to define the range of variation of thermal and hydraulic properties of the earth materials and the energy exchange co-efficients of the ground surface that might reasonably be expected. These properties are known to vary greatly not only with the lithology, but also with the soil moisture and thermal regime of the location. Because of these variations, it is impossible to make predictions accurate to within a few centimeters or decimeters. Frost penetration may 'occur where it is not expected. Therefore the dimensions of the insulation and associated construction must be such as to allow for these uncertainties. The alternative mitigation measure in such cases would be the consistent use of insulation dimensions far in excess of those required if more precise calculations were possible.

Recommendation 4: A rigorous error analysis should be made of the geothermal calculations needed to support the pipeline design. This should include better information on thermal and hydraulic properties of the soil and ground surface energy co-efficients.

The Problem of Subsidence Along the Route After Abandonment

The Panel required *"information on impacts associated with subsidence following abandonment of the project".*

Several design modes have been proposed by Foothills to meet a variety of ground conditions. Apart from the view that post-abandonment subsidence will be avoided, Foothills has brought forward no new information on this information requirement.

Recommendation 5: Before leave to commence construction is given, Foothills should file a viable project abandonment plan with options to mitigate predicted environmental impacts, including post-abandonment subsidence.

Slope Stability

The Panel required, "information *on methods of* ensuring *slope stability for different designs, particularly in areas of permafrost. This should include details on pipeline mode, foundation design and slope stability implications".*

Much new information was provided in the Foothills submissions and at the technical hearings. However studies of slope stability and engineering procedures for northern areas are still generally at a relatively early stage of development.

Possible Effects of Climatic or Microclimatic Change

The Panel required information *"on the proposed plans to deal with the* potential *effects of* climatic *change on the permafrost bodies along the route".*

Foothills has submitted that the effects of any climatic change would be small in relation to the temperature influence of the pipe itself. This may be true as the very large range of temperature of the pipe has been noted and will require especially detailed consideration. However, in some situations calculations of the efficiency of particular designs could not be made to the accuracy implied without precise assessment of future climatic conditions.

It is clear that Foothills now has a better understanding for the implications of climatic change.

The Integrity of the Pipeline In the Event of Earthquakes

As noted in the 1979 Panel Report, the pipeline corridor is located in a region of relatively high seismic activity. The pipeline could be threatened in the event of earthquake activity. The Panel required *"a description of the risks to the pipeline due to earthquakes and the appropriate designs to mitigate the effects of such activity".*

The risks to the pipeline due to earthquakes have been identified and the related design problems and mitigation measures have been discussed in the Foothills documentation. The Panel is satisfied that Foothills is aware of the risks posed by seismic activity and of the requirement for site specific designs in some areas to prevent slope instability, excessive soil movements, and loss of support to the pipe.

The Panel also required information on *"the sediments of Kluane Lake and the potential for the sediments to liquefy under cyclic seismic loading".* Disturbance of lake sediments could lead to pipe failure unless adequate design and mitigation measures are taken. Foothills is aware of the Panel concerns on the technical aspects of the Kluane Lake crossing, including the possibility of general slope failures of the west and east banks leading to failure of the pipe within its restricted environment of protective or improved fill. Similarly, where the pipe crosses the relatively flat lake bed, earthquakes could trigger settlement and slope movements in adjacent ground.

Regarding the Foothills methods of identifying areas of potential liquefaction, there are risks in making exclusive use of "Cumulative Damage Procedures" and the value of the use of empirical methods is acknowledged. The computer approach of Foothills is a probabilistic one which is not in wide use in the profession, because its verification indicates that one out of seven slopes which are classified as safe would actually fail under disturbance. Foothills understands these concerns.

The Panel assumes that the Kluane Lake Crossing is technically feasible. However if the crossing route is found to be unacceptable because of engineering or economic reasons, the alternative would be to follow the land route along the south-west shore of Kluane Lake, through or adjacent to Kluane National Park and across the Slims River delta. The Panel concludes that a route change of this dimension and sensitivity would require a further technical and public review.

Recommendation 6: The technical feasibility of the Kluane Lake crossing should be given on-going review to ensure the integrity of the pipeline, and the

subject of lake sediment liquefaction potential should be more rigorously analyzed.

Recommendation 7: A technical and public review would be required if the lake crossing route is dropped In favor of a land route through or adjacent to Kluane National Park.

Conclusion:

With respect to geotechnical subject matter, the Panel has concluded that considerable progress has been made in problem identification and options for solutions. Much of the required information has been provided indirectly in design drawings and descriptions. However the overall engineering feasibility of the project design for permafrost areas is not yet certain. The Panel therefore stresses the need for research, monitoring, and development aimed at problem solutions, especially the continuing work at the Foothills test sites.

HYDROLOGY AND WATER CROSSINGS

Design Flow Criteria and Small Stream Hydrology

The Panel required "detailed information *on the methods used by the Proponent in determining project design flows for streams to be crossed by the pipeline and access roads including an analysis of the risks of exceeding them. The* project *design flow should be analyzed* for a 30 *and 50 year service life and,*

"information on the determination of design flows for small drainage basins and for right-of-way drainage, where runoff data are inadequate. *This should include* the type of data *needed, and data gaps and plans for collecting the required data. Special attention should be given to the effect of stream icings in the design of small stream crossings ".*

In the 1982 review the Panel received information on two approaches to solving the problem, one from Foothills and the other from federal government reviewers.

Concern still exists among federal government reviewers about the adequacy of Foothills' methodology for determining design flows for crossings of small and intermediate-sized streams. These concerns involve the adequacy of streamflow estimates for deriving scour-depth estimates, lateral erosion estimates, and probability estimates for extreme flood peaks from out-bursts of glacier-dammed lakes, as well as sizing of culverts. The information base for guiding the estimates of factors used in the "rational method" for determining design flows has not been fully explained by Foothills. For example, meteorological data do not normally provide adequate information in Yukon on precipitation and snow cover, especially at higher elevations in mountainous areas, which are major factors in the generation of high runoff rates.

On the other hand, Foothills has obtained a wealth of information on stream-channel characteristics, which will be used in checking the design-flow estimates obtained by the "rational method". Foothills claims that this information, taken together with the available experience in the design of pipeline river crossings, will permit the design of technically and environmentally safe crossings.

Recommendation 8: The Panel notes these differences in opinions and approach by Foothills and government reviewers and recommends that the Northern Pipeline Agency consider the lack of an agreed solution and, more Importantly, lead the way in Identifying and executing a resolution to the problem. In addition, Foothills' claim on river crossing designs should be checked against available records on pipeline failures at river crossings during the past 10—20 years.

Recommendation 9: As a means to further assuring adequate hydrologic design, the Northern Pipeline Agency and Foothills should consult with Shakwak Project, Public Works Canada, and Government of Yukon highway maintenance personnel to determine their calculation methods and subsequent performance of structures.

Streams on Alluvial Fans; Mud Flows, Debris Torrents, and Related Phenomena.

The Panel required *"information on the incidence of avulsions, mud flows, debris torrents and channel degradation on alluvial fans, on the design measures to be employed to prevent adverse effects on pipeline integrity, on the co-ordination of the Proponent's work with the Yukon Department of Highways and Public Works, and on the environmental impact to be expected from such measures.*

At the technical hearings, Foothills referred to its contacts with other agencies responsible for projects which need to be reviewed for their additive or related impacts on the proposed pipeline. Although Foothills maintains these contacts, the information requirement has not been dealt with explicitly.

Recommendation 10: Foothills should present a plan for dealing with shifting stream channels, debris torrents, mud flows and channel degradation that may occur on high-energy streams on alluvial fans. The plan should reflect consultations with government agencies and industry responsible for other projects along the pipeline route in Yukon.

Risk of Flood Resulting from Glacier-Dammed Lakes

The Panel required *"up-dated river-crossing designs taking into account both out-burst peak-flow estimates and potential changes in Alaska Highway crossing designs".*

The Foothills documentation on water crossing generally covered the information requirement. The Panel is satisfied that the company is aware of the design requirements to accommodate out-burst flood flow levels.

Water Crossings Designs

The Panel required *"Detailed design of special problem areas at river and lake crossings and approaches, for which special crossing crews would be employed ...*
and *"Typical* designs for stream *and* lake *crossings for which mainline crews would be employed ...*
and *"Channel scour estimates for detailed design and typical design for water crossings ...*

and *"Evaluation of scour estimates reliability, pipeline safety in relation to scour and environmental consequences of construction and repairs at the water crossings ...*
and *'information is required on the locations, origin, and magnitude of natural icings within the proposed pipeline right-of-way and information on subsurface water flows encountered at stream crossings.. .''.*

The Foothills documentation and technical hearings have yielded the required information. The Panel is satisfied that Foothills is aware of the significance of factors affecting water crossing designs, including the influence of natural icings which has been the subject of field surveys by Foothills in recent years.

Recommendation 11: For the purposes of final designs and locations of stream crossings, Foothills surveys of natural icings should be continued to establish the maximum extent of recurring icings and intermittent occurrences.

Disruption of Ground Water Flow by a Chilled Pipeline

The Panel required *"data on groundwater flow and temperatures needed for the prediction of the potential occurrence of project-induced icings . . . ''* and *''...on plans to identify where potential icings could occur, to describe the expected magnitude of induced icings, and to propose mitigation measures to minimize or remove harmful environmental impacts to fisheries and hazards to pipeline integrity".*

The Foothills documentation and the technical hearings have not demonstrated the desired predictive capability with respect to project-induced icings.

Recommendation 12: Foothills should further investigate the potential for occurrences of project-induced icings, their expected magnitude and impact, and also propose mitigative measures.

REVEGETATION AND EROSION CONTROL

The Panel required *'a comprehensive revegetation and erosion control plan ... to include the results of the Proponent's revegetation research program, a description of the revegetation management program to be undertaken, identification of problem areas and special revegetation methods to be used, and a description of the potential effects of forest fires on the long- term success of the revege ta tion program ''.*

The Panel learned that Foothills has demonstrated an improved understanding of the problem of establishing ground-cover on selected areas of the right-of-way and other cleared areas. However the logistics and support facilities required to achieve success over the entire route require further development. From the Foothills documentation and from supplementary verbal information offered by Foothills at the technical hearings, it is clear that there are optional means for dealing with the potential problems.

Recommendation 13: On particular points, the Panel recommends that:

13a. Foothills should continue to monitor and evaluate the results of the seven test sites along the Alaska Highway in Yukon, since this is the only field testing associated with the revegetation plan. Serious problems may yet arise which can be taken into account in the operational revegetation program.

13b. Before leave to commence construction is given, Foothills should furnish a developed plan for a Yukon nursery to provide shrubs and trees for the revegetation program. At present, plans for the nursery are not sufficiently advanced to assess the adequacy of the facility.

13c. Before leave to commence construction is given, Foothills should submit a plan for the acquisition and use of hay and/or straw for ground cover during the revegetation operation. Local sources are in high demand at present and large amounts may have to be trucked in from outside the project area.

13d. The results of the revegetation monitoring program should be reviewed annually for the first 3-5 years following project completion. Presumably, after that period of time, the major problems will be evident and appropriate measures can be taken.

RELATED STRUCTURES AND ACTIVITIES

Access Roads

The Panel required *"information on the location and standards and scheduling of temporary and permanent access roads. including culvert designs and installation plans, methods of road construction and plans for abandonment for the following four sections where there is a major deviation from the Alaska Highway: the east shore of Kluane Lake, Ibex Pass and alternatives, the Mount Michie-Sguanga Lake section, and the Ranch-eria River section. In addition the predicted potential environmental impacts of access road construction, operation and abandonment are required together with details on mitigative measures proposed to minimize these impacts.*

Should the use of snow roads be contemplated for winter construction spreads, then the methods of snow road construction and their impacts should be evaluated".

The Foothills submissions and the technical hearings provided the required information and demonstrated the company's ability to plan, construct and operate access roads so as to avoid unnecessary environmental damage.

Granular Materials

The Panel required *"information on total volumes of granular materials to be used as well as typical plans for location, operation and rehabilitation of granular extraction sites, including a channel zone and a flood plain for one of the White, Donjek or Duke Rivers ''.*

The Panel received data on the project demand for granular materials and on estimates of available supplies. The information on project demand fluctuates with project design changes. In turn, the selection of extraction sites is dependent on demand figures. A granular resource protection plan for extraction sites was not submitted by Foothills for review by the Panel.

Recommendation 14: Before leave to commence construction is given, a granular resource protection plan should be submitted and reviewed for location, operation and rehabilitation of all granular extraction sites.

Compressor Stations, Construction Camps, Material Storage Areas, and Concrete Fabrication Plants

The Panel required *"information on the criteria and methodology, predicted impacts and mitigation measures considered in the siting of compressor stations, construction camps, material storage areas and concrete fabrication plants':*

The Panel determined that this requirement was largely met in the Foothills submissions and discussions at the technical hearings.

BIOLOGICAL CONCERNS

FISHERIES

The Panel required the following information: *''A detailed construction schedule in text and chart form for a typical summer spread and a winter spread along the route, including a description of the progression of pipelining steps and mitigation measures to protect fisheries. This should include assessments of site-specific impacts on fish species and impact mitigation plans based on the schedule.*

An assessment *of* potential impacts on fish population due to changes *in proposed pipeline routing, including Kluane* Lake and *the* section along *the* Rancheria *River.*

Detailed examples of measures which will be taken to prevent erosion of stream banks and approaches to streams, including a representative cross-section of sites along the proposed route.

Plans for inspection and monitoring of erosion and pipeline integrity at water crossings during the operational phase.

Details of pipeline construction methods to be employed in stream crossing and measures which will be taken to minimize sedimentation. Data on stream discharge and stream bed and sub-bed materials at crossings should be provided to show whether or not the volumes of suspended material, derived from the excavated sub-bed materials, would be significant and whether the proximity of crossings to important fish habitat presents significant problems.

The Panel requires typical culvert designs to accommodate fish passage and measures taken to prevent accelerated erosion, including specifications for culvert ins talla tion.

A site-by-site assessment of the potential for over-exploitation of fish stocks during pipeline construction, and the measures which would be required to achieve adequate protection. In addition, details *of* actions *the* Proponent will undertake *to* assist the responsible government resource agency **in the** *protection of these* resources **are** required",

Foothills addressed these issues in the 1982 Submissions and at the technical hearings at Whitehorse. After a review of this information, the Panel is now satisfied that Foothills has the **ability to** design the project in a manner that will satisfactorily protect fishery resource values along the Yukon pipeline route.

With respect to scheduling, at the technical hearings Foothills acknowledged the need for refinement of data on timing of sensitive life cycle stages for fish in particular areas. Foothills is committed to conduct further field studies where site-specific data deficiencies become evident.

The subject of potential impacts on fish populations due to pipeline routing changes at Kluane Lake and Rancheria River was adequately covered in the Foothills Submissions.

Detailed examples of measures to prevent erosion of stream banks and approaches were addressed adequately in the Foothills Submissions dealing specifically with water crossing design and construction. Erosion control on pipeline right-of-way approaches to streams was also briefly covered.

No specific reference was made by Foothills to the requirement of plans for inspection and monitoring of erosion and pipeline integrity at water crossings during the operational phase although such inspection is planned for the land part of the right-of-way.

Recommendation 15: Right-of-way inspection should include monitoring of erosion and pipeline integrity at water crossings in order to protect fishery resource values.

Measures will have to be taken to minimize sedimentation at water crossings. The Foothills documents do not make specific commitments to deal with this problem. However at the technical hearings, Foothills undertook to implement safeguards recommended by the Department of Fisheries and Oceans in exceptional cases where construction scheduling changes would not adequately mitigate impact.

Recommendation 16: Construction techniques to minimize sedimentation at stream crossings should be submitted to the Northern Pipeline Agency.

On the significance of suspended sediment produced and the sphere of impact from pipeline water crossings, Foothills has addressed the Panel's request and has provided a rationale based on several studies which have documented sediment deposition from pipeline crossings.

On culvert designs to accommodate fish passage, Foothills has addressed this subject in the Submissions. In addition, Foothills has committed to implement fish passage design guidelines prepared by the Department of Fisheries and Oceans.

On the matter of site-by-site assessment of potential for over-exploitation of fish stocks, protection measures and assistance to management agencies, Foothills has provided only a general assessment. Continuing changes **in construction camp** location is the stated reason for this. At the technical hearings Foothills and the Department of Fisheries and Oceans stated that adequate data were probably available for the site-specific assessments requested by the Panel. In addition, Foothills made commitments to measures which could, in the view the Panel, reduce the impacts of construction personnel on local

fish and wildlife populations. Foothills committed to assist the responsible government agencies in the protection of fish resources.

As indicated later in this report the fisheries information requirements on route alternatives have been adequately addressed.

WILDLIFE

The Panel required the following information:

'Map of all critical wildlife habitat or ranges with an analysis providing details of construction scheduling and alignment and mitigative measures to reduce predicted impacts.

A detailed construction schedule for a typical summer spread and a winter spread along the route, with a description of the progression of pipelining steps and mitigation measures for wildlife in text and chart form, and assessments of site-specific impacts on important wildlife species and impact mitigation plans based on the schedule.

Measures to minimize wildlife disturbance resulting from aircraft use, blasting and other noise sources.

The implications of new access on wildlife, particularly where there are major diversions of the pipeline from the Alaska Highway".

The Panel has determined that changes in the preferred route alternatives since 1979 have alleviated several major wildlife issues. From the standpoint of wildlife issues the Panel concurs with 1982 proposals for the Kluane Lake Crossing, the Marsh Lake—Squanga Lake area and the Rancheria/Swift River areas. The issues pertaining to these preferred routes have generally been adequately addressed, although further baseline information on winter range use for the development of mitigation measuresis required in the case of the Rancheria caribou population, as described by Foothills.

On the matter of scheduling and mitigation measures the Foothills responses are adequate. The following specifics should be dealt with:

Waterfowl

The Panel is in agreement with Foothills' approach to sensory disturbance zones for spring concentrations of waterfowl, but it is apprehensive about Foothills' approach to autumn concentrations. Specifically, the Panel is of the opinion that the importance of certain waterbodies and their susceptibility to disturbance may have been underestimated.

Recommendation 17: Foothills should prepare a well-documented report on the subject of sensory disturbance zones for waterfowl. The report should be submitted to the Northern Pipeline Agency for technical review with the Canadian Wildlife Service.

Maps of Critical Wildlife Habitat or Ranges

The proponent provided some maps of selected critical wildlife habitat in several submissions to the Panel. In the discussion of this topic Foothills indicated a desire to compile a fisheries and wildlife critical habitat atlas since much material of this type has already been catalogued.

Recommendation 18: An atlas of critical fisheries and wildlife habitat should be compiled. This could be coordinated by the Northern Pipeline Agency and accomplished cooperatively by Foothills and the appropriate management agencies.

Raptors

Agencies responsible for the protection and maintenance of raptors have established sensitive periods for gyrfalcons based on research. Foothills has suggested a different sensitive period not in agreement with that.

Recommendation 19: In order that these raptors be afforded protection, the Panel recommends that the existing sensitive period be recognized and respected unless otherwise agreed to by the Yukon Department of Renewable Resources through the Northern Pipeline Agency.

Alternative Modes and Wildlife

For the presently proposed lengths of above-ground sections, the suggested mitigation measures appear to be reasonable from a wildlife standpoint. The recommended standards for ramps and spacing of crossing locations should be implemented. Providing the measures are taken, the impacts on wildlife will probably be acceptable. However the above-ground design options, including the concrete restraining mode, are untested for moose and woodland caribou.

Recommendation 20: A well-designed monitoring study is recommended to include adequate pre-construction data on ungulate movements in the vicinity of the proposed raised sections. This should be followed by a detailed post-construction study of crossing success including behavioral responses and effectiveness of the three proposed design options. This could lead to further design modifications. The use of the ramps by species other than ungulates should also be documented.

ROUTE ALTERNATIVES

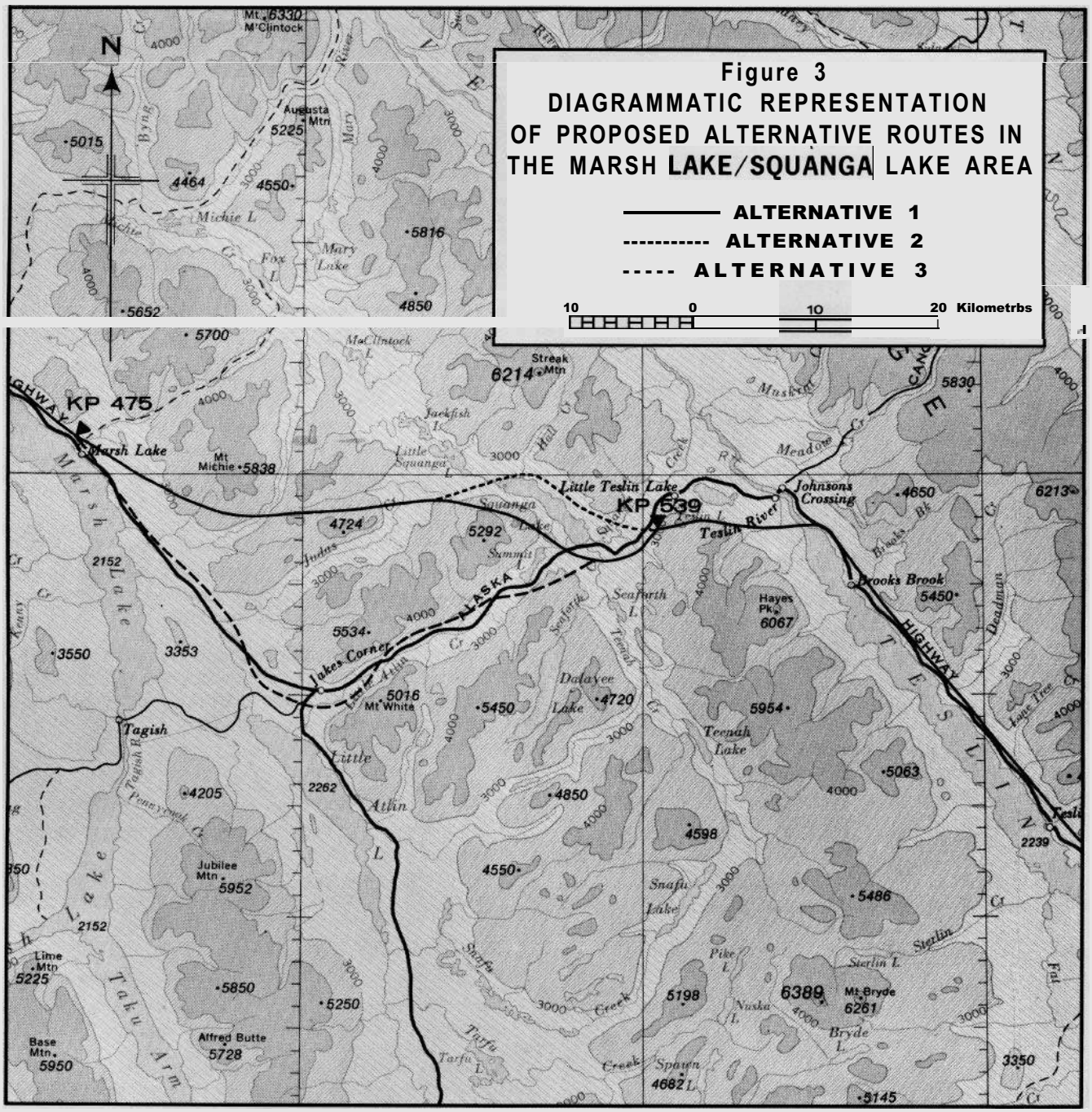
KLUANE LAKE AREA

The Panel required *'an evaluation of environmental impacts and proposed mitigation measures for the area extending from the east end of the Kluane Lake underwater crossing to where the alignment rejoins the Alaska Highway (approx. KP* 225 *to* 250). (See Figure 2.)

A comprehensive statement on the probable extent of burial of the underwater section, the procedures necessary for burial of the pipe, and an analysis of probable effects of the burial procedure, including such factors as turbidity, siltation of spawning areas, physical interference with fish movements, and the probable duration and/or area of extent of such effects.

An analysis of the effects of a major gas leak on aquatic biota of Kluane Lake under worst-case conditions".

Figure 2
PROPOSED ALTERNATIVE ROUTES
IN THE KLUANE LAKE REGION
ALTERNATIVE 1
ALTERNATIVE 2
ALTERNATIVE 3
ALTERNATIVE 4
5 0 5 Kilometres
N
KLUANE
LAKE
215
220
225
230
235
237.5
240
245
250
255
260
265


N
Figure 3
DIAGRAMMATIC REPRESENTATION
OF PROPOSED ALTERNATIVE ROUTES IN
THE MARSH LAKE/SQUANGA LAKE AREA
ALTERNATIVE 1
ALTERNATIVE 2
ALTERNATIVE 3
10 0 10 20 Kilometrbs
KP 475
KP 539
Marsh Lake
Little Teslin Lake
Squanga Lake
Johnsons Crossing
Teslin River
Brooks Brook
Jakes Corner
Tagish
Little Atlin L
Dalayeh Lake
Teenah Lake
Snafu Lake
Mt Michie 5838
Mt White 5016
Jubilee Mtn 5952
Alfred Butte 5728
Base Mtn 5950
Lime Mtn 5225
Mt Bryde 6261
Hayes Pk 6067
Streak Mtn 6214
Augusta Mtn 5225
Mt McClintock 6330
ALASKA HIGHWAY
Marsh Lake
Taku Arm

The Panel was advised that geotechnical investigation of potentially unstable sediments on the lake floor is continuing. The Panel was further advised that conventional techniques are available for stabilization of the sediments if required. Because on-going geotechnical investigations will be used in determining the need for stabiliration measures, and also in determining the extent and depth of burial of the pipe on the lake bottom, procedures for installation of the underwater section of the pipe remain tentative. Accordingly, the Panel was given only a very general assessment of the probable effects of the installation procedure in terms of such factors as turbidity, siltation of spawning areas, physical interference with fish movements, and the probable duration and/or area of extent of such effects.

Kluane Lake supports valuable commercial, domestic and sports fisheries and hence warrants extreme care in selection of installation procedures that will minimize damage to the fish resources.

Recommendation 21: Close scrutiny should be given to the installation procedure to minimize environmental effects on fish and fish habitat.

As recommended on page 26 of this report, a technical and public review would be required if the lake crossing is dropped in favor of a land route through or adjacent to Kluane National Park.

IBEX PASS AREA

The Panel reviewed this route alternative question and in the 1981 report to the Minister recommended that the Ibex Pass route not be used, in favor of an alternative which more closely follows the Alaska Highway.

MARSH LAKE-SQUANGA LAKE AREA

The Panel required *"a* comprehensive description *and comparison of the preferred route and potential alternatives, together with the implications or building and operating the oil pipeline nearby. Factors to be considered should include impacts on wildlife populations and habitat, potential for terrain degradation, visual impact, and effect on recreational values. "* (*See* Figure 3.)

After the 1979 Panel hearings, Foothills revised the preferred routing to follow the Alaska Highway corridor from Marsh Lake to the Squanga Lake Area. The Panel then required a description of the potential environmental impacts and mitigation measures for the new route.

At the 1982 technical hearings it was noted that Foothills does not intend to proceed with plans for an oil pipeline parallel to the Alaska Highway from Jake's Corner to Watson Lake and south.

The Panel agrees with the re-location of the preferred routing of the gas pipeline in the Marsh Lake-Squanga Lake Area and with the environmental planning for the section, as submitted by Foothills.

RANCHERIA VALLEY

Prior to the 1979 Panel hearings, Foothills re-routed the alignment to the north side of the highway near Swift River and to the south side of the Rancheria River and Alaska Highway to the point where the line enters British Columbia near Watson Lake (See Figure 4).

The Panel required *"the rationale for location of the route south of Rancheria River, and*

A *detailed* comparison of terrain conditions on respective *sides of the valley, including such factors as prevalence of permafrost, location and extent of intervals of side slopes requiring benching* for construction of *the pipeline; location and* extent of *intervals with near-surface bedrock requiring blasting for benching and/or ditching; susceptibility of the terrain to erosion and* consequent stream *siltation.*

The location of access roads and bridges across Rancheria *River and its tributaries (if required by construction plans); if bridges are required, enough information on size and manner of* installation to permit assessment of possible impact of *bridge cons truc tion on aqua tic bio ta.*

Evaluations and comparison of fisheries values in tributaries crossed by routes on the respective sides of the valley.

A comparison of other environmental factors on the respective sides of the valley, particularly for wildlife impacts and prevalence of raptors, furbearers, moose and caribou ranges, etc.

A comparison of visual impact of location on the respective sides of the valley".

The Foothills 1982 documentation and technical hearings yielded the required information and the Panel is satisfied with the planning of the relocation. Potential impacts and mitigation measures have been reviewed adequately, with the exception addressed in the following recommendation.

Recommendation 22: Further information should be obtained on winter range use by the Rancheria caribou population in order to develop mitigation measures to protect the population.

ALTERNATIVE MODES

The Panel required *"information on alternative modes of installing the pipeline along the proposed* route *including the embankment mode and the placement of the pipeline on piles. This information should include details of engineering design, location, materials required, as well as details* on *potential environmental impacts and appropriate mitigation measures ".*

The Panel received updated designs and installation procedures for proposed alternative modes, including the concrete restraining mode for above-ground construction.

Field tests are presently proceeding at Foothills' Quill Creek Test Site west of Kluane Lake. At the hearings, Foothills supplied updated information on aggregate and borrow requirements for the project.

In the 1982 documentation and at the technical hearings, the Panel received sufficient information to satisfy this requirement. Foothills is aware of the environmental implications of the use of the buried mode and the above-ground configurations.

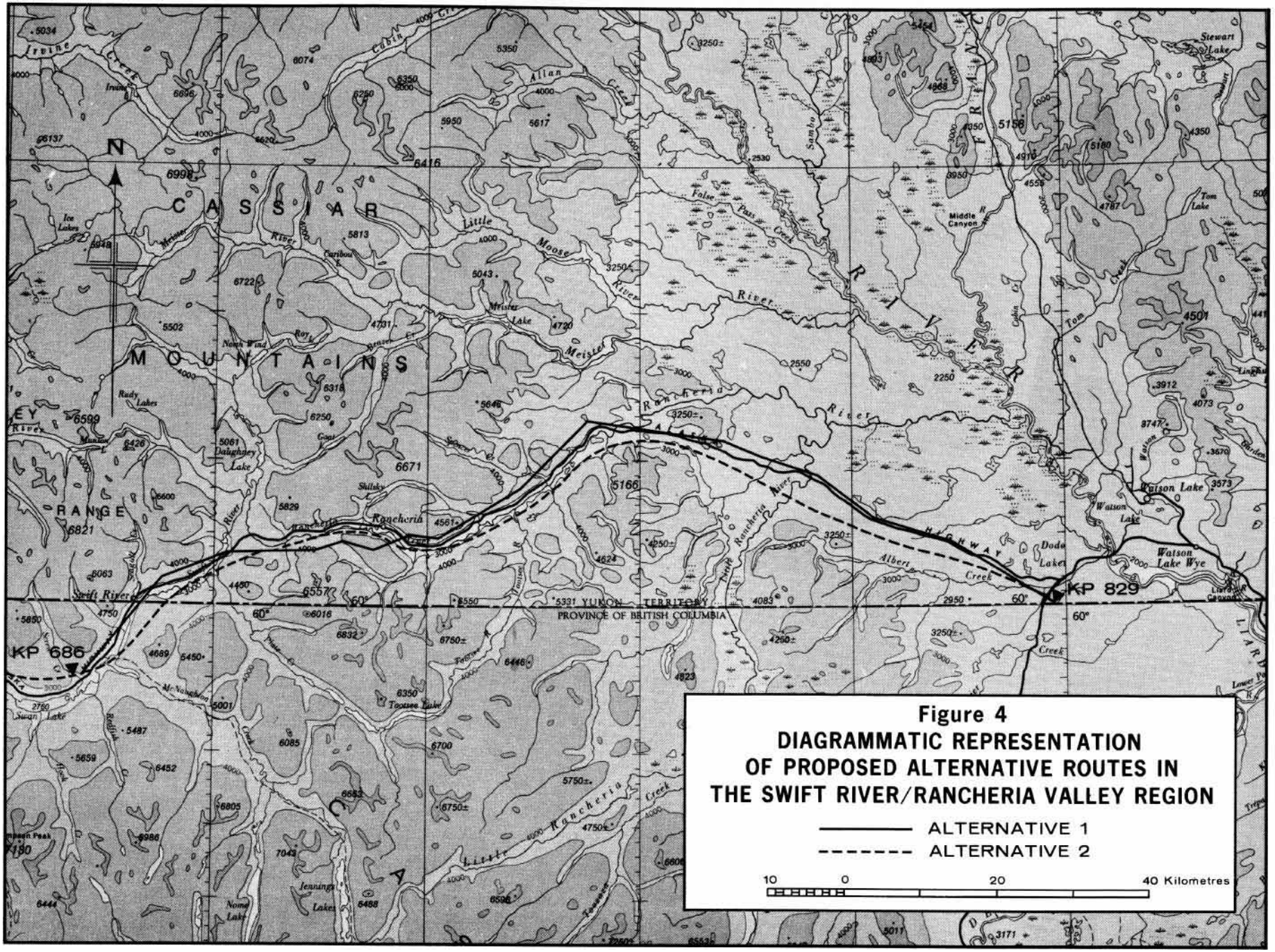


Figure 4
DIAGRAMMATIC REPRESENTATION OF PROPOSED ALTERNATIVE ROUTES IN THE SWIFT RIVER/RANCHERIA VALLEY REGION

Recommendation 23: When the final modes and their extent are known, a review should be undertaken by the Northern Pipeline Agency and a mechanism established for a monitoring program to examine the performance of these modes over time.

SCHEDULING ALTERNATIVES

The Panel required *"(in addition to those points raised in the fisheries* and *Wildlife sections above)* an environmental *impact analysis of scheduling alternatives including the rationale used in deciding the construction seasons for spreads, as well as the length of the spreads. This analysis should synthesize and accommodate all the environmental concerns to the maximum extent possible. In areas where conflicts exist the analysis should specify the approaches to be taken to resolve conflicts* and to *minimize the* overall environmental impacts. *''*

Foothills' submissions on fish and wildlife demonstrate the need to exercise careful timing in mainline construction as a means of mitigating adverse impacts. Should such timing not be sensitive to the needs of fish and wildlife, these impacts could be significantly worsened. Accordingly, the Panel is convinced that Foothills should take every opportunity to reduce impact on fish and wildlife through construction scheduling both at the macro and micro levels. At the macro level, the selection of summer and winter construction schedules to take account of fish and wildlife needs is essential. At the micro level, flexibility must be exercised in the construction spread at locations and times of particular sensitivity for both fish and wildlife.

Recommendation 24: In establishing its construction schedules, whether between summer and winter or at specific times and locations, Foothills should take full advantage of opportunities to reduce impacts on both fish and wildlife.

OTHER ISSUES

AESTHETICS

The Panel required *"a systematic assessment of probable aesthetic impacts and a comprehensive approach to mitigation of such impacts. Such an assessment should include not only* visual aspects but also *noise, odour,* construction *and operations activity, and air quality. The potential for impact from the following features of the project should also be assessed:*

berm mode of construction
sidehill cuts or benching
gravel crushing and washing
concrete plant operations
bono w pits
access roads
material storage sites
scheduling of activities ''.

Although not initially apparent from Foothills' aesthetics report, discussion at the technical hearings in response to the Panel's questioning indicated that Foothills is in a position to consider and plan adequately for aesthetics.

ASSOCIATED PROJECTS

"Where there are interactions between the gas pipeline and such projects as the Dempster Lateral Pipeline, the proposed Foothills oil pipeline, Northern Canada Power Commission power projects, including transmission facilities, the Shakwak Project and Alaska Highway reconstruction, the Panel required a discussion of potential impacts with particular emphasis on cumulative environmental impacts and suitable mitigation measures ''.

The Panel learned that Foothills is aware of the status of associated projects in Yukon, and of their broad environmental implications. Specific mitigation measures have not been developed because of the uncertainty of the timing of the projects. The Panel's Report of 198 1 on the Ibex/Whitehorse routing alternatives did address the tie-in location of the Dempster Lateral pipeline with the proposed Alaska Highway Gas Pipeline, near Whitehorse.

Recommendation 25: Prior to the approval of the final design stages of the project, Foothills should be required to update the status of associated projects in Yukon in order to insure that proper environmental planning is undertaken and mitigative measures are put in place to take account of these other projects.

RECREATIONAL LAND USE

The Panel required *"that the Proponent provide a plan to minimize negative impacts on existing or proposed campgrounds ''.*

Foothills' documentation on camp grounds and recreation impacts gave only a very general treatment of potential problems and mitigation. However, the discussion at the technical hearings satisfied the Panel that Foothills is sensitive to potential impacts on camp grounds and recreation and options to mitigate the impacts.

NOISE

The Panel required:

'A systematic analysis of noise impact, using "Guidelines for Preparing an EIS on Noise" published by the U.S. National Research Council, and using suitable criteria for the southern Yukon setting to give a clearer picture of the predicted impact of noise from the pipeline on humans and on wildlife.

Results of sampling of ambient sound levels at proposed compressor stations. Surveys were conducted by the proponent in early 1979. These surveys seem to be adequate to yield this information.

A plan to mitigate predicted noise impacts from various project sources such as construction machinery, aircraft, blasting, and *road transport.*

A plan for the mitigation of compressor operation noise and blowdown noise, taking into account the expressed need for noise reduction near human habitation and sensitive wildlife locations. The plan should also take into account revised information on noise propagation by the atmosphere, which was tabled at the hearings. ''

Several aspects of noise impact management were reviewed in the Foothills submissions and during the technical hearings, including compressor operation and blowdown noise mitigation during operations, background noise levels, and plans to

mitigate construction noise levels in sensitive areas in terms of residents and wildlife.

The Panel is satisfied that Foothills is aware of problems of noise generation and reduction and of the potential impacts on northern residents and wildlife. Several valuable points were made in the technical hearings. The Panel recommends them to the Northern Pipeline Agency for implementation.

Recommendation 26:

26a. The NEMA (d) curve should be used, in general, for silencing compressor stations as specified in Foothills' 1982 documents and at the technical hearings, but also the criterion of general audibility should be used for sensitive outdoor recreational areas such as the Marsh Lake cottage area.

26b. The use of the Province of Ontario Startle Criterion is recommended for blowdown noise. Control of noise from construction machinery and trucks is required. The Province of Ontario method is recommended, which is to write permissible levels into contracts and then to have compliance enforced by project authorities. The Federal Government noise standards for new trucks should be used to protect communities along the main haulage routes which will be subject to noise throughout the whole construction period.

WATER USE, WASTE WATER TREATMENT, AND DISPOSAL

The Panel required "selection *criteria for locating water supply facilities and waste water treatment and disposal installations. Water quantities and treatment /eve/s should also be detailed for representative water-consuming facilities such as construction camps and for hydrostatic pipe testing. In addition potential environmental impacts and mitigation measures should be described".*

At this stage in project planning the Panel is satisfied with the information provided in the Foothills submissions on this subject matter and in the undertakings given by the company at the technical hearings,

SOLID WASTE MANAGEMENT, TOXIC AND HAZARDOUS MATERIALS, FUELS AND CONTINGENCY PLANNING

The Panel required *"information on types and quantities of solid wastes for the Project and a typical plan for the management of such wastes, including the gathering, transportation* **and methods of disposal, and**

'a plan for the management of toxic and hazardous materials and fuels. Such a plan would include details on dykes, berms, records and logs, metering systems, distribution systems and disposal techniques, and

"a contingency plan for spills of hazardous or contaminating materials, fires, explosions and other environmental emergencies ".

The Foothills documents and the technical hearings yielded a substantive response to these issues. Undertakings were made at the hearings which should meet the requirements.

ARCHAEOLOGY AND HERITAGE AND CULTURAL RESOURCES

Foothills was not required to provide information on this subject for the 1982 technical hearings. However, briefs were received from the Department of Heritage and Cultural Resources, Government of Yukon, the National Museum of Man, and the Council for Yukon Indians.

The Panel learned that the recent establishment of the Heritage Branch in the Government of Yukon permits an opportunity for co-operation and coordination of surveys with the Archaeological Survey of the Museum of Man. It is expected that the subject will be given further attention in Yukon. Foothills carries out work on archaeological investigations in Yukon under terms and conditions and guidelines pursuant to the Northern Pipeline Act and under permit issued by the Government of Yukon. The draft of the terms and conditions and guidelines was provided to the Northern Pipeline Agency by an archaeologist from the National Museum of Man.

The Panel is satisfied that the organizations are in place to ensure that project aspects of archaeology and heritage and cultural resources can be properly managed.

4. CONCLUSIONS

The Panel concludes that the preliminary environmental planning of the project is adequate and that the proposed pipeline can be constructed and operated in an environmentally acceptable manner, that the information for project planning is largely available and that Foothills and technical agencies of government are aware of the problems and options for solutions.

By following the recommendations given in this report and listed below, the Northern Pipeline Agency, other government agencies, and Foothills will effectively minimize the detrimental effects. The recently announced two-year delay period gives more time to act on these recommendations. The Panel attaches particular importance to Recommendation 24 on construction scheduling.

5. RECOMMENDATIONS

PHYSICAL AND ENGINEERING CONCERNS

GEOTECHNICAL ASPECTS AND PIPELINE INTEGRITY

Permafrost

1. The Northern Pipeline Agency should ensure that Foothills actively pursues engineering and environmental information on new and existing large diameter pipelines in permafrost areas and incorporates the results into the pipeline design in critical areas.

2. Secondary frost heave should be further researched and assessed for its risk to the project in permafrost zones and where the pipe is chilled.

Frost Heave and Thaw Settlement

3. Research and development on pipe behavior under differential frost heave and resulting design modifications should be given a high priority to insure the integrity of the pipe in permafrost conditions and to avoid environmental impacts that might arise along the right-of-way.

4. A rigorous error analysis should be made of the geothermal calculations needed to support the pipeline design. This should include better information on thermal and hydraulic properties of the soil and ground surface energy co-efficients.

The Problem of Subsidence Along the Route after Abandonment

5. Before leave to commence construction is given, Foothills should file a viable project abandonment plan with options to mitigate predicted environmental impacts, including post-abandonment subsidence.

The Integrity of the Pipeline in the Event of Earthquakes

6. The technical feasibility of the Kluane Lake Crossing should be given on-going review to ensure the integrity of the pipeline, and the subject of lake sediment liquefaction potential should be more rigorously analyzed.

7. A technical and public review would be required if the lake crossing route is dropped in favor of a land route through or adjacent to Kluane National Park.

HYDROLOGY AND WATER CROSSINGS

Design Flow Criteria and Small Stream Hydrology

a. The Panel notes differences in opinions and approach on methodology for predicting flows by Foothills and government reviewers and recommends that the Northern Pipeline Agency consider the lack of an agreed solution and, more importantly, lead the way in identifying and executing a resolution to the problem. In addition, Foothills' claim on river crossing designs should be checked against available records on pipeline failures at river crossings during the past 10-20 years.

9. As a mean to further assuring adequate hydrologic design, the Northern Pipeline Agency and Foothills should consult with Shakwak Project, Public Works Canada, and Government of Yukon Highway maintenance personnel to determine their calculation methods and subsequent performance of structures.

Streams on Alluvial Fans; Mud Flows, Debris Torrents, and Related Phenomena

10. Foothills should present a plan for dealing with shifting stream channels, debris torrents, mud flows and channel degradation which may occur on high-energy streams on alluvial fans. The plan should reflect consultations with government agencies and industry responsible for other projects along the pipeline route in Yukon.

Water Crossing Designs

11. For the purposes of final designs and locations of stream crossings, Foothills surveys of natural icings should be continued to establish the maximum extent of recurring icings and intermittent occurrences.

Disruption of Ground Water Flow by a Chilled Pipeline

12. Foothills should further investigate the potential for occurrences of project-induced icings, their expected magnitude and impact, and also propose mitigative measures.

Revegetation and Erosion Control

13a. Foothills should continue to monitor and evaluate the results of the seven test sites along the Alaska Highway in Yukon. This is the only field testing associated with the revegetation plan. Serious problems may yet arise which can be taken into account in the operational revegetation program.

13b. Before leave to commence construction is given, Foothills should furnish a developed plan for a Yukon nursery to provide shrubs and trees for the revegetation program. At present, plans for the nursery are not sufficiently advanced to assess the adequacy of the facility.

13c. Before leave to commence construction is given, Foothills should submit a plan for the acquisition and use of hay and/or straw for ground cover during the revegetation operation. Local sources are in high demand at present and large amounts may have to be trucked in from outside of the project area.

13d. The results of the revegetation monitoring program should be reviewed annually for the first 3-5 years following project completion. Presumably, after that period of time, the major problems will be evident and appropriate measures can be taken.

RELATED STRUCTURES AND ACTIVITIES

Granular Materials

14. Before leave to commence construction is given, a granular resource protection plan should be submitted and reviewed for location, operation, and rehabilitation of all granular extraction sites.

BIOLOGICAL CONCERNS

FISHERIES

15. Right-of-way inspection should include monitoring of erosion and pipeline integrity at water crossings in order to protect fishery resource values.

16. Construction techniques to minimize sedimentation at stream crossings should be submitted to the Northern Pipeline Agency.

WILDLIFE

Waterfowl

17. Foothills should prepare a well-documented report on the subject of sensory disturbance zones for waterfowl. The report should be submitted to the Northern Pipeline Agency for technical review with the Canadian Wildlife Service.

18. An atlas of critical fisheries and wildlife habitat should be compiled. This could be co-ordinated by the Northern Pipeline Agency and accomplished co-operatively by Foothills and the appropriate management agencies.

Raptors

19. In order that gyrfalcons be afforded protection, the Panel recommends that the existing sensitive period be recognized and respected unless otherwise agreed to by the Yukon Department of Renewable Resources through the Northern Pipeline Agency.

Alternative Modes and Wildlife

20. A well-designed monitoring study is recommended to include adequate pre-construction data on ungulate movements in the vicinity of the proposed raised sections. This should be followed by a detailed post-construction study of crossing success including behavioral responses and effectiveness of the three proposed design options. This could lead to further design modifications. The use of the ramps by species other than ungulates should also be documented.

ROUTE ALTERNATIVES

KLUANE LAKE AREA

21. Close scrutiny should be given to the installation procedure to minimize environmental effects on fish and fish habitat.

RANCHERIA VALLEY

22. Further information should be obtained on winter range use by the Rancheria caribou population in order to develop mitigation measures to protect the population.

ALTERNATIVE MODES

23. When the final modes and their extent are known, it is essential that the Northern Pipeline Agency undertake a review of the proposals and establish a mechanism for a monitoring program to examine the performance of the modes over time.

SCHEDULING ALTERNATIVES

24. In establishing its construction schedules, whether between summer and winter or at specific times and locations, Foothills should take full advantage of opportunities to reduce impacts on both fish and wildlife.

OTHER ISSUES

ASSOCIATED PROJECTS

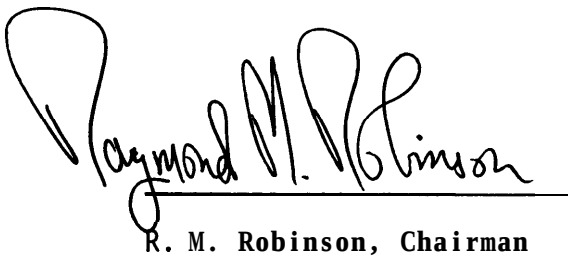
25. Prior to the approval of the final design stages of the project, Foothills should be required to update the status of associated projects in Yukon in order to insure that proper environmental planning is undertaken and mitigative measures are put in place to take account of these other projects.

NOISE

26a. The NEMA (d) curve should be used, in general, for silencing compressor stations as specified in Foothills' 1982 documents and at the technical hearings, but also the criterion of general audibility should be used for sensitive outdoor recreational areas such as the Marsh Lake Cottage area.

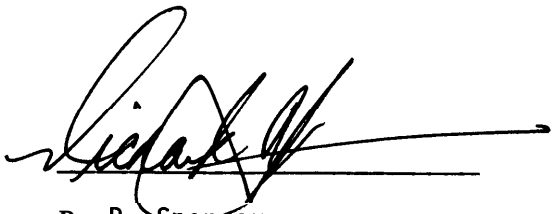
26b. The use of the Province of Ontario Startle Criterion is recommended for blowdown noise. Control of noise from construction machinery and trucks is required. The Province of Ontario method is recommended, which is to write permissible levels into contracts and then to have compliance enforced by project authorities. The Federal Government noise standards for new trucks should be used to protect communities along the main haulage routes which will be subject to noise throughout the whole construction period.

Environmental Assessment Panel
Alaska Highway Gas Pipeline Project

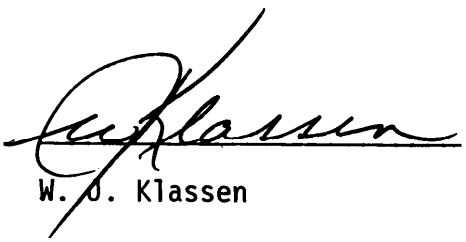


R. M. Robinson, Chairman

D. S. Lacate

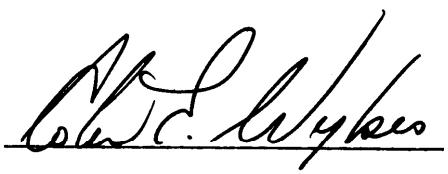


R. B. Spencer



W. J. Klassen

O. L. Hughes



C. E. Wykes

APPENDIX I
LETTER OF CLARIFICATION

Hull, Quebec
K1A OH3

1980.12.12 File: 4300-38P

Mr. A.B. Yates
Deputy Administrator
Policy and Programs
Northern Pipeline Agency
4th Floor, Shell Centre
400—4th Avenue S. W.
Calgary, Alberta
T2P OJ4

Dear Mr. Yates:

Subject: Clarification of the 1979 Report of the Environmental Assessment Panel on the proposed Alaska Highway Gas Pipeline Project.

The purpose of this letter is to clarify requirements given in the 1979 Panel Report on Alaska Highway Gas Pipeline Project, Yukon Section. This clarification is a result of two meetings held on August 7 and September 11, 1980, in which the Panel discussed the relevant issues with officials of the Northern Pipeline Agency and Foothills Pipe Lines (Yukon) Limited. A record of the meetings is attached.

Under the Federal Environmental Assessment and Review Process the roles of the Panel, NPA and Foothills are as follows:

Panel — Conducts a public review of an environmental impact statement prepared by the Proponent and reports to the Minister of the Environment on the adequacy of the preliminary environmental planning of the project.

NPA — The Initiating Department in the Process, NPA takes responsibility for the submission of the EIS and is the sponsor of the project within government. The NPA's responsibilities also include matters relating to final design in accordance with licensing and permitting requirements.

Foothills -The proponent for the project, responsible for information assembly and preparation of the EIS; Foothills is available to answer questions of the public during the public review stage.

In order for the Panel to clarify its report which was issued in September, 1979, trilateral meetings were held at Calgary on August 7 and September 11, 1980. All outstanding Issues were discussed and notes were taken for incorporation into this letter.

Because of the size and complexity of the overall project, it is useful to describe the state of preparedness on the Yukon portion of the pipeline. Preliminary location and design studies have been undertaken by the Proponent on all phases of the project. The Environmental Assessment Panel has requested further information on certain aspects of the preliminary plans including alternative routing, river crossings and facility siting. For particular aspects of preliminary design, surveying and field data collection and analysis is still underway. Examples are in frost heave-thaw settlement and in the search for alternative routes around Whitehorse, including the Ibex Pass route. In this respect, the Panel requires information on routing and design, including the potential environmental impacts and mitigation measures required. The Northern Pipeline Agency requires preliminary design and impact mitigation information for review in connection with the requirements of the environmental and socioeconomic terms and conditions. The Agency's responsibilities also include the review and approval of all final design aspects of the project.

Thus the rationale for the environmental assessment and review by the Environmental Assessment Panel is to examine in public the preliminary design and potential environmental impacts and mitigation measures and then to report to the Minister of the Environment.

With regard to the transmittal of the required information, the Panel is prepared to receive separate submissions on different topics such as Routing Alternatives, Geotechnical Issues, Fish and Wildlife Concerns and others provided that the separate submissions taken together will form a comprehensive and reviewable document. Separate submissions will afford reviewers the opportunity to begin the examination of new information well in advance of the public review.

As a result of the trilateral meetings the Environmental Assessment Panel has made the following points of clarification in relation to the information requirements set forth in the 1979 Panel Report to the Minister of the Environment. It is important to note that these points do not in any way remove or alter information requirements set forth in the Panel Report. The points are made principally to emphasize that the Panel's requirements are related to preliminary design, potential environmental impacts, and mitigation measures, including typical designs, but not to final designs.

1. Page 15

   The separate submissions referred to above must, when ultimately combined, form a single comprehensive document which when taken in conjunction with the 1979 EIS will be reviewable and respond to the concerns In the 1979 Panel Report. Each submission should summarize those related sections of the 1979 EIS which were found acceptable, make cross-references to the appropriate annex material, and elaborate the sections which were found deficient, all in a manner which will assist the public and technical reviewers to focus on the outstanding issues.

2. Page 16 PHYSICAL AND ENGINEERING CONCERNS, GEOTECHNICAL ASPECTS AND PIPELINE INTEGRITY, PERMAFROST

   The Proponent has prepared a frost-heave/ thaw settlement study program which will be submitted in response to requirements given on pages 16-2 1 of the Panel Report. Because of the lack of field data in some subject areas, it is noted that some design concepts in this section will be preliminary.

3. Page 23 SLOPE STABILITY

   The Panel seeks design concepts and discussion of impacts in this section, particularly for subject matter on which there is a lack of field data.

4. Page 26 HYDROLOGY AND WATER CROSSINGS DESIGN FLOW CRITERIA

   The Panel seeks the rationale for the criteria for project design flows. Design flows are also requested for typical streams along the project route.

5. Page 29 WATER CROSSING DESIGNS

   The Panel seeks a developed approach to studies on crossings in order to understand the potential environmental impacts and proposed mitigation measures.

6. Page 31 PROJECT INDUCED ICINGS

   The Panel will seek a description of potential effects of pipeline induced icings including effects on downstream overwintering areas of fish.

7. Page 32 REVEGETATION AND EROSION CONTROL

   It is noted that the Proponent had submitted a satisfactory outline for a program of revegetation and erosion control at the 1979 Public Hearings In Yukon. The Panel requires a revegetation plan based on that outline, and including the methodology used and examples of solutions for different terrain types.

RELATED STRUCTURES AND ACTIVITIES

Page 32 ACCESS ROADS

The Panel requires examples of design, operation and maintenance standards to be applied to temporary and permanent access roads. The Ibex Pass area may be used as an example. The east shore of Kluane Lake is another area which may be used as an example.

8. Page 34 COMPRESSOR STATIONS, CONSTRUCTION CAMPS, MATERIAL STORAGE AREAS, AND CEMENT (CONCRETE) FABRICATION PLANTS

   The Panel notes that at the 1979 Public Hearings in Yukon, the process for locating the compressor stations was not well understood by the public, the technical review agencies and by the Panel. The Panel requires a description of the methodology used to locate compressor stations.

   The Panel requires the rationale for the criteria used to locate pipeline facilities along the route, together with an update on proposed location of facilities and a description of potential environmental impacts and mitigation measures, including the ice fog potential at compressor station sites.

9. Page 35 BIOLOGICAL CONCERNS FISHERIES

   The Panel requires descriptions of typical summer and winter construction spreads giving the integration of time windows when fish and wildlife values would be least affected by construction and operation of the pipeline.

10. Page 37 CULVERTS

The Panel requires information on how culverts are to be designed, installed and operated so as to minimize detrimental effects on fish life.

11. Page 38

The Panel requires a general discussion of the fish over-exploitation problem and potential mitigation measures along the pipeline route.

12. Page 39 WILDLIFE

See: Item no. 9 above re integration of time windows for fisheries and wildlife. The Panel requires examples of critical wildlife maps or ranges with an analysis providing an indication of construction scheduling and alignment and mitigative measures to reduce predicted impacts.

The Panel notes that an example of a construction schedule for the Ibex Pass section has been prepared by the Proponent and will be submitted for review.

The Panel notes that information on the implications of new access on wildlife, particularly where there are major diversions of the pipeline from the Alaska Highway (P. 40), may be dealt with under the Route Alternatives section (P. 41).

13. Page 4 1 ROUTE ALTERNATIVES KLUANE LAKE AREA

With regard to the section of the pipeline from the east end of the Kluane Lake underwater crossing to where the alignment rejoins the Alaska Highway (approx. KP 225 to 250), the Panel will require a typical crossing evaluation, and the identification of sensitive areas and the potential environmental impacts and mitigation measures.

With regard to the probable extent of burial of the underwater section and related matters (p. 42, bottom paragraph), the Panel will require design concepts and a discussion of the potential environmental impacts and the proposed mitigative measures.

The Panel requires a scenario of a major break In the pipeline in Kluane Lake wlth a description of potential environmental impacts and mitigation measures (p. 43, top paragraph).

Page 43 IBEX PASS AREA

In order for the Panel to give this routing matter a thorough examination, information is required in report and map form on the preferred route, alternatives and sub-alternatives, land use and access road locations and a discussion of impacts and mitigating measures along the routes. Maps scales of 1:50,000 or I:I00,000 should be used and comparative cost figures should be given for the alternatives. For access roads in the Ibex Pass area, the Panel seeks information of general design measures.

Page 45 MT. MICHIE-SQUANGA LAKE AREA

The Proponent has announced its intention to move the route location next to the Alaska Highway in this area. The Panel requires a description of the potential environmental impacts and mitigation measures for the new route.

Page 58 RANCHERIA VALLEY

The Panel requires the rationale for relocating approximately 33 km of the line on the south side of the Rancheria River, together with a description of problem areas. wtential impacts including those havina to do with fisheries. wildlife and aesthetics, and mitigation measures. In this regard, the Panel seeks a general description of terrain conditions on the respective sides of the valley.

14. Page 48 ALTERNATIVE MODES

The Panel seeks information on design concepts for alternative modes and on the potential environmental impacts and mitigation measures associated with these modes.

The Panel requires an estimate of the amount of borrow material required for alternative modes and confirmation that such supplies do exist. The Panel notes that specific information on the location of borrow material may not be available until the final design stages of the project.

17. Page 49 SCHEDULING ALTERNATIVES

The Panel requires the rationale and an overall scheduling plan with information on the lengths of spreads and the implications to fish and wildlife.

18. Page 50 AESTHETICS

The Panel requires an aesthetics plan based on material submitted by the Proponent at the 1979 Public Hearings.

19 Page 51 ASSOCIATED PROJECTS

The Panel requires a scenario of future associated projects and their environmental implications.

20 Page 51 RECREATIONAL LAND USE

The Panel seeks developed responses to deficiencies tabled at the 1979 Public Hearings.

21 Page 53 NOISE

The Panel notes that items 3 and 4 under this item call for mitigation plans which the Proponent has not yet prepared because it is the Proponent's view that these are final design items. Therefore it may be necessary for the Northern Pipeline Agency to take over responsibility for these items.

22 Page 54 SOLID WASTE MANAGEMENT, TOXIC AND HAZARDOUS MATERIALS, FUELS AND CONTINGENCY PLANNING

The Panel requires that the Proponent demonstrate the capability to deal with collection, storage, transportation and disposal of solid wastes, toxic and hazardous materials and fuels, as well as the capability to react to emergency spills of hazardous or contaminating materials, fires, explosions, and other environmentally damaging events.

If there are questions on this matter please contact me at (819) 997-1000.

Yours sincerely,

Ewan R. Cotterill
Chairman
Alaska Highway Gas Pipeline
Environmental Assessment Panel

Attachments

APPENDIX P-PANEL MEMBER BIOGRAPHIES

RAYMOND M. ROBINSON-CHAIRMAN

Mr. Raymond Robinson was appointed Executive Chairman of the Federal Environmental Assessment Review Office (FEARO) January 1, 1982. He came to the position after eight years with Environment Canada, the last three as Assistant Deputy Minister, Environmental Protection.

Raised in Victoria, B.C., Mr. Robinson received a B.A. from the University of British Columbia. Upon graduation in 1958, he joined the Department of External Affairs as a Foreign Service Officer. With External Affairs, he gained varied experience in Canada, Colombia, Ecuador and New Zealand serving as Counselor and Acting High Commissioner at his last overseas post. In 1963-65 while serving in Ottawa, Mr. Robinson dealt with Canada's relations with Israel and certain Arab countries. In 1971-73 he was the Deputy Director of External Affairs' U.S. Division. In that position, he served as coordinator of the Canadian Government team which negotiated the Canada-United States Agreement on Great Lakes Water Quality signed in 1972.

Since 1973, Mr. Robinson has served successively as Environment Canada's Director of Federal-Provincial and Canada-U.S. Relations, Director General of Air Pollution Control within the Environmental Protection Service and Assistant Deputy Minister in charge of the Environmental Protection Service. Acid rain and toxic chemicals were among the most challenging problems which he had to face while in E.P.S.

Mr. Robinson is also Chairman of the Vancouver International Airport Expansion Environmental Assessment Panel.

OWEN HUGHES

Dr. Hughes holds a Bachelor of Applied Science degree from the University of British Columbia (1950) and a Doctor of Philosophy degree from the University of Kansas (1959).

From 1950-52 Dr. Hughes was Technical Officer and from 1953 to the present, Geologist and Research Scientist with the Geological Survey of Canada. Up to 1960 he worked on problems of Pleistocene and engineering geology in Nova Scotia, northern Ontario and northern Quebec. From 1960 to the present has carried out similar studies in Yukon and the Northwest Territories.

In 1974 Dr. Hughes was a member of the Mackenzie Valley Pipeline Assessment Group. During the Berger Inquiry on that project he served as advisor to the Inquiry Counsel.

Since 1977 Dr. Hughes has been a member of the Alaska Highway Gas Pipeline Environmental Assessment Panel

WILLIAM J. KLASSEN

A native of Manitoba, Mr. Klassen arrived in the Yukon in 1966 as a constable in the Royal Canadian Mounted Police. In 1970, he began employment as a Game Guardian with the Yukon Game Branch. He graduated from the University of Alaska (Fairbanks) with a B.Sc. in Wildlife Management in 1976.

Since 1976 he has been employed by the Yukon Wildlife Branch and the Yukon Pipeline Branch, working on environmental impact assessment, particularly concerning effects of development on wildlife. He recently received a Master of Forestry degree from the Yale School of Forestry and Environmental Studies.

DOUGLAS S. LACATE

Dr. Lacate received a B.Sc.F. from University of New Brunswick in 1956 and an M.Sc. from Cornell University in 1959.

He was employed as research scientist with federal Forestry Branch, 1956-1960, working on forest land classification throughout eastern Canada. He transferred to British Columbia in 1960 and continued forest land classification research until 1964 at which time he was seconded to the Canada Land Inventory Program (ARDA) and served as provincial Co-ordinator of the Forestry and Agriculture Capability program.

Dr. Lacate completed his Ph.D. in 1970 at Cornell University in the fields of natural resource management and environmental impact assessment of highway developments. He was associate professor at the University of British Columbia from 1970-1973, teaching airphoto interpretation and land classification and evaluation.

He worked on the evaluation of terrain in the Mackenzie Valley 1971-72 and in 1974 he returned to federal public service as Regional Director of the Lands Directorate, Environment Canada, in the Pacific and Yukon region where he has been stationed up to the present.

Dr. Lacate has been a member of the Alaska Highway Gas Pipeline Environmental Assessment Panel since 1977. In addition he served as panel member on the Shakwak Highway Project Environmental Assessment Panel.

RICHARD B. SPENCER

Mr. Spencer graduated from the University of Alberta with a Bachelor of Arts degree in 1971. Later he received a Master of Science in Geography from the same University, specializing in the field of Resource Management.

During the period 1971 to 1978, Mr. Spencer worked as a research contractor and a consultant with environmental consulting firms. He has conducted environmental assessments on a broad range of developments, including northern oil exploration and pipeline construction, northern highway construction and park proposals.

In 1978, Mr. Spencer joined the federal department of Public Works and moved to Whitehorse as Environmental Coordinator for Shakwak Highway Project. Currently, Mr. Spencer is Regional Manager of Land Resources with the Department of Indian and Northern Affairs in Whitehorse. He is Chairman of the Department's Regional Environmental Review Committee and the Territorial Land Use Advisory Committee.

COLIN E. WYKES

Mr. Wykes has a B.Sc.A. (1965) from University of Guelph, majoring in Fisheries and Wildlife Biology, and an M.Sc. in Limnology (1967) from the same university.

From 1967 to 1973, Mr. Wykes was Biologist, Resource Development Branch, Federal Department of Fisheries, Halifax, N.S, working in fisheries management and development work throughout the Maritime Provinces.

From 1973 to the present he has been Director, Environmental Protection Service, Environment Canada, at Whitehorse. Mr. Wykes also serves as a member of the Yukon Territory Water Board. Since the fall of 1981, Mr. Wykes has been Director of Corporate Affairs, Environment Canada, in Yukon.

APPENDIX 3

Technical Hearings Agenda
Environmental Assessment Panel
June 7-12, 1982, Yukon Inn, Whitehorse, Yukon

Monday, June 7, 1982

14:00—17:00 hours	Opening Statements and Overview Briefs Geotechnical Issues
19:30—22:00 hours	Geotechnical Issues (continued)

Tuesday, June 8, 1982

14:00—17:00 hours	Geotechnical and Hydrological Issues
19:30—22:30 hours	Hydrological Issues (continued) Revegetation Issues

Wednesday, June 9, 1982

10:00—12:30 hours	Revegetation Issues (continued) Design Mode Issues
14:00—17:00 hours	Design Mode Issues (continued) Alternative Routes
19:30—22:30 hours	Fisheries and Wildlife Issues

Thursday, June 10, 1982

14:00—17:00 hours	Wildlife Issues (continued) Scheduling Issues Noise Impacts and Mitigation Ice Fog
19:30—22:30 hours	Fuels and Hazardous Materials Waste Disposal Associated Projects Campgrounds and Recreation Areas Aesthetics Archeology and Heritage Resources

Friday, June 11, 1982

10:00—12:00 hours	Closing Statements

APPENDIX 4

PARTICIPANTS IN THE PUBLIC REVIEW, 1982.

Government (Federal, Territorial, Municipal)

K. Ambrock, Northern Pipeline Agency
J. Cinq-Mars, Chairman, Rescue Archaeology Program, National Museum of Man
J. Kuhn, Biologist, Renewable Resources, Yukon Territorial Government
R. Edwards, Energy, Mines and Resources Canada
J. Ferbey, Deputy Minister, intergovernmental Relations, Yukon Territorial Government
D. Kittle, Environmental Protection Service, Environment Canada
R. McCandless, Environmental Protection Service, Environment Canada
J. Naysmith, Northern Pipeline Agency
J. Payne, Habitat Protection Branch, Department of Fisheries and Oceans
D. Perry, Department of Heritage and Cultural Resources, Yukon Territorial Government
M. Romaine, Lands Directorate, Environment Canada
V. Schilder, Environmental Assessment Division, Department of Indian Affairs and Northern Development
G. Zealand, Department of Fisheries and Oceans
D. Steventon, Ministry of the Environment, British Columbia
P. Strilaeff, Inland Waters Directorate, Environment Canada
Derek Wolff, Environment Canada
A. Yarranton, Northern Pipeline Agency

Groups, Associations, & Industry

Foothills Pipe Lines (South Yukon) Ltd.

M. Carlson
W. Deyell
P. Dixon
R. Eccles
J. Ellwood
D. Fernet
D. Fielder
R. Galatiuk
M. Lesky
G. Lipsett
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R. Jakimchuk
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Sidney, British Columbia

D.B. Lister
D. B. Lister and Associates Limited
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National Research Council
Acoustics Laboratories
Ottawa, Ontario

R.O. Van Everdingen
Inland Waters Directorate
Environment Canada
Calgary, Alberta

P. J. Williams
P.J. Williams and Associates Limited
Ottawa, Ontario

APPENDIX 5

Written Briefs Received by the Panel, 1982 Hearings, Whitehorse.

1. **National Museums of Canada**

   "Heritage issues and the Alaska Highway Gas Pipeline Project: The Case of Prehistoric and Protohistoric Archaeology". J. Cinq-Mars. May 18, 1982. 4 pages.

2. **Department of Indian Affairs and Northern Development**

   "Review of Addenda Submissions to the Environmental Impact Statement of Alaska Highway Gas Pipeline". V. Schilder. May, 1982. 18 pages.

3. **Department of Fisheries and Oceans**

   "Brief on Addendum to the Environmental Impact Statement for the Yukon Section of the Alaska Highway Gas Pipeline". J. Payne. June, 1982. 8 pages.

4. **Department of Environment**

   "Alaska Highway Pipeline Project-Department of Environment Submission to the Federal Environmental Assessment and Review Process Panel Public Hearings". M. Romaine. June, 1982. 58 pages.

5. **Department of Energy, Mines and Resources**

   "Comments on Addenda to the Environmental Impact Statement for Alaska Highway Gas Pipeline Project". R. Edwards. June 1982. 4 pages.

8. **Government of Yukon**

   "Overview Brief on Addendum to the Environmental Impact Statement for the Yukon Section of the Alaska Highway Gas Pipeline". J. Ferbey. June, 1982.4 pages.

7. **Department of Indian Affairs and Northern Development**

   "Supplement to Review of Addenda Submissions to the Environmental Impact Statement for the Yukon Section of the Alaska Highway Gas Pipeline". V. Schilder. June, 1982. 1 page.

8. **Peter J. Williams and Associates Ltd.**

   "Review of Addenda to Environmental Impact Statement for the Yukon Section of the Alaska Highway Gas Pipeline". P. Williams. June 5, 1982. 33 pages.

9. **Government of Yukon**

   "A Yukon Perspective on Heritage Issues and the Alaska Highway Gas Pipeline Project". D. Perry. June, 1982. 6 pages.

10. **Council for Yukon Indians**

    "Yukon Indian Heritage Resources and Preservation in the Context of the Alaska Highway Gas Pipeline Project". J. Hunston. June, 1982. 8 pages.

APPENDIX 6

Acknowledgements

The Environmental Assessment Panel wishes to thank the public and members of government agencies for information provided during the review, as well as the following Panel staff for their assistance:

Patrick Duffy	Panel Secretary
Robert Greyell	Assistant to the Secretary
James Clarke	Hearings Clerk
Audrey Laing	Secretarial Support
Norma Felker	Secretarial Support
Peter Williams	Technical Advisor
William Bowes	Technical Advisor
Robert Van Everdingen	Technical Advisor
Brent Lister	Technical Advisor
Ronald Jakimchuk	Technical Advisor
Joseph Piercy	Technical Advisor
William Hodge	Technical Advisor
Gordon Beanlands	Technical Advisor

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