PRELIMINARY ENVIRONMENTAL IMPACT
ASSESSMENT OF THE
PROPOSED ALCAN PIPELINE
VOLUME I
(BEAVER CREEK TO ZAMA LAKE)

ALCAN PIPELINE COMPANY
DOCKET NO. CP75-96, ET AL
HEARING EXHIBIT NO. AP-6 (LWM-1)

PRELIMINARY ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED ALCAN PIPELINE VOLUME I (BEAVER CREEK TO ZAMA LAKE)

June 1976

FOR

GULF INTERSTATE ENGINEERING COMPANY
Houston, Texas

BY

C.D. SCHULTZ & COMPANY LIMITED
Vancouver, Canada

SCHULTZ

June 18, 1976
Our File: G52.3.1

Gulf Interstate Engineering Company
930 Americana Building
P.O. Box 1916
Houston, Texas 77001

Attention: James T. Pinto
Project Manager

Dear Sirs:

In accordance with your request of 8th of June, 1976, we submit herewith our report: "Preliminary Environmental Impact Assessment of the Proposed Alcan Pipeline". This report covers two sections of the Canadian portion and is structured in two parts. Volume I deals with the Beaver Creek, Yukon Territory to Zama Lake, Alberta line, and Volume II with the Fort Nelson, British Columbia to Sumas, Washington line. A third volume contains the appendices to these reports.

The report on the Beaver Creek to Zama Lake section is based on a review of existing information. Field work was limited to a single overview flight. The Fort Nelson to Sumas report is based primarily on previous studies undertaken for Westcoast Transmission Company Limited, by the Schultz organization. A report entitled "Environmental Impact Assessment for the Proposed Mainline Looping" was submitted in October, 1975, and pertains to all of the loops proposed for the Alcan Pipeline.

A specialized, interdisciplinary team was assigned to this project, and consisted of the following key personnel:

Management Team

L.W. Mottus, Ph.D.	Project Director
G. Mains, Ph.D.	Project Manager
J.M. Teversham, M.Sc.	Coordinator, Physical Factors
K.J. Clark, B.Sc.	Coordinator, Biotic Factors
A.L. Horsman, M.Sc.	Coordinator, Socio-Economic Factors

June 18, 1976
Our File: G52.3.1

Team Members

C.E. Barker	Pipeline Construction
M.G. Boyd, B.Sc.	Wildlife Biology
J.A. Boyle, P.Eng.	Engineering
S.M. Geddes	Social Structure
D.E. Gyton, M.Sc.	Forestry
J.S. Hart, B.Sc.	Hydrology
C.M. Hayward, B.Sc.	Ecology
M.J. Kent, M.A.	Physical Geography
M.R. Malzahn, B.A.	Economics
P.E. Ostergaard, M.A.	Economics
D.G. Paton, B.Sc.	Ecology
S.L. Pattison, B.A.	Cultural Geography

Curricula vitae of these professionals have been submitted in Appendix V of Volume III.

This report presents our understanding of the proposed project and its potential impacts on the natural and socio-economic environments, along with suggested means for mitigating or avoiding these impacts. In general, this overview evaluation suggests that significant long-term impacts are unlikely to result from the proposed Alcan pipeline. While many potential and important short-term impacts along the corridor have been identified, it is our conclusion on the basis of this overview study, that with proper planning and the use of mitigative measures most of these impacts can be avoided or greatly reduced. Further detailed studies on a regional and site-specific basis are necessary to confirm this situation.

Thank you for considering C.D. Schultz & Company Limited to undertake this project. It has been both challenging and stimulating, and we look forward to the opportunity of serving you in the future. We would welcome the opportunity to discuss with you any aspect of this report that requires clarification.

Yours truly,

C.D. SCHULTZ & COMPANY LIMITED

L.W. Mottus, Ph.D.
Project Director

Geoff Mains

G. Mains, Ph.D.
Project Manager

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OF THE
PROPOSED ALCAN PIPELINE
(BEAVER CREEK TO ZAMA LAKE)

1.0 DESCRIPTION OF PROPOSED ACTION

Northwest Pipeline Corp., Westcoast Transmission Company Limited, Alberta Gas Trunk Line Co. Ltd., and Foothills Pipe Lines Ltd. propose to construct and operate a pipeline system that will transport natural gas from the Prudhoe Bay area of Alaska to the metropolitan United States. This pipeline, known as the Alcan Pipeline, would follow the Alyeska Pipeline from Prudhoe Bay to Fairbanks, then parallel the Alaska Highway to Fort Nelson in northern British Columbia. From Fort Nelson, a portion of the gas would be delivered into the main transmission line of Westcoast for transport to the Northwest Pipeline Corporation system near Sumas on the B.C. - Washington border. The rest of the gas would be delivered to the Alberta Gas Trunk system east of Fort Nelson near Zama Lake for eventual delivery to the U.S. mid-west.

The section of the Alcan Pipeline between the Alaska/Yukon border at Beaver Creek and Zama Lake in Alberta will be constructed by Foothills Pipe Lines Ltd., Westcoast Transmission Company Limited, and Alberta Gas Trunk Line Co. Ltd. Foothills will be responsible for the Yukon section (512 miles), Westcoast for the British Columbia section (350 miles), and Alberta Gas Trunk Line for the Alberta section (50 miles). The mileage for this total section is approximately 912 miles. This report presents the environmental assessment of this part of the Alcan proposal.

A detailed description of this project is presented elsewhere in this submission. A summary of the proposed development is presented below.

1.1 Purpose

The rationale behind, and justification for the Alcan Pipeline is presented elsewhere in this submission. However, the primary purpose of the Beaver Creek/Zama section is to transport natural gas from the State of Alaska to existing pipelines in British Columbia and Alberta.

The section of the pipeline from Beaver Creek to Fort Nelson will carry approximately 2.3 billion cubic feet of Alaska gas a day when at peak capacity. At Fort Nelson, 31 percent (700 million cubic feet per day) of the volume will be diverted into the mainline system of Westcoast for transport to Sumas on the B.C. - Washington border. The remainder will move into Alberta for ultimate transport to the U.S. mid-west.

Consideration is presently being given to establishing a "gas swap" between Westcoast Transmission Company Limited and Foothills Pipe Lines Ltd. Under previous agreement, Foothills is committed to supplying Westcoast with 500 million cubic feet of gas per day via the proposed Mackenzie Valley system. If the Alcan project goes ahead, and if the "gas swap" agreement is made, Westcoast would not have to construct the connecting pipeline (141 miles) between Fort Nelson and the Northwest Territories (the proposed Territories Mainline Extension). The 500 million cubic feet of gas (after B.T.U. adjustment) would be delivered into the Westcoast system at Fort Nelson via the Alcan Pipeline. The equivalent amount of Mackenzie Valley gas would be replaced at Zama Lake.

1.2 Location

The Beaver Creek/Zama section of the proposed Alcan Pipeline follows, in general, the Alaska Highway between the Alaska/

Yukon border and Fort Nelson in British Columbia. From Fort Nelson, it extends eastward to Zama Lake in northwestern Alberta.

This section of the Alcan project consists of approximately 912 miles of pipe. The general location of the route is shown in Figure 1, and described in Table 1. Detailed location of the line is shown in the Section Maps (Figures 1A-1P). Mileages on the Section Maps are designated in three ways. From the Yukon-Alaska border to its entry into British Columbia, the Foothills Pipe Lines Ltd. portion is numbered Y0 to Y510; from the British Columbia border to the Alberta border the Westcoast Transmission Company Ltd. portion is numbered B0 to B350; and in Alberta, the Alberta Gas Trunk Line Co. Ltd. portion is numbered A0 to A50.

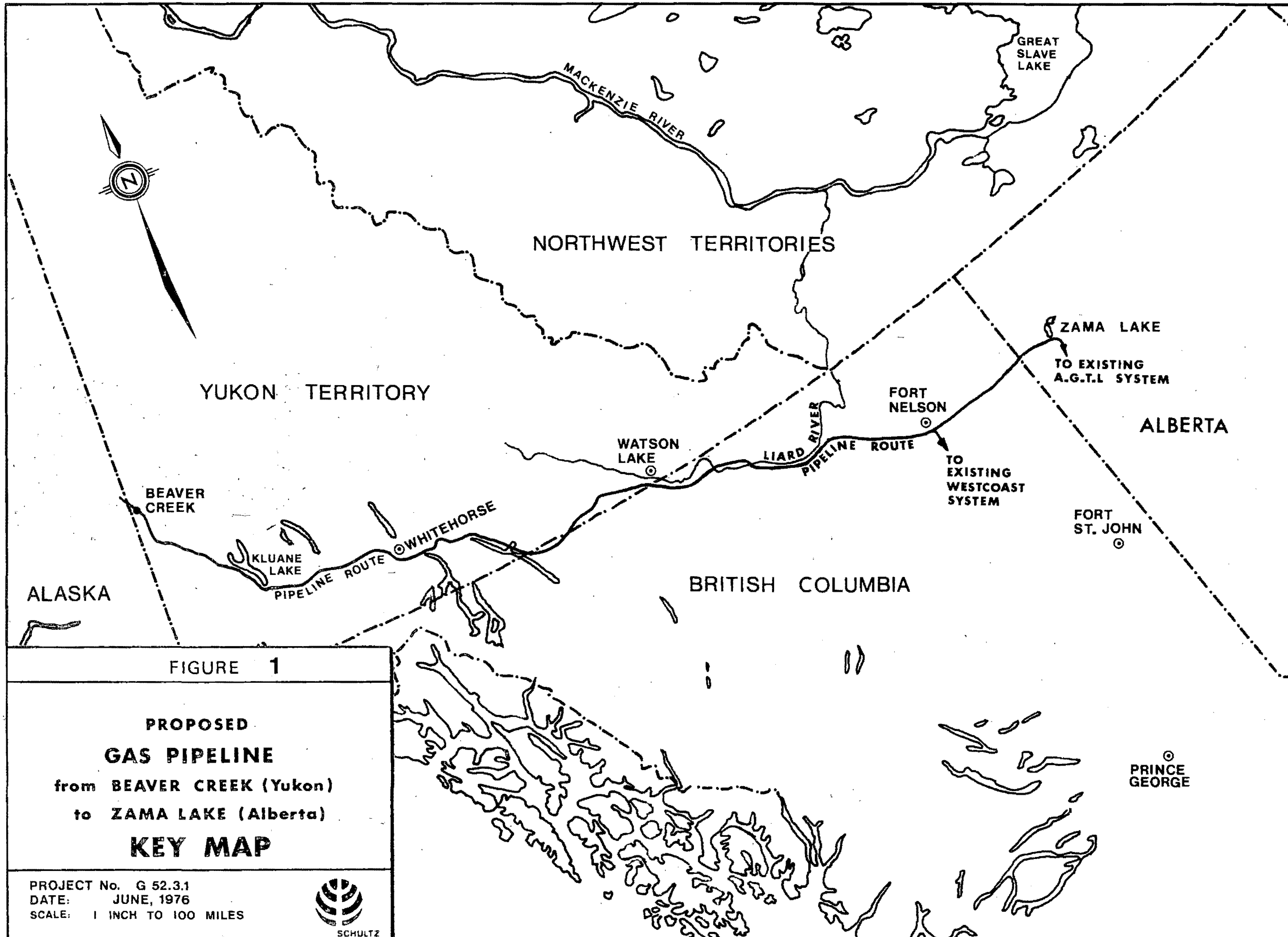


FIGURE 1

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

KEY MAP

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 INCH TO 100 MILES

TABLE 1

LOCATION OF FACILITIES ON BEAVER CREEK/ZAMA LAKE SECTION

	Section Mileage			
Compressor Station	Yukon	B.C.	Alberta	Remarks
	Y0.0			Alaska/Yukon Border
1	Y4.5			
2	Y53.6			
3	Y103.0			
4	Y162.6			
5	Y214.8			
6	Y261.8			
7	Y313.3			
8	Y372.0			
9	Y417.4			
10	Y474.7			
	Y511.6	B0.0		Yukon/B.C. Border
1		B7.0		
2		B57.4		
3		B104.0		
4		B152.0		
5		B202.6		
6		B254.0		Fort Nelson Process Plant
7		B350.5	A0.0	B.C./Alberta Border
1			A49.8	Zama Lake

Total Compressor Stations = 18

Total Mileage = 912.3

1.3 Land Requirements

Construction of the Beaver Creek/Zama Lake section of the proposed Alcan Pipeline will require approximately 20 square miles of land. Approximately 99 percent of this total represents pipeline right-of-way; the remaining 1 percent represents land required for the construction of related facilities.

The above mentioned land requirements must be considered as approximate. Detailed specifications were not available at the time of this writing. The calculations, and assumptions made at arriving at the estimated land requirements are as follows:

Rights-of-Way	912	miles
	100	feet wide
	11,056	acres
Compressor Stations	18	stations
	40	acres per station
	720	acres
Roads	30	miles
	66	feet wide
	240	acres
Miscellaneous	500	acres
Total Land	12,516	acres
	(20 square miles)	

1.4 Proposed Facilities

The Beaver Creek/Zama Lake section of the proposed Alcan Pipeline consists of approximately 912 miles of pipe. From Beaver Creek to Fort Nelson (766 miles), the pipe will measure 42 inches outside diameter. From Fort Nelson to Zama Lake (146 miles), the pipe will be 36 inches outside diameter.

Within British Columbia, the 42-inch steel pipe will generally have a wall thickness of 0.520 inches. In areas where additional strength is required (i.e. road crossings), the 42-inch pipe will have a wall thickness of 0.625 inches. In the 36-inch section, the pipe will have a wall thickness of 0.450 inches (0.540 inches at road crossings). All pipe will be Grade 70, Westcoast Specification No. 102, Revision 34, and will be manufactured in accordance with Categories I and II of the CSA-Z245 Series.

Specifications for the 42-inch outside diameter steel pipe within the Yukon Territory will probably be similar to those within British Columbia. The same probably applies to the 36-inch pipe in Alberta.

A total of 18 compressor stations will be required when the line is operating at full capacity. These stations will be located at approximately 50-mile intervals. Within British Columbia, only 2 of the ultimate 7 stations will be required during the initial stages of operation. The remaining stations will be constructed as required. Information on the initial compressor requirements in the Yukon and Alberta was not received. It is anticipated that no chilling of the gas will be done unless extensive amounts of permafrost are encountered. Chilling would be a possibility only on the section between the Alaska border and Kluane Lake.

Information on miscellaneous support facilities such as pipe storage yards, roads, campsites, etc. was not available at the time of this writing. However, it is assumed that Fort Nelson would continue to function as a major base of operations, and that facilities would also be located in major centers such as Whitehorse and Watson Lake.

1.5 Schedule

The schedule of activities for Westocast Transmission Company Limited on works related to that section of the Beaver Creek/Zama Lake Pipeline that traverses British Columbia is summarized is Figure 2.

Pre-construction activities on the Beaver Creek/Zama Lake Pipeline within British Columbia will be undertaken concurrently with the Fort Nelson/Sumas Looping Program.

Construction of the 350 miles of pipeline within British Columbia is planned to commence in December, 1978. The section between the Yukon/B.C. border and Fort Nelson will be constructed over four periods (two winters and two summers), and the Fort Nelson to Alberta section in two periods (two winters); completion dates are November 1, 1980 and April 1, 1980, respectively. Final testing of the total system will be completed by November 1, 1980 (anticipated).

The two compressor stations required to handle the initial flows will be constructed during the summers of 1979 and 1980. The nine major river crossings will be completed during the January-March period of 1979 and 1980.

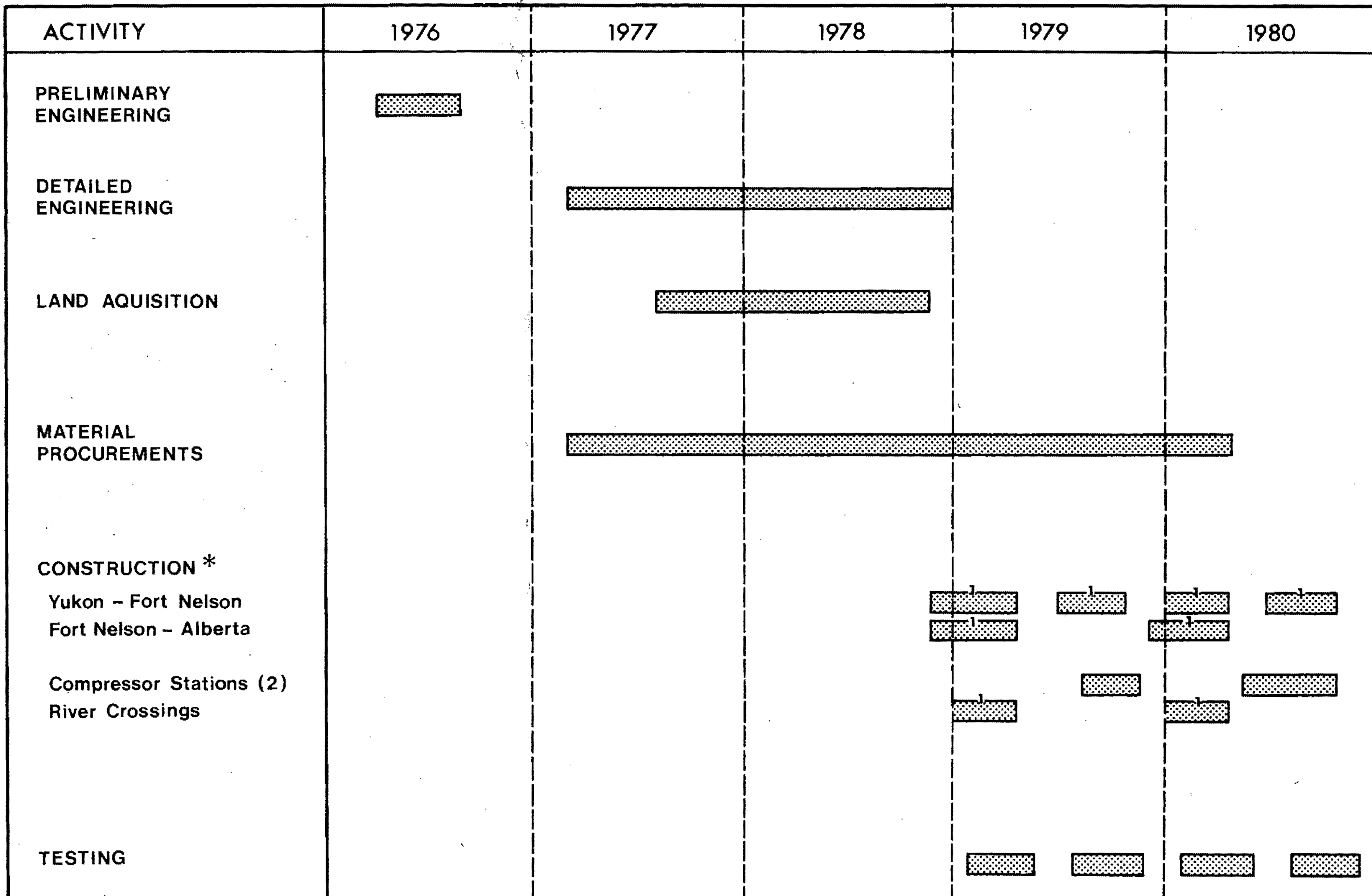
The schedule of activities for Foothills Pipe Lines Ltd. on the Yukon section of the Alcan Pipeline is as follows:

Year	Period	Mileage Segment/Spread
1	February-April	Y0-Y40
1	February-April	Y40-Y80
1	June-October	Y80-Y187
1	June-October	Y512-Y401
2	June-October	Y187-Y294
2	June-October	Y401-294

Further information was not available at the time of this writing.

FIGURE 2

SUMMARIZED SCHEDULE OF ACTIVITIES
for
WESTCOAST TRANSMISSION COMPANY LIMITED



*Numbers on bars indicate spreads

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1.6 Construction Procedures

The following procedures refer to those of Westcoast Transmission Company Limited. Similar procedures will probably apply in the Yukon Territory and in Alberta.

The standard procedures utilized for constructing previous pipelines in British Columbia will be employed. These are:

Route Location - based on functional requirements, aerial photographs and map interpretations, aerial reconnaissance, and environmental factors.

Clearing - machine cleared, with hand-clearing in sensitive areas. Unmerchantable timber is burned on a sled, and any merchantable timber salvaged if required.

Grading and Ditching - right-of-way is graded as required to facilitate access and location of the ditch.

Installing Pipe - involves stringing, welding, x-raying of welds, coating and lowering in of the pipe.

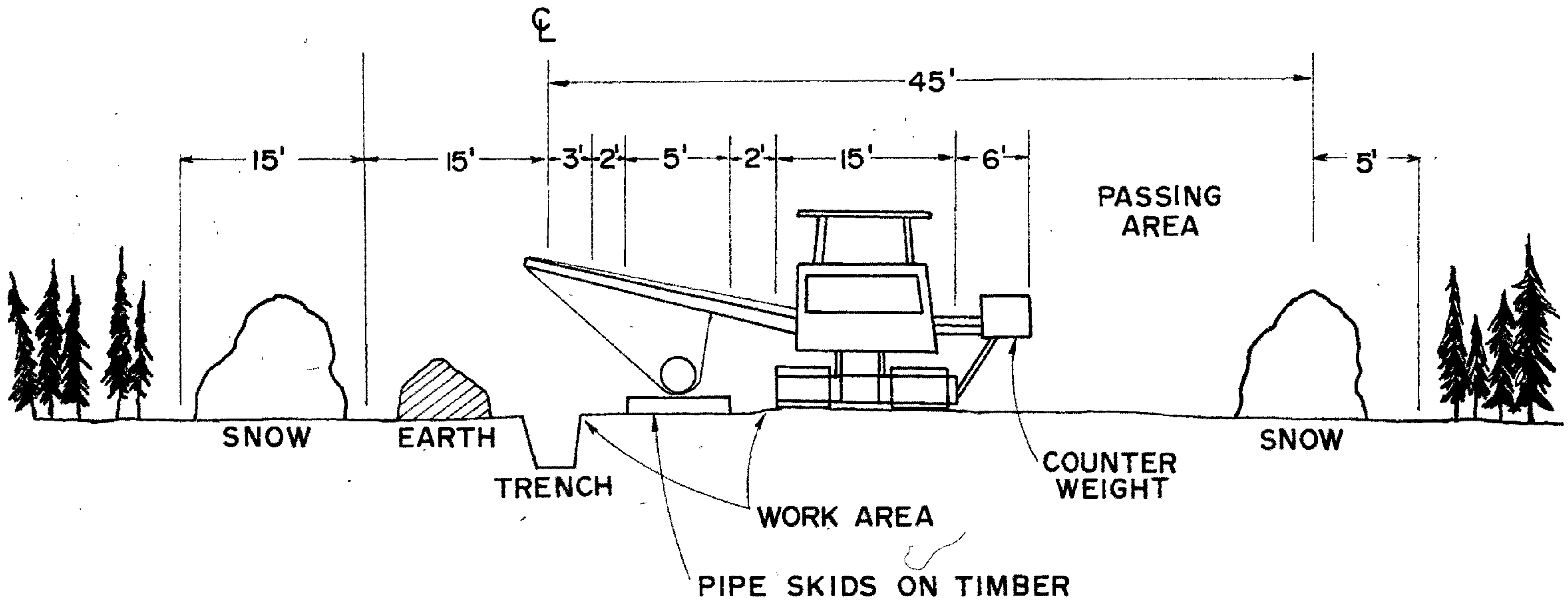
Back-filling - pipe is covered and mounded to allow for settlement of soil.

Testing Pipe - installed pipe is air or hydrostatic tested to check for structural soundness.

Cleanup - all debris that results during construction is removed from the right-of-way and surrounding area, and all areas utilized during construction are restored to their natural contour, as nearly as is reasonably possible.

FIGURE 3

PIPELINE R.O.W. DURING CONSTRUCTION



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Revegetation - left to natural means unless required to control erosion in which case artificial seeding and/or fertilization is undertaken. Revegetation is also done at the request of the landowner and/or controlling government authority.

The above procedures would be utilized for construction of the proposed pipeline. A schematic diagram of construction activities during the winter is presented in Figure 3.

In addition to the standard procedures presented above, the following procedures are utilized when and if required:

Erosion control - Drainage blocks are installed on all slopes where rill and/or gully erosion will occur. On specific steep slopes with high potential for erosion, berms are constructed.

Watercourse Crossing - Concrete river-weights are installed on all major river crossings. Also, across the complete floodplain of a meandering watercourse, it is standard practice to bury the pipeline at full river depth (four to ten feet).

Bog Crossings - Neutral buoyancy of the pipe traversing saturated organic terrain is achieved by installing concrete swamp weights.

Permafrost - Special procedures for permafrost are required, and provided for in Westcoast's standard contract document (see below).

Environmental considerations are an integral part of the pipeline construction specifications employed by Westcoast on all of their pipeline projects. A copy of these requirements is contained in Appendix II of Volume III.

The maximum work force required for the construction of the British Columbia section of the Beaver Creek/Zama Lake Pipeline is approximately 1,100 men. This is based on 500 men per pipeline spread, 75 for construction of compressor stations, and 50 for river crossings.

It is anticipated that the work force will be obtained from the labor pool within British Columbia. Approximately 20 percent of the work force will be obtained from local communities. Housing in construction camps will be provided as required.

For the Yukon section of the Alcan Pipeline, the maximum work force required during construction will be approximately 1,500 men. This is based on 450 men per pipeline spread, and an additional 200-250 men per spread for logistical support, supervisory services, and building compressor stations, and river crossings.

Further information on the Yukon and Alberta sections was not available at the time of this writing.

1.7 Operational and Maintenance Procedures

The following procedures are those of Westcoast Transmission Company Limited. Similar procedures will probably apply in the Yukon Territory. No information was received on the operational and maintenance procedure of Alberta Gas Line Co. Ltd. in Alberta.

The existing Westcoast system is served by field offices at Fort Nelson, Fort St. John, and Prince George with head offices located in Vancouver. Smaller area offices are maintained at McLeod Lake, Quesnel, Savona and Hope. Principal pipe storage yards are maintained at the Fort Nelson gas processing plant, the Fort Nelson maintenance and operation base, at Mile Post 301 on the Alaska Highway, Cabin Lake, Yoyo Central, various areas in the Fort St.

John gathering system, Chetwynd, Willow Flats, Prince George (Shelly), Station 3 (McLeod Lake), Savona and Hope. Warehouses are located at Fort St. John, Fort Nelson and Compressor Station 5 (Australian), with maintenance machine shops at Compressor Station 5 (Australian), and the Fort Nelson gas processing plant.

Westcoast currently operates an extensive telecommunications system composed of company-owned and leased facilities. "Main Haul" circuits comprise four full-time party line or selective private telephone channels interconnecting all company compressor stations, offices, warehouses and other fixed installations throughout the entire operating area. These channels are in the main leased from the B.C. Railway Company and are carried over that company's microwave system. A small portion of the facilities is leased from CN-CP Telecommunications for service in the southern area of the Westcoast system. In those areas where the Westcoast pipeline system is not within reasonable range of existing telecommunications systems, Westcoast owns and operates multi-channel point-to-point radio coverage.

Westcoast also owns and operates a two-way radio system which provides mobile radio coverage along the pipeline rights-of-way and contiguous highways throughout the pipeline system. Two-way radio base stations are provided at all compressor stations to provide coverage to mobile radio equipped vehicles in the compressor station areas and to provide backup support to telephone channels. The present two-way radio system is controlled from Fort Nelson, Fort St. John, Prince George, Savona, and Vancouver and can, when required, be remotely connected into a continuous end-to-end communications system. At present, the two-way radio system comprises approximately sixty base stations with 125 mobile and portable radio sets.

All of the Westcoast compressor stations, process plants and major sales metering locations are equipped with remote control/telemetry/data acquisition facilities operated under the control of a computerized master station in the Westcoast Vancouver Gas Control office. This system provides the gas control operation with minute-by-minute information regarding volumes into and out of the pipeline system, pressure and line pack conditions, station and unit operating parameters, alarms and status, etc. The control system also provides for remote starting and stopping of various prime movers within compressor stations and for the adjustment of discharge pressure set points.

With the additional responsibilities on the Alcan Pipeline, it is proposed that modest additions or modifications will be made to the already existing crews and operating, communications, and maintenance facilities maintained by Westcoast. In particular, there will be an increase in emergency maintenance equipment in the Fort Nelson area to serve the proposed and existing pipelines. This equipment will be in the form of mobile muskeg, excavation, lifting, welding and dozer equipment. Portable housing units will also be added for crew accommodation.

1.8 Future Plans

Specific information related to future planning is not available at this time. However, in the event of termination of operations and abandonment of the pipeline, the standard procedure within British Columbia is to leave the pipe in the ground, and to salvage the surface facilities. This would also apply in the Yukon Territory and Alberta.

2.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

2.1 Physical Features

2.1.1 Physiography and Topography

The general setting of the southern Yukon and northern British Columbia is influenced by the Cordilleran Region of Western North America. The physiographic boundaries have been delineated for the area by Holland (1964) and Bastock (in Douglas, 1970). Running from west to east the proposed pipeline will traverse seven physiographic divisions; the Shakwak Trench, Yukon Plateau, Cassiar Mountains, Liard Plain, Liard Plateau, Rocky Mountain Foothills and Fort Nelson Lowland.

From Mile Y50.0 to approximately Mile Y190.0, the pipeline traverses the Shakwak Trench.

The southwest border of the trench, the St. Elias Mountains, presents a straight almost unbroken face that rises sharply. It is incised only by large stream valleys from the Kluane Ranges. The northeast side of the valley bounded by the Yukon Plateau is less regular and more deeply incised by rivers and creeks. The Shakwak Trench forms a great furrow trending in a northwest-southeast orientation. The floor of the Shakwak Valley is about 2 to 5 miles wide and is covered by glacial deposits, alluvium, volcanic ash, and loess. These surficial sediments form extensive moraines, long narrow drumlin-like ridges, pitted outwash areas, and alluvial fans.

The Shakwak Trench owes its existence to the Shakwak Valley fault which extends over the length of the valley and has been subjected to vertical and lateral movement in recent centuries. The area was glaciated in the late

Wisconsin (earlier advances are suspected to have taken place). This glaciation is responsible for the extensive covering of drift and till.

From Mile Y0 to Mile Y50, Mile Y190 to Mile Y345, and Mile Y375 to Mile Y475 the pipeline crosses the Yukon Plateau. The first part of the Yukon Plateau has been subdivided into the Wellesley Basin. This is a broad undulating plain which slopes gently towards the Alaskan border. The plain is covered with drift and pitted terraces of gravels and silts. Low hills of bedrock may protrude above the plain up to 1,500 feet. The Beaver River has formed a meandering course along this plain with broad flats.

The second portion of the pipeline that crosses the Yukon Plateau from the Skakwak Trench traverses an area known as the Teslin Plateau. This plateau consists of a raised upland which may reach elevations of 6,000 to 6,650 feet. It is deeply incised by large rivers, effectively isolating the plateau into large segments. There is moderate relief within these segments over the level of the plain. The north and east sides of ridges and peaks exhibit signs of glaciation through cirque formation. The gently sloping surface has many small glacial depressions which are now waterfilled, especially west of Teslin Lake.

Between the Pelly Mountains, Teslin Lake, and the Cassiar Mountains, lies the Nisutlin Plateau of the Yukon Plateau. The area is relatively lower lying in elevation than other regions of the Yukon Plateau. It is covered with glacial drift and numerous small lakes which occur within the drift. The topography is broadly rolling and bedrock exposures are restricted in extent.

Along the eastern edge of Teslin Lake the pipeline follows a lacustrine terrace along the flank of the Big Salmon Range of the Pelly Mountains. This terrace has an average elevation of 2,500 feet.

From Mile Y425 to Mile Y465 the pipeline passes through the Stikine Ranges of the Cassiar Mountains. This range of mountains of moderate height (8,000 feet) is sharply scalloped by cirque glaciers above 7,000 feet. The slopes are often rounded and gentle in slope. There is a transition between the mountains of the Stikine Ranges and the lowland of the Liard Plain in the Dease Plateau. In this section the mountains are rather rounded or flat topped and the valleys are wider. The Dease Plateau lies between 3,000 and 5,000 feet in elevation. The mountains are mantled with extensive deposits of drift.

From Mile Y465 to Mile B90 the pipeline passes through the lowland of the Liard Plain. This area of slight relief lies between elevation 2,500 and 4,000 feet and is surrounded on all points by taller mountains and plateaus. The Liard Plain is separated from the Dease Plateau of the Cassiar Mountains by the 3,000 foot contour line. The face of the plain was modelled by glacial action into drumlin-like forms. Numerous depressions are now water-filled, and other evidence of glacial activity (eskers, moraines) contribute to the low relief of the area. The Liard River has incised the Liard Plain to over 100 feet.

From Mile B90 to Mile B145, the pipeline follows the Liard River through the Liard Plateau. This upland area of rounded, flat-topped summits and wooded ridges lies below 5,000 feet in elevation. The surface is incised by smaller creeks which flow into the Liard River. The Liard River has cut through the Liard Plateau by up to 1,000 feet.

The pipeline crosses the Liard and Toad Rivers in northern British Columbia. In the triangle between the two rivers the route cuts through a small portion of the Rocky Mountain Foothills before it enters the Fort Nelson Lowland of the Interior Plains System. This is an area of extremely low relief, in places flat, and alternatively gently rolling. The lowland lies in the Fort Nelson River drainage but over large areas drainage is not established and lakes and muskegs abound. The topography reflects the gentle nature of the underlying rocks and bedrock exposures are rare.

The area was covered by the Keewatin Ice Sheet in the Pleistocene. Ice movement was west and southwest with transported drift and boulders coming from the east. Elongate drumlins and flutings are readily apparent but of low relief so as not to show up in mapping. The land is covered by extensive moraines and meltwater channels, many of which now contain underfit streams.

2.1.2 Bedrock Geology

The proposed pipeline right-of-way follows the Alaska Highway from the Alaska-Yukon border to the British Columbia-Yukon border. The line then traverses northern British Columbia to Zama Lake, Alberta. Throughout the length of this line, a large number of regions are traversed, and several geologic studies (Bostock, 1952; Muller, 1967; Kindle, 1953; Wheeler, 1961; Mulligan, 1963; Gabrielse, 1963; Lord, 1944; Green et al., 1970; and Rutter et al., 1973) have been conducted within the proposed route of the pipe.

In order to describe the bedrock geology succinctly, the Yukon Territory is considered first, followed by northern British Columbia to Alberta. A study by the Alaska Natural Gas Transportation System described the bedrock geology from the Alask/Yukon border to Watson Lake. Their description is summarized below with additional data on British Columbia and Alberta sections gathered from Geological Survey of Canada.

Throughout most of the Yukon the proposed line lies within the Yukon Plateau, and passes briefly through the Pelly and Cassiar Mountains. Within these major physiographic regions there are a large number of differing geologic units.

a) Alaska-Yukon Border to Kluane Lake

The area from Mile Y0.0 to Y50.0 is underlain by metamorphosed sedimentary and igneous rocks of Paleozoic and Precambrian age. These have been designated as belonging to the Yukon Group and are continuous with the Birch Creek schist of Alaska. Within this portion of the proposed line phyllite and argillaceous chert is interbedded with quartzite. Prominant cliffs of resistant greenstone are also found in this region. Prior to the boundary of the Shakwak trench there occur intrusions of sedimentary and volcanic rocks of the Kluane Range.

b) Shakwak Trench and Dezadeash Valley

The Shakwak Trench from Mile Y50.0 separates the permo-Triassic and jurasso-Cretaceous rock of the Yukon Plateau to the northwest from the mid and lower Paleozoic rocks of the St. Elias Range to the southeast. Between White River and Kluane Lake, volcanic and sedimentary rocks are of the Cache Creek Group. Muller (1967) indicates volcanic rocks of basaltic and andesitic lavas with associated pyroclastic rocks underlying the slopes overlooking Kluane Lake.

Structural trends in this region have received considerable attention by a number of researchers (Campbell and Eisbacher, 1974; Muller, 1967; St. Amand, 1957; and Bostock, 1952). The Shakwak, Duke River and Dalton faults are part of Denali Fault System (Figure 4). These faults are remarkably linear from the Alaska/Yukon border in the northwest to Haines Junction in the southeast. Field studies in recent years have indicated minor activity on the Shakwak Fault at the Donjek River (R.B. Campbell, pers. comm.). However, the age of this activity is not known at present. These fault contacts are marked by small bodies of metamorphosed mafic and ultramafic rocks.

From Kluane Lake (mile Y150.0) and Haines Junction (Y190.0) to Y235.0, the line is flanked by the Dezadeash Group (Kindle, 1953). This group consists of argillite, greywacke, impure limestone, tuffaceous sandstone, and bedded volcanic tuff. At Mile Y235.0 the right-of-way traverses

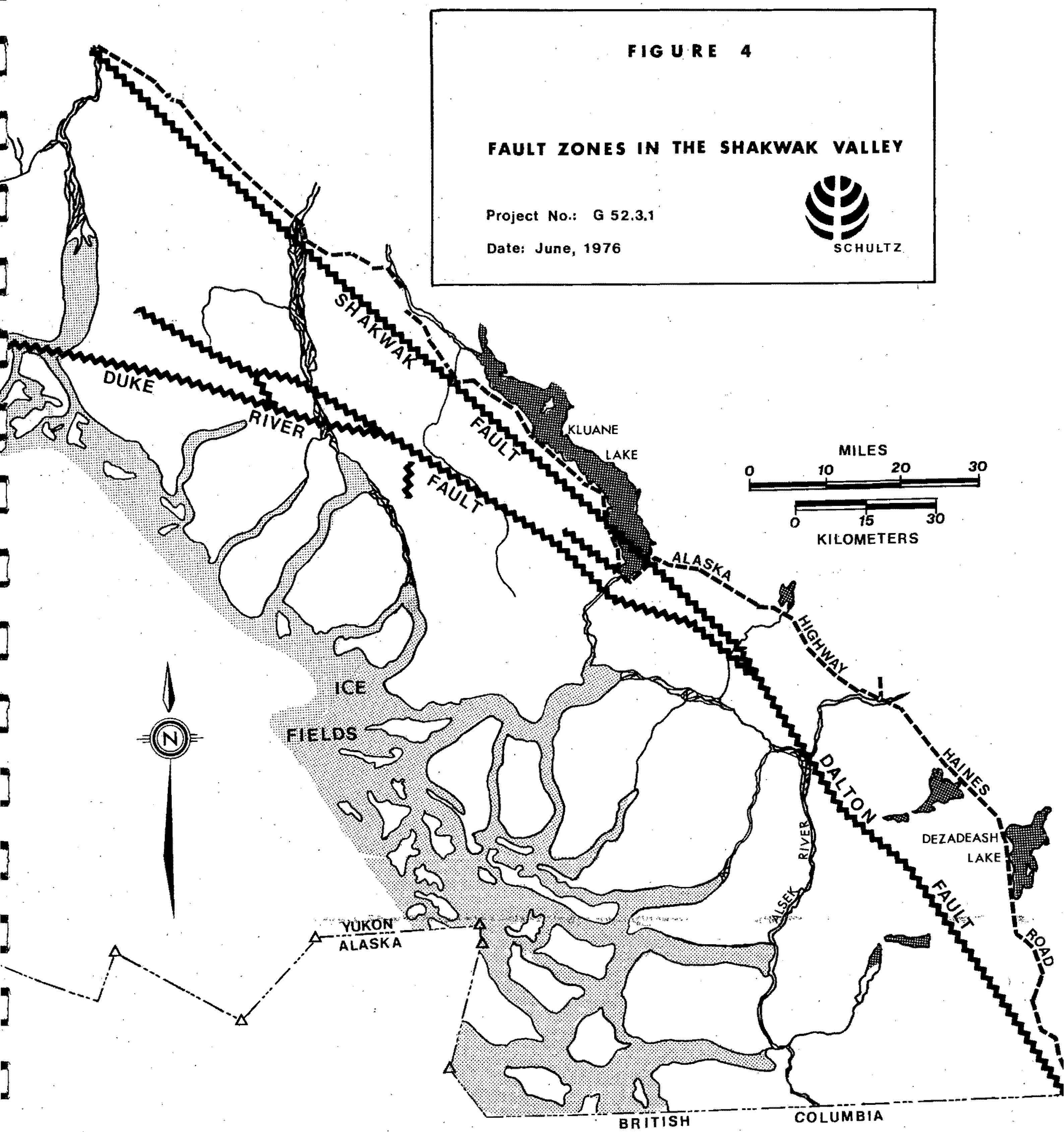


FIGURE 4
FAULT ZONES IN THE SHAKWAK VALLEY
Project No.: G 52.3.1
Date: June, 1976
SCHULTZ
SHAKWAK
FAULT
DUKE
RIVER
FAULT
KLUANE
LAKE
MILES
0
10
20
30
0
15
30
KILOMETERS
ALASKA
HIGHWAY
HAINES
ROAD
DALTON
FAULT
DEZADEASH
LAKE
ALSEK
RIVER
ICE
FIELDS
N
YUKON
ALASKA
BRITISH
COLUMBIA

coast intrusions of grandiorite, granite, quartz monzonite and quartz diorite.

Mile Y235.0 to Mile Y260.0 passes through Coast intrusions as mentioned above. Also, at Mile Y260.0 the line will traverse Haeckel Hill, and the bedrock is Upper Trassic of the Lewis River Group, comprising of greywacke, siltstone, argillite, conglomerate, and tuffaceous equivalents (Wheeler, 1961).

c) Whitehorse to the B.C./Yukon Border

From Mile Y265.0 to Y340.0 the proposed right-of-way traverses areas underlain by Paleozoic and Mesozoic sedimentary, metasedimentary, and volcanic rocks intruded by granitic and mafic plutons of late-Mesozoic age (Wheeler, 1961; Mulligan, 1963). Northeast of Mile Y340.0 volcanic and metavolcanic rocks occur with outcrops of mafic and ultramafic plutons.

Mile Y340.0 to Y380.0 follows the shore of Teslin Lake. Above the lake, late Paleozoic and early Mesozoic sedimentary and volcanic rocks occur, and are classified by Mulligan (1963) as belonging to the Big Salmon Range.

From Mile Y380.0 to the Cassiar Mountains (Mile Y430.0), the line will cross the Yukon Plateau underlain by the Yukon Group of late Palaeozoic Metamorphic bedrock, comprising of schist, gneiss, quartzite, and greenstone.

However, upon passing through the Cassiar Mountains (Mile Y430.0 to Mile Y480.0), granitic plutons of Cretaceous age intrude the bedrock of late Paleozoic sedimentary and metasedimentary rocks. Gabrielse (1969) also reported the occurrence of late Pleistocene volcanic rocks in this area. These include larva, tuff, and agglomerate.

These volcanic assemblages occur along the proposed right-of-way at Smart River, Swan Lake, and along the Rancheria River.

From the Cassiar Mountains to the B.C./Yukon border (Mile Y480.0 to Mile Y512.0) the pipeline crosses the Liard Plain. Bedrock mapping is incomplete. However, sedimentary and metasedimentary rock of undifferentiated Paleozoic age are known to occur here (Lord, 1944).

d) British Columbia-Yukon Border to Fort Nelson

This portion of the proposed pipeline traverses northern British Columbia, but does not follow the Alaska highway except near Liard Hotsprings (B60.0 to B120.0). The corridor then goes eastward to Fort Nelson.

The pipeline crosses the Liard Plateau which is underlain by Paleozoic and Mesozoic sedimentary rocks (McLearn and Kindle, 1951). Between Mile B60.0 and B120.0 the bedrock is upper Devonian Carbonate rocks (Williams, 1944). Gabrielse (1961) describes these rocks as simple, with open folds and with structural trends towards the north-west.

After leaving Liard Hotsprings the line follows the Liard Canyon. At Mile B150.0 the line moves southeast to Fort Nelson. McLearn and Kindle (1951) indicate that bedrock is Upper and Lower Cretaceous, with the Shaftesbury and Dunvegan Formations.

e) Fort Nelson to Zama Lake, Alberta

The bedrock of the area is composed of the nearly flat lying Cretaceous, (Shaftesbury and Dunvegan Formations), The Shaftesbury Formation underlies most of the area except for some broad hills consisting of the Dunvegan Formation. The formations described by Green et al. (1970) consist of the following:

Dunvegan Formation: grey fine-grained feldspathic sandstone with hard calcareous beds, laminated siltstone and grey silty shale; deltaic to marine origin.

Shaftesbury Formation: dark grey fish-scale bearing shale, silty in upper part; numerous nodules and thin beds of concretionary ironstone; bentonite partings; interbedded locally in lower part with thin silty and sandy intervals; marine origin.

The Shaftesbury Formation is subject to slumping in the Peace River area in Alberta but no signs of slumping were noted on steep slopes of the Fort Nelson River banks in British Columbia, and none are described from the Kakisa River (Rutter et al., 1973). The Dunvegan Formation is not subject to slumping.

2.1.3 Climate

The proposed route of the pipeline lies in two climatic zones, the northern and northeastern, both of which are influenced by intrusions of mild moist Pacific air and cold Arctic air that sweeps down from the Beaufort Sea. Because most of the route lies in the rainshadow of the St. Elias Mountains, the Arctic influence is greater, and the climate is more similar to northern cold, dry continental regimens.

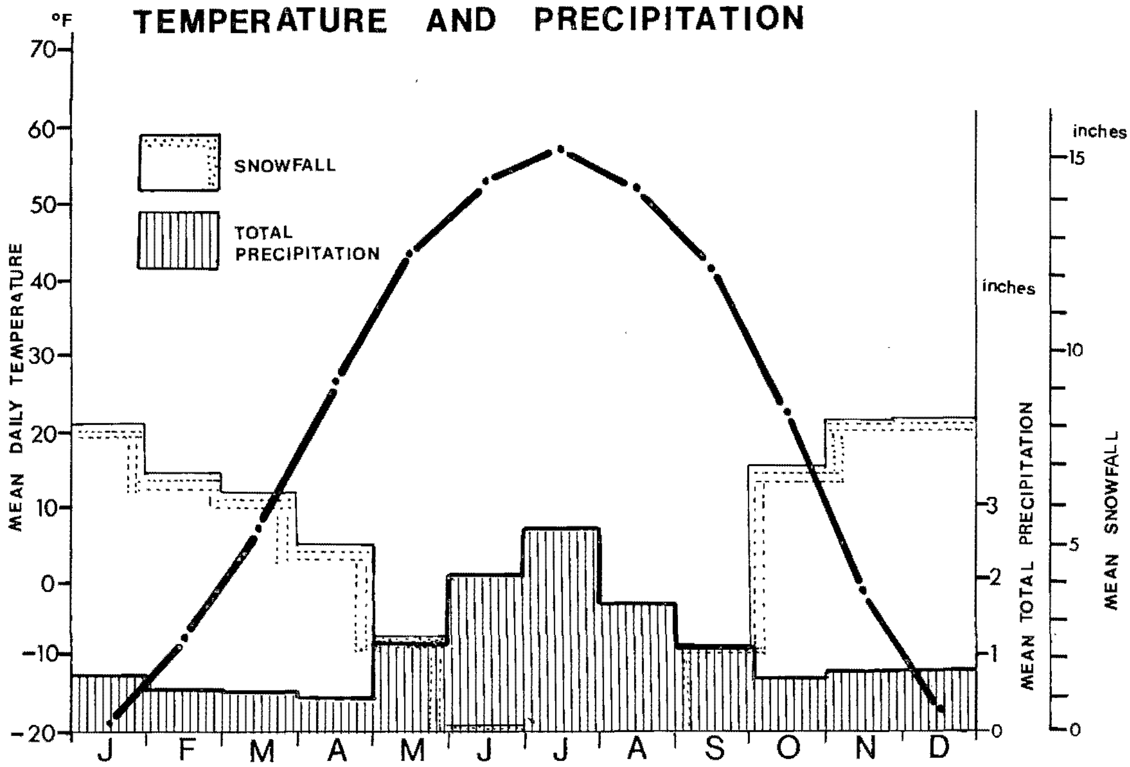
Throughout the southern Yukon and northern British Columbia, the summers are short and cool; the transition to winter is relatively abrupt and the winter months are long and cold. The Arctic high pressure systems which lie over the area produce clear cold days with little precipitation.

Throughout the route the highest monthly temperatures are recorded in July. They range from 55-60°F in the west, increasing to 60-65°F in the east. Mean daily temperatures increase eastwards along the route from 57°F at Snag to 62.1°F at Fort Nelson (See Figures 5-9). From Snag, with an extreme maximum of 89°F, the values increase to 98°F in Fort Nelson. These extreme values have been recorded in June or July.

During winter, five or six months have a mean daily temperature of below freezing. January is usually the coldest month, with a mean monthly range of -10°F to 10°F. However, mean daily temperatures in January vary from station to station, but show little significant change eastward. This reflects the influence of the Arctic high pressure systems which dominate winter conditions. On February 3, 1947, Snag recorded the lowest temperature in continental North America, -81°F.

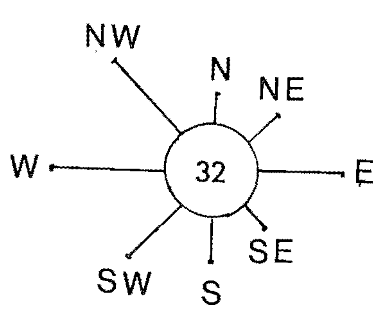
FIGURE 5 CLIMATIC DATA FOR SNAG

TEMPERATURE AND PRECIPITATION

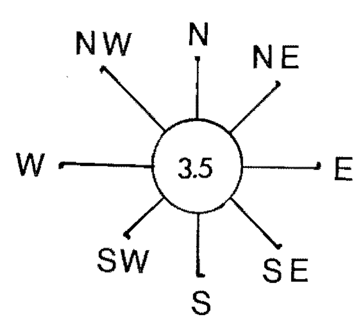


WIND

Direction



Speed



1 mm. REP. 1 %

32 % CALM

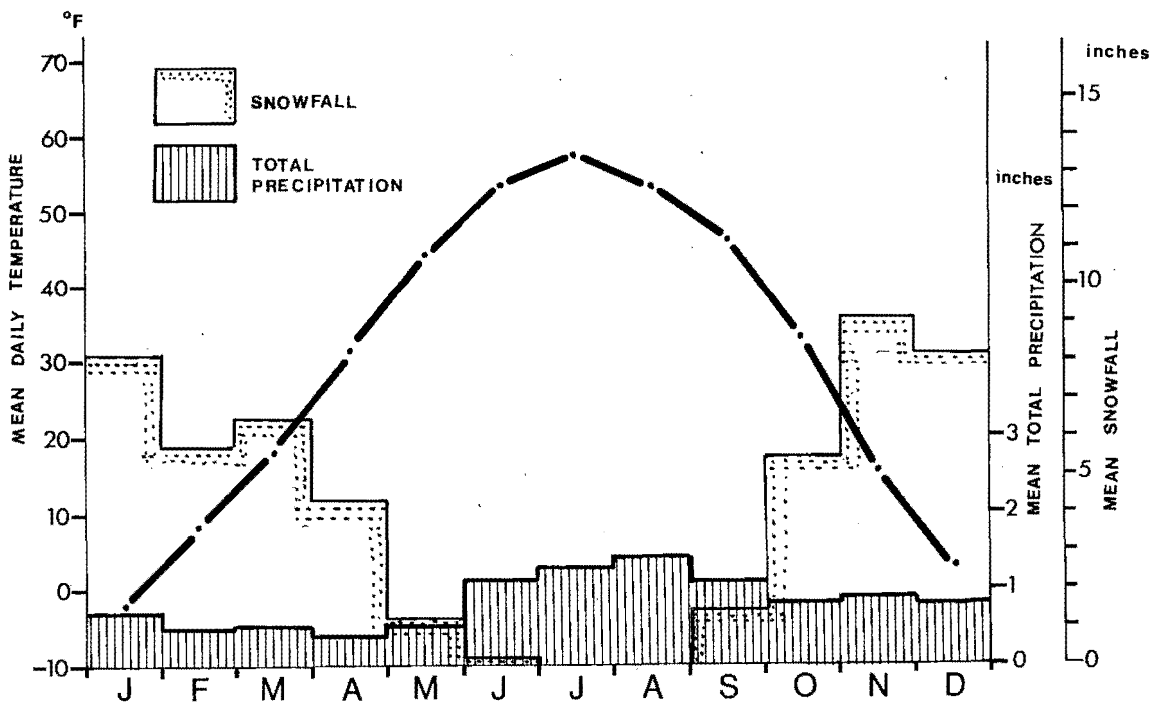
1 mm. REP 1 M.P.H.

3.5 M.P.H. MEAN ANNUAL WINDSPEED

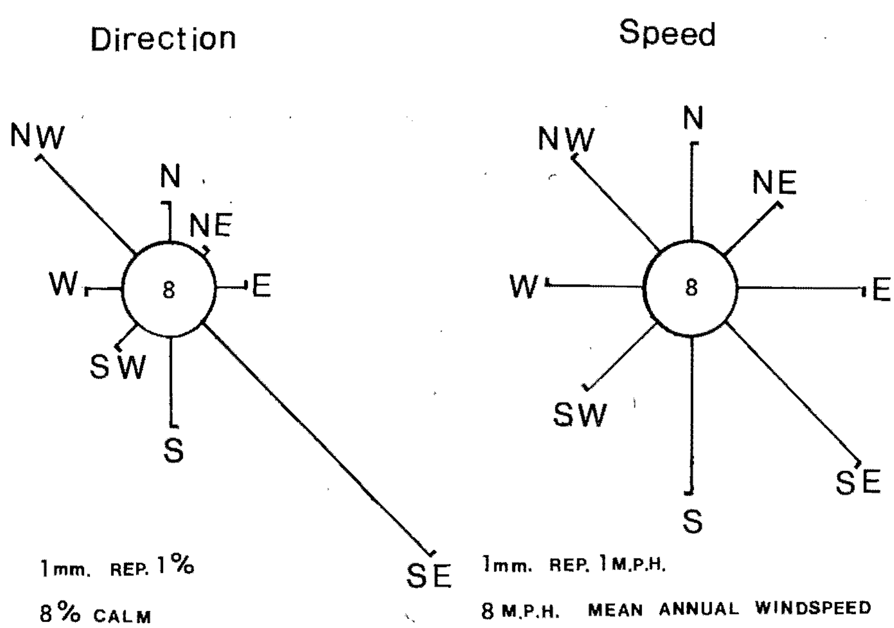
SCHULTZ

FIGURE 6 CLIMATIC DATA FOR WHITEHORSE

TEMPERATURE AND PRECIPITATION



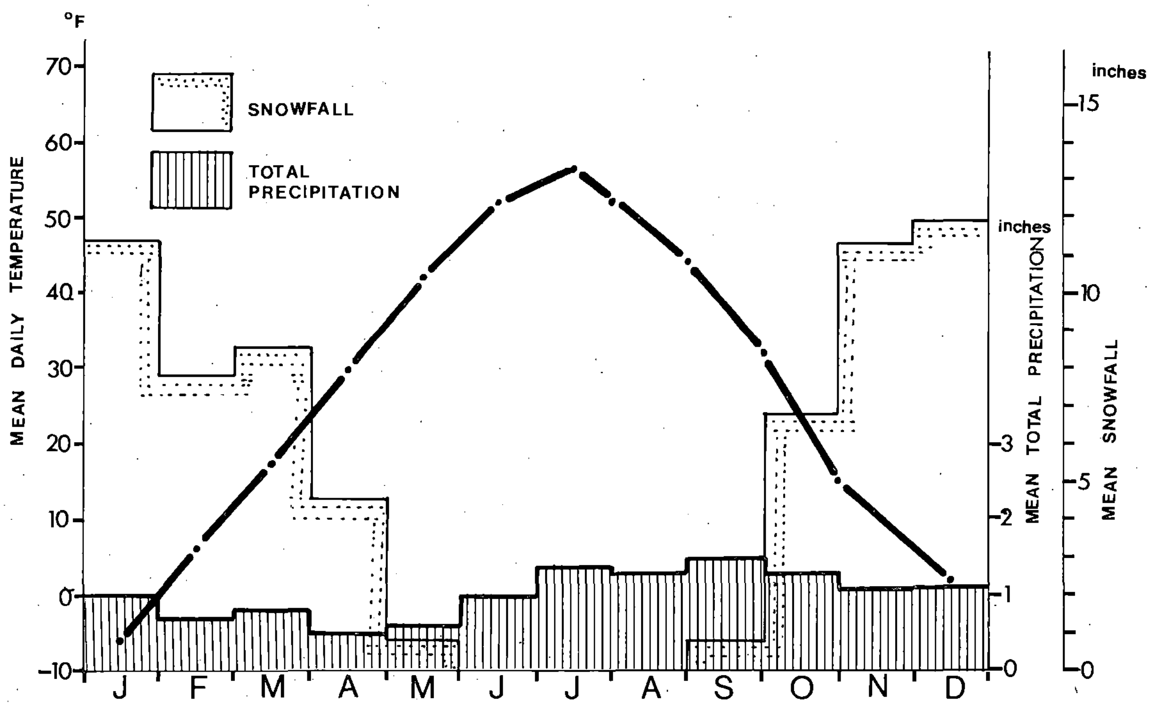
WIND



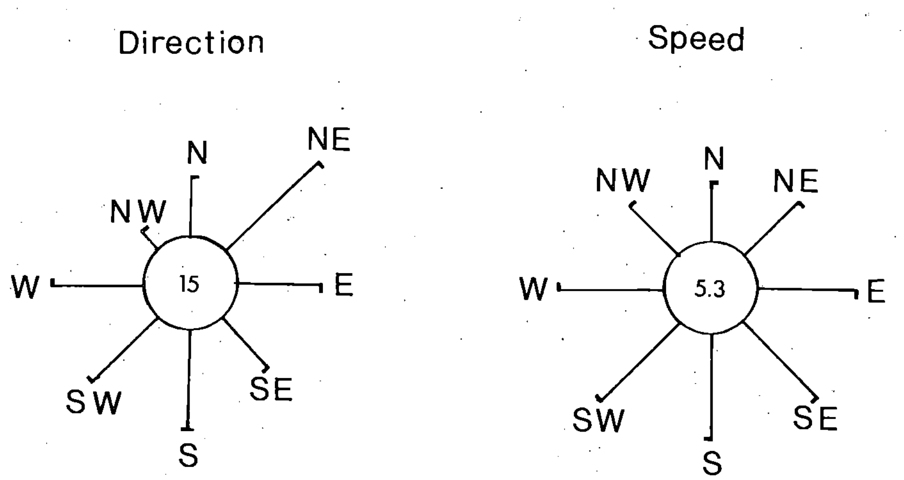
SCHULTZ

FIGURE 7 **CLIMATIC DATA FOR TESLIN**

TEMPERATURE AND PRECIPITATION



WIND



1mm. REP. 1%

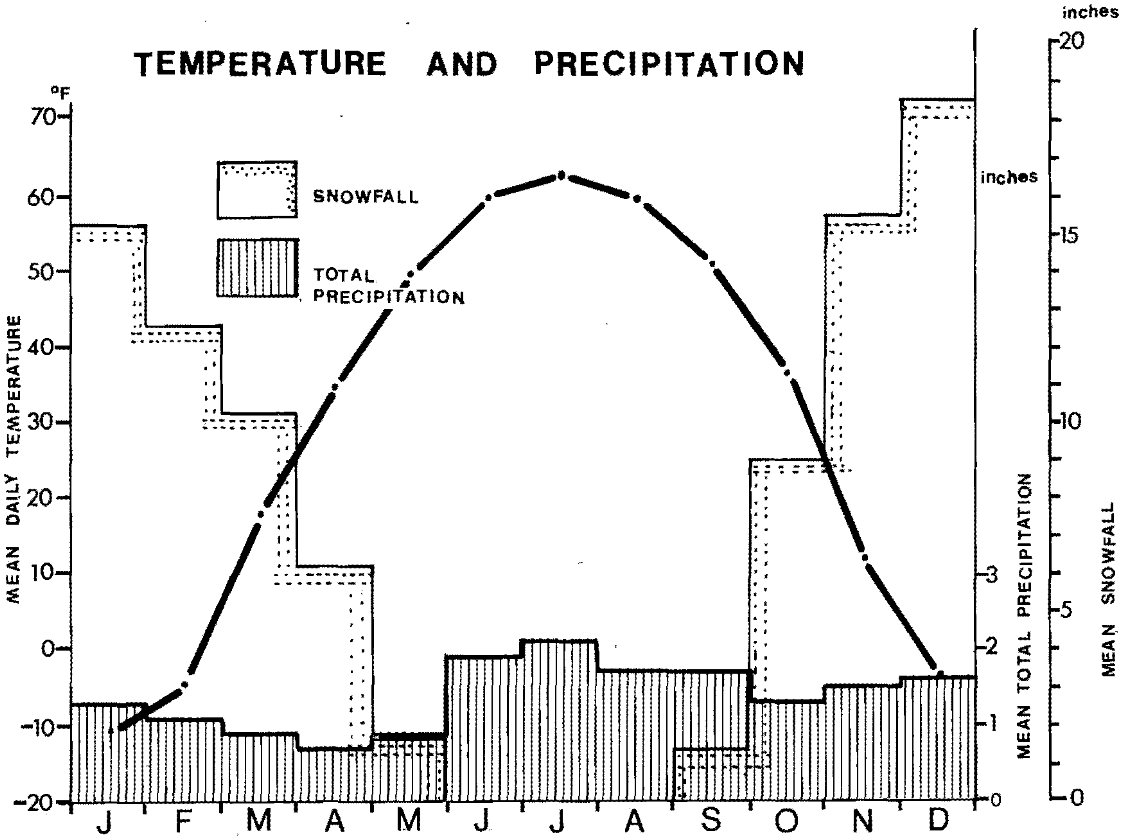
15% CALM

1mm. REP. 1M.P.H.

5.3 M.P.H. MEAN ANNUAL WINDSPEED

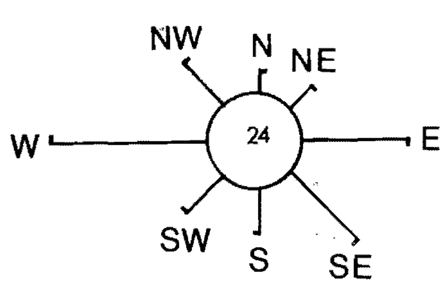
SCHULTZ

FIGURE 8 CLIMATIC DATA FOR WATSON LAKE

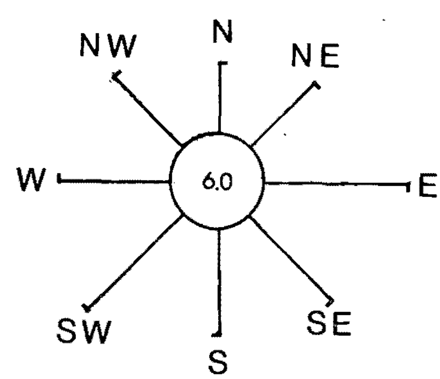


WIND

Direction



Speed



1 mm. REP. 1 %

24 % CALM

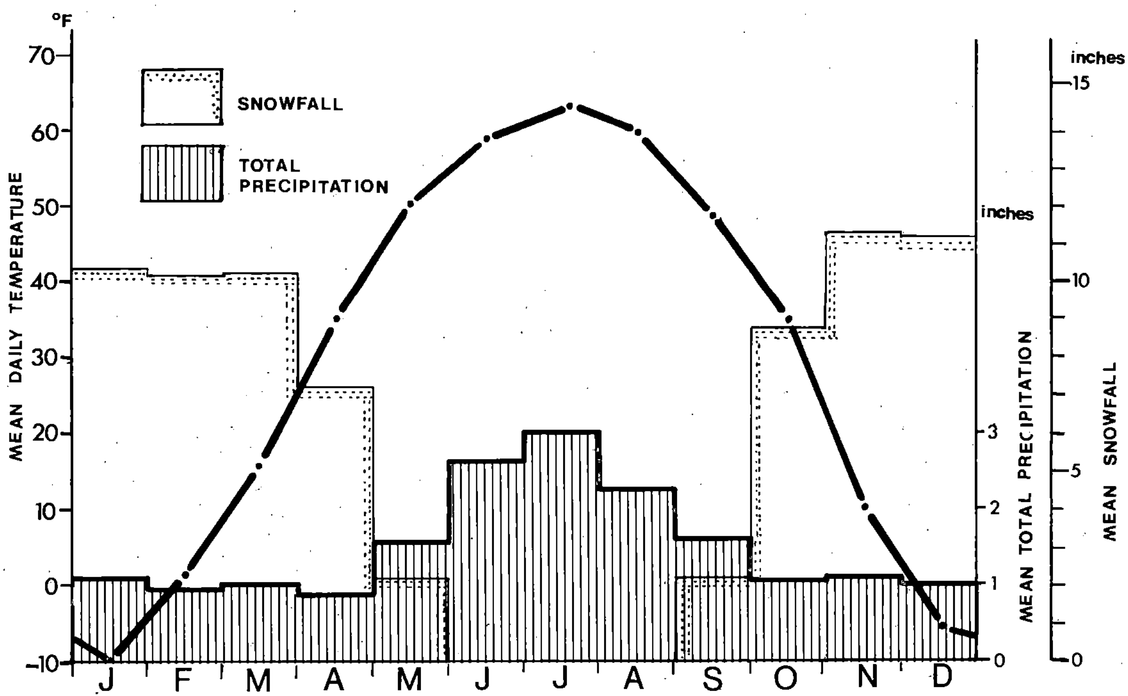
1 mm. REP. 1 M.P.H.

6.0 M.P.H. MEAN ANNUAL WINDSPEED

SCHULTZ

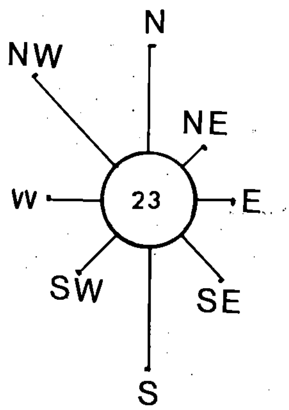
FIGURE 9 CLIMATIC DATA FOR FORT NELSON

TEMPERATURE AND PRECIPITATION



WIND

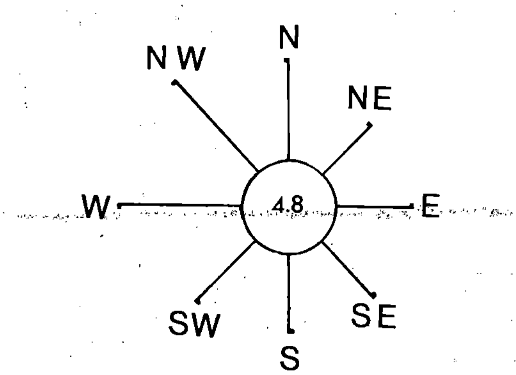
Direction



1 mm. REP. 1%

23 % CALM

Speed



1 mm. REP. 1 M.P.H.

4.8 M.P.H. MEAN ANNUAL WINDSPEED

SCHULTZ

Other extreme minimums recorded over the route lie between $-60^{\circ}F$ and $-74^{\circ}F$.

Mean annual precipitation along the proposed pipeline varies from 10 to 20 inches, however, up to 50 percent of this amount occurs as snow. This can be seen in Figures 5 to 9. Specifically, annual precipitation varies from 10.24 inches at Whitehorse to 17.57 inches at Fort Nelson. Local topographic variations mask the general trends in precipitation patterns. Watson Lake and Fort Nelson have pronounced summer maximums which are mainly in the form of convectional rainfall. Maximum precipitation that has fallen in 24 hours is 3.17 inches at Fort Nelson, while it is less than 3 inches for the more westerly stations. All maximums occurred as rainfall in the summer.

A summary of wind roses of speed and direction from available stations is shown in Figures 5 to 9. Topography affects the local winds at each station but in general the southern Yukon experiences strong winds from both east and west. However, data from Fort Nelson does not show this characteristic.

The strongest winds recorded from the Yukon stations vary from easterly to southwesterly, and are more pronounced in the summer and fall. Monthly mean wind speeds range from above 10 m.p.h. for every month at Whitehorse, to less than 5.2 m.p.h. at Snag. Westerly winds show maximum hourly windspeeds from 40 to 50 m.p.h. Recorded maximum gusts are less than 70 m.p.h., with the exception of Watson Lake where the greatest gust recorded is 93 m.p.h.

Fort Nelson, representing the easterly portion of the route has variable winds, with the highest windspeeds originating from the north and west. The mean monthly winds are all less than 6.3 m.p.h. with a maximum hourly speed of 40 m.p.h. from the northwest.

Fog occurs mostly in the autumn and early winter months over most of the Beaver Creek-Zama Lake Line. Valley situations will be more prone to fog than higher slopes, especially when temperature inversions during extreme cold weather develop, and ice fog results. The data does not differentiate between the two types of fog so that the frequency of ice fog will vary from place to place. From Table 2, Fort Nelson and Watson Lake experience the greatest number of days with fog.

Freezing drizzle or rain, which can lead to icing conditions, occur occasionally in the area. Watson Lake and Snag experience four to five days per year on average, whereas the other stations experience less frequent freezing rain-fall.

TABLE 2

MEAN MONTHLY AND ANNUAL DAYS WITH FOG

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Fort Nelson	1.1	0.6	0.5	0.8	1.4	2.9	4.6	5.4	7.3	3.5	2.5	1.4	32.0
Snag A	2.3	1.6	1.2	0.5	0.6	0.6	1.0	2.0	3.8	6.5	3.8	2.6	26.5
Teslin A	1.6	0.7	0.6	0.2	9.5	0.6	0.6	0.7	1.2	1.0	0.8	2.5	11.0
Watson Lake A	4.5	3.2	1.4	0.8	0.5	0.9	0.9	2.5	3.6	4.8	3.7	4.1	30.9
Whitehorse A	3.8	1.2	0.2	0.3	0.2	0.6	0.3	1.5	1.8	1.9	2.1	3.7	17.6

SCHULTZ

2.1.4 Soils and Surficial Geology

a) Alaska-Yukon Border to Whitehorse

From mile Y0.0 to Y10.0 the area traversed by the pipeline was unglaciated. The soils in the hills and in the valleys are deeply weathered with a mantling of peat, volcanic, and loess deposits. Loess, derived from postglacial alluvial fans of the White, Donjek and Slims Rivers has accumulated as overburden (Bostock, 1952).

The area eastward of mile Y10.0 to Y50.0 exhibits glaciated landforms. Hummocky moraine with peat-infilled kettles and incised glacial drift result from the recession of the Mirror Creek Glaciation. Northwest of the White River, young glacial deposits result from the Macauley Glaciation. The area is underlain by young fresh appearing drift, and streams have incised V-shaped valleys. As described above, the area is mantled by extensive postglacial deposits of volcanic ash (White River Ash, approximately 1,500 B.P.) and aeolian deposits. The volcanic ash is one-half to one foot in thickness between the White and Donjek Rivers. The White, Donjek and Kluane Rivers have extensive gravel outwash plains, and with large discharges in spring and summer, rapid changes in channel pattern occur.

Mile Y50.0 to Y150.0 includes Kluane Lake and the Shakwak Trench. Bedded deposits of silt and sand are common in valley bottoms (Muller, 1967). The Kluane Lake area's glacial and postglacial history has received the attention of a number of authors (Muller, 1967; Bostock, 1969). The surficial deposits of the newly-designated Kluane Park have been mapped and described by V. Rampton (unpublished manuscript). However, this report is not yet available.

Former beach levels are found at 43 and 12 feet above the present lake level (Bostock, 1969). The Slims River, south of Kluane Lake, exhibits a complex alluvial fan of gravels and finer sediments.

From mile Y150.0 to Y250.0 the proposed line will pass through the Dezadeash Valley which is floored with thick deposits of stratified silts, resulting from glacio-lacustrine sedimentation in Glacial Lake Champagne (Kindle, 1953). This large pro-glacial lake occupied the Dezadeash and Shakwak Valleys during the postglacial. Well developed beach deposits of sand, gravel and silt occur between 2,300 to 2,800 feet from the base of the valley walls. Kindle (1953) identifies glacio-lacustrine rhythmites of 200 feet thick in the central part of the Dezadeash Valley.

From mile Y250.0 to Y270.0 the line will traverse coarse alluvium and isolated deposits of glacio-lacustrine sediments. Postglacial fluvial incision has exposed these alluvium. Terrace faces exposed by fluvial action also exhibit volcanic ash and loess deposits, with bedrock exposed beneath these unconsolidated deposits.

Eutric Brunisols are the dominant soils in this section, but other soils exist including Gleysols, Chernozems Luvisols, Regosols and scattered organic deposits (Day, 1962).

Parent material of the Eutric Brunisols includes till, alluvium and coarse fluvial deposits. Usually these are well drained and calcareous in composition. Horizons in these soils are poorly developed and in most cases the soils are less than 12 inches deep. An organic surface of one to two inches lies directly over the mineral horizon. An organic-mineral horizon up to two inches deep occasionally occurs. On poorly drained lacustrine deposits from Glacial Lake Champagne, and some fluvial deposits, gleysols have developed with the distinct gleyed mineral horizons beneath the peaty organic surface material.

In some places in well drained lacustrine deposits, vegetation has been dominated by grasses and forbs so that prairie soils belonging to the Chernozemic Dark Grey Great Group have developed. The soil has a very dark greyish surface organic horizon underlain by a thin eluviated horizon. The illuviated mineral horizon below is dark brown and underlain by the grey calcareous parent material.

Luvisolic soils are found on well drained lacustrine and fluvial deposits where soil development has progressed further than the rest of the area. Eluvial and illuvial horizons have developed in these soils. Common throughout the area are Regosols which are found on recent fluvial deposits, sand dunes, volcanic ash, colluvium and creep. They are found on both well and imperfectly drained soils that lack discernible horizons.

Pockets of organic soils have developed in depressions such as the kettles found in hummocky moraines.

Throughout the area there are sites where, because of the nature or age of the surface, soils have not developed: these include rock outcrops, recent alluvium, eroded river banks, sloughs and saline meadows.

b) Whitehorse to Yukon-B.C. Border

From Mile Y270.0 to Y340.0 the surface is underlain by glacial drift, and lacustrine sediments. Between Whitehorse and Marsh Lake, glaciolacustrine deposits have been identified by Wheeler (1961). From Marsh Lake to Teslin Lake (Y300.0 to Y340.0), the valley is floored with till and alluvium, while Kame terraces and lateral moraines are found along the valley walls.

Teslin Lake (Mile Y340.0) to Mile Y400.0 was ice-dammed during deglaciation (Mulligan, 1963). During this period the lake level was 300 feet above the present lake lèvel and glaciolacustrine deposits flank the northwest side of the lake.

The proposed pipeline will traverse glaciated valleys from Mile Y400.0 to the Cassiar Mountains (Mile Y450.0). These valleys are floored by till and outwash gravels. Lacustrine sediments are associated with temporary former proglacial lakes.

East of the Cassiar Mountains from Mile Y450.0 to the Yukon-B.C. border(Mile Y512.0), the line will traverse the Liard Plain. Glacial and glacio-fluvial deposits are 200 feet in thickness (Bostock, 1948). The area exhibits hummocky moraine, drumlinoid features, and postglacial fluvial sediments.

Soils from Y270.0 to the Yukon-B.C. border are similar to those discussed in the previous section. Most of the Cassiar Mountains are essentially bare rock with no soil development. However, as the pipeline route follows the valleys which are covered by till, outwash gravels and lacustrine deposits, the various soils discussed will be present there.

C) Yukon-B.C. Borderto Fort Nelson

The line traverses the Liard Plateau to Liard Hotsprings at mile B150.0. The surficial deposits in this area are glacial sand and gravel in most lowland areas and glacial till on the uplands. To Liard Hotsprings, the proposed right-of-way follows the entrenched valley of the Liard River.

From Liard Hotsprings to Fort Nelson the pipeline route is mainly in glacial till with occasional glacio-lacustrine sediments indicating former proglacial lakes. Drumlins and flutings occasionally occur within this area.

Following the Liard River Valley and extending eastwards to Fort Nelson, the line crosses areas where luvisolic soils are dominant. These soils are deeper than Brunisols, with about two inches of organic matter overlying a deeply eluviated Ae horizon that extends up to 12 inches in depth. Accumulations of clay are found lower down in the Bt horizon which overlies the parent material approximately 36 inches beneath the surface. Slight lime carbonate accumulations can occur directly beneath the B horizon. Parent material is commonly lacustrine but includes fluvial deposits. All of the Luvisols present in the area are moderately to well drained and are found on level to steeply sloping land.

Associated with the Luvisols and generally occurring on level and depressional areas are soils having organic surface layers. Where the organic surface contains more than 30 percent organic matter, the associated soils are Organic soils; where the content of organic matter is less than 30 percent, the soils are Gleysols. The organic surface consists of layers of peat differing from one another in color and composition. Total thickness of the organic layer generally does not exceed 48 inches. The groundwater table in these soils is at or within a few inches of the surface throughout the year.

Regosolic soils and areas where no soil development has occurred are limited to the river valleys. Regosols are found on the river terraces where silty alluvium forms the parent material. Recent surfaces consist of river bars, abandoned river channels and valley side slumps.

d) Fort Nelson to Zama Lake

Surficial deposits along the pipeline route are mainly of glacial origin. Recent alluvial sediments lie adjacent to creeks and rivers. Glacial deposits are mainly till. The till is generally compact, slightly calcareous, more or less stony, and stable to erosion and slumping. Minor amounts of lacustrine sediments may be encountered along the route. Lacustrine sediments are positioned on level ground and because of this, are not subject to erosion. Minor outwash sand and gravel, aeolian sand, and some sand dunes are also present. Aerial photo interpretation indicates that these coarse-grained deposits have not been subjected to erosion along the pipeline route.

Recent alluvial deposits are composed of sand and silt. Gravel is present in the Fort Nelson area.

Floodplains of rivers along the proposed route are composed of sand and silt. Recent alluvial deposits along all of the creeks and rivers are unstable. They are constantly being eroded due to normal meander migrations, especially during periods of high water.

Organic soils dominate the route from Fort Nelson to Zama Lake. The most common organic soils are Cryic Fibrisols and Cryic Fibric Mesisols. These are indistinguishable from each other at the surface in terms of topography and vegetation. Near the surface, fibrisolic soils are composed of uniform partially decomposed fibric material (moss). At depth, sedge and wood material form the main components. Mesisolic soils are composed of a layer of partially decomposed moss material, a moderately decomposed moss layer and a partially decomposed sedge material layer. Valentine (1971) found frozen material at depths of 40 inches and 60 inches within organic soils near Fort Nelson. Organic material extends up to 15 feet in thickness and directly overlies the glacial till and lacustrine deposits.

Soils of inorganic materials along the route belong to the Luvisolic and Regosolic Great Soil Groups. These will be found mainly along the river valleys, and to the north of Zama Lake.

2.1.5 Permafrost

The proposed pipeline will traverse an area that lies within the discontinuous permafrost zone. The first 100 miles of the route from the Yukon-Alaska border to Kluane Lake lies within the discontinuous zone where permafrost is widespread. Deeply weathered peaty soils in the Snag area, and lacustrine sediments in the Shakwak Trench will exhibit ice-rich permafrost conditions.

From Kluane Lake to Zama Lake the pipeline will encounter sporadic permafrost conditions. Perennially frozen ground occurs intermittently and is generally restricted to poorly drained areas, such as organic peat bogs and treed muskeg.

a) Yukon Border to Kluane Lake

Active thermokarst, indicative of ice-rich permafrost is abundant in this northwest section of the route where it is associated with poorly drained loess, muck and residual soils of unglaciated terrain. Thaw lakes, particularly common along the valley floors through this area, become less common towards the floor of the Shakwak Trench. The ice within the various deposits will normally be finely disseminated throughout the soil. The ice content can account for 70 percent of the volume in peat, 30 percent in silty soils, and 7 percent in sandy soils.

b) Kluane Lake to Fort Nelson

Between Mile Y100 and Mile Y280, at Whitehorse, permafrost has been located along the floor of the Takhini Valley. The surface of lacustrine deposits is pitted with 'thaw sinks' caused by subsidence of frozen ground, although some, according to Day (1962) may be kettles. These are further reported by Rampton (1972).

Continuing eastwards, permafrost becomes increasingly rare, although based on construction records of the Alaska Highway about 10 percent of the corridor between Whitehorse and Teslin Lake is underlain by permafrost (Kingsley et al., 1971). In these valley situations, permafrost is restricted to organic terrain.

c) Fort Nelson to Zama Lake

Permafrost underlies the organic materials that are found extensively in this region. Valentine (1971) recorded frozen ground at a depth of 40 and 60 inches to the east of Fort Nelson. Permafrost may be extensive in this section, and at varying depths.

2.1.6 Air Quality and Noise

Existing ambient air quality along the proposed pipeline route can be considered good. Potential sources of air pollution arising from human activities are few and forest fires represent the only major natural source of air pollutants. Air quality will vary along the proposed route, depending on the degree of human development.

The route from the Yukon/Alaska Border to Fort Nelson generally follows the Alaska Highway. Consequently, automobile exhaust emissions will contribute to air pollution in this section.

The route from Fort Nelson to Zama Lake does not follow a major road and, therefore, will probably have the highest air quality along the route.

Settlements can be expected to generate small amounts of pollutants. However, these should not constitute a major air pollution problem. At present, the processing plant and gas fields near Fort Nelson can be considered the only major sources of man-made air pollution.

Existing ambient noise levels along the proposed pipeline route can be described as generally low. In sections where the route parallels the Alaska Highway, sound levels can be expected to be higher than in non-highway sections, particularly during the summer tourist season when traffic is heaviest. Apart from noise generated from the Alaska Highway, human settlement areas will be the only other major sources of noise along the proposed route.

2.1.7 Mineral and Energy Resources

a) **Alaska-Yukon** Border to Yukon-B.C. Border

The Yukon Territory has a large number of mineral properties. Some of the largest are as follows: Clinton Creek (asbestos); Sixtymile River (gold); Klondike (gold); Henderson Creek (gold); Clear Creek (gold); Mayo area (gold); United Keno (silver, lead, zinc, and cadmium); Livingstone Creek (gold); Pueblo (copper); Big Chief-Little Chief (copper, gold, and silver). The only developments that are in or near the proposed pipeline are Pueblo and Big Chief-Little Chief in the Whitehorse area, Mile Y270.0.

Minor mineral extraction and prospecting occur throughout the Yukon Territory in close proximity to the Alaska Highway. The Kluane Lake area has been an active placer mining region since the 1900's (Muller, 1967). The Whitehorse copper belt contains the Pueblo and Big Chief-Little Chief mines. Production plus reserves for this area total between 1 and 15 million tons of ore (Alaska Natural Gas Transportation System Study, 1976).

The Teslin area has received some prospecting attention (Mulligan, 1963). However, very few placer mines or hard rock mine extraction developments occur adjacent to the Alaska Highway at present.

East of the Teslin area there is a paucity of data on metallic and non-metallic mineral resources. However, prospecting in the Cassiar Mountains has received some attention. The proximity of the Alaska Highway makes it highly unlikely that further mineral resources of value will be discovered.

Sedimentary basins, potentially containing oil and gas, occur along the pipeline right-of-way. However, recoverable accumulations are considered too low for an estimate of potential exploration (Alaska Natural Gas System Study, 1976).

Abundant postglacial alluvial deposits all along the Alaska Highway should provide adequate supplies of sand and gravel materials for construction purposes. In some areas there may be a shortage of materials, particularly the first fifty miles of the proposed pipeline and the Teslin Lake area.

b) B.C.-Yukon Border to Zama Lake

The data for metallic and non-metallic mineral resources are not readily available in detail for this length of the proposed right-of-way. Adequate sand and gravel resources should be available from postglacial fluvial deposits. Stream entrenchment has caused these deposits to stand above the ground and surface water levels.

The Fort Nelson to Zama Lake area has received a significant amount of exploration for natural gas reserves. Active fields occur in and around Fort Nelson at Clarke, Yoyo and Kotcho Lakes.

2.2 Terrestrial Environment

2.2.1 Vegetation

The vegetation along the proposed route lies in the boreal forest region of Canada (Rowe, 1972). The major coniferous tree species of this zone are white spruce, black spruce, lodgepole pine, tamarack, and alpine fir. Aspen, balsam poplar, paper birch, and alder are the most frequent deciduous trees and shrubs.

Black spruce is the most shade tolerant tree, growing well only on acid, poorly drained and nutrient-poor soils. On rich soils at higher elevations, alpine fir is the most shade tolerant tree. Tamarack grows mainly in neutral to alkaline bogs, or on limestone substrate. White spruce and lodgepole pine grow well in siltier soils with moderate drainage. However, lodgepole pine is a major colonizer of a region following the effects of fire or logging. It grows extensively over the southern areas of the boreal forest, but is very shade intolerant.

Aspen and scrub birch are major colonizers of burn areas following severe fires. Balsam poplar prefers wetter, moderately drained soils for optimum growth. White birch is usually found on hillsides in well drained soils in associations with aspen, white spruce, or lodgepole pine. Scrub birch and alder are found with aspen or in wetter areas in open muskeg or along creeks.

In crossing the boreal forest, a number of different forest communities will be traversed, including upland forests, treed muskeg, floodplain forest, and sub-alpine forest. Following are brief descriptions of each community.

a) Upland Forests

Upland forests in the boreal forest regions are characterized by the occurrence of white spruce, aspen, birch, and lodgepole pine. In mesic habitats (moderately drained, moderately textured, moderate soil nutrients) white spruce becomes the dominant forest tree forming extensive forests. However, much of the region has been logged in the past or has been swept by fire. Very few climax, virgin forests remain. Hence, white spruce is most often found in mixed stands with varying amounts of aspen, birch, or lodgepole pine.

Fire is the major factor in re-establishing a new forest of white spruce in mesic habitats, which otherwise would become dominated by black spruce as the climax tree. Modern logging practices also encourage new growths of white spruce by tree cultures. White spruce will grow in any habitat except nutrient-low, poorly drained bogs occupied by black spruce. On all mesic habitats it becomes the tallest tree and makes its best growth in moderately rich silty soils.

Common associates of white spruce are aspen, white birch, and lodgepole pine. In the past, logging practices of clearing out all the trees and effecting little or no revegetation, led to the occurrence of extensive stands of aspen, birch, or lodgepole pine. These trees are relatively fast growing compared to white spruce. They tend to enrich the soil, especially birch, aspen, and balsam poplar, with their leaves. White spruce becomes the dominant shrub and will, in time, overtop the aspen and birch and form a white spruce forest. Following severe fires, when all ground cover is removed, frequently the first tree species to move into the area is lodgepole pine. This tree has a low shade tolerance and will only grow where other trees are absent. It forms very dense forests; the lower branches are generally shaded out, die and form the characteristic shape of the tree with a straight branchless trunk and a crown of branches at the top. Dense forests of lodgepole pine cannot regenerate themselves unless thinning occurs. White spruce usually comes in as the dominant shrub in these areas, in time rising above and shading out the pine.

Shrub growth and ground cover are most extensive in young deciduous forests of aspen and birch where the soils are richer and the canopy is more open. As the amount of spruce increases, the soils become more acid, the canopy more closed, shrub growth is reduced and ground cover is sparser until all that remains is feather moss under tall closed white spruce forests.

Shrub growth expected to occur in tall mixed forests of white spruce, aspen, and birch would include wild rose, raspberry, labrador tea, willow, buffaloberry, scrub birch, red-osier dogwood, edible cranberry, saskatoon, gooseberry, and alder. Herb growth is more extensive under deciduous cover and would include horsetail, fireweed, coltsfoot, bedstraw, wild lily of the valley, false solomon's seal, strawberry, vetch, gentian, locoweed, hedysarum, milk vetch, clover, yarrow, wintergreen, Venus's slipper, bunchberry, bearberry, grass, sedge, peltigera, and mosses such as feather moss.

b) Treed Muskeg

In the boreal forest zone, black spruce treed muskeg represents the climatic climax forest type. It is a highly frost resistant tree and the most shade tolerant conifer in the boreal forest. In densely stocked black spruce forests however, shade is so deep that only after natural thinning may new regeneration occur. Black spruce is a very slow growing tree and because of its shade tolerance, the productivity of a mature forest is very low. Black spruce grows best in low nutrient, poorly drained soils.

Lodgepole pine is frequently seen in association with black spruce. Presumably it grows there due to its uncompetitive nature and its low shade tolerance. It may grow in black spruce stands or in random belts scattered throughout the black spruce forests. Sjors (1961), in discussing similar patterns found in the subarctic parts of the boreal zone, suggests that the reason for the elevated ridge seems to be the pressure of the ice being exerted horizontally during the freezing period in early winter. A similar explanation may well apply to the patterned ground of northern British Columbia.

Tamarack is another shade intolerant tree. It makes its best growth in neutral to alkaline bogs, rich in nutrients or on a limestone substrate. It is easily overshaded by other trees and seldom exists in pure stands.

Shrub and herb growth in treed muskeg is rather limited. However, there are many different kinds of mosses and lichens in such an area. In open or drier muskeg areas, more varied shrub and herb growth is observed.

In an open treed muskeg, ericaceous shrubs are the dominant plant form. These include labrador tea, blueberry, crowberry, bog kalmia, and bog rosemary. Other shrubs include sweet gale, scrub birch, willow, and alder. Herb growth is limited and dominated by grasses and sedges, but also includes bog cranberry, horsetail, lady's slipper, wood orchids, calypso, and various mosses and lichens including reindeer moss and peltigera.

c) Floodplain Forests

Floodplain forests develop on the alluvial sediments deposited on islands and riverbanks. The forest types are variable, ranging from short dense clumps of willow to tall white spruce forests. Balsam poplar may be the dominant deciduous tree in these areas. The growth forms are variable just as the watercourse forms are variable. Meandering streams, particularly in muskeg areas may support low dense willow bushes. Sandbars, gravel flats, and alluvial deposits along swifter rivers may be colonized by other types of willows and balsam poplar. Riverbanks or deposits with higher silt contents may support tall mixed forests of white spruce, aspen, birch, and balsam poplar or tall forests of white spruce.

The shrub growth is much more lush and extensive in deciduous riverine forests than in coniferous types. Under a deciduous cover, shrub growth includes wild rose, alder, saskatoon, huckleberry, waxberry, scrub birch, balsam poplar, and willow. Herb growth may be limited by the dense deciduous cover of trees and shrubs, but is similar to that under upland deciduous forests.

d) Sub-alpine Forests

Sub-alpine forests are found in the Yukon and northern British Columbia at higher elevations until the edge of the treeline. The principal species involved are alpine fir and white spruce or Engelmann spruce. Alpine fir is very shade tolerant and as a result, the lower branches are not shaded out (as in lodgepole pine). The fir forest is likely to be open in structure but rather dense at the shrub layer owing to the basal cover of the trees. In the Central Yukon, alpine fir is found in association with white or black spruce and it may also occur in pure stands.

Shrub growth in sub-alpine forest is limited in variety due mainly to the climatic effects of elevation. Creeping juniper flourishes in the open spaces between the clumps of trees, especially near treeline. Labrador tea is infrequent but bearberry, rock cranberry, scrub birch, willow, rosemary,and rhododendron are common. Herb growth is also limited in extent and may consist of alpine fireweed, harebell, columbine, dryads, indian paintbrush, elephant's head, lupine, penstemon, saxifrage, sedge, grass, moss, and lichen.

The proposed pipeline crosses six forest sections identified in the Boreal Forest Region. From west to east these are Kluane, Central Yukon, Eastern Yukon, Upper Liard, Upper Mackenzie,and Hay River.

a) Kluane Section

This section of forest is situated in the rain shadow of the St. Elias Mountains. The alpine fir-spruce association of higher elevations and spruce-aspen-birch in the lower valleys are characteristic. Forest growth is open and park-like. Undergrowth is moderate. Black spruce bogs and treed muskeg are not prominent in the valleys, except towards the Alaskan border near Beaver Creek; white spruce also occurs in association with the black spruce. Lodgepole pine is largely absent from this area which has a colder climate than any of the other sections. There are frequently open grassy areas on the slopes and in the valleys. Alpine fir shrubs and willow and birch shrubs form the ecotone between alpine tundra and sub-alpine forest.

b) Central and Eastern Yukon Sections

The Central and Eastern Yukon forest sections are basicially similar. White spruce-aspen-birch associations and stands of lodgepole pine cover the upland areas below 1,000 meters. Aspen and birch are found on the drier, warmer south-facing slopes of valleys and hillsides. Topography is more sharply accentuated in these sections: slopes are steeper and river valleys are narrower. Consequently, forests are generally more open and the tall riverine forests of white spruce and balsam poplar are more restricted in extent. Alpine fir is of greater importance in these sections of forest, especially at higher elevations, and is found in association with spruce up to treeline at about 1,500 meters. Above treeline is alpine tundra, consisting largely of lichens, mosses, sedges, and ericaceous shrubs. Black spruce and tamarack are found in poorly drained bogs and on permafrost slopes which maintain a high water table. Interlaced throughout the open-treed muskeg are ice ridges which sustain open to closed cover of lodgepole pine and white spruce.

c) Upper Mackenzie and Upper Liard Sections

The Upper Mackenzie and Upper Liard sections include the valley of the Fort Nelson River and floodplain of the lower Liard River. The large quantities of glacial outwash sediments found along both these rivers have produced a special edaphic effect which has been termed "aspen-white spruce parkland." The valleys of the Liard and Fort Nelson Rivers support good merchantable stands of closed white spruce forest and balsam poplar on the rich alluvial flats. White spruce is found in pure stands more often on the cool, shaded north-facing slopes of the valleys, while balsam poplar, aspen, and birch occur on the drier south-facing slopes of the Liard and Fort Nelson Rivers. The upland areas are covered with good stands of mixed forest of white spruce, aspen, and birch, and large areas of lodgepole pine forests, the result of repeated, widespread forest fires. These occur along the sandy terraces of the Liard River and towards the western edge of the region. In low lying areas of poorly drained soils, open black spruce treed muskeg may also be found with ericaceous heath vegetation. There are string bogs of sphagnum moss dotted throughout the muskeg areas.

d) Hay River Section

The Hay River section runs from the Fort Nelson River to Zama Lake. The land is flat and poorly drained. As a consequence there are large areas of open black spruce treed muskeg. Jack pine or lodgepole pine and aspen may be found on the upland areas. White spruce is restricted to river valleys and a few better drained slopes. The forest is generally of poor quality and there are few stands of merchantable spruce.

2.2.2 Terrestrial Wildlife

Information on the occurrence of wildlife along the proposed pipeline corridor was determined, primarily, from an examination of available literature. At present, there exists little detailed information on the status of wildlife populations along much of the Yukon and Northern B.C. pipeline sections. Consequently, our observations must be considered preliminary and restricted in scope. Further detailed study will be necessary on a site specific basis.

Most wildlife species have evolved a dependent relationship, either direct or indirect, upon various plant associations, habitat types, or combinations of types. The diversity of wildlife species encountered along the proposed pipeline route will, therefore, vary according to the diversity of habitats traversed. The abundance of individual species within a habitat type or group will vary according to the quality of that habitat; quality being primarily a measure of the ability of a habitat to fulfill the animals minimal nutritional and shelter requirements. One area, in particular, along the route is outstanding in terms of faunal diversity - the Kluane Ranges. Faunal diversity (mammals and birds) here is among the highest of any North American sub-arctic region.

A list of the mammals and birds which are likely to be encountered along various sections of the proposed pipeline route is presented in Tables 3 and 4.

Four main habitat types will be encountered along the proposed route. These are the upland forest, treed muskeg, floodplain forest, and sub-alpine forest communities. A detailed discussion of these communities

TABLE 3

LIST OF MAMMALS AND THEIR PROBABLE OCCURRENCE
ALONG THE PROPOSED PIPELINE SECTIONS

Common Name	Scientific Name	Occurrence on Pipeline Sections: Yukon	Northern British Columbia	Northern Alberta
Arctic Shrew	Sorex arcticus	-	-	x
Cinereus Shrew	Sorex cinereus	x	x	x
Wandering Shrew	S. vagrans		x	x
Navigator Shrew	S. palustris	x	x	x
Dusky Shrew	S. obscurus	x	-	-
Pygmy Shrew	Microsorex hoyi	x	x	x
Varying Hare	Lepus americanus	x	x	x
Collared Pika	Ocotona collaris	x	-	-
Woodchuck	Marmota monax	x	x	-
Hoary Marmot	Marmota caligata	x	x	-
Arctic Ground Squirrel	Spermophilus undulatus	x	-	-
Least Chipmunk	Eutamias minimus	x	x	x
Red Squirrel	Tamiasciurus hudsonicus	x	x	x
Northern Flying Squirrel	Glaucomys sabrinus	x	x	x
Beaver	Castor canadensis	x	x	x
Muskrat	Ondatra zibethica	x	x	x
White-footed Mouse	Peromyscus maniculatus	x	x	x
Bushy-tailed Wood Rat	Neotoma cinerea	x	x	x
Northern Bog Lemming	Synaptomys borealis	x	x	x
Siberian Lemming	Lemmus sibericus	x	-	-
Arctic Heather Vole	Phenacomys ungava	x	-	-
Brown Lemming	Lemmus trimucronates	x	-	-
Boreal Redback Vole	Clethrionomys gapperi	-	x	x
Tundra Redback Vole	C. rutilus	x	-	-
Meadow Vole	Microtus pennsylvanicus	x	x	x
Long-tailed vole	M. longicaudus	x	x	x
Alaska Vole	M. miurus	x	-	-
Tundra Vole	M. oeconomus	x	-	-
Meadow Jumping Mouse	Zappus hudsonicus	x	x	x
Western Jumping Mouse	Z. princeps	x	x	x
Porcupine	Erethizon dorsatum	x	x	-
Coyote	Canis latrans	x	x	x
Wolf	C. lupis	x	x	x
Red Fox	Vulpes fulva	x	x	x
Black Bear	Ursus americanus	x	x	x
Grizzly Bear	U. arctos	x	x	-
Marten	Martes americana	x	x	x
Fisher	M. pennanti	x	x	x
Short-tailed Weasel	Mustela erminea	x	x	x
Least Weasel	M. rixosa	x	x	x
Mink	M. vison	x	x	x
Wolverine	Gulo luscus	x	x	x
Striped Skunk	Mephites mephites	x	x	x
River Otter	Lutra canadensis	x	x	x
Canada Lynx	Lynx canadensis	x	x	x
Mule Deer	Odocoileus hemionus	x	x	x
Moose	Alces alces	x	x	x
Mountain/Woodland Caribou	Rangifer tarandus	x	x	x
Elk	Cervus canadensis	x	x	-
Mountain Goat	Oreamnos americanus	x	x	-
Thinhorn Sheep (Dall and Stone)	Ovis dalli	x	x	-

N.B. No information is available on the type, distribution, and occurrence of bat species.

TABLE 4

SUMMARY OF BIRDS THAT MAY BE ENCOUNTERED

ALONG THE PROPOSED PIPELINE ROUTE

(N.B. Insufficient information is available to permit presentation of the distribution of avifaunal species by pipeline section)

Common Name	Scientific Name
Red-throated Loon	Gavia stellata
Common Loon	G. immer
Arctic Loon	G. arctica
Red-necked Grebe	Podiceps grisegera
Horned Grebe	P. auritus
Pied-billed Grebe	Podilymbus podiceps
American bittern	Botaurus lentigirosus
	Olor columbiarus
Trumpeter Swan	O. buccinator
Canada Goose	Branta canadensis
White-fronted Goose	Anser albifrons
Snow Goose	Chen hyperborea
Mallard	Anas platyrhynchos
Pintail	A. acuta
Green-winged Teal	A. carolinensis
Blue-winged Teal	A. discors
Gadwall	A. strepera
American Widgeon	Mareca americana
Shoveler	Spatula clypeata
Canvasback	Aythya valisineria
Greater Scaup	A. marila
Lesser Scaup	A. affinis
Redhead	A. americana
Common Goldeneye	Bucephala Clargula
Barrow's Goldeneye	B. islandica
Bufflehead	B. albeola
Ruddy Duck	Oxyura jamaicensis
Oldsquaw	Clangula hyemalis
Harlequin Duck	Histrionicus histrionicus
White-winged Scoter	Melanitta deglandi
Surf Scoter	M. perspicillata
Common Scoter	Oidenia nigra
Common Merganser	Mergus merganser
Red-breasted Merganser	Mergus serrator
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	A. striatus
Red-tailed Hawk	Buteo jamaicersis
Rough-legged Hawk	B. lagopus
Swainson's Hawk	B. Swainsoni
Golden Eagle	Aquila chyrsaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Cirais cyareus
Osprey	Pondion haliaetus
Gyrfalcon	Falco rusticolus
Peregrine Falcon	F. peregrinus
Pigeon Hawk	F. columbiarius
Sparrow Hawk	F. sparverius
Spruce Grouse	Carachites caradersis
Ruffed Grouse	Bonasa umbellus
Willow Ptarmigan	Lagopus lagopus
Rock Ptarmigan	L. mutus
White-tailed Ptarmigan	L. leucurus
Sharp-tailed Grouse	Pedisecetes phasiarellus
Ring-necked pheasant	Phasiarus colchicus

Table 4 - Cont'd

Common Name	Scientific Name
Black-capped Chickadee	Parus atricapillus
Boreal Chickadee	P. hudsonicus
Mountain Chickadee	P. gambeli
Red-breasted Nuthatch	Sitta canadersis
Brown Creeper	Certhia familiaris
Brown Thrasher	Toxostoma rufum
Dipper	Circlus mexicanus
Robin	Turdus migratorius
Varied Thrush	lxoreus naevius
Hermit Thrush	Hylocichla guttata
Swanson's Thrush	H. ustulata
Gray-cheeked Thrush	H. mirina
Mountain Bluebird	Sialia currucoides
Wheatear	Oenarthe oenarthe
Townsend's Solitaire	Myadestes townserdi
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	R. calerdula
Water Pipet	Arthus spiroletta
Bohemian Waxwing	Bonbycilla garrulus
Solitary Vireo	Vireo solitarius
Northern Shrike	Lanius excubitor
Starling	Sturnus vulgaris
Orange-crowned Warbler	Vermivora celata
Yellow Warbler	Dendroica petechia
Myrtle Warbler	D. coronata
Audubon's Warbler	D. auduboni
Blackpoll Warbler	D. striata
Plam Warbler	D. palmarum
Townsend's Warbler	D. townsendi
MacGillivray's Warbler	Oporornis tolmiei
Northern Water thrush	Seiurus noveboracersis
Yellowthroat	Geothlypis trichas
Wilson's Warbler	Wilsonia pusilla
American Redstart	Setophaga ruticilla
Red-winged Blackbird	Agelaius phoericeus
Rusty Blackbird	Euphagus carolinus
Brewer's Blackbird	E. cyarocephalus
Western Tanager	Pirarga ludoviciana
Purple Finch	Carpodacus purpureus
Pine Grosbeak	Pinicola erucleator
Gray-crowned Rosy Finch	Leucosticte tephrocotis
Hoary Redpoll	Acanthis glammea
Pine Siskin	Spirus pirus
American Goldfish	S. tristis
Red Crossbill	Loxia curvirostra
White-winged Crossbill	L. leucoptera
Savannah Sparrow	Passerculus sandwichersiis
Conte's Sparrow	Passerherbulus caudacutus
Slate-colored Junco	Junco hyenalis
Tree Sparrow	Spiyella arborea
Chipping Sparrow	S. passerina
Brewer's Sparrow	S. breweri
White-crowned Sparrow	Zonotrichia leucophrys
White-throated Sparrow	Z. albicollis
Golden-Crowned Sparrow	Z. atricapilla
Harris' sparrow	Z. querulla
Fox Sparrow	Passerella iliara
Song Sparrow	Melospiza melodia
Lincoln's Sparrow	M. lincolnii
Swamp Sparrow	M. georgiana
Lapland Longspur	Calcarius lapponicus
Smith's Longspur	C. pictus
Snow Bunting	Plectropherax rivalis

Table 4 - Cont'd

Common Name	Scientific Name
Whooping Crane	Grus americana
Sandhill Crane	G. canadersis
Semipalmated Plover	Charadrius semipalmatus
Killdeer	C. vociferus
American Golden Plover	Pluvialis domirica
Common Snipe	Capella gallirago
Whimbrel	Numerius phaeopus
Upland Plover	Bartrania longicauda
Spotted Sandpiper	Actitis macularia
Solitary Sandpiper	Tringa solitaria
Wandering Tattler	Heteroscelus incarum
Greater Yellowlegs	Totarus melaroleucus
Lesser Yellowlegs	T. flavipes
Pectoral Sandpiper	Erolia melanotos
Baird's Sandpiper	E. bairdii
Least Sandpiper	E. mirutilla
Dunlin	E. alpira
Short-billed Dowitcher	Limrodromus griseus
Long-billed Dowitcher	L. scolopaceus
Semipalmated Sandpiper	Ereuretes pusillus
Western Sandpiper	E. mauri
Sanderling	Crocethia alba
Northern Phalarope	Lobipes labatus
Long-tailed Jaeger	Stercorarius longicaudus
Herring Gull	Larus argentatus
California Gull	L. californicus
Mew Gull	L. canus
Bonaparte's Gull	L. philadelphia
Arctic Tern	Sterna paradisaea
Mourning Dove	Zenaidura macroura
Great Horned Owl	Bubo virginiarus
Snowy Owl	Nyctea scandiaca
Hawke Owl	Surnia ulula
Great Gray Owl	Strix nebulosa
Barred Owl	S. varia
Short-eared Owl	Asio flammeus
Common Nighthawk	Chordeiles minor
Belted Kingfisher	Megaceryle alcyon
Yellow-shafted Flicker	Colaptes auratus
Yellow-bellied Sapsucker	Sphyrapicus varius
Hairy Woodpecker	Derdrocopes villosus
Downy Woodpecker	D. pubescens
Black-backed Three-toed Woodpecker	Picoides arcticus
Northern Three-toed Woodpecker	P. tridactylus
Eastern Kingbird	Tyrannus tyrannus
Say's Phoebe	Sayornis saya
Eastern Phoebe	S. phoebe
Hammond's Flycatcher	Empidonax hammondii
Dusky Flycatcher	E. oberholseri
Traill's Flycatcher	E. trailli
Least Flycatcher	E. mirimus
Western Wood Pewee	Contopus sordidulus
Olive-sided Flycatcher	Nuttallornis borealis
Horned Lark	Eremophilia alpestris
Violet-green Swallow	Tachycireta thalassira
Tree Swallow	Uridoprocre bicolor
Bank Swallow	Riparia riparia
Barn Swallow	Hirurdo rustica
Cliff Swallow	Petrochelidon pyrrhonota
Steller's Jay	Cyanocitta stelleri
Gray Jay	Perisoreus canadersis
Black-billed Magpie	Pica pica
Common Raven	Corvus, corax
Common Crow	C. brachyrhynchos
Clark's Nutcracker	Nucifraga columbiara

is presented in Section 2.2.1 and, therefore, only their use by wildlife is considered here.

a) Upland Forest

The upland forest community composed of white spruce, aspen, birch, and lodgepole pine is used primarily by moose, mountain caribou, elk, and mule deer. In particular during the winter such areas, in combination with treed muskeg, provide critical winter ranges for moose and mountain caribou. Black bears, squirrel, porcupine, hare, grouse, marten, fisher, lynx, weasel, coyote, red fox, and a large number of small mammals and birds are also associated with this community.

Regenerating cutover areas and old burns provide improved foraging areas for most ungulates with the exception of caribou who are displaced by the removal of mature stands upon which they normally rely for lichens - their principal food.

b) Treed Muskeg

The treed muskeg community consisting of black spruce, lodgepole pine, and Tamarack in poorly drained areas, often with many open water areas, is used primarily by moose and mountain caribou. Moose utilize these areas and adjacent upland forest during the winter months and the many open-water areas provide the aquatic plants preferred by moose during the summer. Mountain caribou may winter in these areas, where the interspersion of openings and tree cover enhance arboreal lichen growth.

Muskeg habitat and its open water areas support beaver, muskrat, mink, cranes, and migratory and nesting waterfowl.

c) Floodplain Forest

The floodplain forest community is restricted to alluvial deposits along streams and rivers. Forest elements usually include white spruce, balsam, poplar, and willow. Alluvial deposits are generally the most productive areas in northern latitudes and the brush shrub growth is an important source of nutrition for browsing ungulates. Moose tend to congregate along stream and river bottoms during the winter. Beaver, mink, fisher, fox, coyote, and wolf all utilize such areas in addition to a variety of waterfowl and shorebirds. Grizzly bears may be encountered along river and stream bottoms in the early spring where they feed on early emergent vegetation.

d) Sub-alpine Forest

The sub-alpine forest composed of alpine fir and white spruce or Engelmann spruce and adjacent, but altitudinally higher alpine tundra areas, provide the principal habitat of thinhorn sheep (both Dall and Stone subspecies), mountain caribou, mountain goats, grizzly bears, wolverine, marmot, ptarmigan, and a variety of smaller mammals and birds. The mountain caribou and grizzly bear principally utilize these areas in the summer, moving to lower elevation forests in the winter to either winter ranges or, as in the case of the grizzly, to winter denning areas.

This assessment of the wildlife resources along the proposed pipeline route has been divided into three sections: Yukon section covering 512 miles of pipeline; Northern British Columbia section covering 350 miles of pipeline; and the northern Alberta section covering 50 miles of pipeline. The major wildlife resources of each of these sections is considered below. Particularly sensitive wildlife features are identified with an asterisk (*). These are discussed in Chapter 3.0 (Environmental Impact of the Proposed Project).

a) Yukon Section

	Comments
Mile Y0.0 - Y43.0	Beaver and muskrat are common in this area. Nesting waterfowl are present in summer.
Mile Y40.0 - Y280.0	Thinhorn sheep are present in high numbers to the south of the proposed route. Grizzly and mountain caribou are also present.
Mile Y48.0	*Grizzly bears present in spring along the White River .
Mile Y51.0 - Y62.0	Beaver and muskrat are common. Nesting waterfowl are present in summer. This is moose summer range.
Mile Y70.0 - Y98.0	Beaver and muskrat are common. Nesting waterfowl are present in summer.
Mile Y83.0 - Y85.0	*Donjek River used as spring and summer range by grizzlies.

Mile Y100.0 - Y110.0	*Critical winter range for Thinhorn sheep adjacent to the south side of the proposed route.
Mile Y109.0 - Y118.0	*Known range of the rare Osborn caribou (a sub-species of Woodland caribou) on both north and south sides of route. Potential caribou crossing between mile Y109.0 and Y114.0.
Mile Y110.0 - Y114.0	Arctic ground squirrels occur in high densities here.
Mile Y120.0 - Y124.0	*Critical winter range of Thinhorn sheep adjacent to the south side of the route.
Mile Y138.0 -Y148.0	*Critical winter range of Thinhorn sheep to the south of the proposed route.
Mile Y147.0 - Y154.0	*The south end of Kluane Lake is an important spring and fall staging area for migratory waterfowl.
Mile Y174.0 - Y190.0	*Critical grizzly bear denning area to the south of the proposed route.
Mile Y230.0 - Y240.0	Elk have been introduced to the Menderhall River area. Mule deer may also be present here.
Mile Y287.0 - Y299.0	*Staging area for migratory waterfowl particularly whistler and trumpeter swans.

Mile Y322.0 - Y330.0	*Staging and nesting area for waterfowl.
Mile Y371.0	*Nisutlin Bay is an important area for staging and nesting waterfowl. The Nisutlin River, to the north, is one of the highest density nesting areas for the interior Yulcan race of Canada Geese.
Mile Y400.0 - Y440.0	Grizzly bears are common in the Cassiar Mountains north of the route and may be expected along the route.
Mile Y432.0 - Y474.0	Represents the northern limit of fisher range in the Yukon.
Mile Y435.0 - Y474.0	*Caribou migration corridor (F.F. Slaney, pers. comm.)
Mile Y458.0 - Y460.0	*Swan nesting area.
Mile Y480.0 - Y512.0	Area important for beaver, muskrat, and moose. Waterfowl nesting area.
Mile Y505.0 - Y512.0	Sandhill crane staging area to the north and east of the proposed route.

b) Northern British Columbia Section

Mile B0.0 - B105.0	Moose range. Beaver and muskrat are present. Waterfowl nesting area.
Mile B105.0 - B180.0	*Area to the south of the route contains populations of Stone sheep, grizzly, mountain goat and mountain caribou.
Mile B280.0 - B350.0	Moose and Woodland caribou range.

c) Northern Alberta Section

Mile A0.0	Moose and Woodland caribou range.
Mile A50.0	*Hay-Zama Lake area to the south of the route is an important spring and fall staging area for migrating Whitefront, Canada, and Snow geese.

Endangered species of birds of prey (bald eagle, osprey, gyrfalcon, and peregrine falcon) may occur along the proposed pipeline route. However, detailed information on their distribution is presently not available. Bald eagles and ospreys normally nest in trees within a short distance of lakes or rivers. Peregrine falcons and gyrfalcons are usually found nesting in cliff areas.

2.3 Aquatic Environment

2.3.1 Hydrology

a) Overview

Seven major drainage basins are traversed by the proposed pipeline route between the Yukon/Alaska border and Zama Lake, Alberta. With the exclusion of the ungauged White River system and the Hay River system, streamflow gauging stations have been selected to characterize the hydrologic regime of each system. These drainage basins are tabulated in Table 5, with the length of route within each basin indicated. The route traverses 247 watercourses of which there are 19 major crossings in the Yukon and 19 in British Columbia.

The timing and volume of flow vary widely over the region under study, in response to differing climatic and physiographic environments. Figure 10 (based on information presented by the Northern Canada Power Commission, 1975) indicates a range of average annual runoff values from 0.5 to 1.5 cubic feet/second/square mile. The runoff isolines are calculated at the major drainage basin scale, and it is accepted that local variability would produce still greater extremes. The greatest runoff per square mile is generated in the glacier covered St. Elias Range and the Boundary Ranges of the Coast Mountains, with a progressive decline inland. The river systems discussed below are dominated by either nival or glacial regimes, and the timing of the peak runoff is first a function of this control. The snowmelt peak is typically in June, while peak glacial melt occurs in August.

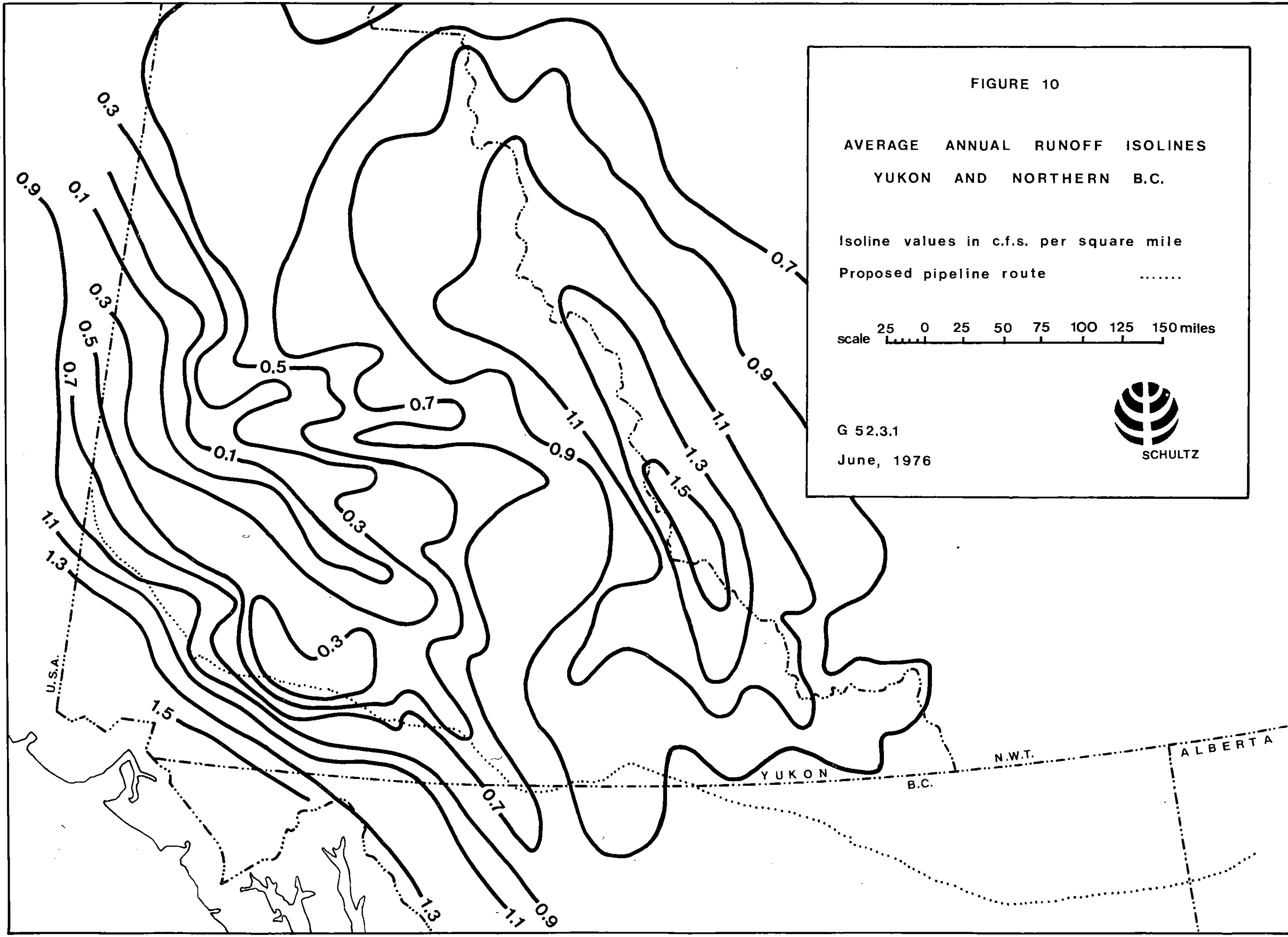


FIGURE 10

AVERAGE ANNUAL RUNOFF ISOLINES

YUKON AND NORTHERN B.C.

Isoline values in c.f.s. per square mile

Proposed pipeline route ....

G 52.3.1

June, 1976

TABLE 5

MAJOR DRAINAGE BASINS

Drainage Basin	Representative Gauging Station	Length of Route Within Basin (Miles)	Principal Drainage System
White River	Ungauged	60	Yukon River
Donjek/Kluane Rivers	Kluane River below Kluane Lake	83	Yukon River
Alsek River	Dezadeash River (tributary to Alsek River)	55	Pacific Seaboard
Yukon River	At Whitehorse	90	Yukon River
Teslin River	Below Teslin Lake	125	Yukon River
Liard River	At upper crossing At lower crossing	258	Mackenzie River
Hay River	Ungauged	110	Mackenzie River

b) Representative Streamflow Gauging Stations

Information tabulated in Table 6 was collected by the Water Survey of Canada and is based on data up to and including 1973. The low flow period is considered to be that which experiences monthly mean discharges one order of magnitude less than that of the higher flow period.

i) Kluane River at the Outlet of Kluane Lake

Peak flow at this station occurs in August due to the derivation of runoff in the glacial covered St. Elias Range. The low flow period is similarly later than the nivally-controlled systems.

ii) Dezadeash River at Haines Junction

This river is tributary to the Alsek River, the only system within the study area which drains south to the Pacific seaboard. Dezadeash River rises in the Coast Mountains and has a nival regime.

iii) Yukon River at Whitehorse

The main source of runoff for this system is the glacierized Boundary Ranges of the Coast Mountains. Peak flow, related to the period of highest temperature, occurs in August. This station is the only one of the six selected which is presently regulated; it is also substantially lake-controlled.

iv) Teslin River at Outlet of Teslin Lake

Teslin River drains north into the Yukon system. Low flow occurs from November to April and peak snowmelt normally occurs in June.

TABLE 6

HYDROLOGIC CHARACTERISTICS OF REPRESENTATIVE BASINS

Station	Drainage Area (sq. miles)	Period of Record (years)	Annual Mean Flow (cfs)	Low Flow Period	Minimum Monthly Vol. (cfs)	Mean Flow Month	Normal Peak Flow Month	Normal Peak Flow Vol.(cfs)	Maximum Daily Discharge On Record Vol.	Maximum Daily Discharge On Record Date
Kluane River	1,910	22	2,470	Dec-May	355	Feb	August	8,150	13,500	Aug 14/71
Dezadeash River	3,200	21	1,530	Nov-April	448	March	June	3,710	10,100	June 28/61
Yukon River *	7,500	31	8,440	Nov-May	2,780	April	August	17,500	22,800	Aug 9/53
Teslin River	11,700	29	10,800	Nov-April	2,650	April	June	32,100	65,000	June 28/62
Liard River (Upper Crossing)	12,500	14	14,000	Nov-April	2,380	March	June	52,500	108,000	June 2/72
Liard River (Lower Crossing)	40,300	29	40,500	Jan-April	7,420	March	June	134,000	301,000	June 13/64

* Regulated since 1969

v) Liard River at Upper Crossing

This station represents the greater area of the Liard River basin to be found in the Yukon Territory. It flows south and east into the Mackenzie system. The snowmelt peak is in June, and the low flow period occurs from November to April.

vi) Liard River at Lower Crossing

This station integrates the Upper Liard River basin (in the Yukon) and much of the area in British Columbia traversed by the proposed pipeline route. The effective low flow period may extend from November to April with a snowmelt peak occurring in June.

2.3.2 Water Quality

a) Suspended Sediment Yield

Guymon (1974) reports that glacial streams in Alaska have suspended sediment concentrations up to 2,000 $mg.l^{-1}$ which are greater by a factor of 10 to 20 than the non-glacial streams. Data collected daily over the 1962-66 period at a Yukon River station near the Alaska /Yukon boundary integrate sediment yield information for much of the Yukon Territory. Guymon determined that the average sediment concentration of 330 $mg.l^{-1}$ produced an annual sediment yield of 260 tons per square mile per year. These results are in agreement with levels presented by Stichling (1974). The Liard River system, based on Stichling's results, has typical concentrations of 51-200 $mg.l^{-1}$ as does the Alsek drainage system to which the Dezadeash River is tributary. As expected, high rates are maintained in streams draining the glacierized St. Elias Range.

The above figures may only be regarded as best first estimates of sediment yield rates. Clearly, rates vary widely with spatial scale and time. To date, only sporadic sampling has been undertaken by the Water Survey of Canada; daily suspended sediment stations are not maintained, and bedload transport rates are not yet available.

b) Dissolved Sediment Yield

Estimates of annual solute yields have not yet been developed. The dissolved sediment concentrations tabulated below (Table 7) are the only total dissolved solids concentrations available for the region under study. The data, collected by the Water Survey of

Canada, represent sampling periods of variable length between 1961 and 1973.

TABLE 7

DISSOLVED SEDIMENT CONCENTRATIONS

Station	Average Total Dissolved Solids ($mg.l^{-1}$)	Standard Deviation
McClintock River near Whitehorse	92	26
Takhini River near Whitehorse	40	15
Yukon River at Whitehorse	53	10
Teslin River below Teslin Lake	67	4
Liard River at Upper Crossing	115	39

2.3.3 Fisheries Resources

A preliminary description of the aquatic environment along the proposed pipeline route has been produced from published information and communication with government officials. The data pertaining to Mile Y.0 - Mile Y.512 (i.e. the Yukon section) has been extracted from maps of the Land Use Information Series of the Department of the Environment. Data pertaining to Mile B.0 - Mile B.350 and Mile A.0 - Mile A.50 has been extracted from miscellaneous publications and reports about the study area. Presented here is an overview assessment of fisheries resources along the proposed pipeline route. Site specific comments have been made where possible. However, information is incomplete and further detailed studies are necessary.

The proposed pipeline route will cross portions of four general watersheds. The fish species occurring in each watershed are listed in Tables 8 and 9. Both resident and anadromous species are represented.

The climate of the area directly affects the role of different habitats in the lives of the fishes concerned. Some smaller streams freeze to the bottom during winter and thus are only utilized during the summer months. In many cases, fishes resident in lakes and large rivers will only move into the smaller streams for spawning. The small streams are also important in that they have a greater abundance per unit area of benthic organisms than do the larger rivers. These are important as colonizers for downstream communities that are removed during spring freshet and for food for fishes resident in the streams.

TABLE 8

PROBABLE FISH SPECIES ALONG PROPOSED PIPELINE ROUTE

OCCURRENCE BY WATERSHED

Common Name	Scientific Name	Upper Yukon	Lower Liard	Alsek	Hay
Arctic grayling	Thymallus arcticus	x	+	x	+
Broad whitefish	Coregonus nasus	x			
Brook stickleback	Culaea inconstans		*		+
Burbot	Lota lota	x	+	x	+
Chinook salmon	Oncorhynchus tshawytscha	x		x	
Chum salmon	Oncorhynchus keta	x			
Coho salmon	Oncorhynchus Kisutch	x		x	
Dolly Varden char	Salvelinus malma	x	o	x	
Emerald shiner	Notropis atherinoides		+		
Finescale dace	Pfrille neogaea		+		+
Flathead chub	Platygobio gracilis		+		
Goldeye	Hiodon alosoides		+		
Inconnu	Stenodus leucichthys	x	+	x	
Lake chub	Couesius plumbeus	x	+	x	
Lake cisco	Coregonus artedii	x			
Lake trout	Salvelinus namaycush	x	+	x	
Lake whitefish	Coregonus clupeaformis	x	+	x	
Least cisco	Coregonus sardinella	x			
Longnose dace	Rhinichthys cataractae		+		+
Longnose sucker	Catostomus catostomus	x	+	x	+
Mountain whitefish	Prosopium williamsoni		+	x	
Ninespine stickleback	Pungitius pungitius		+		
Northern pike	Esox lucius	x	+	x	+
Pygmy whitefish	Prosopium coulteri	x			
Rainbow trout	Salmo gairdneri	x		x	
Round whitefish	Prosopium cylindraceum	x	+	x	
Slimy sculpin	Cottus cognatus	x	+	x	+
Sockeye salmon	Oncorhynchus nerka			x	
Spoonhead sculpin	Cottus ricei		+		
Spottail shiner	Notropis hudsonius		*		
Troutperch	Percopsis omiscomaycus		+		+
Walleye	Stizostedion vitreum		+		+
White sucker	Catastomus commersoni		+		+

Sources: x Sigma Resource Consultants Ltd. et al., 1975
+ McPhail and Lindsay, 1970
o Scott and Crossman, 1973
* Stein et al., 1973

TABLE 9

POTENTIAL OCCURRENCE AND HABITAT TYPE OF FISH SPECIES

ALONG THE PROPOSED PIPELINE ROUTE

Mile B.0 to Mile B.350, Mile A.0 to Mile A.50

		Preferred Habitat Type*			Potential Occurrence in each Section Liard River Watershed							Hay River Watershed
Common Name	Scientific Name	Stream	River	Lake	B0-B50	B50-B100	B100-B150	B150-B200	B200-B250	B250-B300	B300-B350	A0-A50
Spottail Shiner	Notropis hudsonius								←	→		
Arctic grayling	Thymallus arcticus	x	x	x	←	—	—	—	—	—	—	→
Lake trout	Salvelinus namaycush		x	x	←	—	—	—	—	→		
Dolly Varden char	Salvelinus malma	x	x	x	←	—	—	—	—	→		
White sucker	Catostomus commersoni	x		x	←	—	—	—	—	—	—	→
Longnose sucker	Catostomus catostomus	x		x	←	—	—	—	—	—	—	→
Finescale dace	Pfrille neogaea	x		x						←→		
Flathead chub	Platygobio gracilis	x	x						←	→		
Lake chub	Couesius plumbeus	x	x	x	←	—	—	—	—	→		
Longnose dace	Rhinichthys cataractae	x		x	←	—	—	—	—	—	—	→
Northern pike	Esox lucius		x	x	←	—	—	—	—	—	—	→
Burbot	Lota lota		x	x	←	—	—	—	—	—	—	→
Troutperch	Percopsis omiscomaycus	x		x					←	—	—	→
Walleye	Stizostedion vitreum		x	x					←	—	—	→
Spoonhead sculpin	Cottus ricei	x	x	x					←	→		
Slimy sculpin	Cottus cognatus	x		x	←	—	—	—	—	—	—	→
Goldeye	Hiodon alosoides		x	x					←	→		
Inconnu	Stenodus leucichthys		x	x					←	→		
Round whitefish	Prosopium cylindraceum	x	x	x	←	—	—	→				
Mountain whitefish	Prosopium williamsoni		x	x	←	—	—	—	—	→		
Lake whitefish	Coregonus clupeaformis		x	x	←	—	—	—	—	→		
Emerald shiner	Notropis atherinoides		x	x						←→		
Brook stickleback	Culaea inconstans	x		x						←	—	→
Ninespine stickleback	Pungitius pungitius	x	x	x					←	→		

* Source: Scott and Crossman, 1973, Stein et al., 1973.

Large lakes and rivers provide over-wintering areas and are used by those species spawning during the fall. Large rivers provide migratory pathways for certain species.

a) Existing Environment - Mile Y-O to Mile Y-512

The section of pipeline route through the Yukon Territory is approximately 512 miles in length. Of this, about 160 miles cross watercourses which drain north into the White River system, 50 miles cross watercourses which drain south into the Alsek River and thence to the Gulf of Alaska, and about 300 miles cross watercourses which drain north into the Yukon or Teslin River systems. The White and Teslin rivers join the Yukon system which flows through Alaska to the Bering Sea.

The watercourses in all of these sections support populations of Arctic grayling, lake trout, Northern pike, Dolly Varden char and various species of whitefish, many of which are used in recreational, domestic, and commercial fishing.

Recreational fishing especially has evolved to a well-used resource along the proposed pipeline route, with access provided by the Alaska Highway (Henning, 1973, Grundle, 1975).

Throughout the area in suitable rivers, Chum and Chinook salmon ascend from the ocean to spawn. Chinook salmon spawning in tributaries of the Yukon River accomplish a spawning migration of the greatest length recorded, moving 2,000 miles downstream to the Bering Sea as juveniles and returning up 2,000 miles of river to spawn as adults.

Large lakes and the rivers closely associated with them are in contact with the pipeline at four locations and for a total distance of more than 100 miles. These lakes, although low in nutrients and with a short annual productive season relative to southern lakes, nevertheless support large populations of fish, especially Lake trout, of considerable value to the domestic, commercial, and recreational fisheries of the Yukon Territory. Lake tributaries may be essential to certain stages in the life cycle of otherwise lake resident fish.

The following is a more detailed description of the fish resources in the Yukon section of the proposed route.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y0-Y50	6 unnamed creeks	
	7 named creeks	
	Enger Lakes	Grayling recreational fishery
	White River	Chum and chinook salmon ascend the White river to spawn in late summer and fall (August-October). The precise location of spawning grounds is difficult to determine because of the milky coloration of the water and because the latter part of the chum salmon run is believed to spawn under the ice. The young of these species descend the rivers in spring and summer and are particularly vulnerable to the effects of pollution.
	Koidern River	Ice-free areas exist year-round on the Koidern River. These may be important habitat areas for fish.

General comments: The rivers within this section originate from glaciers within a few miles of the proposed pipeline. Limited recreational fishing occurs in the clearer lake waters.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y50-Y100	small lakes 12 unnamed creeks 3 named creeks Kluane River Donjek River	Chum salmon spawn at various points on the Kluane River and along the shores of Kluane Lake. These fish also probably spawn in the upper reaches of the Donjek River, but precise locations are not known. Spawning grounds should be protected at all times of the year.
	Koidern River	Ice-free areas exist year-round on the Koidern River. These may be important habitat areas for fish.

General comments: Large rivers in this section support spawning by Chum salmon, especially in the clearer water draining from Kluane Lake.

Y100-Y150	23 unnamed creeks 7 named creeks Duke River Kluane Lake	Spawning occurs in creeks near the shore of Kluane Lake. Kluane Lake is fished commercially and has an annual quota of 37,000 pounds, of which only 18,500 pounds may be Lake trout. The rest of the catch is comprised mainly of Lake whitefish. Other species not actively sought but netted during the fishery include Longnose sucker, burbot, pike, Round whitefish, Broad whitefish, inconnu, and grayling. Pike, Lake trout, and grayling are taken by angling.
	Slim's River	

General comments: The relatively rich environment of Kluane Lake is supported by the many small tributaries entering it. Commercial, subsistence, and recreational fishing are successfully carried out in the lake.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y150-Y200	4 unnamed creeks 6 named creeks Jarvis River Pine Lake	Within the headwaters of the Dezadeash system, where Northern pike are found.

General comments: Some of the creeks crossed are tributary to Kluane Lake where they may provide spawning habitat at their outlets.

Y200-Y250	2 unnamed creeks 2 named creeks Aishihik River Mendenhall River Takhini River	In August, Takhini River is used as a migration route by adult Chinook salmon. Juvenile chinooks travel downstream in the spring. It is particularly important that all salmon spawning grounds be carefully protected from any disturbance throughout the year.

General Comments: The protection of salmon migration routes and spawning areas is of great concern in this section when dealing with tributaries of the Yukon River.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y250-Y300	small lakes	In recent years, several lakes in the vicinity of Whitehorse have been stocked with rainbow trout. Some of the lakes now support spawning populations of these fish and provide recreational fishing for local anglers.
	14 unnamed creeks	
	4 named creeks	
	Ibex River	
	Yukon River	In late summer, the Yukon and M'Clintock Rivers and Michie Creek are used as migration routes by adult Chinook salmon. Juvenile chinooks travel downstream in the spring.
	M'Clintock River	A fishway around the dam at Whitehorse is used by migrating species including Chinook salmon, Arctic grayling, inconnu, Lake trout, Northern pike and Longnose sucker.
	Michie Creek	Chinook salmon spawn in Michie Creek at the outlet of Michie Lake in late August. They are extremely vulnerable to disturbance at this time.

General comments: The migration route of Chinook salmon having the longest recorded spawning migration is crossed by the route near known spawning beds. The salmon are also a valuable component of commercial fisheries downstream. Recreational fishing is popular with good access and a large population center nearby.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y300-Y350	17 unnamed creeks 2 named creeks	
	Squanga Lake	Squanga Lake is reported to contain a population of Pygmy whitefish. Lake whitefish and Broad whitefish are also present. Sports fishing facilities have been established at the lake.
	Little Teslin Lk. Teslin River at Johnsons Crossg. at the inlet to Teslin Lake	Chum salmon spawn in the Teslin River in September and October, but precise spawning locations are not known. The river also supports populations of grayling, pike, broad whitefish, inconnu, and longnose sucker. Other species may also be present. Domestic native fisheries are present on Teslin Lake at Johnsons Crossing and at the settlement of Teslin. Lake trout and Chinook salmon are the most important species taken. The Teslin River is a migration route for Chinook and Chum salmon. Spawning migrations occur in the summer and fall. Other species probably undertake feeding and spawning migrations at various times of the year.

General comments: The pipeline crossing of the Teslin River at Johnsons Crossing is a very sensitive area, providing fish migration and spawning habitat, and supporting a valuable recreational and domestic fishery.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y350-Y400	10 unnamed creeks 6 named creeks	
	Teslin Lake at mouth of Nisultin Bay	Species known to occur in Teslin Lake are Broad whitefish, Lake whitefish, Least cisco, Round whitefish, inconnu, burbot, grayling, Lake trout, Longnose sucker, pike, and Slimy sculpin. Chinook and Chum salmon are taken during their spawning migrations. Domestic native fisheries occur in Teslin Lake at the settlement of Teslin at the mouth of Nisultin Bay. Lake trout and Chinook salmon are the most important species taken.
	Morley River	Morley River supports population of grayling, pike, Broad whitefish, inconnu and Longnose sucker. Other species may also be present. Chinook salmon spawn along the Morley River in the last two weeks of August. Activities that threaten to disrupt spawning or alter the spawning beds should be avoided.

General comments: Many of the small creeks entering Teslin Lake and crossed by the pipeline route may contribute to the life cycle of fish in the lake. Recreational fishing occurs at several points of access from the highway.

Mileage	Watercourses	Comments
Y400-Y450	3 unnamed creeks 5 named creeks	
	Smart River Swift River	The Smart and Swift Rivers serve as migration routes for Chinook salmon.

General Comments: The Rancheria River, paralleled by the route over a 10 mile area, supports recreational fishing near the Alaska Highway.

Mileage	Watercourses	Comments on Fish Resources including those from Land Use Information Maps
Y450-Y512	6 unnamed creeks	Species found in these streams include grayling, Lake trout, pike, Dolly Varden, and unidentified species of whitefish.
	4 named creeks	In late June, grayling spawn in these clear, gravel-bottomed streams in this section of the pipeline route. All streams with similar characteristics probably support spawning populations of grayling. Dolly Varden probably spawn in the larger streams.
	Rancheria River Little Rancheria River	
	Veronica Lakes	Lake trout, Dolly Varden, and grayling are abundant in these lakes, providing a valuable recreational fishing resource. The lakes also contain whitefish and pike.

General Comments: The Alaska Highway and pipeline route are nearly coincident over this section. Recreational fishing occurs at points of access to several of the above watercourses.

2.3.3.1 Yukon-British Columbia Border to British Columbia-Alberta Border

This section covers 350 miles of pipeline proposed for the British Columbia section of the corridor. Watercourses crossed by the first 300 miles of pipeline flow into the Liard River which in turn empties into the Mackenzie River. The 50 miles of pipeline west of the British Columbia-Alberta border crosses a section of the Hay River watershed as well as crossing the Hay River itself. The Hay River drains eastward into Great Slave Lake which is drained by the Mackenzie River.

Neither the Liard nor the Hay River system supports anadromous fish. Only two salmonid species are present in the study area - Dolly Varden char and Lake trout. These two species, as well as Arctic grayling, Northern pike and various species of whitefish are utilized by both the recreational and domestic fisheries. The recreational fishery should be considered important along those sections of the pipeline paralleling the Alaska Highway since this highway is practically the only access route to recreational fishing in this part of British Columbia. The proposed pipeline parallels approximately 55 miles of the Alaska Highway, and is crossed by the highway in four places.

There is no commercial fishery along the proposed pipeline route.

The list below provides a more detailed description of the fish resources in the British Columbia section of the proposed route.

Mileage	Watercourses	Comments on Fish Resources
B0-B50	Leo Lake Dan Lake Clem Lake Dease River 10 small creeks	No road access from Alaska Highway.

General comments: This section of the proposed pipeline route crosses flat terrain with marshy lakes and watercourses. The slow-moving, heavily vegetated creeks and shallow lakes would be used in the spring by spawning northern pike. During summer months pike will disperse to deeper cooler water but may be found in most of these watercourses through winter.

Mileage	Watercourses	Comments on Fish Resources
B50-B100	Coal River	The highway crossing provides the only recreational fishing access to the Coal River. Fishing for Arctic grayling and pike is good.
	Smith River	The Smith River is accessible for much of its length by a side road. A domestic fishery occurs throughout the Smith River but is concentrated in the area of the falls approximately one mile north of the highway crossing. Most of the recreational fishing pressure will be concentrated at the highway crossing where Arctic grayling & Dolly Varden char are reported to be present.
	approximately 11 unnamed creeks	

General comments: The proposed pipeline parallels the Liard River for almost all of this 50 mile section. The route crosses two major rivers, the Smith and the Coal, both of which have recreational fisheries. Dolly Varden char probably move upstream from the Liard River in the fall to spawn in tributary creeks.

Mileage	Watercourses	Comments on Fish Resources
B100-B150	Liard River	The Alaska Highway crossing of the Liard River provides good access for recreational fishing, including Dolly Varden char, Arctic grayling and some Lake, Mountain and Round whitefish.
	Mould River	No road access
	Trout River	The Trout River drains Muncho Lake into the Liard River. Arctic grayling, Lake trout and the three species of whitefish mentioned above can be caught at the confluence of the Trout and Liard rivers.
	Teeter Creek	Teeter Creek supports a domestic fishery in the vicinity of the proposed pipeline crossing.
	approximately 20 unnamed creeks	

General comments: Fishing pressure on the Liard River at the highway crossing would probably be greater than at other points on the Liard due to the presence of a popular government campground one mile north of the crossing.

Arctic grayling probably spawn in the swift, clear streams running into the Liard River in the canyon section. There is no road access to the canyon section of the pipeline route.

Mileage	Watercourses	Comments on Fish Resources
B150-B200	Toad River Dunedin River Crusty Creek Odayin Creek approximately 20 unnamed creeks	None of these watercourses are accessible by road from the Alaska Highway.

General comments: The marshy drainages between the Toad and Dunedin Rivers are prime pike habitat and are probably used for spawning by this species.

Mileage	Watercourses	Comments on Fish Resources
B200-B250	Muskwa River Prophet River Kledo Creek	Each of these watercourses supports a domestic and recreational fishery for Mountain whitefish, Arctic grayling, burbot, Dolly Varden and Northern pike.
	Steamboat Creek Akue Creek approximately 15 unnamed creeks	

General comments: Inconnu have been reported from the Muskwa River near the crossing of the proposed pipeline. At this time inconnu are not utilized in either a commercial or recreational fishery yet the potential for both is present.

Mileage	Watercourses	Comments on Fish Resources
B250-B300	Fort Nelson River Snake River Nogah Creek approximately 15 unnamed creeks	

General comments: The marshy nature of the country in this section of the proposed pipeline provides Northern pike habitat. Most of this section is inaccessible by road and the fishery potential is not realized.

Mileage	Watercourses
B300-B350	Kotcho River Hay River Klicho Creek Kyklo Creek Metlahdoa Creek Townsoitoi Creek approximately 15 unnamed creeks
General comments:	This section has no road access although it could support a recreational fishery. Sports species such as Northern pike, Arctic grayling and Mountain whitefish are present in the area. The watercourses east of mile B-300 lie within the Hay River drainage system.

2.3.3.2 Alberta-B.C. Border to Zama Lake

The portion of Alberta to be crossed by the pipeline belongs to the Hay River watershed. It was impossible to accurately locate the pipeline route since that information was not available at the time of writing. The line probably crosses four major watercourses including the Hay River; the terrain is flat and marshy.

A more detailed description of the fish resources in the Alberta Section of the proposed pipeline route follows.

Mileage	Watercourses
A0-A50	Hay River Mega River Vardie River Amber River approximately 5 unnamed creeks

General comments: Although there is dry weather road access to most of the area that the proposed pipeline will cross, the fishery potential is limited. Walleye and Northern pike are the only species with recreational or domestic fishery potential. Arctic grayling may be present in the Hay River in this area. It is not known if a commercial fishery is present in the area, however, a domestic fishery is probably present in Zama Lake.

SCHULTZ

2.4 Socio-Economic Environment

2.4.1 Yukon Territory Governmental Structure*

The Yukon is a territory administered through a system of government exercising an authority below that invested in the Provinces.

The equivalent in the Yukon Territory of the usual provincial legislature is the Yukon Legislative Council, which functions in practise as an advisory body to the Territorial Commissioner.

The Commissioner of the Yukon Territory is the senior federal officer and chief executive of Yukon, administering the Government of the territory under instructions issued occasionally by the Governor in Council through the Minister of Indian Affairs and Northern Development. The Assistant Commissioner (Executive) is also appointed administrator by the Governor in Council to act in the absence of the Commissioner. In his dual capacity as the chief representative of the Department of Indian Affairs and Northern Development in the territory and as the head of the Yukon Territorial Government, the Commissioner performs an important function in the coordination of government activities in the territory.

Executive Committee

Members of the Executive Committee assist the Commissioner in an advisory and consultative manner. They recommend broad policy guidelines for the conduct of government business. They are also responsible for the coordination of government activities and advise the Commissioner is carrying out his duties pursuant to the Yukon Act. A degree of liaison between the executive and political aspects of government has been ensured by the provision that three of the members

*Source: Annual Report of the Commissioner, Yukon Territory, 1974-75 of the Executive Committee shall be members of the Yukon Legislative Council. Through the subcommittees on legislation and finance they recommend final legislative and budgetary requirements to be tabled for Council's consideration. Individual members of the Executive Committee also have direct responsibility for one or more government departments subject to the direction and control of the Commissioner.

Yukon Legislative Council

The Yukon Legislative Council consists of 12 elected members representing the various constituencies in the territory. The Whitehorse area has five representatives on Council, while Kluane, Mayo, Pelly, Ogilvie, Klondike, Hootalinqua and Watson Lake have one each.

Functions

The Territory exercises its responsibilities through a number of departments and branches, each responsible for various aspects of the Territory and reporting to their respective heads.

All of the usual functions are performed through the administrative-executive system, including such matters as recreation and tourism, licensing of commercial services, health and welfare, etc.

The Clerk of Council is a core service department within the government, providing administrative support to the Commissioner and to the Executive Committee. The department also provides legislative support services to the Council. As secretariat to the Executive Committee and its subcommittees, the department maintains the records of the committees, investigates procedural matters and serves as the information link between the committees and government departments. Core administrative services performed by the clerk's office include the consolidation of ordianances and registration of regulations.

Of particular interest is the Directorate of Intergovernmental Affairs. This Directorate, established August 20, 1974, provides support services to the office of the Commissioner in the coordination of federal and territorial programs and in the general area of interdepartmental and intergovernmental affairs. Responsibilities also encompass administration of the Federal Interdepartmental Coordinating Committee (FICC).

Wtih the establishment of the new directorate the territorial government assumed a larger and more responsible role in all federal government activities affecting the Yukon and its people, and established more effective communication and a more positive liaison with the (Federal) Advisory Committee on Northern Development.

The directorate is responsible also for the administration of the Yukon Manpower Needs Committee and for the provision of secretariat services to the committee. It was restructured in 1974-75 and a subcommittee on Manpower Training and Research Needs was established.

Local governmental matters are the responsibility of the Local Government Branch, whose primary responsibility is to foster, encourage and assist in the establishmend and development of local government in Yukon committies.

Land use has been the subject of recent studies in the Yukon. The Lands Branch administers the development of sub-division for community residential growth.

The Assessment Branch of the Territory is responsible for local tax matters. The Taxation Ordinance assigns the property assessment function for taxation purposes of tax rolls for other taxing authorities and assessment appeal provisions. General assessments are now being carried out for the City of Whitehorse and annual assessment updating for the Town of Faro and the City of Dawson.

In addition, the remainder of the Local Improvement Districts, communities and unorganized areas in the Yukon are assessed and tax rolls are prepared for the Territorial Treasurer's office to permit the levy of annual property taxes.

The branch is responsible for all of the real property assessment in the Yukon Territory; preparation of assessment rolls for the Municipalities and the Yukon Territorial Government; provision of technical assistance to the Territorial Tax Collector; provision of information and data for the Court of Revision and appeal hearings; and real property appraisals for land sale purposes.

Other departments are branches active in the Territory; and their responsibilities include:

Territorial Secretary and Registrar General	Commercial licenses
Tourism, Conservation and Information	Wildlife, outdoor recreation, etc.
Highways and Public Works	Highway construction, maintenance, etc.
Treasury	Finances, budgets, etc.
Corrections	Probations, prisons, etc.
Education	Schooling
Vocational and Industrial Training	Upgrading, technical training, etc.

In general, the major difference of relevance to this overview study between the Yukon Territory and the Provinces of British Columbia and Alberta resides in the stronger role played by the Federal presence in the Yukon.

The Yukon Territory, nonetheless, has been moving steadily along the path toward provincial status, and the residents of the Territory are conscious of their growing authority over their own affairs.

2.4.2 Historical and Economic Overview

The Alaska Highway crosses the sixtieth parallel into the Yukon Territory 627 miles northwest of Dawson Creek, British Columbia, and continues through the Yukon, with a minor incursion back into B.C., for almost 600 miles to the Alaska border. Much of the route is upland plateau, interspersed with wide river valleys and lake basins. The corridor passes through and parallels numerous mountain ranges, including the St. Elias Range containing some of the highest and most rugged mountains in North America.

The physical character and remote location of the southern Yukon has been instrumental in establishing the basis for the prevailing settlement pattern and economy. Historically, the Yukon has undergone several phases of resource discovery, boom, then recession. At various times and locations these resources have included furs, whales, gold, and various other minerals.

Yet, it was not until the Second World War when the southern Yukon and Alaska were seen as locations strategic to the war effort, that this main east-west Alcan (Alaska-Canada) corridor began to dominate the economic, settlement, and transportation network of the territory.

By the middle of the 19th century, fur trading companies had moved into the general northwest of the continent. Alaska based trades, trades on the Pacific coast, and others operating in northern British Columbia and areas to the east of the territory had begun to tap the fur resources of the region.

Throughout this period, and indeed until the introduction by American traders of steam power onto the Yukon River, the transportation links between the Yukon and the outside world were tenuous, slow, and costly.

From the time of the Alaska purchase, development in the northwest accelerated, although the Yukon Territory did not share in that development until the impetus of the major gold discoveries occurred late in the 1890's.

By the 1890's, faster and more reliable means of transportation and communications such as the railroad and telegraph opened up new areas of the Yukon for potential exploitation.

The Klondike gold rush played a vital economic and psychological role in northern development. The Canadian Pacific Trans-Continental Railroad had been completed and steamship transport was available from the west coast News of the discovery disseminated rapidly. An estimated 100,000 people set out for Dawson City and the Klondike, three hundred miles north of what is presently Whitehorse. The majority travelled into the Territory via Skagway, but many parties arrived by other routes, including routeways out of northwest Alberta and northeastern British Columbia. The present highway communities of Whitehorse, Teslin, and Upper Liard became stopover and supply centers for the activities further north. A railway from Skagway to Whitehorse was completed in 1900 (the White Pass and Yukon route), enhancing Whitehorse's role as a transportation and distribution center.

The population of the Yukon fell drastically as capital intensive methods of gold recovery displaced the earlier and more labor intensive methods. "Exhausted" claims were bought up and consolidated for mechanical dredging operations. While the value of gold mined in the Klondike rose between 1908 to 1914, the population of the Yukon declined from 27,000 in 1901 to 8,500 in 1911. The population of the territory in the inter-war years hovered between 4,000 and 5,000.

Other mineral resources were discovered during the post-1900 period. Attempts to exploit silver, lead and zinc deposits in the Mayo district, 200 miles north of Whitehorse, between 1900 and 1920 failed because of poor transport facilities to the Whitehorse railhead.

The introduction of tractors and a concentrating mill in the early 1920's near Mayo, helped lower transport costs; in 1950 the Mayo-Whitehorse highway eliminated the mine's dependence on winter roads and river transportation. Copper deposits near Whitehorse were mined in the 1920's; but were subsequently abandoned until changes in technology and improvements in transportation brought renewed activity in the 1960's.

Despite these developments, riverboats of the Yukon River to the north and west of the Alcan corridor continued to be the major transport mode until 1942. River transport, in fact, remained significant until 1954. The arrival of the airplane in the 1930's foreshadowed the war and post-war periods of expansion.

The continental northwest became a possible theater of war in 1940. The Northwest Staging Route, a series of airports from Edmonton to Alaska via Fort St. John, Fort Nelson, Watson Lake, and Whitehorse, was upgraded for the war effort. The land link to connect these airports was provided by the construction of the Alaska Highway.

In the spring of 1942, with the co-operation of the Canadian government, the U.S. Corps of Engineers began surveying the route from Dawson Creek. Construction was completed nine months later: 1,523 miles in length, it opened up thousands of square miles of territory. Gas and oil for aircraft and trucks were to be supplied by two pipeline projects. The Canol Project was to supply crude oil from Norman Wells to a Whitehorse refinery. It took two years to build the 530 mile pipeline and service road from Norman Wells to Johnson's Crossing east of Whitehorse. It was completed at a cost of $434,000,000 in 1944 but abandoned shortly thereafter. The production of oil at Norman Wells in the Northwest Territories continues into the present day for local consumption.

A second pipeline project from Haines, Alaska, to Fairbanks via the Haines and Alaska Highways through Haines Junction, was constructed by the U.S. Army.

Wartime activity in the Yukon concentrated population, transportation and economic activity along the Alcan Corridor. Whitehorse grew in importance, and because of its highway, railroad, and air links, the capital was moved there from Dawson City in 1952. The road link from Dawson City and Mayo to Whitehorse was completed, putting an end to river traffic.

The population of the Yukon has grown since 1941, increasing to 9,100 in 1951, and to 14,600 in 1961.

After stagnation in the early 1960's, mineral developments and government expansion in the latter half of the decade brought about a population increase, to 18,400 in 1971, from 14,400 in 1966. For the first time since 1951, net migration exceeded natural increase as components of this 4,000 resident increment. The population of the territory in early 1975 has been estimated at 22,500.

An estimated 75 percent (or 15,500) of the Yukon population lives in communities along the Alaska Highway corridor. Of these, all but 1,800 live in the dominant urban center of Whitehorse, which is growing at a rate faster than the territory as a whole.

Of the other Alaska Highway corridor settlements, only Watson Lake and Haines Junction have shown steady, albeit moderately slow, population increase.

The territorial economy has diversified as growth has occurred in the mining, government and tourism sectors. Anticipated growth in the economy is expected to be based on the primary resources of the Territory, although government and tourist activity is responsible for the bulk of the employment available.

Figures 11 and 12 provide a descriptive overview of the Alaska Highway corridor region. Further details are discussed for the region.

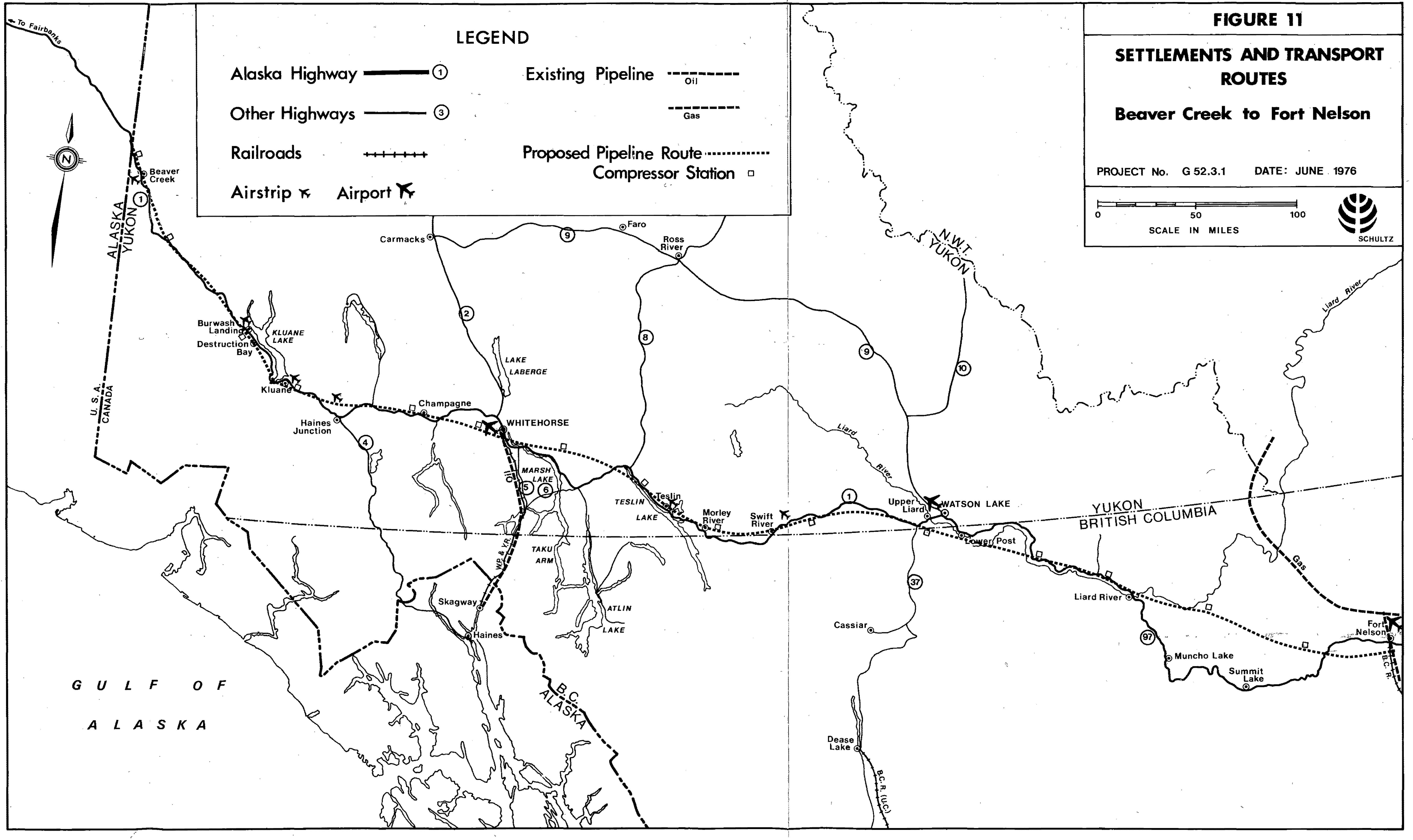


FIGURE 11
SETTLEMENTS AND TRANSPORT ROUTES
Beaver Creek to Fort Nelson
PROJECT No. G 52.3.1
DATE: JUNE 1976
0
50
100
SCALE IN MILES
SCHULTZ
LEGEND
Alaska Highway
Other Highways
Railroads
Airstrip
Airport
Existing Pipeline
Oil
Gas
Proposed Pipeline Route
Compressor Station
To Fairbanks
Beaver Creek
ALASKA
YUKON
U.S.A.
CANADA
Burwash Landing
KLUANE LAKE
Destruction Bay
Kluane
Haines Junction
Champagne
Carmacks
Faro
Ross River
LAKE LABERGE
WHITEHORSE
MARSH LAKE
TESLIN LAKE
Teslin
TAKU ARM
ATLIN LAKE
Skagway
Haines
W.P. & Y.R.
Oil
Morley River
Swift River
Upper Liard
WATSON LAKE
Lower Post
N.W.T.
YUKON
Liard River
YUKON
BRITISH COLUMBIA
Gas
Liard River
Cassiar
Muncho Lake
Summit Lake
Fort Nelson
B.C.R.
Dease Lake
B.C.R. (U.C.)
B.C.
ALASKA
GULF OF ALASKA

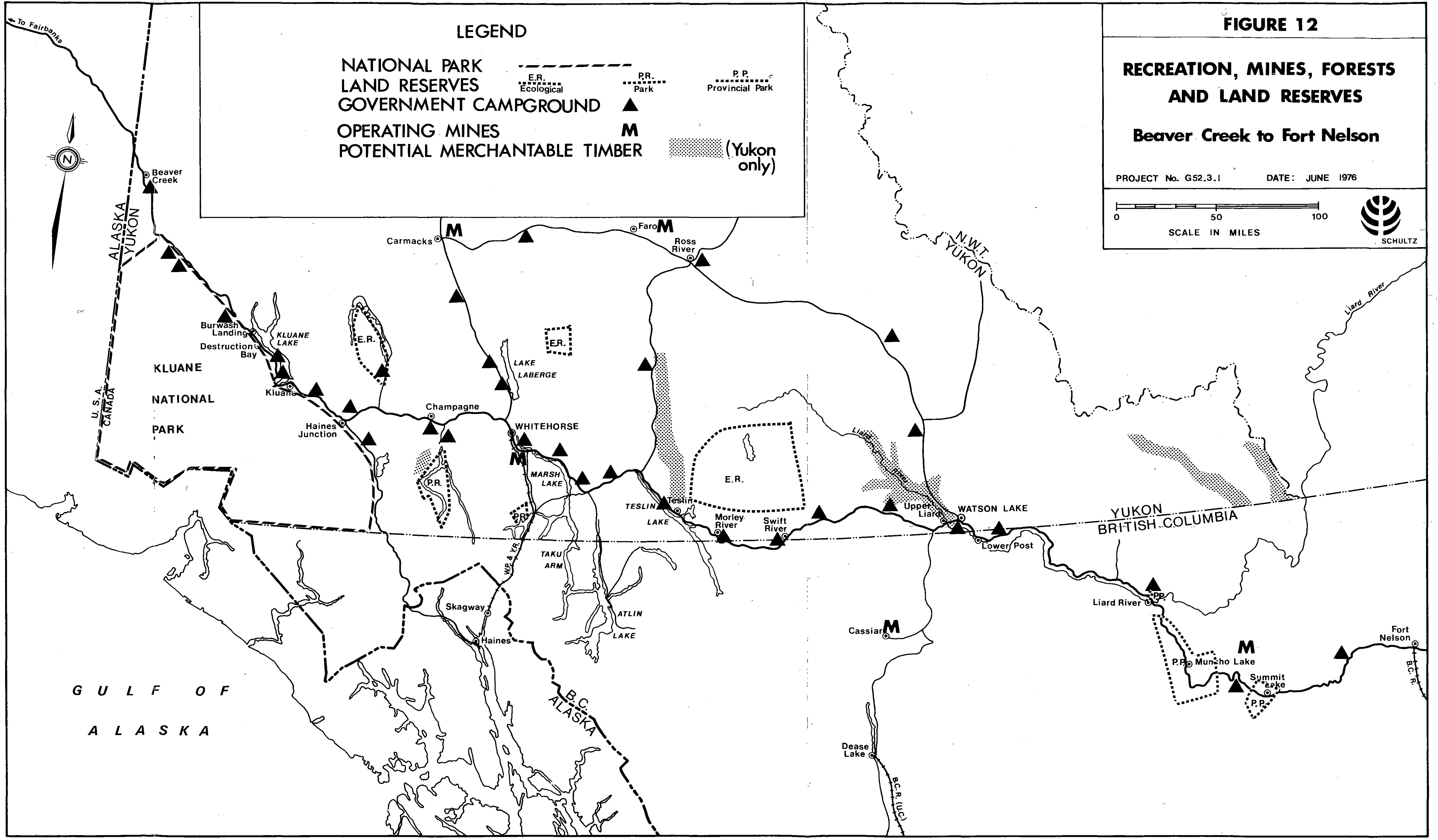


FIGURE 12

RECREATION, MINES, FORESTS AND LAND RESERVES

Beaver Creek to Fort Nelson

2.4.3 Economic Base and Outlook For the Region

a) Mining

From the time of the Klondike gold rush, mining has played an important role in the economic base of the territory. While gold is now a small industry (although activity has increased of late due to a quadrupling in the world price since 1971), zinc, lead, silver, asbestos, copper and small amounts of nickel and cadmium are part of the Territory's mineral production. In addition, industrial minerals, sand and gravel, etc., are available.

There were five producing mines in the Yukon in 1975, only one of which is found along the Alaska Highway corridor. This is the Whitehorse Copper operation, located seven miles from Whitehorse. This underground mine produced at an average rate of 1,920 tons per day during 1974, after re-opening in December, 1972. Official reserves at the end of 1973 were enough for four and one-half years operation at a milling rate of 2,000 short tons per day, although recent discoveries and open pit reserves might increase the expected life of the mine. It employed slightly under 200 workers in 1974; all live in Whitehorse.

The remaining four operating mines in the Yukon are located north of the corridor. The Anvil lead zinc mine at Faro is the largest producer in the territory, with a 1974 production rate of 8,150 tons per day; its capacity has recently increased to 10,000 tons per day, with proven reserves providing 16 years operation at this increased rate. Its 420 employees live in the instant town of Faro (population 1,400). The Tantalus Butte coal mine is operated by Anvil Mining Corporation at Carmacks, 112 road miles west of Faro. The coal is used at Faro for drying the lead-zinc concentrates. Employing 20 in 1974, the production rate was about 70 tons per day.

United Keno Hill Mines, in the Keno-Elsa-Mayo area, produces silver along with some lead, zinc, and cadmium from an underground operation. Its 300 employees mined and milled an average of 297 tons per day during 1974. Life expectency of the mine is uncertain: the mine generally operates with only enough proven reserves for about a year of operation.

The Cassiar Asbestos open pit asbestos mine is near the Yukon River at Clinton Creek, 50 miles northwest of Dawson. The operation milled at a rate of 5,314 tons per day during 1974. The company announced in 1974 that it intends to close down its operation by 1977, due to failing ore reserves.

The small Hudson-Yukon nickel and copper mine at Mile 1111 of the Alaska Highway ceased operation in 1974. Fifty-seven employees, living at the site, Burwash Landing, and Destruction Bay, were on the payroll.

The value of mineral production in the Yukon has increased 15 fold in the 1966-1974 period, from $12 million in 1966 to a high of $200 million in 1975. The 1974 to 1975 increase was the result of both higher market prices, and a gain in actual production. The increase in production is significant as although the value of 1974's mineral production increased, the 1974 actual production decreased from the 1973 level. The number of direct employees in the Yukon mining industry totalled 1,285 in 1973, up from 1,203 in 1972. This constitutes about 18 percent of the Yukon labor force. Wages and salaries paid to mining employees represented about 24 percent of the total paid in the Yukon in 1973.

Mineral production value from the Yukon was 1.6 percent of the Canadian total in 1974. The Yukon ranks in tenth place of the country's twelve provinces and territories - above Nova Scotia and Prince Edward Island production, but below that of the Northwest Territories, which ranked eighth highest in 1974 with a production value of $228 million.

There has been a high degree of exploration activity in recent years, particularly in 1974 and 1975. This activity has tended to concentrate on lead, zinc, copper, and tungsten. There has been relatively little successful exploration activity in the Alaska Highway corridor. The areas which have received most attention are the Faro, Mayo, and Selwyn Mountain region near the Northwest Territories border. There is also a large iron deposit in the Snake River Basin north of Dawson.

Exploration activity in the Whitehorse-Kluane regions has concentrated on copper and silver deposits. Coal prospects occur in the Dezadeash Lake area south of Haines Junction, and the Laberge-Teslin valleys north and east of Whitehorse. Showings of copper, nickel, and molybdenum are found around Burwash Landing. East of Whitehorse there is evidence of coal around Watson Lake, as well as zinc, copper, lead, and silver prospects in the Frances River region 50-100 miles north of the town.

Seismic activity for oil and natural gas has taken place in the Beaver River area in the southeastern Yukon portion of the Liard Plateau. Because of its proximity to major drilling areas and the northeastern B.C. gas pipeline network, this area offers some potential for gas development. A pipeline has been constructed from Pointed Mountain's gas field near Fort Liard, Northwest Territories, along the LaBiche River in the extreme southeastern Yukon, to link with existing lines near Fort Nelson.

The outlook for the Yukon mineral industry, while generally favorable, is conditional upon changing market prices for minerals, transportation costs and networks, federal and territorial policies and provincial mining regulations in British Columbia, and electric power developments.

The four areas in the Alaska Highway corridor that may experience mineral developments are the Destruction Bay-Kluane area, the Whitehorse region, Watson Lake-Frances River, and the Liard Plateau. Nonetheless, it is significant to note that most mineral exploration is occurring well north of the corridor.

Table 10 shows the trend in mineral production in the Yukon Territory for the past several decades.

b) Tourism

Tourism is the second most important industry in the Yukon Territory, preceded in economic returns only by the mining industry. The tourist industry doubled in importance between 1971 and 1973, with tourist spending increasing from $12 million in 1971 to over $25 million in 1973, (See Tables 11,12, 13, 14). During 1974, while tourist travel generally declined throughout North America, the number of out-of-Territory visitors to the Yukon increased by 4.5 percent over 1973.

A decline in independent highway traffic was offset by an increase in package tours arriving by air, bus, and railway (via Skagway). While the majority still travel by automobile or recreational vehicle, this market segment appears to be declining steadily. This trend may be viewed as a direct result of increasing gasoline prices and the priorities of the Yukon Tourism and Information Branch, which is attempting to encourage

TABLE 10

GROSS VALUE OF YUKON TERRITORY
MINERAL PRODUCTION, SELECTED YEARS
($000 - unadjusted)

Year	$	%
1950	9,036	
1955	14,725	+62.9
1960	13,330	-9.4
1965	13,401	+.5
1970	77,512	+478.4
1971	93,111	+20.1
1972	106,781	+14.7
1973	150,667	+41.1
1974	185,194	+22.9
1975	200,000	+8.0%

Source: Yukon Territory, Statistical Appendix to the Annual Report of the Commissioner, 1970-71; and

Yukon Territorial Government, Statistical Review 1970-74.

TABLE 11

YUKON VISITORS

Year	Number of Visitors	Estimated Value
1970	156,416 (+13%)	$ 10,167,000
1971	183,681 (+17%)	$ 11,939,265
1972	270,897 (+21%)	$ 21,768,750
1973	311,374 (+15%)	$ 25,210,970
1974	325,310 (+4.5%)	

TABLE 12

DAWSON CREEK O/D SURVEY OF NORTHERN TOURISTS

1972 - 1974

	Percent		
Point of Origin	1972	1973	1974
U.S.A.	82.5%	75.8%	74.0%
Canadian	15.5%	21.9%	23.4%
Foreign	2.0%	2.3%	2.6%

Source: Yukon Territorial Government, *Statistical Review 1970-74*

TABLE 13

YUKON VISITORS IN 1974

	HIGHWAY				AIR	OTHER	TOTAL
	Beaver Creek	Haines Road	Dawson 60 Mile	Alaska Highway Watson Lk		(Train, boat walking, bicy-cle)	
January	1,545	953	-	109	3,312	531	6,450
February	1,556	861	-	84	3,328	163	5,992
March	2,655	1,466	-	111	4,142	148	8,522
April	3,122	2,483	36	199	3,347	743	9,930
May	5,271	3,452	348	7,474	4,960	2,107	23,612
June	13,756	5,788	1,754	20,319	6,141	8,135	55,893
July	22,875	9,132	3,623	32,573	9,427	9,419	87,049
August	20,916	6,614	3,286	19,167	8,095	11,752	69,830
September	9,694	4,308	907	5,104	4,830	6,345	31,388
October	4,015	1,620	-	160	3,870	1,208	10,873
November *	3,140	1,050	-	75	3,302	562	8,129
December *	2,866	826	-	116	3,503	531	7,842
TOTAL	91,411	38,553	9,954	85,491	58,257	41,644	325,310

*Projected

Source: Yukon Territorial Government, <u>Statistical Review 1970-74</u>

SCHULTZ

TABLE 14

ORIGIN OF YUKON VISITORS FROM TOP 10 AREAS
(Percent of Total Visitors)
1974

Origin	Percent
California	12.6%
Alaska	10.7%
British Columbia	7.8%
Ontario	5.4%
Alberta	4.6%
Washington	4.4%
Ohio	2.9%
Michigan	2.8%
Florida	2.7%
Illinois	2.7%
TOTAL	56.6%

Source: Yukon Territorial Government, Statistical Review 1970-74 package tours. Resident travel within the Territory is also increasing.

Since the construction of the White Pass and Yukon Railway from Skagway to Whitehorse in 1900, the southwest corner of the Yukon has been accessible to travellers and recreationists. The opening of the Alaska Highway to civilians in 1948, and establishment of regular air services, has given a tremendous boost to the tourist industry since World War II.

The prime attraction to tourists is still the region of the Klondike Gold Rush, and to retain this attraction the concept of an International Gold Rush Park has been adopted by the governments of Alaska, Yukon, British Columbia, Canada and the U.S.A. Significant relevant sites are being preserved and restored.

The fastest growing visitor group is that of the wilderness traveller. As a result, Kluane National Park, the McArthur Game sanctuary, and some 54 campgrounds have been set aside for recreation use. The major river systems are being studied as potential recreation areas, and the Yukon Department of Tourism has put forward a proposal for a Territorial Park System which is designed to retain wilderness travellers and other traffic for longer periods of time to increase tourist revenue. It is anticipated that as the area of accessible wild lands in the southern parts of North America decrease, increasing numbers of people will travel to the Yukon for an experience in wilderness vacations.

At present, most visitors to the Yukon are still travelling to and from Alaska, while others are generally confined to the Skagway or Haines-Whitehorse-Dawson-Anchorage Loop. It is estimated that 90 percent of all recreation takes place in the valley bottoms, centered largely along the lakes and rivers, for they contain most of the items of natural and historic interest, and are easy travel routes. Fishing is concentrated in the major rivers and lakes, because access to smaller streams is often impractical and requires air travel.

It should be noted that most travel in the Territory is limited to the very short summer season, although the Tourism Branch is actively encouraging extension of the tourist season through the winter months, for example by publicizing the Sourdough Rendezvous in early spring.

In the southeast portion of the proposed corridor, particularly in the Muncho Lake area, considerable use of the region is made by British Columbia and Alberta residents. This region has a high potential, particularly for wilderness recreation.

c) Recreational Hunting and Fishing

Hunting and fishing oriented recreation is a major resident and tourist activity, supported by almost ubiquitous distribution of desirable species of fish, game mammals, and to a lesser extent game birds. Most "sporting" activity is determined directly by road access to game populations, but this pattern is changing with the increasing use of four-wheel drive and all-terrain vehicles, as well as aircraft. The highway is still the major route for casual or non-resident sportsmen, and many favored locations are contingent on this all-weather access. Almost every service stop on this route provides facilities and services to support this industry.

All the Territory is divided into game management zones, and a baseline survey of wildlife resources is still underway. Presently the elk, musk-ox, and deer are protected species because of their rarity. Hunted species and counts are tabulated in Table 15, but it must be realized that the harvest figures are suspect in that considerably more game (and predators) is taken for domestic use than is reported.

During the 1974/75 licence year the following permits were issued:

463 non-resident hunters (81 percent American, 3 percent Canadian) of which 86.6 percent were successful
3,618 resident hunting
7,893 resident fishing
4,080 non-resident fishing (short and full-term)
76 resident game bird hunting
40 non-resident game bird hunting

It is an indication of the access value of the Alaska Highway that non-resident short-term fishing licences decreased in 1974 by 23.3 percent from the previous year because of washouts and delays on that highway.

The contribution of tourism and recreation to the territorial economy was valued at over $26,000,000 in 1974. It is sufficient to note that outfitters and guides required for game hunting by non-residents received the following permits:

outfitters licence - 23
chief guide licence - 58
assistant guide licence - 91

TABLE 15

GAME TAKEN DURING THE LICENCE YEAR 1974/75,
YUKON TERRITORY

Game Taken	Non-Resident	Resident	Trappers	Total
Sheep	241	95	6	342
Grizzly Bear	86	24	8	118
Black Bear	8	71	30	109
Moose	192	1,162	301	1,655
Caribou	176	344	1,023	1,543
Goat	20	10	-	30
			Total Game	3,797

Predators	Non-Resident	Resident	Trappers	Total
Wolf	41			41
Wolverine	9			9
			Total Predators	50

Source: Annual Report of the Commissioner, Yukon Territory, March, 1975.

d) Transportation Network - Southern Yukon

The Yukon Territory has 1,803 miles of all weather roads which are maintained on a year round basis, while another 629 miles are accessible during the summer season.

The single most important artery is the Alaska Highway, running from Dawson Creek in northeastern British Columbia. to Watson Lake, Whitehorse and the Yukon-Alaska border.

A number of secondary highways provide access to much of the southern half of the Territory. The new Cassiar Highway runs south from Watson Lake to Stewart, B.C., but this road is of poor quality. Most roads in the Territory function as links to resource-extraction sites. On the whole, the road network in the southern Yukon is considerably more developed than that in the north of British Columbia.

The only railway line in the Yukon is the White Pass and Yukon Railway, which connects Whitehorse to the deep-water port of Skagway in the Alaska panhandle. Freight and passenger service is provided. Coastal tour services operating out of Vancouver make use of the railway to take tourist parties into the Yukon from Skagway.

Scheduled air carriers fly out of Whitehorse and Watson Lake to points in Alaska, British Columbia, and Alberta. Air charter services are available throughout the Territory, and the Yukon government maintains 30 airstrips.

A petroleum products pipeline operated by the White Pass and Yukon Railway runs from Skagway to Whitehorse, where the products are distributed for local use.

e) Hydro-Power - Yukon

At present, the Yukon Territory has only three operational hydro-power sites. One of these is at Whitehorse Rapids, about 15 miles southeast of the City of Whitehorse. A second is located just south of Aishihik Lake, approximately 30 miles northeast of Haines Junction. The third facility is located at Mayo, several hundred miles north of Whitehorse.

A number of potential sites have been identified, and these have been ranked in order of development priority. Three level 1 sites (of primary importance) are located near the pipeline right-of-way: the Primrose/Kusawa site, on the Primrose River about 40 miles southwest of Whitehorse; a site on the Teslin River to the southeast of Whitehorse; and a site on the Frances River north of Watson Lake. These projects would cause significant damage to the recreation potential of the areas.

In addition to the possible developments listed above, a level 2 site is found about 45 miles north of Watson Lake, also on the Frances River. A third priority potential site is located on the Upper Liard River, about 15 miles southeast of Watson Lake. This project would flood the community of Upper Liard and require the re-routing of part of the Alaska Highway. The British Columbia Hydro and Power Authority is also considering three possible developments on the Liard River between the Yukon-B.C. border and the Fort Nelson River. (see Appendix IV - Part D).

The existing network of transmission lines is relatively small. One line runs from the Aishihik site to Whitehorse, another from Whitehorse north to Carmacks and then east to Faro, and a third line runs from Whitehorse Rapids south to Carcross. Other centers such as

Burwash Landing, Destruction Bay, Haines Junction, Teslin, Swift River, and Watson Lake are served by diesel plants.

f) Forest Industry

The Yukon Territory is not a major area of forest production in Canada. Production has been limited to supplying the local market for mine timbers and building studs.

Early exploitation of the resource occurred during the gold rush to supply building materials for the then new cities of Dawson and Whitehorse. The construction of the Alaska Highway saw some minimal use made of the local timber supply.

Two larger saw mills at Whitehorse and Watson Lake cut the bulk of the annual lumber production, which averages about 15 million board feet per year or, about $1 million in value. Several smaller portable mills operate on a seasonal basis or when the local timber market appears favorable. Between 26 and 77 persons list "lumbering" as their prime means of income from 1970-72.

Presently accessible productive forest areas are about 9 million acres. An addition 18 million acres is indicated to be potentially accessible, though the forest resource as a whole has not yet been well surveyed. An extensive forest road infrastructure would be necessary before these potentially accessible areas could be utilized.

All indicators point to a slow development for the Yukon's forest industry. Because of distances to North American markets and better, yet untapped forest resources in northern British Columbia, little outside demand is anticipated during the next decade. The available merchantable species infrequently grow to a diameter that will permit their utilization in higher value products such as softwood plywood. The growth of the industry will therefore be related to the growth of the Yukon itself, unless governments artifically stimulate growth and provide costly infrastructures.

The Federal Government has the responsibility of managing the Yukon's Forests. In the past, much manpower has been employed during the summer months in forest fire detection and suppression activities. The number of man-days devoted to this activity probably exceeds the total of those employed in the industry. Many of the more advanced forest fire detection and suppression techniques have been developed or assessed in the Yukon.

g) Agriculture

Aside from some domestically cared for vegetable gardens and some marginal cattle ranching in the southwest corner of the Territory, very little agriculture is undertaken in the Territory. A Federal agricultural experimental station is located near Haines Junction.

Due to the exceptionally short growing season and lack of suitable agricultural or range land, agricultural development has not been encouraged.

Of twelve farms in the Yukon, only three reported sales of $2,500 or more in 1971. Sales of farm products totalled a mere $18,380 in that year. An estimated 2,700 acres are agriculturally productive, but only 1,400 acres are classed as "improved".

Food costs in the southern Yukon are generally 20 to 40 percent higher than in the south. Most of this difference is due to the costs for transporting food from British Columbia. While high food prices are a major complaint among Yukon residents, it is unlikely that prices would drop even if agricultural production in the Yukon were expanded. Besides a limited physical base, northern producers would lack the benefits of scale economies and an efficient vertical infrastructure.

h) Trapping - Yukon

Current information indicates that trapping activity in the Yukon involves some 570 individual trappers and 387 registered traplines, with an annual harvest of approximately 30,000 fur-bearing animals. Fur trapping, like big game hunting, is particularly important in sustaining the economic welfare of native Indian people. During the 1974/75 season, about 70 percent of registered trappers were Indians.

In terms of cash income to trappers, lynx, beaver, and muskrat are the three most important species harvested. During the 1973/74 season the market value of furs rose considerably, and $499,001 worth of furs were produced. When the next rabbit cycle peaks in 1980-82, it is expected that the harvest will increase substantially.

Between 30 percent and 50 percent of trapping activity in the Territory is concentrated in a 100 mile wide corridor following the Alaska Highway. The range of species sought in this corridor is approximately the same as for the Territory as a whole.

i) Commercial Fishing - Yukon

Commercial fishing in the Yukon Territory is carried out at twenty lakes, but Teslin, Laberge, Atlin, Bennett, and Kluane Lakes account for more than 80 percent of the total catch. All of these are in the southwest corner of the Territory and within reach of the proposed pipeline corridor. Catches in the Territory as a whole averaged 13,000 pounds of lake trout and 12,500 pounds of whitefish over the years 1964-71, with a marketed value of $20,000 in 1973. In 1973 there were approximately 155 fishermen engaged in commercial operations.

2.4.4 The Labor Force

a) Yukon

The Yukon labor force (persons over 15 years) in 1974 consisted of 8,250 persons or 65.4 percent of the population. This percentage is slightly lower than the Canadian average of 70.4 percent, indicating a higher proportion of young families than the Canadian average. The education level of the Territorial population is lower than the Canadian average, with 86 percent having reached a level of Grade 13 or less, and a mean level of Grade Nine.

Between 37 percent and 45 percent of the labor force is involved in primary industries such as mining, forestry, agriculture and construction.

The unemployment rate in the Yukon Territory in 1974 was 6.6 percent, slightly below the Canadian average of 7.9 percent. However, the unemployment rate for males aged 21 - 25 and 35 - 60 was higher than the Canadian average. Unemployment has shown a consistent seasonal pattern since 1971: it rises sharply in October, reaches a peak in February, and drops to its lowest rate in September. Most of this fluctuation can be attributed to the seasonality of activities such as construction and tourism.

On June 6, 1976, there were 1,442 unemployed people in the City of Whitehorse. According to the Whitehorse office of Canada Manpower, this figure is approximately double the normal figure for early June, and is attributable to a low rate of construction activity and the presence of a considerable number of transients.

Average weekly earnings in the Yukon in 1974 were $253, as compared to the Canadian average of $177 and the British Columbia average of $194. However, unlike the steady rise in average Canadian weekly wages since 1971, the irregular increase in Yukon average weekly earnings reflects the seasonality of employment.

In general, the permanent population is more than adequate, in most cases, to fill most vacancies (except for some requiring highly skilled licenced tradesmen and technical personnel) as they occur, in all industries. There is seldom a shortage of drivers and operators and there is usually a surplus of semi-skilled and unskilled labor. Clerical and stenographic vacancies can normally be filled, but well qualified office workers can usually find employment. Seasonal demand factors, and in particular the weather, inhibit employment opportunities somewhat. During the spring and summer months there is a major increase in employment in the service and construction industries. Jobs usually last from May through September at lodges along the Alaska Highway, while construction and exploration jobs usually last from May through October. A large portion of the hiring in the Yukon is done through the services of the Canada Manpower Center in Whitehorse and the network of Manpower Centers throughout the Pacific Region and across Canada.

b) Northeast British Columbia

Northeast British Columbia generally has a low unemployment rate, and labor shortages sometimes occur in specific areas. As in most resource-extracting areas in Canada, the instability of the employment situation leads to a high rate of transience and labor force turnover. The labor force and the population as a whole are mainly comprised of people under 35 years, who make up 70 percent of the 45,000 people in the northeast.

Most employment in the northeast is geared to traditional male occupations, as reflected in the 1971 male/female ratio of 65:35 for persons aged 15 or over.

Although unemployment in the northeast is generally low, there are important differences in unemployment rates between communities. Some of these are shown in Table 16. In Fort Nelson unemployment is usually low, averaging in the order of 30 people in 1975. In June 1976 there were 146 unemployed in Fort Nelson. Fort St. John had an estimated average of 600 unemployed people in 1975, while in Dawson Creek the figure was higher at approximately 800. The difference of rates between centers can be attributed to their distinctive characteristics: Fort Nelson is small and extremely reliant on seasonal activities, Dawson Creek is a more stable agricultural and service center, and Fort St. John is a 'boom' town with housing shortages and other related problems.

As in the Yukon, unemployment rates in the northeast vary by season. In Fort Nelson oil and gas exploration activity is at its peak in the winter, and therefore unemployment tends to be higher in the summer months. The situation in Fort St. John and Dawson Creek is very similar, but seasonal variations are less pronounced.

Average per capita incomes in the northeast are about 96 percent of the provincial mean, with a higher proportion of the population living below the poverty line than in the province as a whole. About 33 percent of the 1971 tax returns in the northeast showed incomes under $3,000 annually, compared with approximately 31 percent for the province as a whole. In Dawson Creek the figure rises to 37.5 percent. The higher cost of

TABLE 16

NUMBERS OF UNEMPLOYED PEOPLE IN SELECTED CENTERS

Center	On June 6, 1976	Estimated Average 1975	Estimated Average Number of Males/1975
Whitehorse	1,442	1,400	840
Fort Nelson	146	30	15
Fort St. John	688	600	400
Dawson Creek	903	800	500
Prince George	4,246	4,500	2,700

Source: Communication with Unemployment Insurance Commission in Vancouver and Canada Manpower Centers in settlements listed above.

living in the northeast also tends to lower the real income of regional residents.

(c) The Cost of Living

Although average weekly earnings in the Yukon are generally 25-40 percent higher than the Canadian average, this is at least partially off-set by the higher cost of living. Food costs range from 13-49 percent (1972-75 figures) higher than in Vancouver, for example. High transportation costs increase the price of construction materials and housing to a level where the overall cost of living is 30-40 percent higher than in Vancouver.

2.4.5 Social Conditions

Psychological studies indicate that isolated communities generally exhibit a higher rate of mental illness, alcoholism,and crime than do less isolated cummunities.

Mental illness is more prevalent in women than men in these areas. Some recurrent situations can explain many cases. Much of the economy is based on bush centered employment, where males are away from home for extended periods while women are responsible for childcare and home management. This gives rise to tense family situations, alcoholism, and family breakdowns.

According to a 1975 psychological study, alcoholism is a particular sociological problem in Yukon and northeastern communities. Alcoholism is felt to be the result of a lack of alternative leisure activities, the problems of isolation,and family breakdowns. Existing facilities, programs, and manpower for the treatment of alcoholism and related mental stress problems are completely inadequate.

The northeast section of British Columbia and the Yukon have a higher crime rate than other Canadian areas. Based on figures for theft under and over $200 per hundred thousand population, during 1971-74, northeastern British Columbia and Yukon were 18 - 30 percent higher than other Canadian centers. The high proportion of transients, alcoholism,and seasonal unemployment are felt to contribute significantly to this problem.

2.4.6 Indian Population

There are approximately 2800 native Indians in the Yukon. The registered Indian population statistics for the Yukon vary between sources. The registered Indian membership for Yukon settlements on December 31st, 1974 as indicated by Indian Affairs Branch was 3,109. The 1973 Yukon community census indicates only 1,943 registered Indian residents. The discrepancy may be accounted for by noting that many registered members live outside the Territory. The 1973 census total Metis population was 556.

In the northeastern region of British Columbia, the approximately 2,000 native Indians comprised 4.5 percent of the regional population.

In general, the demographic and economic characteristics of the Indians of both areas of the proposed pipeline are similar. Indian populations are increasing at average rates higher than those of the Province and Territory. Families tend to be larger and the overall population correspondingly younger than that of the population as a whole. Educational levels and employment skills in terms of the wage economy, are lower in the Indian population.

In the Yukon, most of the Indian population is concentrated in the southwest and throughout the Alaska Highway corridor. They constitute minority groups in the larger settlements, such as Whitehorse, but more commonly are the majorities in the smaller settlements which predate the purely "Highway service" period of settlement.

Although Indian consciousness is on the rise, as it is across the continent, the Indian people still have many problems, some of which they share with white populations in similar geographical-economic situations. Various forms of social stress are pronounced. School drop-out rates are high, family dislocation and breakdown is common, and alcoholism is a major problem. Unemployment and under-employment characterize most of the settlements.

Typically, Indians have found employment in bush-oriented occupations, as guides, and in the tourist industry generally. Trapping is dominated by Indians; in the Yukon about 70 percent of registered trappers are Indians.

In more recent years, Indians have directly and independently entered the tourist industry and some native handicraft cooperatives have been established in the Yukon. Similar developments can be anticipated in the northeast of British Columbia.

Programs of education and training designed to raise the employment potential for Indians have a mixed record, although the policy of upgrading education and skills is still in effect.

Negotiations to settle Indian land claims have been carried out in the Yukon and preliminary negotiations have been opened in British Columbia. It is too early to predict the outcome of these discussions.

Indian land claims per se do not appear to be directly related to the proposed pipeline, but the probability remains that some bands might take the opportunity offered by the interest that the proposed pipeline will inevitably generate to put forward claims regarding land in or near the proposed corridor.

2.4.7 Archaeology- Historical Resources

At various times during the most recent Wisconsin Glaciation (65,000 B.P. to 10,000 B.P.), drops in sea level, and light or non-existent ice cover, a wide path of what is now 50 miles of Bering Strait became land. Across this bridge migrated the Paleo Indians and probably Eskimos. They pursued the tundra mammals of the Pleistocene along game trails, up the Yukon River and south along the Mackenzie Corridor into central North America. An archaeological site near Old Crow dates back 30,000 years. Until the arrival of European fur traders, the native occupants of the Yukon (people of the Loucheux, Taqish, Slave, Nahani, Kutchin, and Sicanne Tribes, all classified in the Athapaskan, or Dene, language group) subsisted at the hunting and gathering level of socio-economic organization.

There is extensive, though at times sketchy, archaeological evidence of native habitation prior to contact with white influences, which occurred about 1840. In the highway corridor, exploration has not spread far from the roads, and the entire area east of Teslin has undergone little rigorous investigation. Virtually all known sites are located between Teslin and Beaver Creek, although unidentified ones no doubt exist in the Watson Lake and Liard River areas. The only major pre-contact site in the Liard River basin that has undergone extensive investigation is located at Fisherman Lake, near Fort Liard, N.W.T. Major pre-contact archaeological sites near the proposed right-of-way are found at Burwash Landing, Silver City, and Champagne. There are five documented pre-contact sites in the Burwash Landing region, the most extensive are in the vicinity of the Duke Meadows Ecological Reserve northwest of the hamlet. Silver City ("Kluane") is the site of a pre-contact native village, but as yet, has not been excavated. The small village of Champagne contains nine present sites, one of which has undergone limited investigation.

A second phase of archaeological/historical interest occurred during the period of exploration, fur trade, and initial European settlement from 1840 to 1895. For this period the areas of interest shift southeast from the Kluane region to the Frances River-Liard River basin. The latter in particular was a major exploration waterway along which fur trade posts were established. Lower Post near Watson Lake was established in 1876; it tapped a vast fur hinterland up the Dease and Liard Rivers. Fort Nelson was established early in the 1800's; the original post is now the location of an Indian village fifteen miles from the present townsite. Some promising sites involving early exploration have been investigated at Nelson Forks, at the junction of the Liard and Nelson Rivers. Teslin in the Yukon was originally an Indian Village established in the mid-1800's by the Tlinglit Indians of the northwest Pacific Coast; contact with fur traders brought them inland to the present site.

A third historical phase, the Gold Rush period from 1895 to 1905, is the best documented. Much that was related to the Gold Rush in the corridor area still remains, including steamers, trails, roadhouses, and "jumping-off" points. Wagon roads and prospectors' trails lead from Kluane Lake and Haines, Alaska, to Whitehorse, and from Glenora, B.C., 100 miles to Teslin. Corridor settlements with historical remnants from this period include Silver City, Burwash Landing, Canyon City, and Teslin.

To establish priorities for the preservation of Yukon historic sites, the Territorial Government commissioned a report to evaluate known archaelogical and historic sites. This was completed in 1974; of 35 sites deemed significant, six are in the vicinity of the pipeline corridor. These are, in order of priority for restoration; Silver City, Dalton Post, Champagne, Burwash Landing, Whitehorse, and Canyon City.

Although only a few Yukon archeological and historical sites are receiving developmental emphasis, there are 326 known sites. The responsibility for legislation policies concerning these resources rests with the federal Northern Economic Branch and the Water, Lands and Forests Division of the Northern Development Branch. Present regulations concerning such sites comprise one section of the Yukon Indian Act, Historic Sites and Monuments Act, and the National Parks Act. Increased acedemic interest and economic tourism development in the last 3 years have resulted in more stringent enforcement of this legislation. Recently this June, the Yukon Department of Tourism and Information publicized pertinent legislation regarding historical and archeological finds in Whitehorse public places.

The socio-economic vlue of these resources in relation to tourism has resulted in incrasing the Yukon Department of Tourism and Information's involvement in their protection and development. In co-operation with the federal Department of Indian Affairs and Northern Development, they aided the 1975 opening of the successful George Johnson Museum in Teslin. Recently this June the Burwash Landing community opened a similar operation.

Possible impacts on these sites are discussed in greater detail in Chapter 3.0.

2.4.8 Description of Present Settlements from the Yukon/Alaska Border to Fort Nelson

a) Beaver Creek

Twenty miles from the Alaska/Yukon border, Beaver Creek has the distinction of being the most westerly community in Canada. White settlement in the region was initiated by the discovery of placer gold in 1913 at the head of Beaver Creek, 50 miles to the southwest, in the Chisana district of Alaska. In 1942 Beaver Creek was one of two points of contact where Alaska Highway crews working from opposite directions met, thus completing the 1,523 mile route in less than ten months. The population of the community has not changed appreciably in the last five years; its 1975 estimate is 129.

The community functions as a tourist, service and government center, dependent upon the highway and the border for its existence. Offices of Canada Customs and Immigration, a Royal Canadian Mounted Police Detachment, a Tourist Information center, and a Yukon Territorial Government Highway Maintenance yard employ residents. Other highway oriented functions include motels, gas stations, and grocery stores. Community services and facilities consist of a nursing station housed in a mobile home and staffed by a public health nurse, a post-office, a community hall, covered curling and skating rinks, and a low power relay transmitter rebroadcasting CBC radio from Whitehorse. A good gravel surfaced 5,000 foot airstrip is located just north of the village. Beaver Creek school, employing two teachers, provides elementary education from Grades One through Eight. Enrollment has declined to 19 in 1975 from 44 in 1970.

An estimated 20 percent of Beaver Creek's population is of Indian descent. Most residents employed by governments benefit from subsidized housing, which is adequate in condition and number for the present size of the village. The value of property assessed by the Territorial Government Assessment Branch was $275,000 in 1974, a 21 percent increase from 1971, compared to a 160 percent increment for most other unorganized Yukon communities. This, as well as the population and school enrollment data, suggests the village's economic structure and functions are experiencing little change.

b) Burwash Landing

The small community of Burwash Landing is located between the Alaska Highway and Kluane Lake at Mile Y128.3. Its 1971 population of 57 had declined to 38 by 1974. Most residents are members of the Kluane Indian Band, whose numbers living in the area but not all in the community, totalled 95 in 1974. The remaining residents are employed in highway oriented service functions, primarily the Burwash Lodge.

The settlement was initially established as a trading post by the Jacquot brothers in 1904, and served miners and prospectors making their way to the many rivers in the region. They also established big game hunting and outfitting businesses. Today, the mean family income of native residents is low, based on hunting, trapping, and guiding, supplemented by government social assistance programs and sponsored projects. There is a tourist lodge two miles from the village, capable of accommodating 70 people. Most other public and private services, for example the elementary school, are located ten miles away in Destruction Bay. A 6,000 foot gravel airstrip just west of the village provides radio and weather communications.

Many native residents of working age have left Burwash Landing, leaving disproportionately high percentages in the under 18 and over 65 age groups. A self-assistance project organized through the Kluane Historical Society, with federal aid, has built a handicraft shop and log museum to house indigenous artifacts. The area is rich in archaeological sites: many discoveries in the area confirm the existence of prehistoric campsites. Indications of an Indian settlement dating back 125 years have been found on the eight square mile Duke Meadows Ecological Reserve nearby. There are at least five documented prehistoric sites in the Burwash area and the total archaeological potential for the district has yet to be evaluated.

Development potential for the area lies primarily in recreation and park use. Kluane National Park, Ecological Reserves, Game Sanctuaries, and Archaeological sites restrict future resource extraction industries in the Kluane Lake region. While mining and forestry potential in this region appears limited, there have been studies conducted to evaluate the potential of the Kluane River Canyon as a hydro-electric damsite. However, because of environmental problems, the region has a low priority for hydro development.

c) Destruction Bay

On Kluane Lake ten miles southeast of Burwash Landing (Y138.3), is the highway government service center of Destruction Bay. With a 1975 population of 66 (compared with 82 in 1971) it contains a territorial government highway maintenance camp, one motel and one lodge with total lodging up to 70, two gas stations, and two restaurants. Public services include an elementary school, a small community hall, indoor curling rink, public health station, CBC relay transmitter, and post-office. Destruction Bay was the former service center for Hudson/ Yukon Mines' Wellgreen nickel and copper operations at (D.C.) Mile 1,111. Employing 57 people, the mine was phased-out in 1973/74 due to lack of continuity in the ore body.

The population is essentially comprised of young government employed families; there are very few Indian residents. Most of the housing stock is owned by the territorial government, rented at subsidy to employees. Destruction Bay has no municipal administrative structure. Property values assessed by the Territorial Government totalled $73,650 in 1974, a 39 percent increase over 1971 figures, and $38,980 more than the 1974 Burwash Landing value.

d) Silver City

At the south end of Kluane Lake (D.C. 1,053) is Silver City (or Kluane), a ghost town of log buildings with sod roofs. Archaeologists indicate there was a pre-contact native village on this site. White settlement began in 1904; the town functioned as a roadhouse on the Kluane-Whitehorse wagon road. It has been deserted since 1924. Plans for major restoration and the construction of a major day service center for tourists at the site are under consideration.

e) Haines Junction

Haines Junction is emerging as the major administrative, transport, and service center of the Kluane Region. It is located at (D.C.) Mile 1,016 (Y195) of the Highway, at the junction of the Haines Road (Yukon Highway 3). This makes the town a key divisional point for goods moved from the port of Haines, Alaska.

Government services, mainly in the form of administrative offices for Kluane National Park, have diversified the community's economic base. The population of Haines Junction has almost doubled from 183 in 1971 to a 1975 total of 330.

It was because of its strategic position that the community was established when both highways were being built during World War II. It was also a divisional point for the Haines-Fairbanks oil pipeline, constructed by the U.S. army during the War. This 8-inch diameter, above ground line, 700 miles in length closely following the highway, was phased out in 1971. The Haines Road itself was upgraded to an all-weather road in 1966; previously it was open to traffic in summer only.

Private services provided in Haines Junction include a mobile bank, three service stations, grocery stores, restaurants, cocktail bars, and five motels with a total maximum capacity for 170 people. Educational facilities go as far as Grade Ten. Other government services consist of a branch library, a two-man R.C.M.P. detachment, Liquor Store, public health facilities staffed by a nurse, community hall, covered skating and curling rinks, post-office, territorial government information center, campgrounds, and CBC radio re-broadcast transmitter. Television reception via the ANIK satellite is anticipated. A 6,000 foot gravel airstrip is suitable only for emergency use; there is a 4,000 foot gravel strip at Kluane Lodge 40 miles west.

From 1944 to 1970 the Pine Creek Experimental Farm operated three miles west of the town. The Haines Junction area and Champagne to the east are the two areas in the Kluane Region most suited to marginal agriculture. Commercial agriculture is unlikely under present market and distribution conditions; however, in fact, food costs in Haines Junction in 1974 and 1975 were the lowest in the Yukon, probably due to the town's proximity to the seaport of Haines.

Haines Junction is slated to be a major urban center for southwestern Yukon. Fifty-four new single family serviced residential lots were developed in the settlement in the 1974/75 fiscal year. The value of assessed property more than doubled from $205,000 in 1971 to $468,000 in 1974.

f) Champagne

The hamlet of Champagne, located at (D.C.) Mile 974 (Y237) contains nine pre-contact Indian sites, indicating extensive pre-European habitation. One has undergone limited excavation. White settlement began in 1898 as a stop-over location on the Dalton Trail (from Pyramid Harbour near Haines to the Klondike goldfields). A post-office and mounted police post were located at Champagne in later times. With a 1971 population of 13, the village is almost abandoned; those remaining are members of the Champagne Indian Band, whose numbers living in the region totalled 104 in 1974. The few families living at Champagne are engaged in big game guiding and outfitting. Except for a gas station, there are no services available in the village. The area is being allocated high priority in archaeological investigations and may be developed as a historic site.

g) Whitehorse

Whitehorse contains almost two-thirds of the total population of the Yukon. With its environs, Whitehorse is the overwhelmingly dominant transportation, service and government center of the territory. Growth rates have reflected the sporadic nature of economic expansion in the northwest since the Klondike period. Whitehorse emerged as a fledgling community during the gold rush, and became a supply and commercial center with the completion of the White Pass and Yukon Railroad in 1900. The population declined after the gold rush of the 1890's and by 1921 the population was only 330. The Second World War brought highway and pipeline construction projects, and by 1951 the population had jumped to 2,600. Growth in the government sector, increased exploration in mining, oil, and gas, and the emergence of Whitehorse as a supply and service center led to both population growth and diversification of the economic base. The 1961 population of 5,000 increased to 11,220 a decade later. The 1966-71 population increment was 45 percent; the equivalent figure for the Yukon as a whole was 28 percent. The 1976 population is estimated to be 14,300.

The city is made up of the central business district, a 330 acre wholesaling-industrial area, a native village (possibly to be relocated), four residential subdivisions adjacent to the city core, and three residential subdivisions strung along the Alaska Highway.

An estimated 30 percent of the current work force are employed by the federal or territorial governments; the remainder of the labor force is found in the transport, construction, retail, and personal and professional service categories. Seven miles from downtown, the Whitehorse Copper Mine, re-opened in 1972 after a year's closure, employs 200 workers. Services include two radio and two television stations (one Canadian Broadcasting Corporation via ANIK satellite, one local cable station), a tri-weekly newspaper, four department stores, 29 building contractors, 24 licenced premises, 15 auto service centers, three supermarkets and four banks. Some 80 percent of the estimated 250,000 visitors entering the Yukon in 1973 visited Whitehorse; they were served by 24 motels and hotels with a combined total of 709 rooms and 1,154 beds. Five scheduled air carriers provide service to Yellowknife, Inuvik, centers in Alaska and northern B.C., and Vancouver.

Five elementary and three secondary schools employ 160 of the 262 teachers in the Yukon. There is also a vocational/technical training center serving the territory. A 120 bed regional hospital, employing 170 people, provides a high level of medical service; in addition there is an extended care hospital and two senior citizens' homes.

Recreation facilities include a bowling alley, curling rink, nine-hole golf course, indoor pool, arena, library, and museum.

After a long period of male dominance, a function of its transient base, the city is approaching a demographic sex balance, with 52.6 percent male in 1971. The population is young, with 72 percent under 35 years, and 43 percent under 20 years. The native Indian and Metis population numbered 725 in 1971 comprising seven percent of the total urban population. About 524 of these are registered Indians of the Whitehorse Band.

Whitehorse is administered through the City Manager system, with an elected mayor and council of six aldermen. Annexation in 1971 increased the municipal jurisdiction from 2.66 square miles to 162 square miles. This in itself doubled the population and expanded the municipal assessment by 65 percent from $35 million in 1971 to $58 million in 1972. 1976 assessed value is

$78 million, an increase of 35 percent over 1972. Both jurisdictional expansion and rapid growth in the functional urban area have placed a heavy burden on the city in providing physical and social services. New, serviced, residential lots numbered 130 in the 1974/75 fiscal year, and plans exist for an additional 250 to be available in 1976. But, to quote the Annual Report of the Commissioner, Yukon Territory (1974/75 fiscal year, p. 42):

> Despite these developments, we are pressed to meet the demand for lots, particularly in Whitehorse....Future land development programs call for an accelerated residential land development program in the City of Whitehorse to meet the demands of rapid growth.

Whitehorse residents are generally aware of the problems caused by rapid urban growth; effects of any major resource or transportation development in the southern Yukon would inevitably have an impact on this major center.

h) Johnson's Crossing

The highway service center of Johnson's Crossing is located at the junction of the Alaska Highway (D.C. 836) and the Canol Road (Highway 8). During the Second World War this junction was a base for construction activity for both the Alaska Highway and the Canol pipeline and service road.

The CANOL ("Canadian Oil") project - a 580 mile pipeline and road from Norman Wells N.W.T. to a Whitehorse refinery and thence to Tidewater at Skagway - was intended to supply fuel for the North Pacific battle zone. It was completed at a cost of $434 million in 1944 but subsequently abandoned. The pipe has been removed and the refinery dismantled.

Johnson's Crossing has a 1975 population approaching 40; most are employed at the one lodge, restaurant, and service station complex. There is also a post-office and government campsite located nearby.

i) Teslin

The unincorporated community of Teslin is situated midway along the 80 mile Teslin Lake, at (D.C.) Mile 804 of the Alaska Highway. The town's population fluctuates between 300 and 350; the 1975 estimate is 315. Half of the population are of Indian or Metis descent. Most native residents are members of the Teslin Band, whose numbers totalled 248 in 1974. The Teslin Indians were originally Tlingits of the northwest coast, near the present site of Juneau. Contact with fur traders in the 1700's and 1800's brought their ancestors inland to trap and hunt. White settlers arrived during the gold rush via a rough trail from Glenora, 100 miles south of the lake. Construction of the Alaska Highway brought more white residents to operate highway oriented services, which consisted in 1975 of general stores, three gasoline stations, a handicraft store, restaurants, a marina, and four motels or lodges with a combined total of 45 units.

Teslin is the only government service center between Whitehorse and Watson Lake. Teslin School provides education up to Grade Ten: enrollment has fluctuated between 95 and 125 since 1970. Six teachers were employed in 1974. Other public services include a public health nurse and center, community hall, covered curling and skating rinks, indoor pool, forestry station, highway maintenance garage, campground, post-office, two-man R.C.M.P. detachment, and CBC radio relay transmitter. A seaplane base and a 5,500 foot gravel airstrip provide landing facilities adjacent to the town.

The tourist industry provides a major source of income for the town; to help lessen this dependence, a new native industry involving the construction of sleds and canoes started in 1974. Many residents work part-time as hunting and fishing guides.

As in many northern communities, Teslin has its native and white sections. Housing in the native village, (which also contains two missions) is in generally poor condition, while conditions in the white community are adequate. Property assessments increased by 81 percent to $243,000 in 1974 from $134,000 in 1971. Current assessment figures are not obtainable. Costs of food are about ten percent higher than in Whitehorse.

j) Morley River

The highway service center of Morley River (D.C. 777) had a 1971 population of 12. The center contains a gas station, grocery store, restaurant, motel, and post-office. At this point the highway corridor crosses the 60th parallel and enters British Columbia for a road distance of 40 miles.

k) Swift River

At Swift River, the road re-enters the Yukon Territory at (D.C.) Mile 733. This hamlet is a highway service stop. It contains a maintenance camp, a hotel with 14 units, restaurant, grocery store, two gas stations, and tavern. A relay transmitter provides CBC radio reception. The 6,000 foot gravel Pine Lake airstrip, 12 miles northeast, provides summer-only runway facilities.

l) Upper Liard

The Indian settlement of Upper Liard is at (D.C.) Mile 643, where the Alaska Highway crosses the Liard River. Upper Liard, similar to the Indian settlement at Lower Post, is functionally tied in to the larger regional center of Watson Lake, 13 road miles to the northeast. Residents of Upper Liard numbered 219 according to the 1971 Census; the 1975 estimate is 350. Most of the inhabitants belong to the Liard River band, whose members totalled 594 in 1974 and who live in the three communities of Upper Liard, Watson Lake, and Lower Post.

Employment in the area is seasonal, revolving around trapping, guiding, and other tourist-oriented services. All government services are centered in Watson Lake; the only private services found in Upper Liard are a grocery store, restaurant, motel with 20 units, gas station, and tavern.

m) Watson Lake

Watson Lake is the transportation, communication, and distribution center for southeastern Yukon and proximate areas of northern British Columbia. Its 1975 population is estimated to be about 700; if Upper Liard, Watson Lake Wye, and Watson Lake Airport residents are included, the population is over 1,000.

In addition to being a major Alaska Highway center (Mile 635), it is the start of the Campbell Highway (Number 9) to Ross River, Faro, and Carmacks; the Nahanni Range Road (Number 10) to the small tungsten mining settlement of Cantung on the Yukon/Northwest Territories border; and the Watson Lake/Stewart highway (B.C. Number 37) which passes the asbestos mining town of Cassiar.

White settlement at Watson Lake dates back to the 1930's, with establishment of a landing strip, float plane base, and airport. During the Second World War the airport was upgraded to provide a link between Fort Nelson and Whitehorse for the Northwest Staging Route.

Community facilities include two banks, seven service stations, grocery and general stores, and six hotels or motels with a combined room total exceeding 100. Education services are available to Grade Twelve. Five nurses and a doctor are based at the ten-bed community hospital. The town offers the typical range of public services for a community its size, such as a branch library, six-man R.C.M.P. detachment, post-office, liquor store, gymnasium, covered curling and ice rink, outdoor pool, museum, campground, radio, and T.V. reception. C.P. Air provides scheduled jet service to the south and Whitehorse. Six miles from town, the airport has two 7,200 foot asphalt runways. Float plane docking is available. There are also road maintenance and forestry service offices located in the town.

Housing in Watson Lake is generally adequate, though some houses are in poor condition. Eighty-four new single family dwelling lots were serviced in the 1974/75 fiscal year to help alleviate demand for accommodation. The town has the status of a Local Improvement District. Assessed property in Watson Lake and its surrounding area was valued at $2.7 million in 1974, a 150 percent increment over the 1971 figure of $1.1 million. These figures indicate that Watson Lake (along with Whitehorse and Haines Junction) is destined to absorb much of the future growth that may occur along the Alaska Highway corridor.

h) Lower Post

The Indian settlement of Lower Post is 12 miles southeast of Watson Lake, across the 60th parallel in British Columbia. The community was established as a trading post in 1876. Because of gold strikes in the Cassiar region, trading posts were established at McDame Creek and on the north bank of the Liard at the junction of the Dease. Both were taken over by the Hudson's Bay Company, but only the latter, Lower Post, was kept open. Before the establishment of Watson Lake in the 1930's Lower Post served as an aircraft landing point. The settlement also served as a center from which the Watson Lake sector of the Alaska highway was constructed: materials were hauled in via the water route of the Stikine-Dease rivers to the Liard at Lower Post.

Indians engaged in hunting, trapping, and guiding pursuits comprise the vast majority of the estimated 500 residents. Both an Indian Residential school and a modern public school for 190 children provide elementary education. There are also two stores, a licenced hotel, a garage, post-office, and B.C. Forest Service district office. The area is historically significant as a major fur trade center for voyageurs travelling from the Arctic Watershed, via the Liard, to the Stikine River and Pacific Ocean. As the site of an important fur post and old Indian Village the area has a high archaeological potential.

o) Highway Settlements in Northern British Columbia

South and east of Lower Post the Alaska Highway continues through British Columbia through the highway service centers of Irons Creek (D.C. 590), Contact Creek (D.C. 590), Fireside (D.C. 543), Coal River, and Liard River (D.C. 496). This 125 mile section parallels the Liard

River through an area of wilderness recreation value, the most developed of which is the Liard River Hotsprings Park. Canyons and rapids along the river provide additional aesthetic interest. Irons Creek Lodge provides an auto service center, limited accommodation, and groceries. Contact Creek marks the location of the October, 1942 meeting of construction crews working from Dawson Creek and Whitehorse. There is a service station at (D.C.) Mile 590. Gas, oil, and groceries and a post-office are available at Fireside, the site of scenic rapids and Whirlpool Canyon on the Liard.

Similar facilities are available at Coal River. At (D.C.) Mile 516 a 25-mile side road leads north to the Smith River Military Reserve and airstrip. At the Liard Hotsprings the highway turns south through the Muncho Lake area and the service and recreation centers of Toad River, Summit Lake, and Steamboat Mountain, to Fort Nelson. The pipeline corridor branches east at Liard Hotsprings to follow the Liard River, through the Grand Canyon of the Liard. This wilderness area is the site of rapids and deep canyons of prime recreational value. Environmentalists are already sensitive to development in this wilderness area and have voiced opposition to plans calling for hydro-electric development in this watershed.

p) Fort Nelson

Fort Nelson (D.C. 300) is the next significant center located close to the pipeline. An incorporated village with a 1975 population of approximately 3,200, Fort Nelson is the northernmost settlement in the Peace River Region of northeast British Columbia.

Located too far north for extensive commercial agriculture, Fort Nelson relies mainly on lumbering, and oil and gas exploration and processing; in fact, it claims to have the largest gas processing plant in the world. Mining has increased in importance in recent years and this trend is likely to continue.

Its strategic location at the terminus of the British Columbia Railway, and on the Alaska Highway and Fort Nelson-Liard-Mackenzie River system, makes the village a significant transportation center and stopping-off point for travellers and vacationers. Six motels and hotels have a combined total of over 200 units, catering to tourists in summer and to the seasonal work force engaged in oil, gas, and construction activity in winter.

In recent years Fort Nelson has received a million dollar elementary and high school, an extension to its hospital, and improved its water system and streets. Construction of housing and commercial facilities has increased since the early 1960's, reaching a permit value of $12,579,780 in 1974. A steady increase in the volume of retail trade from $1.3 million in 1961 to $3.7 million in 1974 has encouraged the establishment of supermarkets and the numerous other retail and service industries that can be found in a town serving a trade area of 5,000. An asphalt 6,400 foot airstrip provides facilities for scheduled air service.

In general, unemployment rates are relatively low in the northeast corner of B.C., and the Canada Manpower Center in Fort Nelson estimates that on the average 20 - 30 people are unemployed there. There is a considerable seasonal variation in this figure.

The employment situation in the Fort Nelson area, as in most resource-extracting regions, has always favored traditional male occupations. As a result, the population's male/female ratio was 65:35 in 1971. The predominance of males and the seasonal nature of the economy is reflected by a high rate of transience and work force turnover.

q) Summary

Specific details of the services provided in each of these towns are given in the matrix in Table 17.

TABLE 17

SUMMARY OF SERVICES
ALASKA HIGHWAY CENTRES
(BEAVER CREEK - FORT NELSON)

LOCATION	Alaska Highway Mileage (Dawson Creek)	Pipeline Mileage (Approximate)	Minimum Distance to Pipeline (mi.)	Minimum Distance from Compressor (mi.)	Gasoline	Groceries	Accomodation	Meals	Licenced (Bar or Take-out)	Radio	Television	RCMP Detachment	School-Elementary -Secondary	Bank	Post Office	Airstrip E=Emergency Only	Scheduled Air Service	Population 1975 (Estimated)
Beaver Creek	1202	Y 19	2	13	X	X	X	X	X	X		X	X		X	X		129
"White River Lodge"	1169	Y 50	0-1	8	X	X	X	X	X									
Koidern River	1167	Y 52	0-1	6	X	X		X								E		
"Pine Valley"	1147	Y 70	0-1	12	X		X	X										
"Mountain View Lodge"	1128	Y 86	2	30	X	X												
"Kluane Wilderness Village"	1118	Y 98	2	20	X		X	X	X									
Burwash Landing	1093	Y118	2	2	X	X	X	X								X		57
Destruction Bay	1083	Y127	0-1	12	X	X	X	X	X	X			X		X			66
"Bayshore Motel"	1064	Y146	0-1	22	X		X	X										
Kluane Lake-Silver City	1053	Y155	2	13	X		X	X							X	X		
Haines Junction	1016	Y188	4	22	X	X	X	X	X	X		X	X		X	X		330
"Aishihik Service"	996	Y204	0-1	14	X			X										
Champagne	974	Y224	0-1	5	X													13
Whitehorse Area	919	Y274	5	15	X	X	X	X	X	X	X	X	X X	X	X	X	X	14,600
"McRae Inn"	910	Y277	0-1	20	X		X	X	X									
"Marsh Lake Resort"	883	Y296	0-1	7	X	X	X	X	X									
Atlin/Carcross Junction	865	Y315	9	18	X		X	X	X									
Squanga Lake	850	Y330	3	20	X	X	X	X								E		
Johnson's Crossing	837	Y340	0-1	8	X		X	X	X						X	E		40
"macKinaw Campsite"	813	Y362	1	14	X			X										
Teslin	804	Y370	0-1	23	X	X	X	X	X	X		X	X		X	X		315
Morley River	778	Y393	0-1	2	X	X	X	X							X			12
Swift River	733	Y432	0-1	14	X	X	X	X	X	X						X		33

TABLE 17

SUMMARY OF SERVICES (Continued)

LOCATION	Alaska Highway Mileage (Dawson Creek)	Pipeline Mileage (Approximate)	Minimum Distance to Pipeline (mi.)	Minimum Distance from Compressor (mi)	Gasoline	Groceries	Accomodation	Meals	Licenced (Bar or Take-out)	Radio	Television	RCMP Detachment	School-Elementary -Secondary	Bank	Post Office	Airstrip E=Emergency Only	Scheduled Air Service	Population 1975 (estimated)
"Rancheria"	710	Y452	2	7	X		X	X	X									
"Frontier Villa"	687	Y473	0-1	27	X		X	X	X									
Upper Liard	642	Y512	6	6	X	X	X	X	X									350
Watson Lake	635	Y512	15	15	X	X	X	X	X	X	X	X	X X	X	X	X	X	1,000
Lower Post	620	B 18	2	20	X	X	X	X	X	X			X		X			400
Iron Creek	596	B 40	18	30	X	X	X	X	X						X			
Contact Creek	590	B 40	18	24	X	X		X										
Fireside	543	B 75	2	18	X	X	X	X							X			
Coal River	533	B 78	0-1	22	X	X	X	X										
Liard River Hotsprings	496	B114	0-1	13	X	X	X	X										
Muncho Lake Area	456	S.of 120	25	36	X	X	X	X	X						X			
Summit Lake Area	393	S.of 180	30	45	X	X	X	X										
Fort Nelson	300	253	15	15	X	X	X	X	X	X	X	X	X X	X	X	X	X	4,200

SCHULTZ

2.4.9 Current Land Use

a) Beaver Creek to Kluane (Figures 1A-1D)

Rugged constructive topography in this region restricts transportation activities to a narrow corridor which is incidentally the north-easterly boundary of a series of major ecological sanctuaries and a National Park. This transportation corridor is occupied by the Alaska Highway and the abandoned Haines-Fairbanks oil pipeline right-of-way. The proposed Alcan Pipeline also will occupy this corridor. At no point is any utility located further than two miles from the others. Permanent settlements along the route are concentrated in Beaver Creek Burwash Landing, and Destruction Bay. The recreational, scientific, historical, and archeological resources of this region are among the most significant of the entire pipeline corridor. The region has a small, firm economic base in some forestry, trapping, guiding, tourist services, regional administration and maintenance and protection of reserves, parks, and the Highway.

The Kluane Game and Ecological Reserve (1,987 square miles) has major recreational use as a setting for alpine activities, canoeing, and viewing mountain scenery. North of Burwash Landing, the Duke Meadows Ecological Reserve (eight square miles) contains a unique relic landscape featuring what is probably the largest valley prairie in the southwest Yukon. This area also has a very high potential for archaeological sites.

The segment of the corridor along Kluane Lake is exceptionally scenic; in summer it is a popular recreation area with high capability for cottaging, camping, boating, fishing, and related activities. The lake fishing is well known for lake trout, Arctic grayling, and pike.

Fishing activity for tourists is centered along the lake at two lodges in Burwash Landing and Destruction Bay.

Additional archaeological sites exist between the lake and the Highway along the corridor (see Figures 1-C and 1-D).

In the area around the southwest end of Kluane Lake, the boundary of Kluane National Park (8,500 square miles) reaches to within a mile of the highway. In this area the Park contains the Sheep Mountain Ecological Reserve (121 square miles), another area with very high research and recreation capacity.

Kluane Lake is fished commercially and has an annual quota of 37,000 pounds, of which 18,500 pounds may be lake trout .

At the southeast end of Kluane Lake is the Kluane-Silver City area of prime historical-archaeological interest. Silver City started soon after the Klondike Gold Rush of '98, whereas Kluane was a service center for placer miners around the 1920's. There is also evidence of pre-contact native Indian settlement in the vicinity. Silver City is slated for extensive historic research, archaeological studies, and restoration of historic sites for use in the travel industry.

b) Kluane to Whitehorse (Figures 1D-1F)

The proposed pipeline stays within two miles of the present highway with the exception of a 15 mile stretch north of the highway at Haines and a 40 mile stretch south of Whitehorse. The two permanent communities, Haines Junction and Whitehorse are major territorial centers.

A principal winter trapping area is located east of Kluane, primarily north of the highway. Sulphur Lake in this area has high recreational use. On the north-west shoreline of Kloo Lake an Indian camp and cemetery have been located; around 1915 a trading post was started at this site serving prospectors, trappers, and travellers on the Whitehorse-Burwash Landing Trail. Eastward of Kloo Lake as far as Pine Lake, the transport corridor penetrates a significant big game hunting zone.

Residents of the growing Haines Junction area make considerable use of Pine Lake as a boating, swimming, and sport fishing resource. Archaeological sites also exist near the lake (see Figure 1D).

A Development Control Zone for Haines Junction covers a large area around the community; its northern boundary is at Pine Lake.

Both "relic" settlements of Canyon City and Champagne offer considerable archaeological/historical site potential. Champagne is the site of a pre-contact Indian camp and large native cemetery. During the gold rush the Dalton Trail passed through the area, and a trading post and Northwest Mounted Police Post were established. Some original buildings (see Figure 1E) and a small native population remain.

West of Takhini the pipeline corridor swings southeast up the Ibex River valley to rejoin the highway south of Whitehorse at MacRae. Lakes in this area around the capital are heavily used by residents for hiking, fishing, and canoeing; these include Chadburn, Jackson, Fish, and Alligator Lakes. These lakes are periodically stocked with rainbow trout, and Fish Lake has both park and archaeological reserves at the northern end. There are numerous trails and access roads through the forests in this area, which are extensively used for cross-country skiing and snowmobiling.

In summer, the Yukon River provides a popular boating route from Bennett Lake to Dawson; except for a dam at Whitehorse, there are no major river obstacles. Historically, this route was the principal transport link to Dawson, and many relics of the past enhance the existing recreation potential of the river area.

The proposed right-of-way also passes through the Development Central Zone outside the City of Whitehorse.

c) Whitehorse to Watson Lake (Figures 1F-1J)

The Whitehorse-Watson Lake section of the pipeline right-of-way rejoins the highway at MacRae, parallels the highway to the north end of Marsh Lake, then heads east on a primary route to the north end of Squanga Lake and meets the highway west of Johnson's Crossing. The right-of-way then follows the highway along Teslin Lake and Morley River, and roughly parallels the road along the Swift and Rancheria rivers to the junction of the Alaska Highway and the Stewart-Cassiar Road south of Watson Lake.

The north shore of Marsh Lake has a moderate to high potential for outdoor recreation, including boating, beach activities, and camping. There is an archaeological site near M'Clintock. Michie and Squanga lakes also have a sport fishery, particularly for whitefish and pike. Two archaeological sites exist at the south end of Squanga Lake, and one at the west end of Little Teslin Lake (Figures 1F and 1G).

The area between Johnson's Crossing and Teslin is an active fur trapping region, but most of the activity is located south of Teslin Lake, or several miles north of the highway on the north side of the lake. Teslin Lake is important as a sport and commercial fishery resource; domestic native Indian fishing occurs at Johnson's Crossing and Teslin. Sport fishing lodges are located at Fox Point and Teslin. Much of the scenic lakeshore provides access to potential boating and camping sites. Two archaeological sites are located within the Teslin community's Development Control Zone. The Nisutlin River estuary and bay are also important areas for domestic fishing. Further east, a campground and high capability sport fishery are located at Morley River (Figures 1G and 1H). Other recreational resources are found at Pine Lake, north of the highway, and along the Rancheria River. A swan nesting area at Veronica Lake provides seasonal waterfowl observation (Figures 1H and 1J).

Towards the Upper Liard area trapping activity becomes more intensive. Residents of Upper Liard also fish the Liard River for domestic consumption. At this point the Liard River flows through a low, marshy plain, offering only low to moderate recreation potential. However, further downstream, between Watson Lake and Lower Post, canyons and rapids of the Grand Canyon of the Liard afford geological, historic interest and dramatic viewpoints. Watson Lake itself is used by residents of the town for boating and sports fishing (Figures 1I and 1J).

It is important to note that very little identification or research of potential archaeological sites has been made in virtually all areas east of Teslin in both B.C. and the Yukon.

d) Watson Lake to Liard Hotsprings (Figures 1I-1K)

From the British Columbia/Yukon border crossing at Mile B0.0, about 15 miles west of Watson Lake Wye, the pipeline right-of-way diverges from the Alaska Highway to cross the Dease River at a point four miles upstream from the village of Lower Post. This settlement is the site of an Indian village, an historic Hudson's Bay Company trading post, and an important domestic fishery. Fourmile Rapids, at the point where the pipeline may cross the Dease River, is a potential archaeological site.

Between Lower Post and Coal River (where a compressor station is to be located) at Mile 533 on the Alaska Highway, the pipeline right-of-way is out of sight of the highway. After passing near a picnic site near Coal River, it runs parallel to and just north of the highway, crossing the side road (at Milepost 517) to Smith River Military Reserve and the Alaska Highway at Milepost 498. The Liard River Hotsprings Provincial Park is just north of the Liard River bridge at Milepost 496. The pipeline is to be situated very close to the southern boundary of the Park. The Park's sulfur hot springs are heavily used because of immediate access from the highway.

Much of the territory in the Watson Lake to Liard Hotsprings section is popular for outdoor recreation and is only limited by ease of access. Other than Liard Hotsprings Park, the area most heavily used is the section between Coal River and the Liard River Bridge.

Registered traplines are located along this entire segment.

e) Liard Hotsprings to Fort Nelson (Figures 1K-1M)

North of Milepost 490 the pipeline right-of-way will leave the highway area and run east towards the south bank of the Grand Canyon of the Liard. An area of great scenic beauty, it contains features such as Rapids of the Drowned, Boiler Canyon and Hell Gate Rapids.

Liard is not easily accessible at the present time, but construction of a pipeline right-of-way could open the entire area to hunters, fishermen and tourists, thereby increasing the recreation value and use of that part of the Liard River.

A compressor Station is to be constructed about four miles southeast of Hell Gate, a particularly good potential recreation site. This area contains possible archaeological and historical sites and a focus of geologic interest around Hell Gate.

An established campground is located at Kledo Creek Park (Milepost 335), and the pipeline crosses the Alaska Highway, Steamboat Creek and the Muskwa River within a few miles of this point. The Muskwa River is little used for recreation purposes, but since the pipeline right-of-way runs parallel to the river and is usually within four to six miles of it, recreational access may be increased.

Another significant recreation area is located near the Fort Nelson gas processing plant. Local residents fish the Fort Nelson River here near the plant, by the bridge on the Old Fort Nelson Road.

f) Fort Nelson to Zama Lake (Figures 1M-1P)

From Fort Nelson the pipeline runs in an easterly direction through a low-lying muskeg area underlain by discontinuous permafrost. Overland access in this area is difficult and limited to gas well access roads and seismic lines. The area is almost unpopulated. A compressor station is to be built at the British Columbia-Alberta boundary.

No major archaeological sites are known to exist in this area, and it contains no important historical features.

Two Indian reserves owned by the Slaves of the Upper Hay River Band are located around Zama Lake. The pipeline right-of-way bypasses both reserves but may still cross land considered Band territory.

2.5 Hazards

The southwestern part of the Yukon Territory through which the pipeline passes is considered an area of significant seismic activity, and is classified under National Building Code as an area of high risk. The Shakwak Fault runs roughly northwest to southeast under the Alaska Highway route, crossing the southern end of Kluane Lake and continuing southeastward into British Columbia. Though this major fault is not noticeably active it displays considerable microseismic activity (Boucher and Fitch, 1969). To the west of the Shakwak Fault and Kluane Lake is a small fault which has been active within the last few decades (R.B. Campbell, pers. comm.). Numerous other faults exist in the region with the same general orientation. Seismic risk decreases to the eastward and is considered to be minimal in the Fort Nelson area. Off the Alaska coast, to the west, the Fairweather Fault is very active; tremors from this fault could trigger landslides along sections of the pipeline route.

Except for a few locations (south end of Kluane Lake, the Whitehorse area, and the east shore of Teslin Lake), the route follows reasonably level terrain or runs perpendicular to the contours of the land. Sidehills should be avoided as much as possible, and the hazard due to landslide or slumping because of slope instability should be minimal except, perhaps, in the case of a significant earth tremor. Detailed investigation of the pipeline route, local seismic activity and its effects on surface movements, and the surficial geology of the route are required for a more definitive evaluation of this hazard.

The pipeline crosses numerous rivers and streams where bottom scour during high water is a hazard. Watercourses in the Yukon and Rocky Mountain areas are notorious for incapacitating the Alaska Highway with slides and washouts during spring runoff. This is especially true in the area to the west of Kluane Lake where spring runoff and flash flooding during heavy rains can be severe. River meandering and channel shifting can also constitute a hazard by exposing the pipe to possible damage. This hazard will exist at crossings and where the pipeline route traverses floodplains. Crossings can also be hazardous in that the slopes on either side may be impossible to restabilize after burying the pipe; thus the pipe may be exposed by erosion, rendering it more susceptible to damage by flooding or sudden earth movements.

In addition to these natural hazards there are self-induced and human-induced factors which can lead to rupture in the pipeline. These hazards include defects in materials, unrelieved construction stresses, and accidental or deliberate rupture of the pipe by heavy equipment.

3.0 ENVIRONMENTAL IMPACT OF PROPOSED PROJECT

The proposed pipeline route runs alongside the Alaska Highway for approximately one-third of its route. Impacts along these sections will be minimal for many environmental parameters, owing to the already disturbed nature of the right-of-way. Other considerations of impact have been made on the remaining sections of the route, especially in areas where little disturbance, due to exploration and construction, has taken place.

General impacts are discussed, followed by a more detailed discussion on specific regional impacts. Maps (Figures 1A-1P) have been prepared that show site specific impacts and indicate key areas of concern where the most critical negative impacts have been identified.

The data collected, in the time available, is not at the same level of detail for each environmental component. For some resources, there is sufficient data to provide information on impacts at the general, regional and site specific levels, whereas for others, only a general statement can be made. Further studies, at a more intensive level, will provide a more detailed assessment of impact than is possible in this preliminary overview report.

3.1 General Impacts

3.1.1 Topography

There will be minor topographical impacts along the pipeline route. Borrow pits will create depressions in the landscape which may later fill with water. Indirect effects of these pits may be increased erosion, slumping and thermokarst development. The extent to which these features may develop depends upon the material and slopes of the resultant borrow pit. On a micro topographical level, there will be a mound over the pipeline which may settle with time.

3.1.2 Bedrock Geology

Most of the proposed pipeline route is underlain by glacial drift. However, some areas are traversed where bedrock outcrops do occur. These outcrops are not expected to create any potential adverse impact for construction of the pipeline.

3.1.3 Soils and Surficial Deposits

The pipeline will traverse areas of differing surficial deposits and soils. The physical characteristics of the materials, as well as their aspect and slope, will determine the impact of construction.

The first ten miles of the line will pass through an unglaciated area. The slopes in this area are not steep, but long. However, ice rich permafrost could be present and with termal erosion, could result in slumping or subsidence.

Vegetation removal during construction will expose the soil and subsoil to water and wind erosion, as well as altering the microclimate, especially along the route that does not follow the highway. The more extreme microclimate will in turn, cause changes in soil structure and microbiological activity, which determines the range of species that can invade the disturbed site. Water erosion will be a problem on slopes where soils have formed on homogeneous silty or fine sandy deposits such as lacustrine, aeolian fine alluvial and volcanic surficial deposits. These can all be easily washed downslope during spring runoff and summer rainstorms. Problems of erosion should not exist on surfaces underlain by glacial till or coarse fluvial deposits. Construction activities, including trenching, will involve the removal of the topsoil in some places and degradation of soil structure by compaction at other sites. As some of the parent material will have a low nutrient status, it will not be well suited to plant growth, and studies will be needed to determine potential capabilities at the subsoil to ensure successful natural or planned revegetation measures.

Agriculture is not of major importance in this section of the pipeline. Scattered farmland is found in the Fort Nelson area on luvisolic soils. At these locations, topsoil must be stockpiled and returned to the site to ensure minimum adverse effects for the farmer.

3.1.4 Permafrost

Any construction in a permafrost zone will have some impact on the environment. The delicate heat balance of the permafrost can be altered by changing the insulating qualities of the surficial material. Compaction or removal of the surface material would reduce the insulation between the existing permafrost and the heat of summer.

Pipeline construction will cause the disruption of the vegetative mat by vehicular traffic, placement of structures, and excavation. The thickness and general insulating qualities of the organic layer, and the ice content of the uppermost permafrost layers, are probably most critical in determining specific impacts.

The removal or destruction of the present ground surface materials will have short-term impacts during the construction work, especially if the exposed soil is ice-rich. Degradation of the permafrost then results from exposure of the ice-rich soil to solar radiation which results in termal erosion. If a high-ice content area is involved, subsidence of the soil surface, gullying, and establishment of new drainage patterns may occur. Permafrost degradation is difficult to halt until a new heat balance is achieved. Disturbed areas in permafrost regions are slow to revegetate naturally because of the shortness and coolness of the summer.

Once the pipe is laid and the trench backfilled, progressive thawing of the permafrost could result in the trench becoming a water-filled ditch unless sufficient backfill material is used to offset the reduced volume of the permafrost as it melts and the solid components settle. On sloping terrain, as can occur anywhere along the route, the trench could then divert and capture local drainage causing erosion and removal of solid materials.

Where the pipeline crosses ice-rich permafrost containing silt or organic material, thawing will result in unstable soil condition which will have to be mitigated, especially on sloped terrain. Sand, gravel or bedrock areas containing permafrost will remain relatively stable when thawed and should not result in significant impacts.

3.1.5 Climate

There will be no short or long-term effects on regional climate caused by the construction or operation of the proposed pipeline.

There could be an increased occurrence of ice fog during construction and operation. This will be induced by the addition of emissions from internal combustion engines in vehicles and compressor stations. Ice fog is likely to form when temperatures of -22°F and below occur in conjunction with a temperature inversion and calm conditions.

Long-term changes in microclimate will be caused by the removal of the vegetative cover in forested areas, resulting in more extreme temperatures, greater precipitation, and windier conditions at ground level.

3.1.6 Air Quality

During construction of the pipeline there will be two possible causes of the deterioration of air quality. Exhaust emissions from construction equipment will have minor impact along those parts of the pipeline where similar highway emissions are already present. In areas that do not follow the highway, emissions of carbon monoxide, hydrocarbons, nitrogen oxides, and some particulates will be introduced. These will normally be dispersed rapidly so that there should be no noticeable effect on the air quality. Areas where this impact would be concentrated are high activity areas such as river crossings and locations where temperature inversions and resultant ice fog occur most frequently in winter.

Dust from disturbance of the vegetation and soil will cause an increase in particulates in the air during summer construction. The amounts of dust will vary with soil type, local meteorological conditions and the level of equipment activity. Hence, the greatest impact will be caused by heavy construction activity during dry summer conditions in fine lacustrine, volcanic and aeolian deposits. Further dust may be common at rock crushing and gravel extraction sites.

During the operational phase, emmissions at the 18 compressor stations will constitute the major sources of air quality deterioration. The main cause of this is the introduction of particulates into the surrouding atmosphere, which will increase the incidence of ice fog (see Climate Section 3.1.5), along with pollutants such as carbon monoxide and nitrogen oxides. Usually these emmissions will be dispersed rapidly into the atomsphere and cause no problems. The possibility of elevated levels of NO and NO_2 (nitrogen oxides) at ground level near compressor stations is considered remote. The calculate maximum value for a compressor station near the Parsnip River in British Columbia is 0.1665 ppm (E. Sanderson, Westcoast Transmission, pers. comm.). This is within the propsed federal standard of 0.21 ppm (average over a one hour period). No significant sulfur dioxide emmissons should result from the burning of "sweet gas".

3.1.7 Noise

Where the proposed pipeline route follows the Alaska Highway, the ambient noise levels are higher than in the more remote wilderness areas.

Construction noise will be short-term and widespread. There will be noise generated from extra road traffic along the highway, coupled with noise generated in the actual laying of the pipeline and construction of the ancillary facilities. Higher noise levels will be generated in any areas where the pipeline runs through bedrock that requires blasting.

Long-term effects are those localized sources, such as compressor stations, which will continue throughout the operational phase. Periodically, venting of gas will cause severe short-term increases in sound. Data on these levels are found in the report: Alaska Natural Gas Transportation Study: Canada (1976).

3.1.8 Vegetation

The main impact on vegetation in construction of the Alcan Pipeline would be the clearing of the vegetation itself along the route where a new right-of-way is required. A 100-foot wide corridor would affect a total of 11,056 acres of vegetation. Some of the acreage is already disturbed as it lies along the highway right-of-way. Construction of additional roads and other facilities will require further acreage. Temporary facilities such as airstrips, landing pads, construction camps and storage facilities will also add to the acreage of total destroyed vegetation.

The removal of trees and shrubs will result in a visual impact, but the disturbance of the herb and moss layers will have the most effect in terms of terrain stability. Removal of the moss and lichen layer destroys the insulating effect that it has on the ground. During the summer the permafrost, if present, will melt and thermokarst depressions may form in ice rich permafrost areas.

frequent permafrost areas, found in the western part of the Muskeg areas, where black spruce is usually the dominant tree species, are commonly underlain by permafrost. These areas are usually fairly level so that large scale disturbance should not occur.

There will be an insignificant loss of merchantable timber along the pipeline route due the relatively small amounts of such timber involved. Stands of white spruce and lodgepole pine are considered to have commercial importance, and these stands are far from being fully utilized at present.

3.1.9 Wildlife

Many of the biologically sensitive areas identified are already traversed by the existing Alaska Highway facility. Impact upon wildlife directly attributable to the proposed pipeline in these areas will be limited to the temporary construction phase and, as such, are generally of a short-term nature. Long-term impacts associated with the operation and maintenance phases, will be of an extremely local nature associated with compressor station and processing plant locations. These impacts should not provide a significant addition to impacts associated with the existing highway.

There are several direct impacts that arise from the construction phase of the project. Increases in general human activity in combination with increases in auditory and visual stress, will cause displacement of many wildlife species. This effect will probably be short-term, provided that increased hunting and trapping pressures arising from improved access, are regulated.

In the case of raptoral species, particularly endangered species such as peregrine falcons, improperly timed construction activities may cause nest abandonment or failure to successfully reproduce young.

There could be an increase in pollutants, including garbage and liquid wastes. Waste disposal must be rigidly controlled along the route. Potential bear conflicts, particularly in areas where these animals are common, will only be compounded by poor disposal techniques. Discharge of liquid pollutants (gasoline, oil, etc.) into aquatic areas will adversely affect waterfowl and aquatic furbearer species. Increased silt loads, arising from construction activities, may also adversely affect aquatic furbearer species.

An increased fire hazard represents a potential threat to woodland/mountain caribou distribution. Woodland caribou rely in winter upon mature forest areas where supplies of slow growing ground and arboreal lichen are found. Fire, through the removal of the mature cover which forms the basis for lichen establishment, will cause the displacement of caribou from such areas. Reoccupation will be slow and will depend on the time required to establish adequate stocks of lichen. This length of time will probably be in excess of 100 years in these slow growing areas.

Habitat loss or alteration, which results from the actual right-of-way construction, will be minimal. However, destruction of known denning areas for bears and wolves may be serious, especially in permafrost areas where suitable sites are restricted.

Impact arising from the operation and maintenance phase of the proposed pipeline will primarily be associated with specific sites, such as compressor stations and processing plants. Noise levels around these sites may be sufficient to displace wildlife. Decreased use has been noted within a one-half mile radius of gas compressor stations by barren ground caribou and within one mile for Dall Sheep (McCourt et al, 1974). Similar effects have been noted for red foxes and snow geese. Increased emissions of sulfur dioxide from gas compressor stations may, under conditions of poor wind dispersal, be injurious to surrounding areas of lichen growth, with resultant adverse effects upon woodland caribou.

Additional impacts may arise during aircraft surveillance flights of the pipeline route. Regular surveillance flights may result in displacement of animals along the pipeline route, in accordance with each species' tolerance to overhead aircraft. The exact effect this will have on overall populations cannot be predicted without more detailed information on the distribution of species present.

3.1.10 Hydrology

The proposed pipeline is not expected to affect the flow regime of any of the major drainage basins traversed, but certain activities during the construction phase of the project may cause minor diversions that continue into the operational phase.

If hydrostatic testing of the pipeline is carried out, a great deal of water would be required for the test program which would have to be drawn from nearby lakes and rivers.

Surface drainage could be disrupted by the construction of the pipeline, access roads and construction sites. This could lead to ponding of water along the right-of-way or adjacent to it.

The bed conditions of rivers and streams would be changed by excessive activity. This may lead to a disturbance in the channel form. An established, imbricated lag cobble bed prevents instability.

3.1.11 Water Quality

Impacts may be present in the form of increased pollutants and sediments to stream systems.

Hydrostatic testing of the pipeline requires the use of local water. During the winter, this water is either heated or treated with antifreeze, and then returned to the natural environment where the heat or chemicals could seriously affect aquatic life. Increased human activity may also increase the liquid pollutants reaching streams.

Where the pipeline has to cross rivers, instability of the river bank, or excessive construction activity may result in increased sediment loads for the streams during summer construction.

3.1.12 Fisheries

Pipeline construction can result in complicated, and often long-term effects on the aquatic environment. The sub-arctic environment is relatively sensitive, and pipeline construction may pose serious threats, both directly and indirectly to fish and fish populations. The main concerns are:

i) removal or siltation of spawning gravel and the destruction of vital habitat resulting from increased siltation; and

ii) chemical or oil pollution.

SCHULTZ

Both winter and summer construction are planned for the proposed pipeline. All streams to be affected by the pipeline have varying amounts of natural turbidity and siltation. Streams are normally most turbid during and immediately after ice break-up. At these times, water velocity is great enough to prevent the settling out of much of the sediment. In many cases, the spring freshet serves to clean the gravel interstices of sediment laid down during the previous summer. Ditching and backfilling taking place during summer construction could cause siltation and turbidity to increase severalfold, which in turn could inhibit photosynthesis by aquatic plant communities, limiting the production of aquatic organisms.

Increased siltation during summer months can adversely affect the early life history stages of many spring spawners, including some salmonids and Arctic grayling. These species require well oxygenated flowing water for the developing eggs and alevins. Silt fills the gravel interstices, smothering eggs and preventing emergence of fry.

Winter construction through the overwintering areas of streams and rivers, could adversely affect overwintering fish and the eggs of fall spawners. Under certain conditions, long-term effects on fish stocks could result from short-term environmental degradation.

Severe losses may also occur if the stream level or velocity is reduced, resulting in the complete freezing of overwintering pools.

Generally, although both summer and winter construction will result in high turbidity and siltation, these will subside within a few months following the completion of construction, providing that the stabilization of stream banks and bottoms has been successful.

Streambeds are a potential source of gravel for construction purposes, but extraction from certain localities can result in the alteration or elimination of a critical spawning ground. The use of streambed gravel should be discouraged.

Several potentially toxic materials will be used during construction. If spilled, these could reach streams causing mortality among resident organisms. Of all these materials, methanol, used as antifreeze in hydrostatic testing, has the greatest potential for entering streams, and potentially serious adverse impacts could result. For example, grayling fry cannot tolerate exposure to one percent methanol for greater than 24 hours, and concentrations greater than 2.5 percent are lethal in a much shorter time. Eggs of this species, while not killed by a 24-hour exposure to one percent methanol, will be damaged and development delayed (Environmental Protection Board, 1974). Methanol and fuel spills of sufficient size can kill most or all life in the immediate area, while smaller spills could result in subtle, but deleterious effects that could seriously affect the long-term productivity of an aquatic community.

Other problems encountered on Arctic sections of the pipeline should not be issues in the Canadian section. Removal of blockages caused by debris or winter construction roads is covered under Westcoast Transmission Company Limited's Environmental Requirements for Pipeline Construction, for the British Columbia section of the line. Similar requirements are expected to apply to the Yukon and Alberta sections of the pipeline.

Construction affecting fish populations will have ramifications in the recreational, domestic and commercial fisheries along the route. It has been suggested that recreational fishing is done mainly by persons going up the highway, not on a fishing trip but on a family holiday. Naturally, local residents also fish for recreation. Most streams along the highway provide recreational fishing whether or not they are mentioned in fishing guides. Summer construction of the pipeline may temporarily disrupt recreational and domestic fishing along those sections of the highway contacted by the pipeline route.

Operation and maintenance of the proposed pipeline and related facilities would probably be minimal in comparison to impacts generated by construction. The two main concerns would be erosion and debris at stream crossings.

Erosion from the pipeline right-of-way near river crossings could be a problem if vegetation fails to re-establish itself. Westcoast Transmission Company Limited's Environmental Regulations require that whatever steps deemed necessary must be taken to limit the amount of erosion material entering watercourses. It is expected that similar regulations will apply in the Yukon and Alberta. Despite these regulations, it is not always possible to prevent erosion during the initial phases of the pipeline operation. If this is the case, extended turbidity and siltation could occur.

Debris at stream crossings left after the construction phase could block passage of migrating fish, thus preventing any spawning upstream of the blockage. Debris such as log jams may not completely block streams, but may concentrate the force of the water to the extent that fish passage may be impossible.

During the operational phase, natural gas would probably be the major contaminant leaked. The likelihood of fish kills caused by natural gas is not considered great, since much of the leaking gas would dissipate into the atmosphere. In small waterways, leaking natural gas could deplete oxygen levels and cause fish kills.

Since the Alaska Highway is at present almost the only road access to recreational, domestic and even commercial fishing, it can be expected that the pipeline right-of-way will provide access to formerly inaccessible areas. Fish in the north grow more slowly, become sexually mature later, and have lower turnover rates than comparable populations to the south. These characteristics make them more susceptible to over-exploitation.

Improved access to wilderness areas may prove detrimental to fish populations over the long-term, and should be accompanied by increased conservation and management on the part of government authorities.

3.1.13 Impact of Hazards on Pipeline Integrity

Hazards are of greatest concern when they result in the exposure and rupture of the pipe with a consequent escape of gas. With ignition, a gas fire would cause a loss of nearby surrounding vegetative cover and possibly consequent soil erosion. The potential hazard to wildlife depends upon the density of wildlife and the size of the subsequent burn, and is considered slight. Smaller leaks in the pipe, as a result of material or welding defects, would result in limited devegetation above the leak, and although resulting in a loss of energy resources, are not environmentally serious unless they are undetected for an extended period of time.

Potentially the most serious hazard to the pipeline's integrity is the occurrence of large earthquakes. Seismic shaking or surface faulting accompanying a large shock could rupture the pipeline directly, cause failure in foundation materials, or induce landslides. All of these could cause rupture. Above-ground facilities such as valves and compressor stations would also be susceptible to landslides and rockfalls if poorly located.

River scouring and channel shifting can result in the exposure of the pipeline if it is not buried deep enough. In such cases, the exposed pipe would become susceptible to damage and rupture by forces such as heavy water flows, stream bank slumping and damage from rocks and logs in the channel.

3.1.14 Socio-Economic Impacts

The material presented in this report has been organized systematically and regionally to demonstrate the regional economic and social structures.

Consequently, impacts have been presented in relationship to particular components or aspects of the regional socio-economy. Some particulars within socio-economic sectors have been isolated for comment, even though they are not dealt with specifically in the descriptive sections of this report.

3.1.14.1 Employment Expectations

No final details are on hand regarding construction schedules, or the labor demand that would be made by the proposed pipeline project. The construction activity currently is viewed in relation to two major geographical sections: from Beaver Creek, on the Alaska-Yukon border to the British Columbia border near Watson Lake; and from the British Columbia-Yukon border to Alberta.

The seasonal and work force estimates are presently defined in these geographic forms. For details, see Figure 2 and the following Tables 18 and 19.

As can be seen, present estimates are that neither segment of the proposed pipeline would separately involve more than a maximum of 1,500 workers in the field at any given time. This maximum figure includes various support staff, including service, administration, and logistics personnel.

It must be recognized that both the western and eastern segments of the proposed pipeline focus on well developed transportation and exploration centers, and the proposed corridor is locked into established logistical support systems that can be assumed to contain surplus capacity, although study would be required to establish the capacity (gross and seasonal) available within the existing transportation and service sectors.

There would be an additional number of workers, presently unknown, indirectly engaged in support services, not all of whom would be located in the immediate region. Given the size of the work crew and the limited construction period, it is not anticipated that significant additions to the general infrastructure (Police, government, administrative, and related services) would result from the proposed project, provided the construction bases were kept out of the smaller communities, with only limited service sectors.

Neither segment of the Alaska-Yukon-Alberta proposed pipeline would present a major labor demand. Current information indicates that approximately 20 percent of the proposed work crews would be relatively unskilled workers, and local sources would be tapped for this portion of the crew. Some portion of the more skilled sectors of the work force could also be found within the local labor pool.

In June 1976, there were 1,400 people registered as unemployed with the Canada Manpower office in Whitehorse. About 60 percent of these were male, and the majority were from the construction trades and from the tourist service industries. Even allowing for a reduction in the number of unemployed, and for the fluctuations resulting from the seasonal impact on labor demand in many sections of industry in the north, it seems reasonable to assume that a contractor would have no difficulty in obtaining workers from the Whitehorse regional labor pool at any time throughout the year. It can also be reasonably assumed (although the question should be addressed more specifically in subsequent analysis) that the engagement of workers from the pool of semi and unskilled workers available within the western region of the proposed corridor would not create a labor shortage for local employers in the Territory.

Additional workers would be hired locally for the eastern corridor (Fort Nelson-Zama Lake), and it is not anticipated that the proposed pipeline project would have a significant impact on the Northern B.C. labor market.

In June 1976, there were some 146 men unemployed in Fort Nelson, which is not a town noted for its ability to hold unemployed workers, who tend to move south to larger centers; and in the same period, Prince George, which is within the economic watershed of the northeast, reported over 4,000 unemployed workers.

One possible deleterious overall impact is present in the situation. It is possible that high expectations would be generated by rumor-discussion of the proposed project. This in turn could attract transient workers into the main centers within the proposed corridor - notably Whitehorse and Fort Nelson, and possible Watson Lake. Serious local problems could arise out of any such development.

It is also possible that Indian populations along the proposed right-of-way might desire to participate in the labor force, and present themselves in numbers beyond the scale of the projected demand.

In other studies of northern gas and oil lines proposed for high northern areas, some considerable emphasis has been placed on training local residents, particularly native northerners, for positions with the construction crews. However, in light of the middle-north, relatively developed status of the regions under review, and the comparatively small populations of natives involved, it seems an excessive response to the situation to propose any major training programs within the settlements of the proposed corridor.

If the decision is made, as policy, to employ some decided upon percentage of workers locally, the local skill level is likely to be adequate for the majority of unskilled jobs. In addition, programs of technical, and equipment handling training are already on-going in and near the most likely places of hiring, which can be relied upon to provide workers. Other training needs could be met by on-the-job training, as required.

Operations staffing, however, could be drawn from local populations with the appropriate training.

It should be noted that even a small, temporary impact could be locally significant so far as regional incomes and employment patterns are concerned, and formal study would be required to quantify the economic impact of the demand for labor, goods and services. However, it should not be assumed that the impact anticipated will be of the scales identified, for example, in the MacKenzie Valley of the Northwest Territories.

TABLE 18

PRELIMINARY ESTIMATE: CONSTRUCTION SCHEDULE,
BEAVER CREEK TO THE VICINITY OF WATSON LAKE
(MILE Y0.0 to Y512)

Year One	Segment
No. Spreads 2 = 900 men (450 men per)	
Winter 2	0-40/40-80
Summer 2	80-187/512-401

Year One	Segment
No. Spreads 2 = 900 men (450 men per)	
Winter 0	- -
Summer 2	187-294/401-294

Estimated support logistics and administration etc., plus compressor construction crews = 225 workers per spread = total of 450 workers per two spread seasons.

Maximum work force at any given time, (est.) = 1350 - 1500.
Local labor estimated demand = 20% of total = 270 - 300.

TABLE 19

PRELIMINARY ESTIMATES: CONSTRUCTION SCHEDULE

YUKON/B.C. BORDER TO ALBERTA

	Seasonal Activity			
	First Winter	First Summer	Second Winter	Second Summer
No. Spreads (500 men per)	2 (1000 men)	1 (500)	2 (1000)	1 (500)
Compressor Construction and River Crossing crews	50	75	50	75
Estimated logistical and other support staff, assumed to be 150 workers per spread of 500 men:	300±	150±	300±	150±

Maximum work force at any given time (est.) = 1350 - 1500

Local labor estimated demand = 20% of total = 270 - 300

3.1.14.2 Economic Impact

The construction of the proposed pipeline would have an economic impact within and beyond the proposed construction corridor. Within the corridor, the economic impact would be concentrated largely in three major centers of Whitehorse, Watson Lake and Fort Nelson, although it could be expected to have some degree of impact on minor settlements. Given the small populations and limited services, this could be locally significant. Outside the immediate regional impact, the greatest impact would be in materials and support personnel.

The economic impact cannot at this time be evaluated since no data is available regarding the wage bill, the likely scale of local procurement of goods and services, or the specific on-site shift schedules.

However, assuming that the greater part of all locally levied demands for goods and services will be addressed to the main centers, it is predictable that local resources would be adequate to meet foreseeable demands without stress and without affecting the capability of meeting indigenous demands.

Camp supplies and equipment could be shipped into the region in bulk in the same way as supplies are currently supplied to the Yukon, or they could be obtained through local distributors. The latter case would primarily benefit Whitehorse business.

Construction supplies could be supplied from Alaska for the western segment of the proposed line, and from north-eastern B.C. via the B.C. Railway for the eastern segment. An alternative route, the Dease Lake B.C.

Railroad rail extension does exist. In the absence of data regarding these methods of transporting materials, no analysis has been attempted in this preliminary overview of the impact.

The relative costs of these alternatives cannot be evaluated without additional data regarding the housing and boarding of the proposed work crews.

It should be noted that the seasonal demand for accommodation and food in the Territory and northeast British Columbia, varies greatly between summer and winter. Presumably services would be opened upon a firm offer of winter use (see Table 17).

3.1.14.3 Social Impact

The social impact of the proposed construction would be concentrated in existing settlements, service centers, and towns.

The scale of the proposed project, and its relatively minor extent over time, would suggest that any major impact of any problematical nature would only be experienced in the smaller communities within the corridor.

Within the major camps at either end of the proposed corridor, Whitehorse and Fort Nelson, the impact of the work crews would be noticeable but would be within the capacity of existing services to absorb.

Smaller communities would probably experience stressful impact, particularly those corridor communities containing major Indian bands. Any such stress arising out of competition between construction workers and local residents for limited services and amenities would be heightened if local unemployment was an issue and no jobs were available on the proposed project for locals.

The geographic areas of especial significance in this regard would be the relatively well populated section of the route between Whitehorse and the region of Watson Lake. In terms of the actual distribution or structure of the settlements, there should be no major impact.

3.1.14.4 Highway Traffic

Traffic along the length of the Canadian section of the Alaska Highway is not, in absolute terms, large. In seasonal terms however, and in terms of some local segments, traffic is significant.

Construction activity of the proposed pipeline and associated facilities would affect general traffic movement in the following ways. Increased traffic related to the proposed pipeline would create additional road hazards and, in some areas, might occasion periodic stoppages of traffic. Dust conditions would be worsened, as would roadbed conditions during wet or semi-thaw periods.

No deleterious impacts are expected as a result of the proposed pipeline, so far as the actual road system is concerned. The existing system is highly developed throughout the areas of proposed activity, and is generally considered to have a capacity well in excess of current demands.

A favorable impact might well be produced as the result of improved surface maintenance in areas of construction activity. This would be a temporary situation. It is possible that the activity of the proposed pipeline construction would add to the existing local and industrial pressures for an up-grading of the road network, particularly in the case of the Alaska Highway.

3.1.14.5 Air Traffic and Communications

The main centers within the proposed pipeline corridor are serviced by scheduled air carriers. Smaller communities are generally provided with all-weather air-strips and are in scheduled or chartered connection with the main centers of Whitehorse and points in northeastern British Columbia.

However, it is possible that conflicts will arise between construction-oriented demand for air service and the pre-existing demands. This is especially likely during the summer season and during the traditional moving periods of breakup and freezeup.

Some supplementary improvement of local airstrips might be required if it is proposed to fly heavy loads into any of the secondary centers.

If seasonal scheduling is not sufficient to reduce the conflict, consideration should be given to improving one or more airstrips at strategic locations (most likely Whitehorse, Watson Lake and Fort Nelson) to reduce the impact on the established flight patterns.

Similarly, radio and telephone linkages should be established after discussions with local Department of Transport officials have determined the least disturbing system for use.

3.1.14.6 Recreational Land Use

The proposed pipeline construction and the subsequent operation period of the pipeline could have an immediate and continuing impact on certain recreational activities.

In some areas, the proposed pipeline could impact recreational lands which are used by local residents, visitors, or both. Areas of local significance such as beaches, river and lake boat access points, and community parks could be directly or indirectly adversely affected by the proposed pipeline.

Additionally, recreational access roads and trails, as in the cases of areas utilized for hiking, snowmobiling and all-terrain vehicle activity, could be interrupted by the proposed pipeline construction.

The impact could take two forms; that of interrupting current use, and that of creating a semi-permanent impingement on the use and enjoyment of recreational areas. These can be better evaluated with a more detailed knowledge of the pipeline route and community recreational resources along its path (see Figures 1A - 1P).

3.1.14.7 New Access Routes

The proposed pipeline right-of-way would allow access to some areas presently relatively inaccessible. These areas could include the highway by-pass segments indicated on the maps, and the entire line section from Liard Hotsprings to Zama Lake.

Over other parts of the proposed right-of-way, where it coincides with the Alaska Highway corridor, the proposed project could improve accessibility. It must be anticipated that the proposed pipeline construction would strengthen the existing pressures to up-grade the Alaska Highway.

Improved access could be expected to have an impact on all human activity, from archaeological exploration to hunting and fishing. Consequently, improvement in access has its benefits and its costs, which are not always easy to distinguish or anticipate. Improved access could allow academics into areas for the purposes of study; on the other hand, the same public access could lead to the destruction of archaeological and historical sites by casual explorers and deliberate vandals. Improved access afforded to hunters and fishermen could lead to pressure on the wildlife resources of the region. It could also lead to damage to the countryside by traffic movement above the designed capacity of low grade roads and trails, by littering at campsites, and by increased fire hazards that would inevitably follow the camper-tourist.

3.1.14.8 Aesthetic Considerations

Even after successful revegetation, the impact of cleared rights-of-way on the general aesthetic environment could be significant along new corridors, and of some significance in the existing highway corridor. Additionally, the maintenance of ancillary constructions (compressor stations and roads, airstrips and campsites) would interfere with the natural aesthetic environment. Views from various tourist points would be marred by the proposed clearing, and from the air the long unbroken right-of-way would tend to dominate the visual experience of observers.

On the other hand, many areas in the southern Yukon, northern British Columbia, and northwestern Alberta are heavily scarred by cleared lines cut by exploration programs. These survey and seismic lines eventually revegetate, but even so, generally remain discernible within the surrounding undisturbed environment.

From the ground, the impact of the proposed right-of-way would vary with the local vegetation cover and prevailing topography. From elevated view points, the presence of the clear cuts could only be concealed by screening that which would likely destroy the amenity of the location. In areas of more level terrain, screening could reduce the impact of the proposed right-of-way. In total, some loss of aesthetic amenity is inevitable, should the proposed project go forward.

3.1.14.9 Archaeology and History

In British Columbia, government participation is mandatory in evaluating discovered sites. Both the government of Alberta and the Territorial government of the Yukon provide for the protection and preservation of significant archaeological and historical discoveries.

It is highly probable that, should the proposed project go ahead, the construction activity would uncover many valuable sites which would need protection and scientific evaluation.

3.1.14.10 Indian Population

Most of the Indian population in the Yukon Territory and northern British Columbia is concentrated within the proposed pipeline corridor.

In many areas Indian settlements, lands, and traplines would be impacted by the construction and operation of the proposed pipeline.

In addition to possible physical impacts on Indian lands and land uses, the construction work force and in-field economic demands would have an impact on the services and amenities within Indian communities.

3.1.14.11 Land Use: Mining, Forestry, Agriculture

No significant impact would be experienced in land use related to mining, forestry or agriculture. Neither forestry nor agriculture is a major activity in the Yukon generally, or within the remaining proposed pipeline corridor. The forest and agricultural resources available, as marginal as they are, are in excess of the current levels of exploitation.

Some loss of timber would be brought about by the clearing of the proposed right-of-way. This loss would be total over the operational life of the proposed pipeline. Any such loss would not be economically significant in terms of current or projected demand.

Agricultural activity, if any were developed during the operational life of the proposed project, would be compatible with the cleared right-of-way but would not have access to the areas taken for compressor stations and other operationally permanent services. Some temporary dislocation of agriculture would be occasioned if the proposed right-of-way traversed an area currently farmed. Research has revealed no such areas.

No significant mining activity is currently taking place within the immediate proposed pipeline corridor. An underground copper mine is in operation southwest of Whitehorse, employing some 200 workers, most of whom live in Whitehorse. Other mineral prospects are present, but most of the mining activity in the Yukon takes place north of the proposed corridor.

In British Columbia, southwest of Watson Lake, an open-pit asbestos mine operates, using the Yukon as a support base. This operation is over 70 miles out of the proposed pipeline corridor.

In northeastern British Columbia, the proposed pipeline corridor enters an area of oil and gas exploration and production. Pipelines exist serving areas in the Northwest Territories.

The proposed pipe would have no identifiable deleterious impact on any of these mineral activities.

3.1.14.12 Gas Supplies

At present in the Yukon and in many smaller communities in the B.C. section of the proposed pipeline, energy requirements are supplied by electricity, oil and bottled gas.

For the western corridor region, oil and bottled gas is transported to the Yukon by truck or rail and distributed from Whitehorse.

Wood is still used for domestic energy in many of the smaller communities.

Considerable savings could accrue to the people of the Yukon if natural gas were available to supplement existing energy sources. Projected demands could be more economically met, in part, by the diversion of gas in transit.

The potential for this service is made more practical by the concentrated nature of the demand center. Over two-thirds of the Yukon population is in the Whitehorse region. A major energy demand is concentrated in the Faro-Mayo mining districts, both accessible by year-round roads.

Possibly Cassiar Mines, located about 70 miles southwest of Watson Lake and connected by road with the Alaska Highway, would also be a market for natural gas.

In the longer range, the availability of natural gas could stimulate other resource development. The forest resources of the region, for example, might come into economic reach earlier if local energy supplies were abundant and economic.

3.2 Environmental Impacts on a Regional Basis

Comments on impacts within a regional context can be made for many of the environmental features. However, impacts on bedrock geology and topography will be minimal and at such a localized scale, that they are dependent on the exact location of the pipeline. For this reason, there is no regional or site-specific discussion on these environmental parameters. Soils and surficial geology will have some significant impacts at various sites along the route but these will be localized and will need detailed airphoto interpretation and field investigations to determine the seriousness of these impacts. Other environmental parameters, where applicable, are discussed in the following sections. Specific sites are shown on Figures 1A to 1P at the end of this volume.

3.2.1 Beaver Creek to Kluane Lake (Figures 1A - 1D)

a) Permafrost

There is abundant discontinuous permafrost, some of which is ice-rich. This is the most sensitive area for permafrost.

b) Climate/Air Quality

Three compressor stations are located within this section which may cause increased ice fog and localized air pollution.

c) Vegetation/Forests

Near the Alaska-Yukon border extensive stands of black spruce muskeg are found which are sensitive to build on. In the Shakwak Trench there are stands of merchantable white spruce surrounding Kluane Lake. Isolated muskeg areas occur within the trench where ice-rich permafrost will occur. The pipeline closely follows the perimeter of the proposed St. Elias Range Ecological Reserve. Included in the proposed reserve are the existing Kluane National Park and the Kluane Game Sanctuary. Smaller ecological reserves within the large one are proposed for unique areas. Klutlan Glacier Area, Koidern "Pot hole" country and Sheep Mountain - Mount Wallace proposed reserves lie along the pipeline right-of-way. The proposed Ecological Reserve (No. 67) at Duke Meadow, which is a unique area of prairie, lies adjacent to the proposed pipeline route. The precise routing of the pipeline should avoid all those proposed reserves that contain unique flora, fauna, or geological features.

d) Wildlife

Impacts caused by disturbance to wildlife range, effects of noise or widespread effects of increased access may be felt in the following areas, as well as the Reserves mentioned above. The White River is used as a spring foraging area by grizzly bears. The Donjek River is used as both spring and summer range by grizzlies. An area to the south of Miles Y100 - Y110, near Burwash Flats, is used as winter range for thinhorn sheep. Areas to the north and south of the route between approximately Miles Y109 - Y118 are used by the rare Osborn caribou - a sub-species of the woodland caribou. Caribou may be encountered crossing the route in this area. The areas to the south of the proposed route between Miles Y120 and

Y148 are winter range areas for thinhorn sheep. At the south end of Kluane Lake, there is an important area for staging migratory waterfowl.

e) Hydrology

There is a possibility that certain sections of the pipeline may be chilled. If this occurs, it is possible that a frost bulb could develop around a pipe, thus impeding groundwater flow. If a warm pipe is used then a problem of bank slumpage may occur if permafrost is present. In the cases of the smaller channels, a warm pipe would thaw material in the frozen bed, thus causing scour in early spring.

Steep mountain creeks along Kluane Lake might jeopardize pipeline integrity by the activity of mudflows, shifting channels, and snow avalanches. The Alaska Highway is being rerouted to the north of the river to avoid these problems.

f) Fisheries

The pipeline will cross seven major rivers. Chum and Chinook salmon ascend to spawn the White River in late summer and fall. The young of these species descend the river in spring and summer. Major impacts on these populations could occur by damage to the spawning beds or blockage of migrating adults or young. Similarly Chum salmon spawn at various points in the Kluane River and the Donjek River. Ice-free areas in the Koidern River provide overwintering habitat for fish. If the stream velocity is lowered, then these areas may freeze solid. Excessive siltation from construction may cause depletion of dissolved oxygen which may cause mortality to eggs of fall spawners.

A major commercial fishery occurs in Kluane Lake. This fishery may be indirectly impacted by alteration and possible destruction of spawning beds in tributary streams or along the shores of the lake.

Recreational fishing occurs at several streams along the route and these may be temporarily disrupted during construction.

g) Socio-Economic

The most consistent impacts in this section will result from the proximity of the proposed right-of-way to the Alaska Highway and related service and community centers. These impacts include a visual impact from extended clearings, access roads, borrow sites and storage depots. Access to local side roads, recreation sites, work sites, mining areas and general highway movement will be restricted. Construction may also disrupt the historic community of Silver Creek and local efforts to investigate and restore this site. Accidental destruction of archaeological remains is a distinct possibility in the region of Burwash Flats and Kluane.

Commercial operations of tourist fishing camps at Burwash Landing and Destruction Bay on Kluane Lake may also be affected.

3.2.2 Kluane to Whitehorse (Figures 1D - 1F)

a) Permafrost

Permafrost is intermittent in this section and is limited to sites such as localized peat bogs. No major impacts should be encountered.

b) Climate/Air Quality

Three compressor stations are located within this section which may cause increased ice fog and localized air pollution.

c) Vegetation

The pipeline runs along the boundary of the proposed IBP Ecological Reserve No. 16, including the Sheep Mountain - Mount Wallace area. This will cause visual disturbance to the environment. There are also several good stands of merchantable white spruce and lodgepole pine along this section.

d) Wildlife

The area to the south of the proposed route, from Mile Y174 to Mile Y190, is used by denning grizzly bears. Construction noise and activity may disturb wildlife in the proposed reserves.

e) Fisheries

Five major rivers are crossed by the proposed route which include the Takhini River. This river is utilized by migratory and spawning populations of Chinook salmon. Adult migrations and spawning occur in late summer.

Eggs remain in icefree areas throughout the winter and the juvenile chinooks travel downstream in spring. Improper construction practices and timing could seriously affect populations.

Small lakes, such as Fish Lake and Jackson Lakes in the vicinity of Whitehorse have been stocked with Rainbow trout. These fish provide recreational fishing for local anglers, and some of the lakes now support spawning populations. Increased siltation and turbidity in the tributary streams could cause negative impacts in the lakes. Other recreational fishing sites that could similarly be effected are the Mendenhall River and Kloo Lake.

f) Socio-Economic

The right-of-way routing near Haines Junction and Whitehorse will encounter Development Control Zones wherein community planning goals may present direct conflicts. Construction may also disrupt the small communities of Champagne and Canyon.

Historic and pre-historic sites near Canyon, Champagne, and Whitehorse may be seriously disrupted by construction activities.

There are active mining operations west of Whitehorse. The pipeline locations may conflict with future mine sites, tailings operations, or related access roads.

Recreational areas around Sulphur Lake, Pine Lake near Haines Junction, Louise Lake, and Jackson Lakes near Whitehorse may be directly impaired by construction activity and restricted local access involving the right-of-way.

Negative visual impacts from land-clearing, construction activity, access roads, etc. will be most noticeable around Haines Junction, Whitehorse, and between Pine Lake and Champagne. Visual impairment may also occur at favored recreational sites beside Pine Lake and Louise Lake.

3.2.3 Whitehorse to Watson Lake (Figures 1F-1I)

a) Permafrost

Occurrences of permafrost are intermittent along this section, occurring mainly in peat bogs. No major impacts are expected.

b) Climate/Air Quality

Four compressor stations are located within this stretch. These may cause local increased occurrence of ice fog and air pollution.

c) Vegetation

Near Teslin Lake there is the proposed IBP Wolf Lake Ecological Reserve No. 18 which should be avoided. There are merchantable stands of white spruce and lodgepole pine along the route which could be used by the sawmills at Watson Lake and Whitehorse. Black spruce muskeg occurs which may overlie local pockets of permafrost.

d) Wildlife

Several staging and nesting areas for waterfowl are located in this section. At Mile Y287 to Mile Y299, there is a staging area for migratory waterfowl. Further east at Mile Y371 at Nisutlin Bay, there is an important area for staging and nesting waterfowl. A swan nesting area is located at Mile Y459.

e) Fisheries

The Yukon River, Teslin River, Michie Creek, Smart River, and Swift River are all used as migratory routes for Chinook salmon. Disturbance of the migration in the Yukon River and Michie Creek would have a negative impact on the commercial, recreational and domestic fisheries in the Whitehorse area.

Teslin River is a Chum salmon spawning area. The spawning areas are not known and could be inadvertently disturbed.

Increased siltation in Squanga Lake during summer could affect the fall spawning beds of Lake whitefish which are important to the lake's recreational fishery.

Interference in migratory or spawning populations in Teslin Lake could be detrimental to domestic native fishing at Johnson's Crossing and Nisutlin Bay. Impacts here could be high as the area is used in migration and spawning of both spring and fall spawning species. Most of the fish species here contribute to a valuable recreational as well as domestic fishery.

The section of pipeline from Mile Y450 to Mile Y512 is nearly coincident with the Alaska Highway. Grayling spawn in many of the clear gravel-bottomed streams crossed by the pipeline. Impact of pipeline construction could interfere with spawning habitat and in summer cause temporary disruption of recreational fishing along the highway. Destruction of or interference with Grayling spawning areas could have long-term repercussions to the recreational fishery.

f) Socio-Economic

Lengthy segments of the proposed right-of-way follow the Alaska Highway corridor and will create negative impacts from construction activity, disruption of recreational sites and related impacts, such as temporary restriction of off-highway access.

Commercial fish camp operations may be disrupted at Morley River, Fox Point, Teslin, and on Marsh Lake. Additional recreational fishing areas along the highway may also be disturbed. There is a domestic fishery for native people of Upper Liard.

Disturbance of historic and archaeological remains is a possibility near McClintock on Marsh Lake, alongside Squanga Lake, at Teslin, and other nearby sites.

Right-of-way routing past Teslin and around Watson Lake will encounter Development Control Zones wherein community planning goals may present direct conflicts. Construction activity may also disrupt the small communities of Johnson's Crossing, Brooks Brook, Teslin Lake, Morley River, and Upper Liard.

Many recreational sites of varying interest also exist along the route which would suffer negative impact if the pipeline right-of-way crossed in the immediate vicinity.

3.2.4 Watson Lake to Liard Hotsprings (Figures 1I - 1K)

a) Permafrost

Rare occurrences of permafrost are found in organic soils but should not constitute a significant impact.

b) Climate/Air Quality

Three compressor stations are located in this section. Their location should be chosen so as to avoid increased frequencies of ice fogging and air pollution.

c) Vegetation

Floodplain forests will be encountered at major river crossings while good stands of merchantable timber will be found along much of the route.

d) Wildlife

To the south of Liard Hotsprings populations of stone sheep, mountain goat, mountain caribou, and grizzly bears are located.

e) Fisheries

Five major river crossings, three lakes, and 21 creeks are located within this section.

Coal River, Smith River, Teeter Creek, and the Liard River support recreational fisheries where access from the highway permits. The Liard River is fairly close to the route over about 50 miles, but because of present access, most recreational fishing there occurs at the one highway crossing. It is not expected that pipeline construction will significantly improve access to the Liard.

Disturbance of this recreational fishing in all rivers, and domestic fishing where indicated, is anticipated for the period of construction.

Further investigation of the watercourses is required to identify fish migration and spawning potentials, and to determine the relative sensitivities of various construction periods. Spawning sites marked in Figures 1I and 1K indicate the possible location of suitable spawning habitat. Further studies must be done to determine if these areas are actually utilized for spawning.

If a period of low sensitivity is used for construction and if environmental construction specifications are adhered to, recovery of the watercourses following construction should occur.

f) <u>Socio-Economic</u>

Major sections of primary routing for the pipeline are involved in this region, thus greatly reducing the utility impact on local socio-economic activity.

A major impact will be noticed at Lower Post where the predominantly native population has a valuable food fishery at the confluence of the Liard and Dease rivers.

At Mile 540 there is a historical and archaeological site called Skooks Landing which may be disturbed. Potential also exists in this area for other significant historical and archaeological sites.

Liard River Hotsprings Provincial Park where the highway crosses the river is also susceptible to negative visual impacts from clearing. The visual impact of areas by Whirlpool Canyon and Portage Brulé Rapids may be adversely affected visually from clearing operations.

3.2.5 Liard Hotsprings to Fort Nelson (Figures 1K - 1M)

a) Permafrost

Occurrence of permafrost in mineral terrain is very rare in this section. Muskeg sites will probably be underlain by permafrost.

b) Climate/Air Quality

Two compressor stations occur within this section.

c) Vegetation

IBP Ecological Reserves are located near Fort Nelson. If alternative routes are being studied, the location of these reserves is of importance.

Floodplain forests will be encountered along the Fort Nelson River. In the eastern part of the line, there is extensive black spruce muskeg overlying permafrost.

d) Wildlife

Areas to the south of the road up to route B180 contain populations of stone sheep, grizzly bear, mountain goat, and mountain caribou.

c) Fisheries

There are five major river crossings and approximately 60 creeks along this section.

The Sulphur, Toad and Prophet River crossings have no access at present from the Alaska Highway, although the Prophet River does support a domestic fishery near the proposed pipeline crossing (Jamieson, 1976). The Trout and Muskwa rivers and two of the larger creeks support recreational and domestic fishing. Further information is required to determine the most sensitive period for crossing these watercourses, when construction activities should be restricted from the river channels. Increased access to three rivers may increase the fishing at these locations.

Spawning sites marked in Figures 1K and 1M indicate the possible existence of suitable spawning habitat. Further studies must be done to determine if these areas are actually utilized for spawning.

f) Socio-Economic

For most of this segment the pipeline right-of-way will diverge from the Alaska Highway route. The right-of-way encounters the scenic Liard River gorge, however, and may become a local route into this area. This may engender a level of traffic and local terrain damage not originally planned for.

At the downstream end of the gorge on the Liard River, called Hell Gate, a possibility exists for uncovering historic and archaeological sites related to river use. A compression station planned for this area may compound the local impact.

Kluane Creek campsite at Mile 335 should not be significantly impaired as a campsite, since it is removed from the right-of-way.

No negative impact is expected on the Fort Nelson River recreational fishing area on the road to Old Fort Nelson, downstream from the massive Fort Nelson gas refinery maintained by Westcoast Transmission.

3.2.6 Fort Nelson to Zama Lake (Figures 1M - 1P)

a) Permafrost

Much of the terrain in this section is organic and underlain by extensive shallow permafrost areas.

b) Climate/Air Quality

Three compressor stations are located in this section. The one sited near Fort Nelson is at a process plant where possible impacts may be greatest.

c) Vegetation

Extensive areas of muskeg are found here.

d) Wildlife

The Hay-Zama Lake area to the south of the route is an important staging area for migrating geese.

c) Fisheries

There are eight major river crossings and approximately 40 creeks along this section.

Recreational fishing is not as popular in watercourses through this section as in rivers mentioned previously. Several factors may be responsible. Biological factors such as species composition and lack of lake migrants may be accentuated by others such as scenery, increased incidence of mosquitos, and poorer access.

Improved access or facilities could result in increased use of the fishery resource.

A domestic Indian fishery may exist at Zama Lake. Although more information is required to determine the appropriate construction period, it is expected that winter construction would be most suitable for the biological and hydrological character of these watercourses. With adherence to the standard environmental specifications, impact on the fish resources of this section are expected to be slight and of short duration.

Spawning sites marked in Figures 1M to 1P inclusive indicate the possible existence of suitable spawning habitat. Further studies must be done to confirm the utilization of these areas for spawning.

f) Socio-Economic

The section between Fort Nelson and Zama Lake is an area of virtually no settlement and little human activity beyond trapping and hunting. Impact of any kind along most of the route will be minimal.

The Zama Lake Indian Reserves and the Amber River Reserve on this route may experience disruption of archaeological sites if crossed by the right-of-way.

Traplines along this pipeline section may be significantly disrupted during the winter construction period.

4.0 MEASURES TO ENHANCE THE ENVIRONMENT OR TO AVOID OR MITIGATE ADVERSE ENVIRONMENTAL EFFECTS

Many of the impacts described in the preceding section can be minimized by the application of certain mitigative measures. The mitigative and/or control measures described here are only applicable to the impacts as described in this preliminary study. As further study determines more detailed impacts, these mitigative measures will require elaboration and possible change.

4.1 Topography and Physiography

Minor re-sculpturing may be required to reduce the visual impact of slight topographical changes, especially in high-use areas.

4.2 Bedrock Geology

No mitigative measures are necessary for construction through bedrock outcrops. However, further detailed study of the right-of-way could identify bedrock outcrops that should be avoided.

4.3 Soils and Surficial Geology

If the pipeline closely follows the Alaska Highway, construction will be carried out in a formerly disturbed area where soil development will be minimal. Along that part of the pipeline route where somewhat developed topsoils exist, it may be useful to stockpile topsoil in cases of infertile parent material. This stockpiling could also be warrented in the Fort Nelson area where agricultural land is crossed.

Erosion may be a problem on steep slopes that have fine grained soils. Drainage control structures may be required, and rapid revegetation by artificial means may be necessary. Erosion by wind should not be a significant problem.

Surficial deposits which may require stabilization procedures include aeolian, lacustrine, fine grained alluvial, and volcanic deposits. Till and coarse fluvial deposits are usually relatively stable.

Either temporary or permanent facilities such as mobile construction camps, airstrips, compressor stations, and landing pads should not be constructed on the more sensitive organic soils, but rather on gravelly substrates (where possible).

4.4 Permafrost

Where possible, areas of permafrost should be avoided. Where they cannot be avoided, the mitigating measures employed will depend on the nature of the surficial material, the depth and ice-content of the permafrost, and the slope of the terrain.

Wherever possible, ice-rich permafrost should be completely excavated and the trench backfilled with competent material so that subsequent thawing and settlement of the permafrost component of the backfill material will result in a level or mounded soil cover over the line. Where the permafrost is too extensive to be excavated, the pipe should be provided with concrete collars to give it a neutral buoyancy in the thawed material. Extra backfill material will be required in this case as well.

Where the backfilled trench is unstable as a result of the ground slope, further mitigating measures will have to be provided to prevent subsequent slumping and/or subsidence.

Consideration may have to be given to chilling the gas in some sections, notably between the Alaska border and Kluane Lake. To avoid erosional problems in very sensitive areas, berms, drainage blocks, revegetation and/or other measures may have to be applied. The array and specific locational application of measures to be used can be more specifically assessed only after detailed studies of the permafrost, soils, surficial geology, slopes, and pipeline routing have been carried out. In all cases involving construction in permafrost areas, activity should be minimized as much as possible, confined to as narrow a corridor as is feasible, and carried out in the winter.

4.5 Climate

Local effects of induced ice fog surrounding compressor stations can be reduced by locating the station at sufficient distance from the Alaska Highway and any nearby settlement or airstrip. The specific site should be chosen to avoid any cold air drainage pockets in protected locations which will naturally experience a greater frequency of ice fog.

These effects are not considered adverse to the climate, but may cause bad visibility for a few days a year. Bad visibility may be a safety hazard to persons travelling the Alaska Highway.

4.6 Air Quality

During summer construction, dust levels can be reduced by water spraying at high-use sites.

Little can be done to mitigate emissions from construction machinery but these emissions should be quickly dispersed. Any effects would be short-term requiring little or no mitigative procedures.

4.7 Noise

During the construction phase, construction in the area of settlements or campgrounds should be carried out at times when the effects will be least felt by the surrounding populations. Night construction should not occur in the vicinity of campsites or settlements.

Construction in certain areas should be timed to avoid critical periods in the life histories of birds and mammals. For example, raptor nesting areas should be avoided during the critical nesting period of April 15 to August 15. Under certain circumstances, noise from winter construction may place excessive stress on animal populations. However, further work must be done to determine if this will be a problem along the proposed pipeline route.

Compressor stations should be located to avoid areas of caribou winter range, grizzly range, and important waterfowl staging and resting areas.

4.8 Vegetation

Construction of the pipeline should be carried out during winter in areas of organic soils and muskeg. These areas, in which it is often difficult to operate heavy machinery, are also easily damaged in warmer weather. With the use of properly constructed winter roads, damage to muskeg areas can be minimized. Careful removal of the tree and shrub layer can leave the important moss and shrub layer, although compressed, largely intact. Trenching and laying the pipeline itself will require disruption of surface material; if possible, the organic surface layers should be stockpiled and respread following refilling of the trench. While this may only be feasible in areas where there are substantial amounts of organic matter, it will likely assist greatly in revegetating disturbed sites.

Disturbed areas should be fertilized and/or reseeded the following spring where erosion may be a problem, or where aesthetics is a prime concern. Further studies should investigate the feasibility of using native plants that are adapted to rigorous conditions. Regular maintenance checks should be made to identify problem areas where erosion is occurring.

4.9 Wildlife

Many of the impacts on wildlife populations will be unavoidable. Some impacts, however, can be minimized.

During summer construction activities, adequate fire protection measures must be taken along the route. Construction activities, especially in winter, must be timed to avoid areas (e.g. winter ranges) critical to the survival of large mammals. This is especially important in the case of an extremely hard winter when construction activity might place extra stress on ungulates. This extra stress could result in extensive mortality. Preconstruction studies must identify critical and/or sensitive areas and propose suitable construction timing so as to minimize impacts.

Construction camps and later, compressor stations, must provide for removal or incineration of solid wastes to prevent attraction of bears. Construction activities in known grizzly bear areas should be timed to include the hibernating period (December to April). Not only will this help minimize disturbance to grizzly bear populations but it will prevent confrontations between construction personnel and grizzly bears.

During the operation and maintenance phase as well as during the construction phase, minimal altitudes must be established over sensitive areas for surveillance and supply aircraft. This should minimize disturbance of sensitive animal and bird populations.

4.10 Hydrology

Natural drainage lines tributary to the larger streams should be maintained whereever feasible. This will minimize effects from minor diversions of flow caused by construction activity, and by erosion and runoff control structures. Testing the pipeline with air rather than water will mitigate entirely any adverse environmental impacts that could result from a hydrostatic testing procedure.

4.11 Water Quality

Certain activities are required in order to minimize the impact of the pipeline project on water quality in watercourses affected by the pipeline.

Before construction begins, unstable sections such as alluvial fans and erosional reaches of streams should be identified and plans made to avoid these areas, whenever possible. Construction should take place during low flow periods. When crossing watercourses high moisture zones should be drained where feasible, and activity within the actual steam should be minimized.

Following construction, erosion and runoff control structures should be placed along the right-of-way as required. Where necessary, streambank stabilization structures should be incorporated, for example, riprapping. Revegetation of streambanks will be required, whether by artificial or natural means. Channel form and gradient should be re-established.

4.12 Fisheries

Methods used by contractors constructing the pipeline should be governed by a standard construction procedures contract similar to that used by Westcoast Transmission Company Limtied (see Appendix II of Volume III), especially with regard to the stabilization of stream banks and to the removal of construction debris from watercourses at the completion of the construction phase. It is recommended that construction personnel be given an environmental awareness training program to ensure compliance with the above guidelines.

The time of construction with least impact should be determined for different sections of the pipeline. Seasonal impact will be determined by the presence of fall and spring spawning species.

Special mitigative measures may have to be employed at specific locations when construction interferes with established recreational, domestic, or commercial fishing, or at locations of special fish sensitivity. These may include: extraordinary construction practices to minimize silt disturbance in crossing rivers, manual cleanup of small stream crossings, or other specific actions identified during the detailed environmental assessment program.

Effective procedures to deal with accidental oil spills, chemical spills, and so forth, should be determined and tested before the beginning of construction, and a capability to deal with such impacts should be maintained throughout the construction phase. Procedures to deal with gas leaks during the operational phase, as they relate to watercourses, should be developed. Air rather than hydrostatic testing should be considered.

Provision should be made for cooperation with governmental fisheries agencies for use of construction company personnel and equipment to undertake fish habitat improvement at locations identified during the course of detailed studies. Possible projects include improvement of fish access to additional spawning areas by the removal of existing obstacles or improvement of spawning habitat by limited rechanneling of watercourses. These projects may partially compensate for any losses incurred due to the pipeline project, as well as aiding in public relations.

To reduce the impact of unforeseen environmental problems arising during construction in unfamiliar terrain, it is recommended that on-site construction monitoring be conducted to determine the adequacy and validity of existing construction procedures and recommendations.

4.1.3 Hazards

While the southwestern Yukon is an area of high seismic risk relative to other areas, the likelihood of a pipeline rupture resulting from an earthquake or ensuing landslide is quite small. The impact of such a rupture would also be relatively minor, provided that it occured away from townsites which are rare along this route. Consequently, there is little need to consider the earthquake hazard in designing the pipeline installation.

River crossings must be carefully planned and pipeline routes chosen in careful consideration of past experiences with washouts to avoid those areas of greatest hazard. River crossing hazards, such as scouring, pipe buoyancy, meandering, and bank erosion should be mitigated by good engineering practice, such as burying the pipe below the maximum scour depth for the full floodplain width, providing weighting collars where required, and using heavier gauge pipe for the crossing.

Man-induced hazards will similarly be mitigated by careful installation of the pipeline and by clearly marking the pipe route and fencing off above-ground facilities to prevent damage by third parties.

4.14 Socio-Economic Environment

The recommendations in this section follow the Impact Statements in Chapter 3.0. It will be noted that they deal with components and aspects of the regional socio-economy, rather than with major descriptive catagories since mitigative measures are more readily dealt with in this fashion.

4.14.1 Employment Expectations

As soon as feasible, following the decision to proceed with the proposed pipeline, (assuming such a decision is reached), the prime company should enter into discussions with the appropriate Canada Manpower offices to establish the anticipated labor demand to be made at the local level.

Simultaneously, information should be made public through the media and local unions, and should be designed to make clear the scale of the proposed construction and the degree of its need for local labor.

4.14.2 Economic Impact on Local Communities

No deleterious impacts on a major scale are anticipated. The benefits of the proposed project could be made more demonstrable by a policy of encouraging local business response to the demands of the pipeline project.

Wherever possible within the corridor, a policy of using existing local accommodation in place of or in association with camp accommodation, would increase the local benefit distributed by the proposed project.

Similarly, reliance on local wholesale distributors of foodstuffs, etc., would constitute a practical benefit to the local economy. Further study would be required to establish the practical economies of these proposals.

The location of camps should be decided in terms of criteria designed to reduce the work force impact on small communities.

Cleanup and reclamation programs should be implemented as soon as the campsite is vacated.

Where maintenance personnel are to be stationed at the compressor stations, local people should be retained and trained to fill this need, if possible.

4.14.3 Social Environment

The most promising policy to alleviate the potential conflict between residents of smaller communities and the proposed construction work force would be one which limited the worker access to local communities.

It is not realistic to suppose all contact could be interdicted, but a program of in-camp recreation and assisted travel to major centers for rest and recreation could reduce the level of worker demand for local services.

Opposition to such a policy could be anticipated from local businesses in the communities. However, any such policy could not be 100 percent successful in directing personal service demands away from the local community. The amount of circumvention of the "camp's main center" policy would probably be sufficient to confer economic benefits on local business to a scale sufficient to weaken any opposition to the policy.

4.14.4 Highway Traffic

Road closures should be kept to a minimum and scheduled where feasible to take place at night or during low traffic periods. Information regarding road closures or restricted (e.g. one way) access should be made public along the length of the highway in the form of roadside signs and, if necessary, information attendants.

Construction should include measures to maintain surface conditions to regular highway standards. Oiling and/or watering should receive special attention to reduce dust. Fill should be immediately available to correct any wet surface damage that occurs as a result of construction traffic.

4.14.5 Recreational Land Use

As noted elsewhere, the impact of the proposed pipeline right-of-way on existing land use is not anticipated to be of major significance. However, in some local areas, notably in the Whitehorse region, the proposed right-of-way traverses areas used intensively by local citizens as well as by tourists.

In order to reduce and ameliorate any impact, the company should enter into discussions with local officials, tourist and business associations, and with local recreational and outdoor clubs, to discuss and decide upon measures to minimize the impact of the proposed construction.

This recommendation is of general import but is of particular relevance in the corridor between Beaver Creek and Jake's Corner (see Figure 1B-1F), and principally involves the citizens of the Whitehorse region who make intensive use of the rivers and lakes in this section of the corridor.

In essence, this recommendation implies that the prospective pipeline company establishes a liaison at the municipal level to conduct all community relations discussions.

4.14.6 New Access Routes

The prospective construction firm should enter into discussions with land use authorities, including fish and wildlife personnel and local Indian band councils, with a view to formulating a policy that would reduce impact caused by increased access.

During the construction period, public access will have to be limited to minimize problems relating to vandalism, firearm use, animal harassment, and fire protection. However, it is virtually impossible to prevent public access once the pipeline enters the operational phase. In locations where an influx of hunters, fishermen, or other recreational land users could be detrimental to the survival of animal populations or to scenic areas such as the Liard River Canyon, consideration should be given to protection under reserve or park status. Regardless of protective measures taken, additional enforcement personnel such as game wardens will be required in the areas where the pipeline project has increased access to the back country.

Between Liard Hotsprings and Zama Lake (Figures 1K - 1P) the proposed pipeline corridor departs from existing transportation corridors and creates a new line of clearing and access.

In the case of the Liard to Fort Nelson segment, it is possible that current plans to realign the Alaska Highway might be efficiently coordinated with the selection of the proposed pipeline route, thus creating a single access corridor capable of carrying all proposed communications and utilities.

Such a combined decision would considerably reduce the impact of the proposed pipeline. It would afford a cost sharing operation of mutual benefit to the highway authorities and the prospective pipeline company.

In the Fort Nelson to Zama Lake section, similar opportunities for joint activity might be investigated.

It is therefore recommended that the prospective company contact the appropriate authorities (the Department of Highways of British Columbia and the Yukon, or some higher ministerial level) and investigate the potentials noted above.

4.14.7 Aesthetic Considerations

The guidance of a landscape architect should be sought when deciding upon the proposed final route alignment among present options and the exact locations for compressor stations. Planning for landscape enhancement around right-of-way easements, work depots, access junctions with the highway and other areas is recommended to reduce the visual impact of construction and the remaining right-of-way. This is particularly critical near population centers such as Whitehorse, Watson Lake and Fort Nelson, as well as in the vicinity of the Liard River Hotspings Provincial Park and other campsites. Wherever possible, screening of impacted views should be adopted to reduce the visual impact of extensive sections of pipeline along the shared transport corridor. Following construction, clearing around ancillary structures should be revegetated as soon as the local physical environment allows.

Compressor stations, within the limits of technical requirements, should be located so as to minimize their presence on the landscape. Vegetation screening should be adopted to reduce the impact on the visual environment.

4.14.8 Archaeological - Historical Sites

Close liaison must be maintained with the relevant governments regarding archaeological resources.

Where proposed construction is to pass through or close to known sites, it is recommended that provision be made to have a designated expert in the area to review the site prior to construction and direct construction operations. Archaeological reconnaissance should be made prior to construction in selected areas, especially those with a history of native use. In some cases, it must be accepted that a site of supreme importance may be discovered, requiring a detour of the proposed line or some special procedure to protect the site.

In segments of the proposed route where the archaeological - historical potential is lower, some effort should be made to instruct leading field crews in the elementary recognition of prospective sites. Any discoveries they make should not be disturbed until experts' opinion has been obtained.

4.14.9 Native Communities

Negative social and economic impacts in the vicinity of Indian communities and the five Indian reserves may require compensation. Social disruption of native communities can be minimized with direct supervision by construction management over their personnel.

Care should be taken that Indian fishing, hunting and trapping patterns are not irreparably disturbed. Compensation may be required for disrupted operations of domestic and commercial fisheries and traplines. Band leaders should be consulted in cases where any conflict with Indian subsistence activities is expected.

Where the pipeline is to cross Indian Land, legal issues may be involved. Discussions with band leaders and Federal and Provincial Government authorities must occur.

5.0 UNAVOIDABLE ADVERSE EFFECTS OF PROJECT IMPLEMENTATION

The following discussion is of adverse effects resulting from the construction and operation of the pipeline, despite the undertaking of mitigating measures.

5.1 Topography and Physiography

Borrow pits must be dug at intervals along the pipeline route to supply gravel and crushed rock for construction activities. These will be abandoned as construction proceeds. The mound covering the pipeline will be bermed but should tend to become flatter with time. Both these effects are unavoidable but are of a minor nature, especially if some re-sculpturing is undertaken.

It is unlikely that mitigating measures will be able to eliminate all of the effects of permafrost degradation, and some subsidence of surficial material and development of thermokarst can be expected.

5.2 Bedrock Geology

No unavoidable adverse effects are anticipated on bedrock geology throughout the pipeline route.

5.3 Soils and Surficial Geology

No unavoidable impacts on soils are expected if the top-soil, where thickness merits it, is saved and returned to the disturbed surface after construction.
Agricultural areas crossed in construction may suffer a small decrease or loss in production during the construction year, but should be quickly returned to full use by good

farming practices. No other adverse impacts should occur to soils and other surficial deposits if mitigative measures such as adequate drainage control on slopes and planned revegetation of sensitive areas are instituted.

5.4 Permafrost

The mitigating measures available for avoiding significant impacts to permafrost by pipeline construction should be at least partially adequate, but minor impacts such as thermokarst development will be unavoidable in some areas. Experience with warm gas pipelines buried in permafrost is limited at this time, and adverse effects may develop for which there are no ready solutions. In such cases, impacts will undoubtedly be mitigated but not avoided, and to some extent the impacts discussed in Chapter 3.0 will occur.

5.5 Climate

No unavoidable adverse effects are expected on the regional or local climate. Effects on the human environment caused by increased occurrence of ice fog can be avoided as discussed in Chapter 4.5.

5.6 Air Quality

No unavoidable adverse impacts are likely to occur.

5.7 Noise

Noise will be unavoidable wherever construction activities are carried out and in the vicinity of the compressor stations during pipeline operation. These may be minimized by adequate considerations of timing and location. There may be some unavoidable impacts upon wildlife and human activity, for example, tourism.

5.8 Vegetation

Losses to vegetation due to pipeline construction will be negligible in terms of the total plant community resource. On the pipeline right-of-way, the destruction of all vegetation along the ditch line, spoil pile and access roads will be corrected by natural or induced revegetation. The clearing of trees will be a loss to forest productivity, as long as the pipeline is in operation and regeneration is impeded. Losses of vegetation will also occur on land occupied by permanent roads, compressor stations, stock yards, borrow pits,and other facilities. Unavoidable impacts on vegetation will be caused by the summer movement of heavy equipment over sensitive areas to meet emergency situations such as pipeline ruptures and fires.

When the pipeline is finally abandoned, natural vegetation cover will eventually be reestablished, though in some areas this may take many years.

5.9 Wildlife

Increased visual and auditory stress during the construction phase of the pipeline, and to a limited extent during the operational and maintenance phase, may cause some unavoidable displacement of wildlife from the vicinity of the pipeline. This displacement will be particularly felt if construction activities occur in areas of winter range, waterfowl staging, or raptor nesting during the sensitive periods when they are occupied.

Wildlife populations will be affected by increased hunting pressure as a result of the improved accessibility generated by pipeline construction in areas away from the present highway. This effect will be minimal except where the pipeline is not adjacent to the existing highway.

Attrition of grizzly bear populations will be unavoidable through shooting for reasons of imagined or real threats to human safety.

5.10 Hydrology

With proper mitigating measures, such as the avoidance of hydrostatic testing, no adverse impacts on hydrological systems along the route are anticipated.

5.11 Water Quality

The natural quality of water in streams or lakes will be impaired wherever construction activities such as river crossings, road culverts, and vegetation removal give rise to the erosion of particulate matter. This silt can reduce fish habitat, smother incubating eggs and invertebrates, and reduce light penetration with a consequent decrease in aquatic photosynthesis. Mitigative measures may, through timing and techniques of construction, reduce those effects.

The contamination of streams and lakes by the deliberate or accidental discharge of toxic chemicals, fuel oils, or other materials will be a continuing threat to water quality throughout the construction phase of the project, and to a limited extent during the operational phase.

5.12 Fisheries

Suspended sediments will be unavoidably increased in watercourses crossed by the pipeline during construction. The effect of this sediment will be felt most by gravel-spawning species of fish whose eggs and young may be smothered as the sediment settles and reduces water flow through the gravel interstices. Fish food organisms are similarly sensitive to an increase in suspended sediments. The degree of impact on the fisheries resource will largely depend on how well construction can be timed to avoid sensitive periods of the year and on the construction methods used.

In certain areas, greater access may increase fishing pressure in some watercourses to the point where fish stocks become depleted. With current low levels of enforcement of fishing regulations in the northern areas, this impact may be unavoidable.

5.13 Hazards

Should the pipeline be tested hydrostatically, there may be serious unavoidable impacts on aquatic life. There will be a winter draw down of water from rivers and lakes, and a final dumping of the water which is either hot or treated with anti-freeze. There will also be an acceleration of permafrost degradation if hot water is used. These impacts can be avoided if air testing is used.

While the probability of a pipeline rupture occuring due to seismic activity is small, the hazard and ensuing effects are unavoidable. In most cases a rupture will be followed by a fire which will burn vegetation within a small radius of the pipe.

Pipeline leaks will be an intermittent hazard during the operation of the pipeline which will have minor unavoidable environmental impacts as discussed previously. These may be reduced by incorporating a series of block-valves at 20-mile intervals in the line.

5.14 Economic Conditions

No matter what measures are adopted to channel the economic demands of the proposed project into centers and sections able to absorb them, some spill-off into smaller communities is perhaps inevitable.

Competition for local resources in the form of goods and services is likely to effect the smaller communities adversely. Some local governmental costs such as police costs and highway maintenance activity could be raised by the temporary presence of work crews.

Some costs could be incurred by over-responses on the part of local entrepreneurs to the proposed construction, if the scale of the economic opportunity is misjudged.

5.15 Social Conditions

Adverse impacts on family and community life in some smaller centers could result if major demands for rest and recreation were placed upon them by work crews.

The passage of the proposed construction crews could be a disturbing addition to the experience of people in the smaller communities, even if contact were made only for a brief period of time.

5.16 Land Use

Should the proposed project go ahead, the land occupied by borrow pits and quarries and by roads that served only the project, and the land occupied by compressor stations, communications sites, material marshalling areas, and the like, will be committed during the construction phase of the project. After construction has been completed much of the right-of-way and all temporary facilities, including borrow pits not needed for maintenance, will be available for non-pipeline-related uses. Right-of-way cleared through forested areas will not be available for timber production for the life of the project. None of the right-of-way will be available for surface mining: deep mining will not be affected.

Residential, commercial, and industrial land uses exist on or adjacent to the pipeline. This existing land use on adjacent areas will not change, but will be precluded on the right-of-way itself. In addition, land along the pipeline that is presently unclassified will be precluded from industrial or high density residential zoning for the life of the project.

5.17 Archaeological and Historic Sites

Although procedures and programs exist to protect archaeological and historic sites, which will be followed by the proposed pipeline program, some degree of impact is virtually inevitable.

Given the many areas of potential sites, and the impossibility of identifying and evaluating every sign of history unearthed or discovered, some damage will occur. Additionally, improved access would probably raise the possibility of amateur or chance discoveries that could lead to the loss of artifacts.

Even when programs of preservation successfully rescue a site from impact, aesthetic damage to the nearby landscape (clear-cut right-of-way through forested areas, cut and fill operations, compressor stations, and other ancillary facilities) could detract from visitors' enjoyment and appreciation of such places.

5.18 Aesthetic and Recreational Values

The main adverse impact will be in the form of scars upon the landscape, resulting from right-of-way and site clearing, and associated road building.

Revegetation will be encouraged, but signs of the disturbance will be present for decades, and the compressor stations and support facilities will be present for the length of the life of the proposed pipeline.

Improved access afforded by the proposed right-of-way may lead to excessive harvesting of wildlife and will certainly reduce the wilderness value of the proposed pipeline corridor.

6.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITIES

For the purpose of this statement, "short-term" is generally taken to mean the period during the construction and operation of the proposed pipeline system. "Long-term" is generally taken to mean that period of time beyond the lifetime of the pipeline system.

In general, the proposed section of the Alaska Pipeline between Beaver Creek and Zama Lake will not have a major effect on the short-term use nor the long-term productivity of the local environment. Since the proposed route largely follows an established transportation corridor, changes in use-patterns will be minimal. Also, the possibility that the construction program will initiate a course of action which will be detrimental to future generations is considered to be remote.

The implementation of the Alcan project could reduce the demand in the U.S.A. for Canadian natural gas and thus prolong the life of Canadian gas reserves for Canadian use. There could also be a consequent reduction in the pressure to develop Canada's Arctic gas potential which would allow more time for the settlement of native land claims and for the evaluation of northern development proposals. The project will also give additional economic stability to the existing Westcoast Transmission system.

The 912 miles of pipeline that are being proposed in this section cross a variety of environments which are presently serving a variety of human uses. These uses which have previously been described in detail may be slightly modified because of the construction program. Such modifications, although minor, will probably be on both a short-term and long-term basis. A summary of the present utilization of the land and considerations of future consequences is presented below.

6.1 Beaver Creek to Kluane

The present land use practices in this section of the proposed pipeline are dominated by the Alaska Highway and its supported communities (Beaver Creek, Burwash Landing, and Destruction Bay). The uses are primarily associated with recreation and tourism, and include wildlife habitat, hunting, fishing, canoeing, and hiking. Kluane National Park is paralleled for a short distance, and historical and archaeological sites are common. This portion of the pipeline passes through a region considered to have the greatest potential for recreation and tourism development.

In the short-term, this portion of the pipeline could have major impacts on the visual quality (and thus, recreational appeal) of the area. However, with proper control and planning (especially as related to permafrost) such effects can be limited. In addition, the proposed routing does follow the abandoned Haines/Fairbanks Pipeline right-of-way for several miles, a fact which might reduce impacts.

In the long-term, productivity of the area should increase with revegetation of the cleared right-of-way. Visual impacts should be reduced or eliminated in time, and the wilderness appeal should improve. Permafrost-related problems, however, could initiate major disruptions of the terrain which could significantly detract from the visual quality of the region. Caution and control are required to minimize long- and short-term impacts in this section.

6.2 Kluane to Whitehorse

As in the previous section, land use values are dominated here by the Alaska Highway and the two permanent settlements, Watson Lake and Haines Junction. They relate to tourism and recreation, and the resource industries centered in Whitehorse.

In the short-term, the pipeline will impact wilderness values in the region, but these can be minimized with proper planning.

In the long-term, revegetation of the right-of-way should restore the visual quality of the region.

6.3 Whitehorse to Watson Lake

The principal land uses practices in the Whitehorse to Watson Lake section is again closely associated with highway; tourism and recreation are the predominant uses, although trapping and domestic fisheries are also prevalent. Archaeological and historical sites are common.

In the short-term, a reduction in visual quality could impair the recreational use of the land, although this is avoidable through adequate planning. The new right-of-way could also improve access into the area for trappers and fishermen. With proper conservation and management of these newly opened areas, no significant short-term effects on land use are anticipated.

Long-term effects on the productivity of the region again should be minimal. Following revegetation of the right-of-way, land use patterns will fall into those determined as appropriate by local or regional planning. It is not expected that short-term use as a pipeline route will impair these future uses.

6.4 Watson Lake to Liard Hotsprings

As with the previous sections, land use patterns between Watson Lake and the Liard Hotsprings are dependant upon the Alaska Highway. These uses are primarily associated with recreation and tourism, although trapping and domestic fishing are also common. Large parts of the land are wildlife habitat and some potential forest reserves.

In the short-term, the location of the pipeline away from the Alaska Highway will provide easier access into previously isolated areas. It is anticipated that local trappers will use the right-of-way to expand their trapping network. Visual impacts from the project may be important in terms of the recreational use of the region, but planning can minimize these.

Long-term productivity of the region should not be significantly allayed by the project provided that adequate conservation and mitigation measures are applied.

6.5 Liard Hotsprings to Fort Nelson

Utilization of the land between Liard Hotsprings and Fort Nelson along the pipeline route is presently limited because of poor access. Because this section is, in general, removed from the Alaska Highway, trapping is probably the major human use.

With the construction of the pipeline, a significant area of land that is presently isolated will be opened up. Of special significance is the Grand Canyon of the Liard, an area of high scenic quality. This area contains features of significant visual appeal, as depicted by names such as Rapids of the Drowned, Boiler Canyon, Hells Gate Rapids, and Hells Gate. This area could become a major tourist attraction, and warrants careful consideration during construction of the pipeline. Visual appeal must be maintained.

Access into the region traversed by the pipeline may be provided by a relocation of the highway, proposed by the Department of Public Works of Canada. Close Liaison between the responsible pipeline company and Public Works is recommended to avoid complications in routing and/or the compounding of impacts.

In the long-term, it is possible that the recreational resources of the Liard River could continue to be used, with or without the relocation of the Alaska Highway. Consideration should be given to constructing a permanent, tourist-oriented road into the compressor station near Hell Gate. This could significantly increase the recreational potential on this section of the pipeline.

6.6 Fort Nelson to Zama Lake

Land use practices in this section are presently limited to trapping, and to natural gas exploration and development. Access via all-weather roads is non-existent, and the potential for the development of alternate land uses is very restricted.

In both the short-term and long-term, no significant change in use patterns is anticipated as a result of the project.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Considerations on the irreversible and irretrievable commitments of resources must take into account the fact that the proposed Beaver Creek-Zama Lake line follows, for the most part, an established transportation corridor. In addition, it must be remembered that where the route deviates from the Alaska Highway east of Fort Nelson the terrain has already been extensively impacted by a myriad of seismic lines. Furthermore, where in northern British Columbia a large section of the pipeline deviates from the current highway, it follows close to a proposed new route for the highway. Commitments have, in general, already been made, with the obvious exceptions of the natural gas that must be committed, and the materials that must be used for construction. This is an important consideration when assessing irreversible and irretrievable commitments.

7.1 Land Features and Uses

There will probably be little permanent change in the type of land use patterns that relate to the bio-physical resources of the region. In the short-term, as was discussed in the previous chapter, modifications in utilization patterns could occur. However, in the long-term following abandonment of the pipeline system, the environment should revert to the status quo, and use patterns will probably reflect this.

It is conceivable that during the construction and operation of the pipeline, human utilization of the natural environment may increase with improved access in those areas where the pipeline does not follow the existing highway corridor.

It is also conceivable that this increased utilization will generate public expectation of continued access to presently remote regions. If this should take place, more permanent access may be demanded, giving rise to a shift in land use patterns in the region. In total perspective, however, considering the small extent of these areas, this will probably be of minor significance.

There will inevitably be some permanent changes in land features; pipeline construction necessitates a certain degree of terrain modification, but the area exposed to cutting and filling, and the area required for borrow materials is usually small. This also applies to road and station requirements.

Re-sculpturing and revegetation of visual scars should be undertaken, especially in areas of high scenic potential, where erosion control is important in maintaining surface stability, or where the natural reestablishment of surface cover is slow.

7.2 Endangered Species and Ecosystems

In regions traversed by the proposed Beaver Creek-Zama Lake Pipeline, there appear to be no endangered species or ecosystems that would be threatened by pressures from the pipeline itself. Indeed, given careful planning of timing and construction techniques, impacts on ecological resources will be small.

There will be minor alterations to existing ecosystems as a result of the construction program. However, these changes will be small in a regional perspective. Localized areas along the route which might be of importance to rare or endangered species have been discussed earlier in the text, and mitigative measures proposed.

7.3 Socio-economic Considerations

The existing levels of economic activity in the Yukon and northeastern British Columbia are rooted in resource-based and related industries, and government infrastructures and services. This combination has historically followed a pattern of growth-stagnation cycles, and in all but the peak growth phases, economic resources have offered a surplus of factors for employment.

During the construction of the proposed pipeline, it is unlikely that a major demand for labor, goods, or services will be generated within the context of regional economics. There will be some service and supply requirements, but with adequate mitigation as described in Chapters 3 and 4, should pose no major problem. With the transitory nature of the construction program, it is unlikely that they will be of lasting or major effect.

It is anticipated that construction of the proposed project will not require the creation of a special infrastructure, nor will it be of sufficient scale to employ available surplus. However, it is conceivable that the availability of a "cheap" source of energy in the Yukon Territory could stimulate further development in the region. This warrants a detailed evaluation.

Concerning irreversible and irretrievable commitments of archaeological or historical sites, the proposed route is presently located near several known sites. It is possible that further sites will be discovered during the program. However, every effort will be made to protect heritage resources. If a site is extremely valuable, it should be avoided; if less valuable, artifacts will be salvaged. A detailed heritage assessment should be undertaken before the commencement of construction.

There will be a limited commitment of scenic values as a result of this project. However, with proper reclamation and mitigation procedures, the long-term impact can be minimized or eliminated; in the short-term, adequate planning can prevent a diminution in the tourism values of scenic resources.

7.4 Resources Lost or Uses Preempted

The Beaver Creek-Zama Lake line will not significantly curtail the range of beneficial uses of the environment traversed by the route. With proper planning and control, uses may even be enhanced as discussed in Chapter 3.0.

It is also possible that by supplying natural gas to the Yukon Territory, potential hydro-electric developments on some of the major rivers may not be required. This may be a major benefit of the pipeline, and warrants a detailed appraisal.

It is considered unlikely that the resources used to construct the proposed pipeline will contaminate other associated resources or foreclose their usage. There may be conflicts for materials if the Alaska Highway is rebuilt at the same time the pipeline is being constructed, but such conflicts should be resolvable by communication and joint planning between the parties involved.

7.5 Finite Resources

The non-renewable resources that would be committed as a result of the proposed action include the natural gas to be transported, and all of the materials required for construction.

Construction materials required include all components of the pipeline system, plus the resources required to build it (i.e. fuel and lubricants, replacement parts, welding supplies, cement, lumber, etc.). Estimates on the amounts required were not available at this point. Of these materials, everything but the above-ground components of the pipeline system would be irreversibly and irretrievably committed.

MAPS

OF

POTENTIAL IMPACT

(Figures 1A to 1P)

POTENTIAL IMPACT

L E G E N D

PROPOSED ROUTE OF PIPELINE

GENERAL PROPOSED ROUTE OF PIPELINE

EXISTING ALASKA HIGHWAY

PROPOSED RE-ALIGNMENT OF ALASKA HIGHWAY

FISHERY RESOURCES

MIGRATION ROUTE (M)

EXISTING OR POTENTIAL SPAWNING AREA (S)

RECREATIONAL FISHERY (R)

DOMESTIC FISHERY (D)

COMMERCIAL FISHERY (C)

SPORT FISHING CAMP

WILDLIFE RESOURCES

GRIZZLY RANGE OR DENNING AREA

THINHORN SHEEP RANGE

CARIBOU RANGE

WATERFOWL

MIGRATORY MOVEMENTS

MISCELLANEOUS

INTERNATIONAL BIOLOGICAL PROGRAM ECOLOGICAL RESERVE (IBP 67)

NATIONAL PARK

ARCHAEOLOGICAL SITE A

HISTORICAL SITE H

RECREATION ZONE

DEVELOPMENT CONTROL ZONE

COMPRESSOR STATION

PROCESSING PLANT

SETTLEMENT

MINE M

OVERALL RELATIVE SENSITIVITY

LOW MEDIUM HIGH

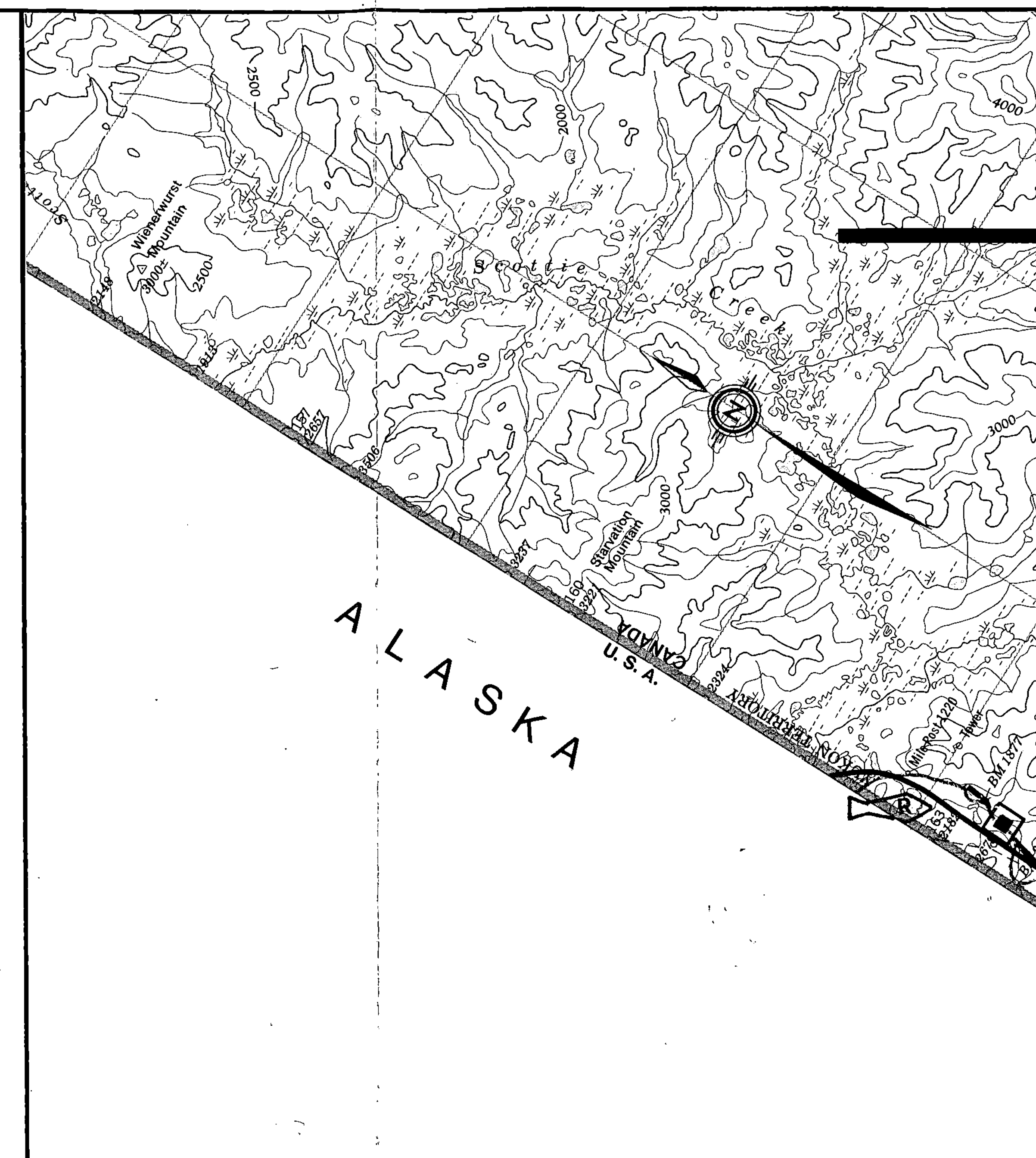


FIGURE **1A**

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

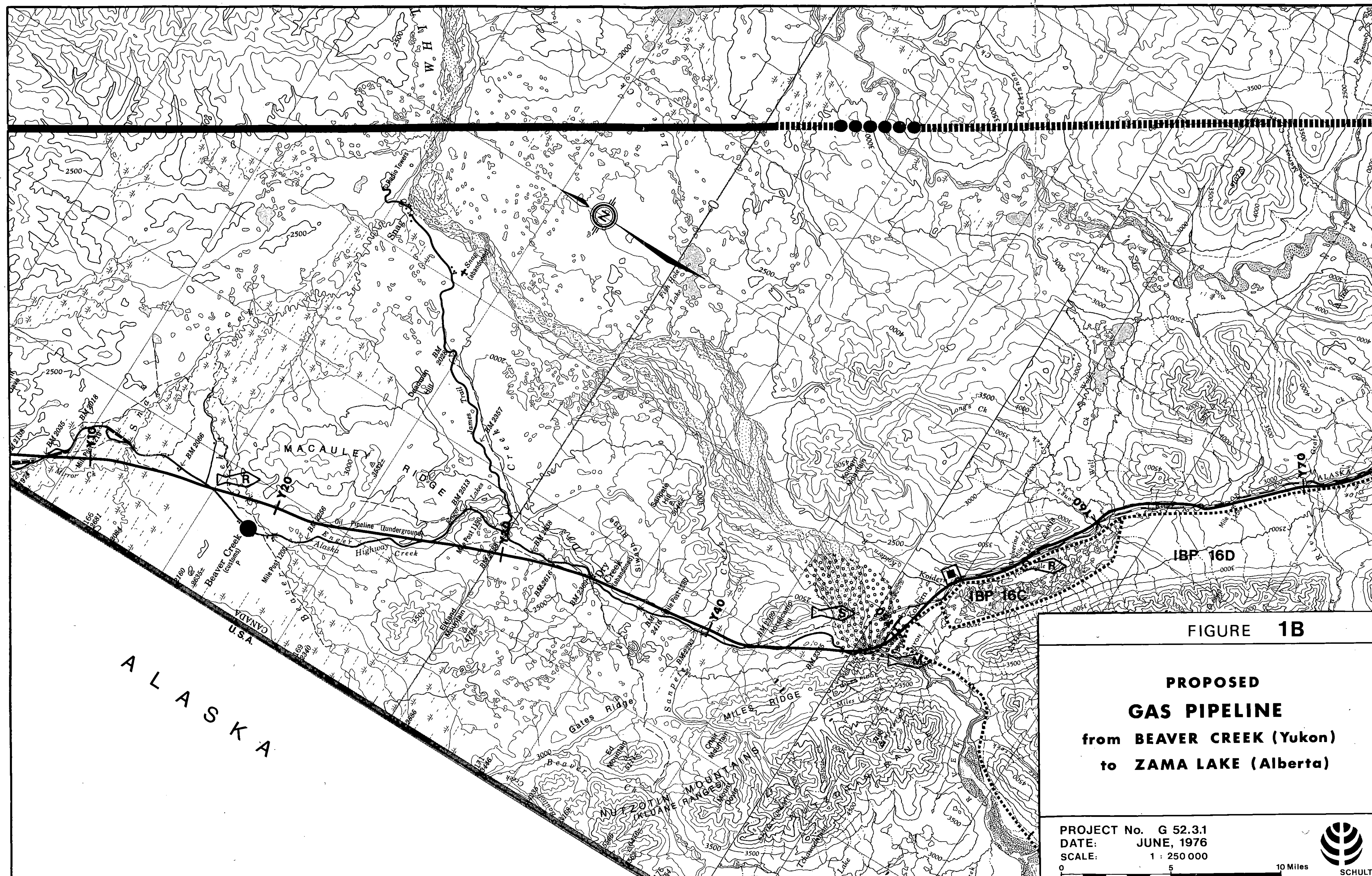


FIGURE 1B
PROPOSED
GAS PIPELINE
from BEAVER CREEK (Yukon)
to ZAMA LAKE (Alberta)
PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000
0 5 10 Miles
SCHULTZ
ALASKA
CANADA
U.S.A.
Beaver Creek (customs)
MACAULEY RIDGE
Alaska Highway
Oil Pipeline (underground)
IBP 16C
IBP 16D
MILES RIDGE
Gates Ridge
NUTZOTIN MOUNTAINS (KLUANE RANGES)
Fish Hole Lake
Snag
Dry Creek (abandoned)
Koidern
Y20
Y40
Y60
Y70

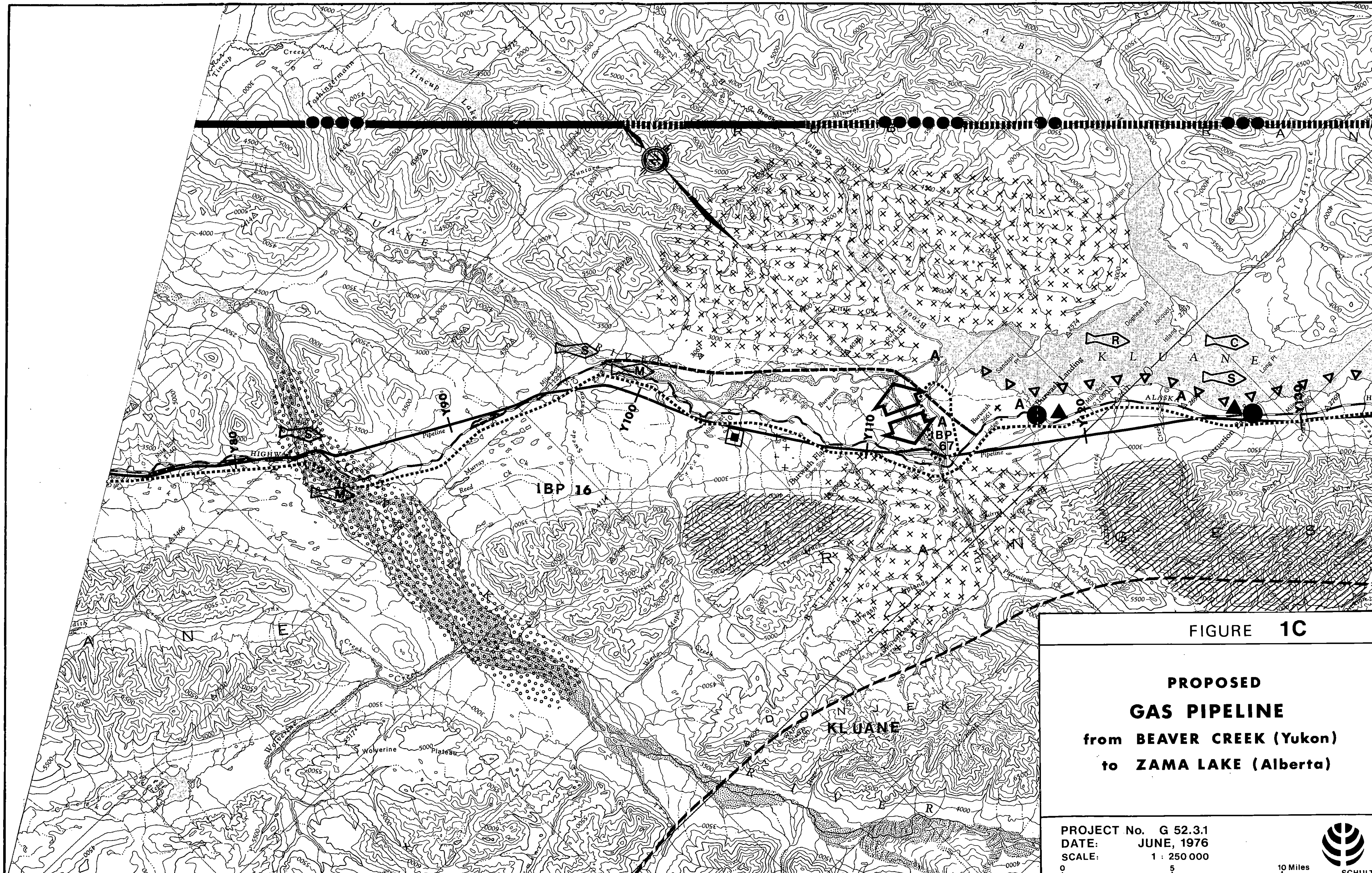


FIGURE 1C

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1

DATE: JUNE, 1976

SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

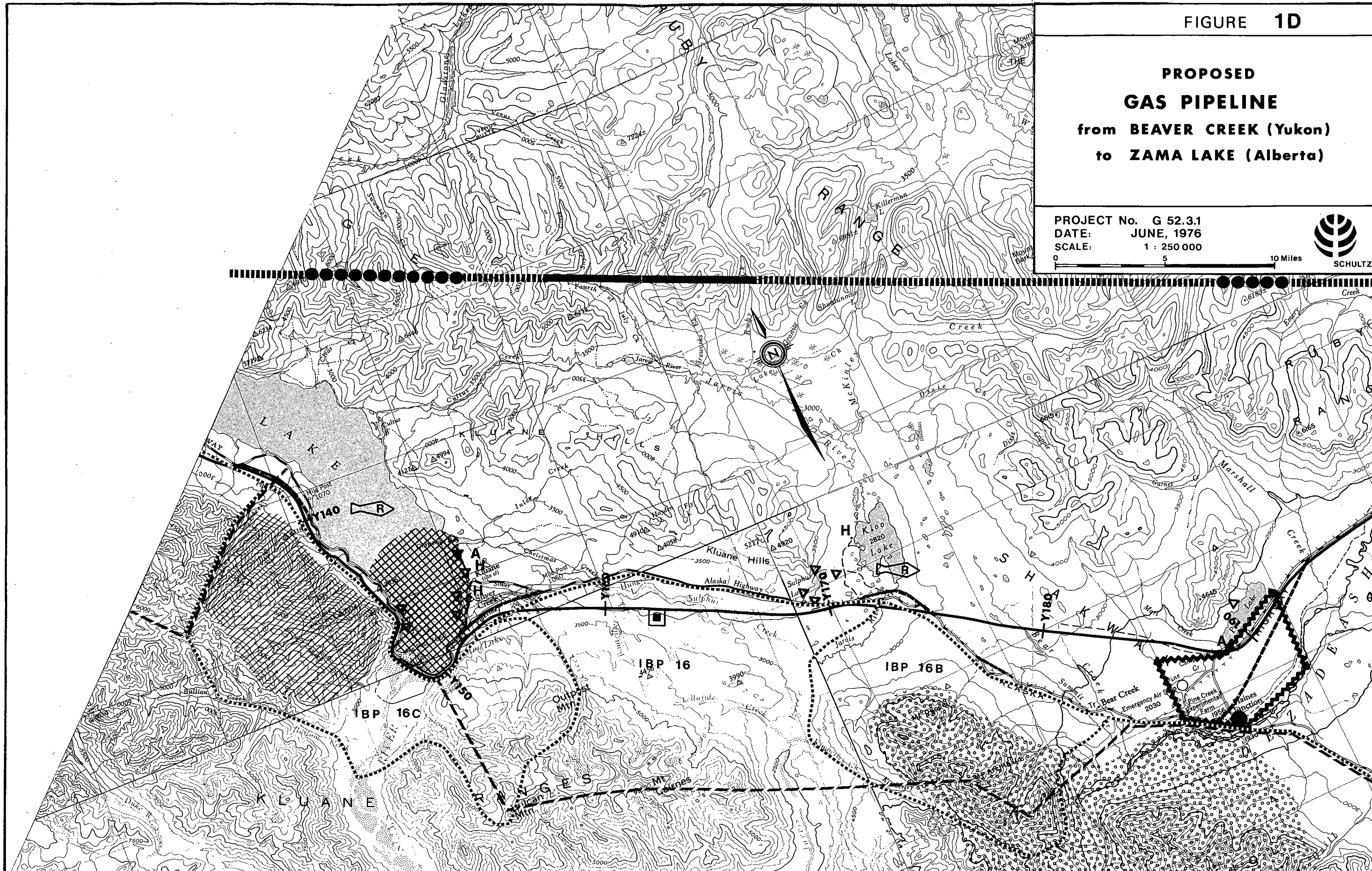


FIGURE 1D
PROPOSED
GAS PIPELINE
from BEAVER CREEK (Yukon)
to ZAMA LAKE (Alberta)
PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000
0 5 10 Miles
SCHULTZ
RUBY RANGE
KLUANE HILLS
LAKE
KLUANE RANGES
SHAKWAK
Kluane Hills
Alaska Highway
Kloo Lake
IBP 16
IBP 16B
IBP 16C
Y140
Y180
Outpost Mtn
Bear Creek
Emergency Air Strip 2030
Pine Creek Experimental Farm
Haines Junction
Marshall
Dezadeash
Jarvis River
McKinley
Mile Post 1070
Mile Post 1060

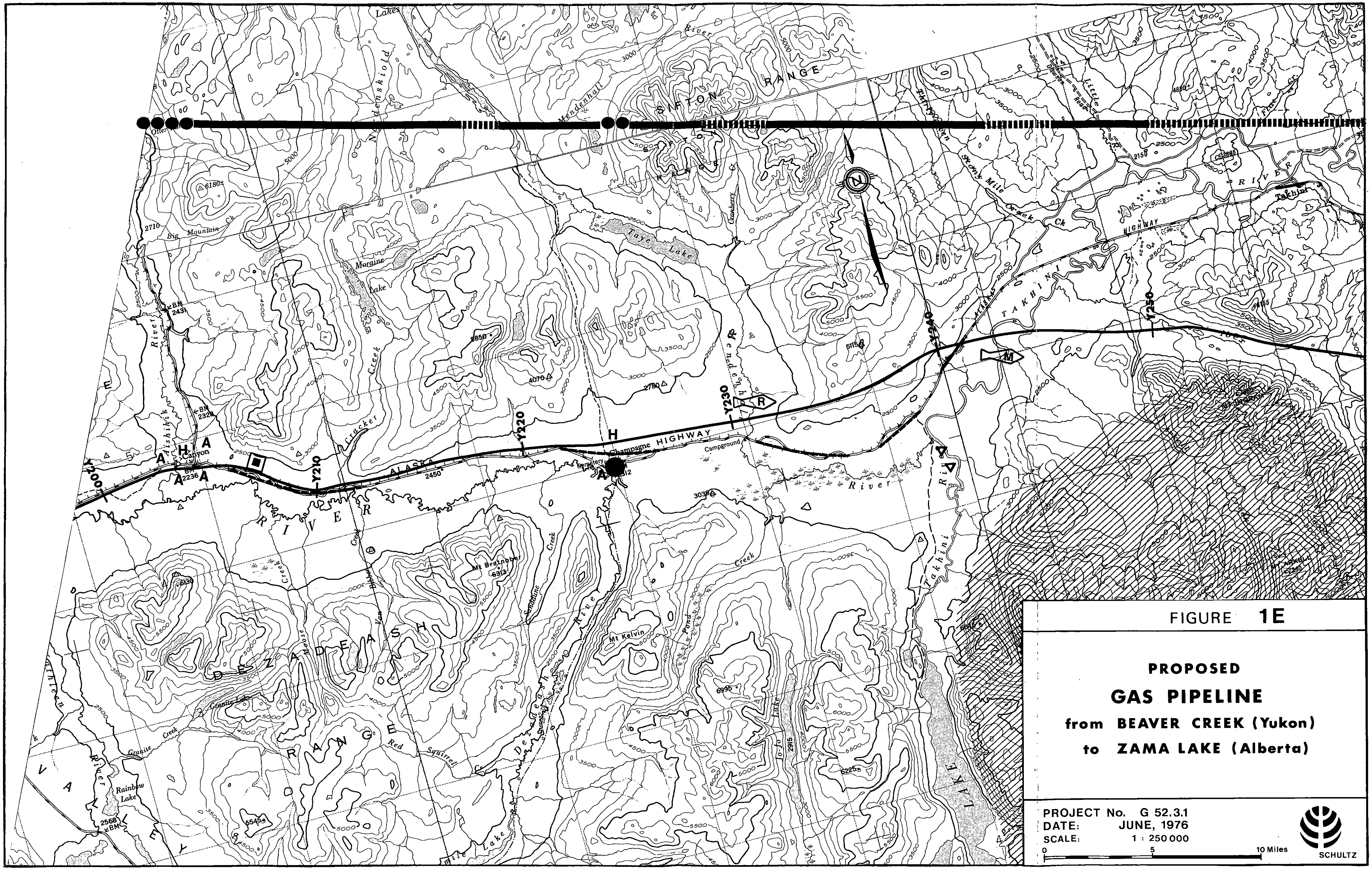


FIGURE 1E

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1

DATE: JUNE, 1976

SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

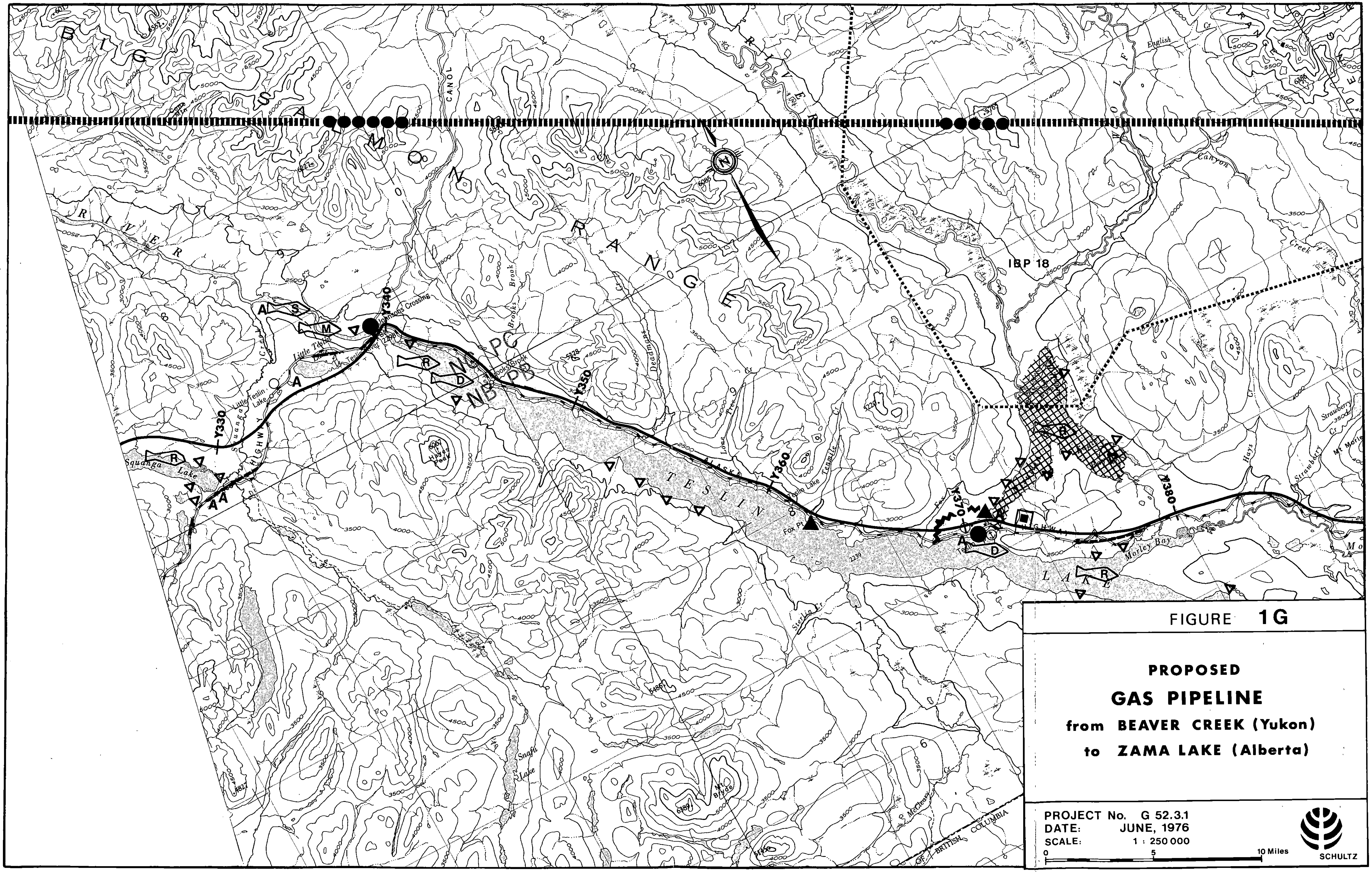


FIGURE **1G**

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

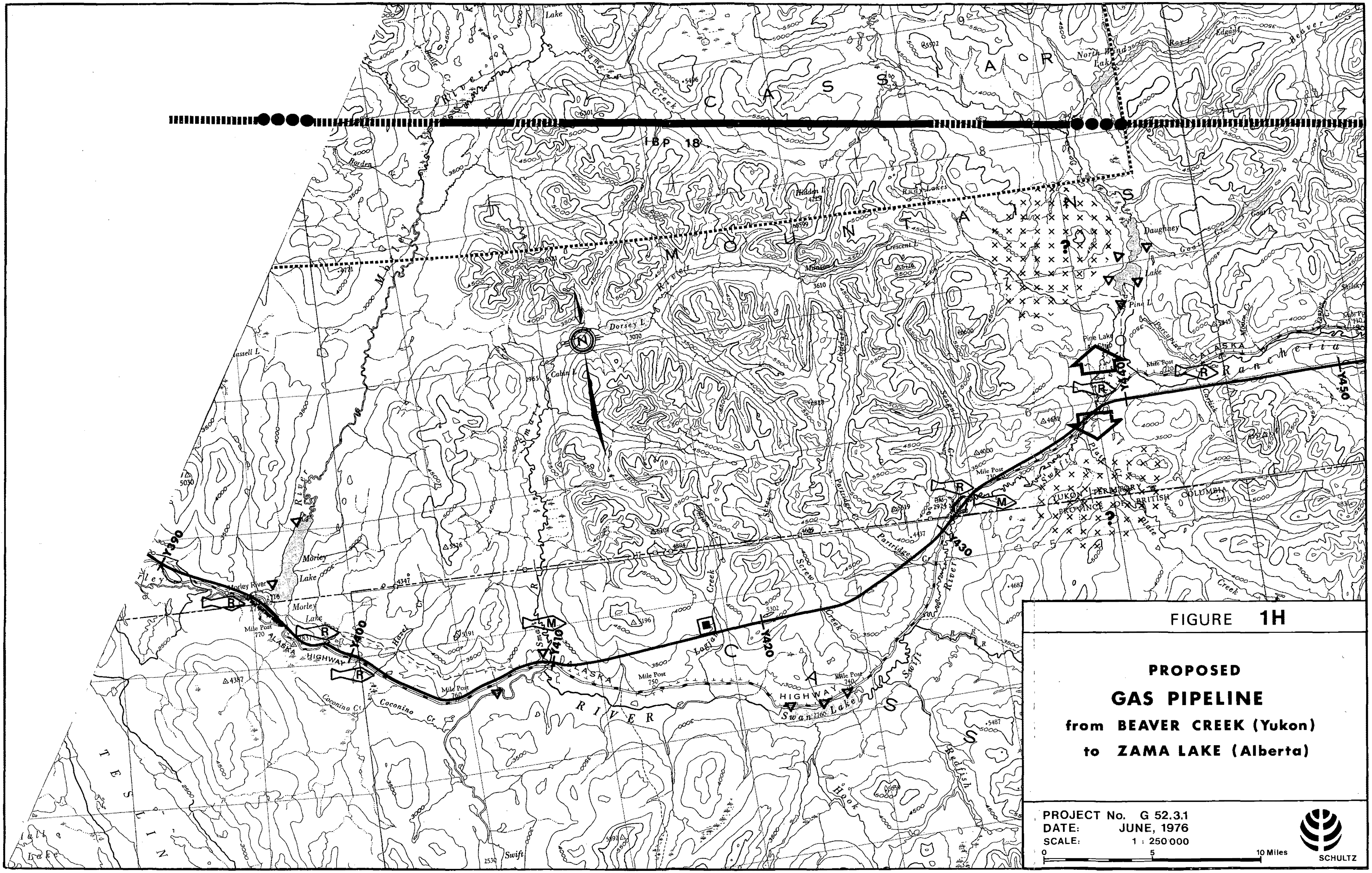


FIGURE **1H**

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

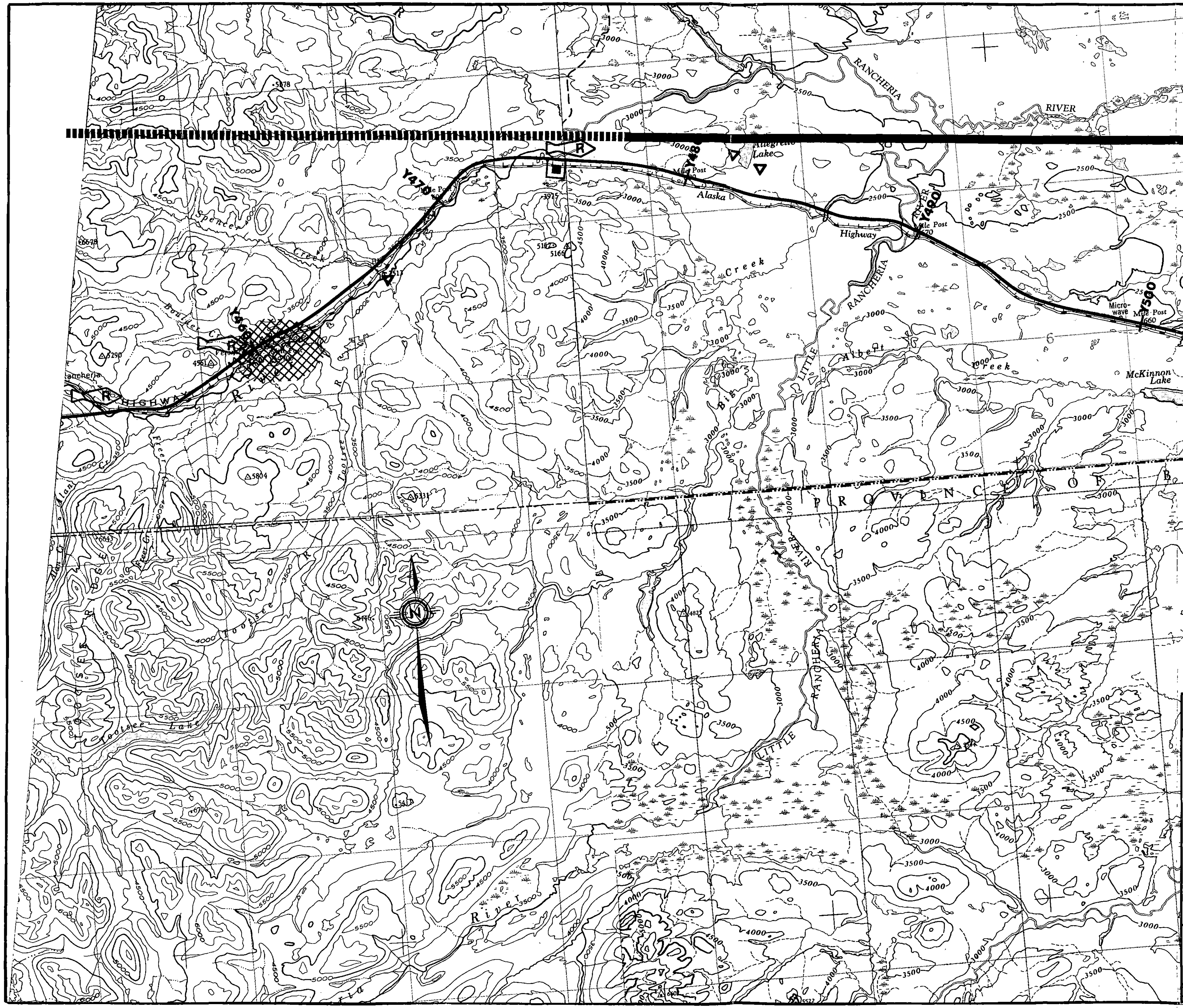


FIGURE 11

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

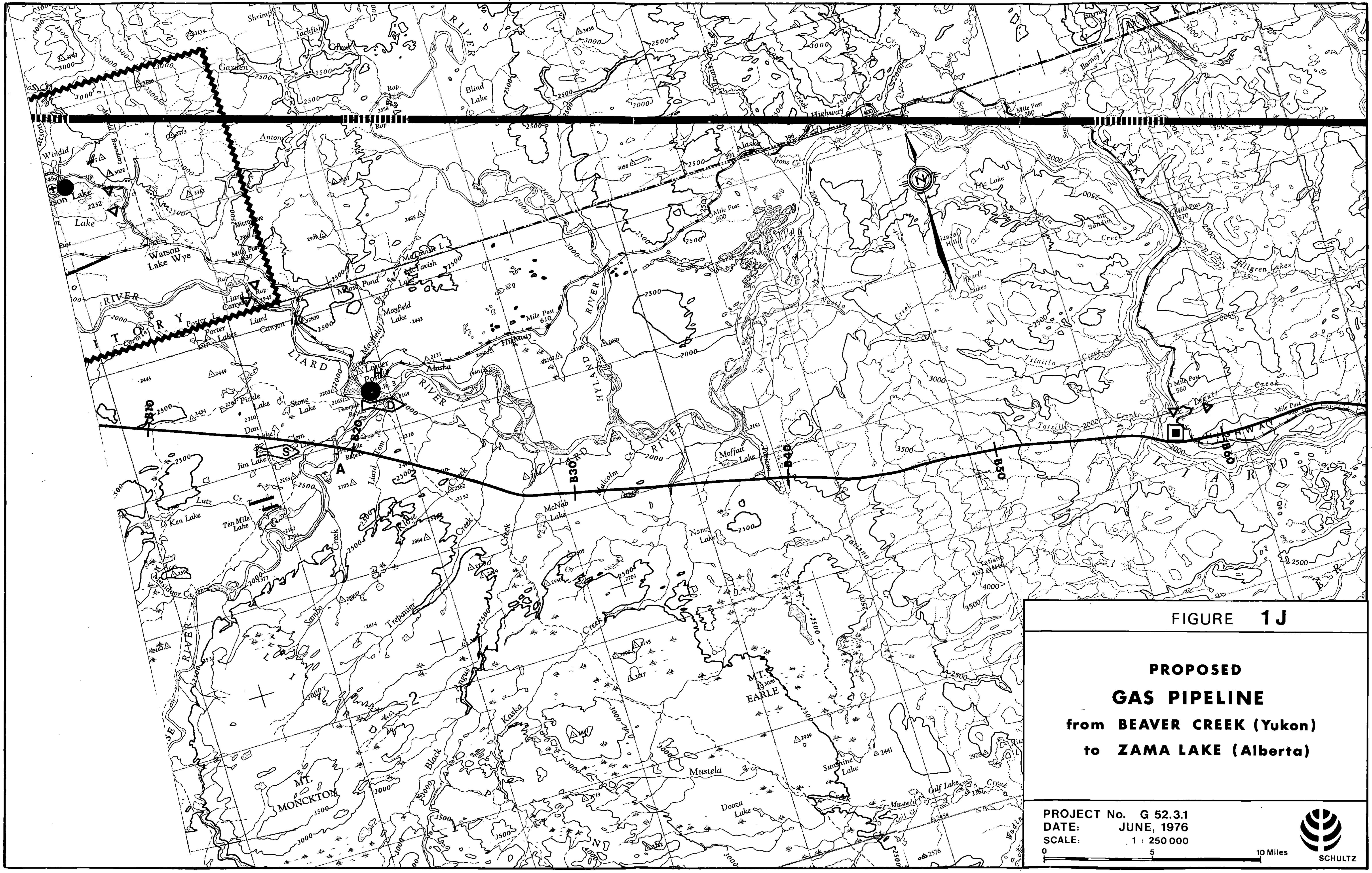


FIGURE 1J

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

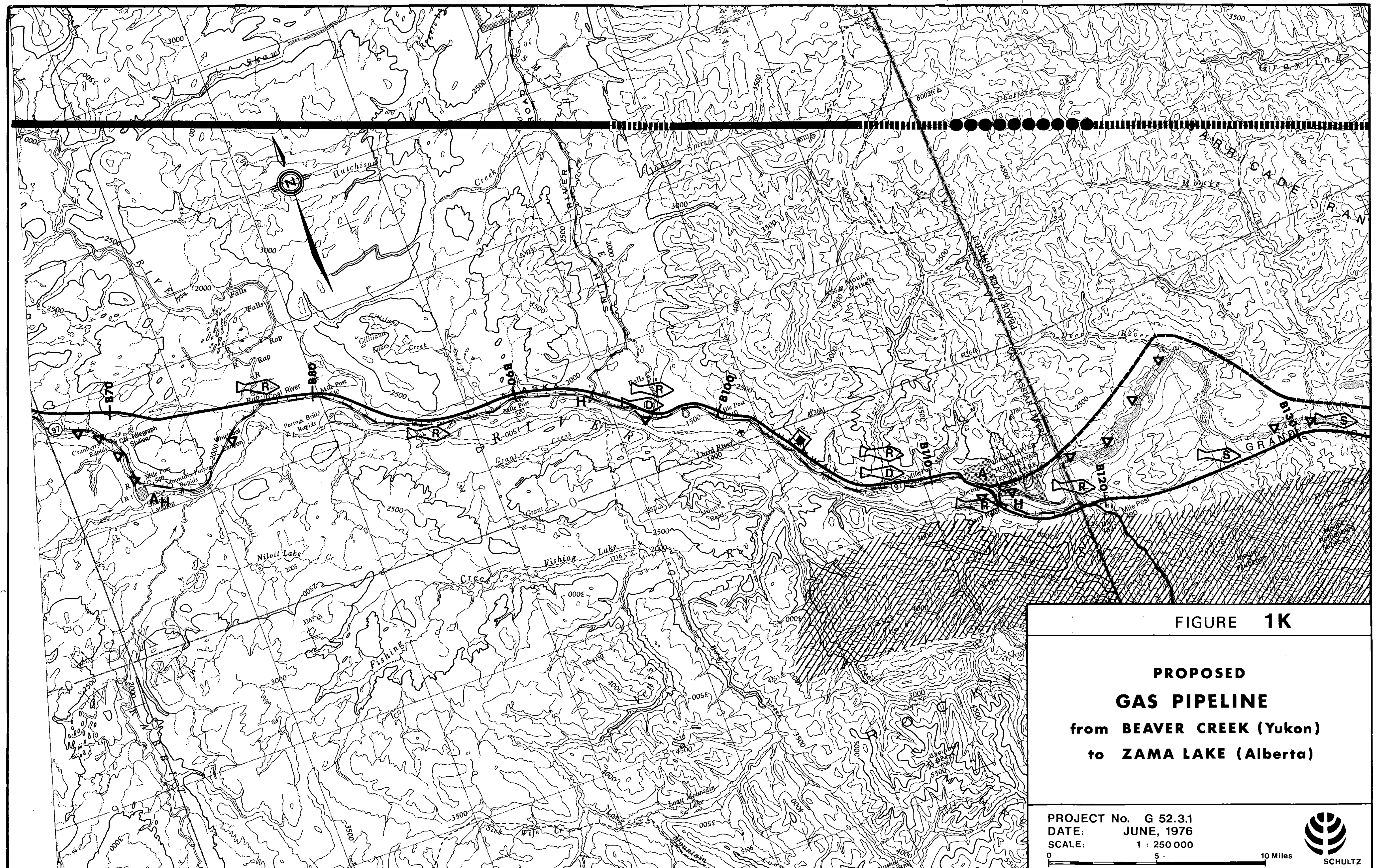


FIGURE 1K

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000
0 5 10 Miles

SCHULTZ

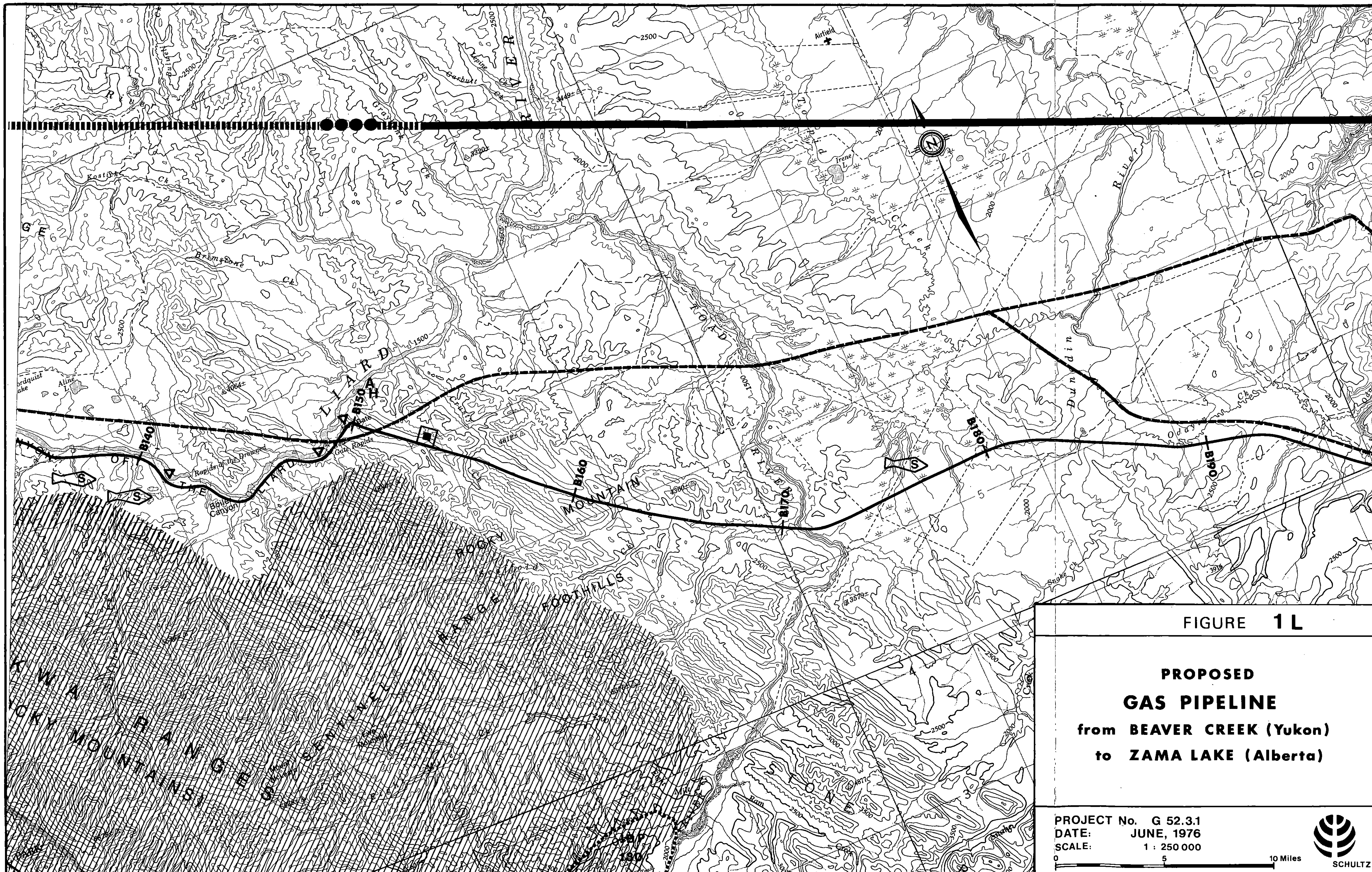


FIGURE **1 L**

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

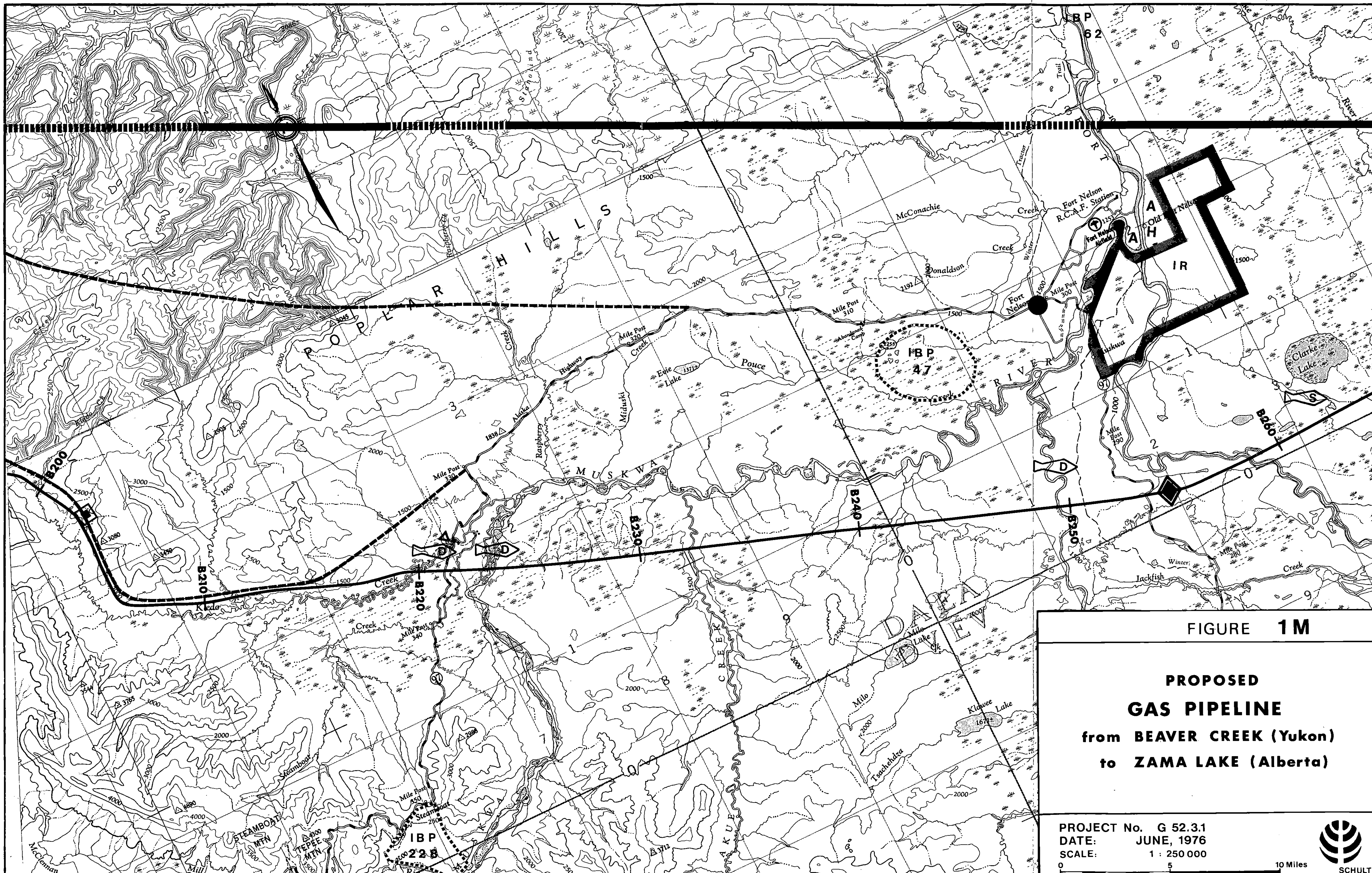


FIGURE 1M

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

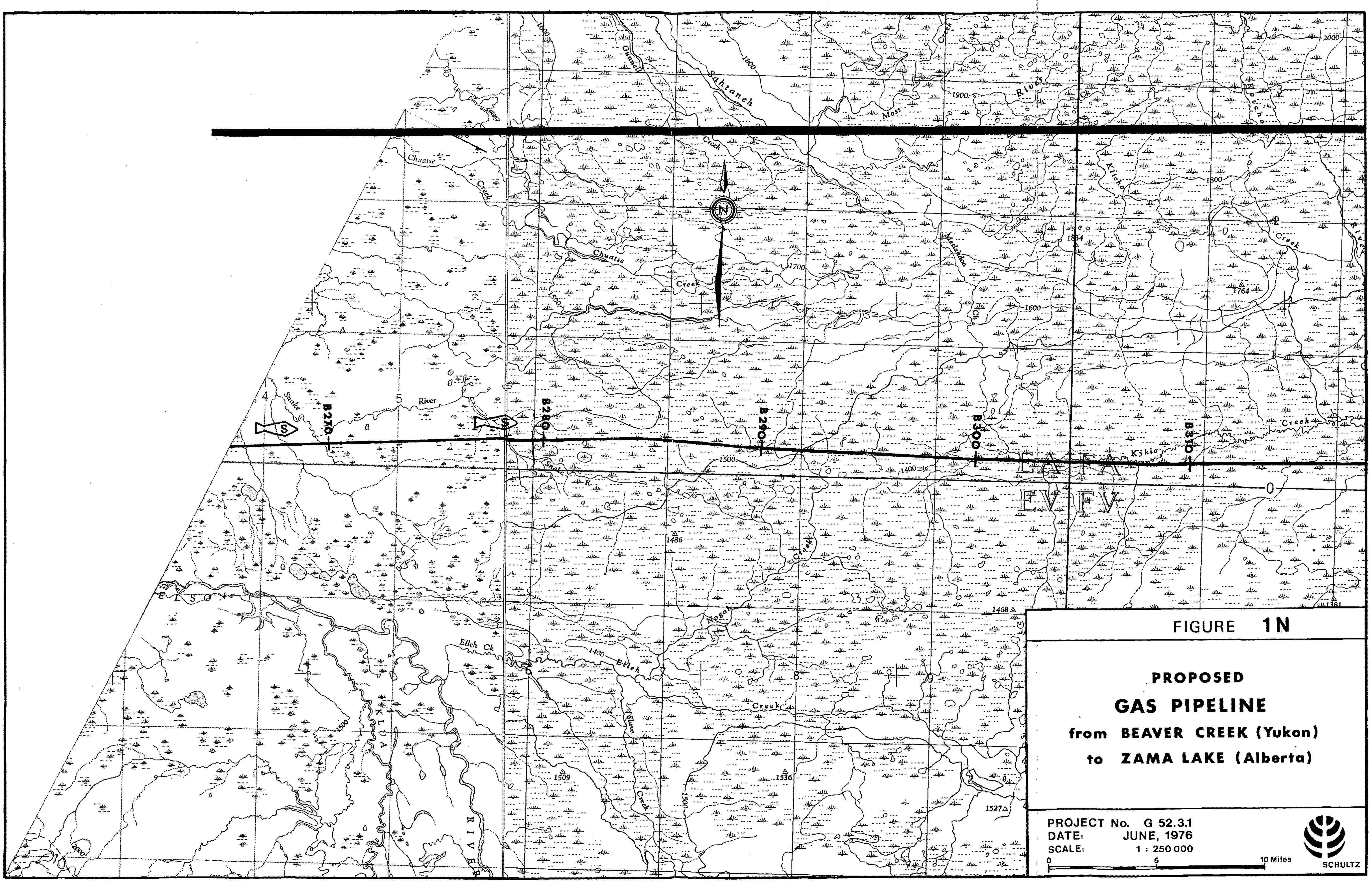


FIGURE **1N**

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

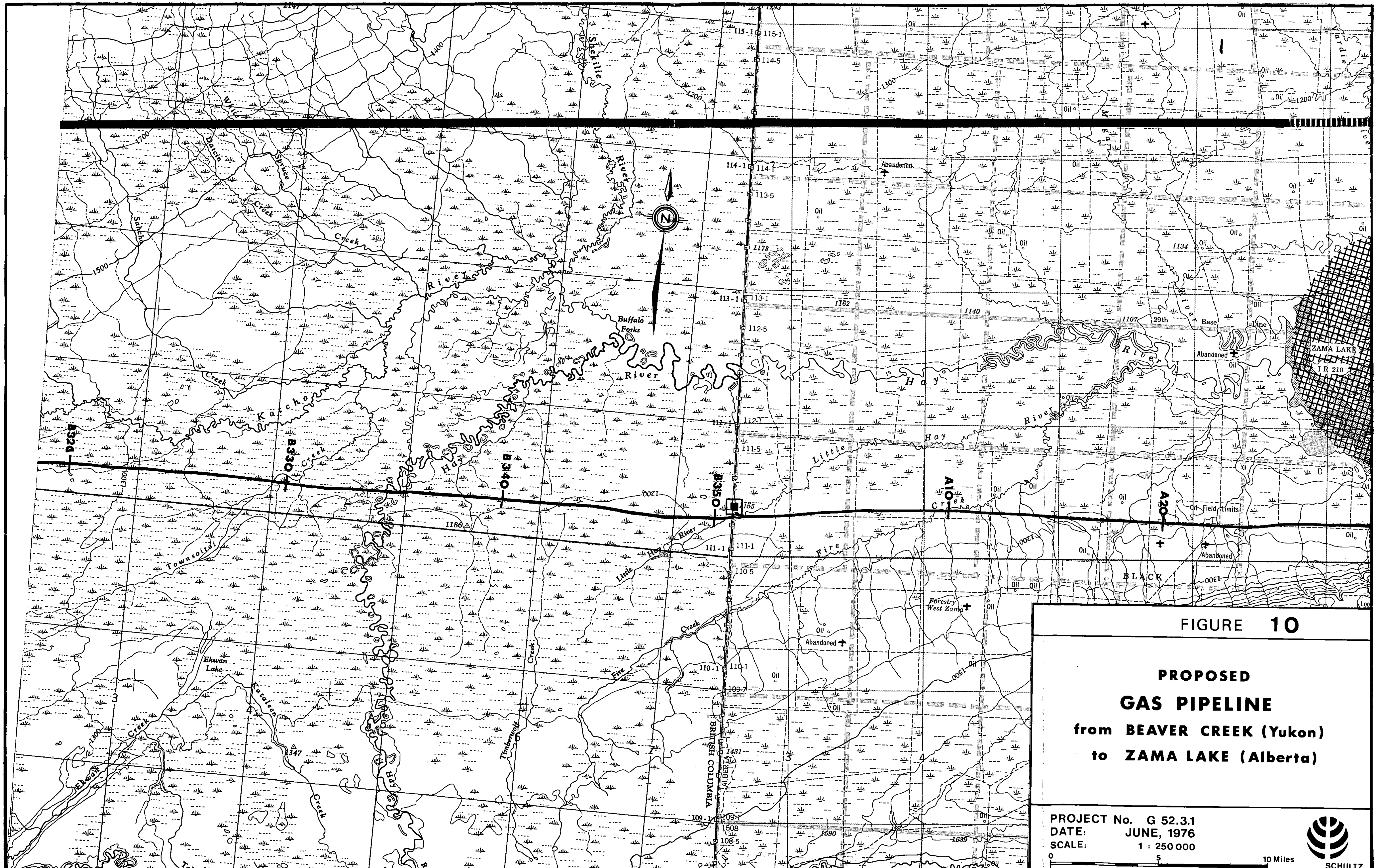


FIGURE 10

PROPOSED

GAS PIPELINE

from BEAVER CREEK (Yukon)

to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000

0 5 10 Miles

SCHULTZ

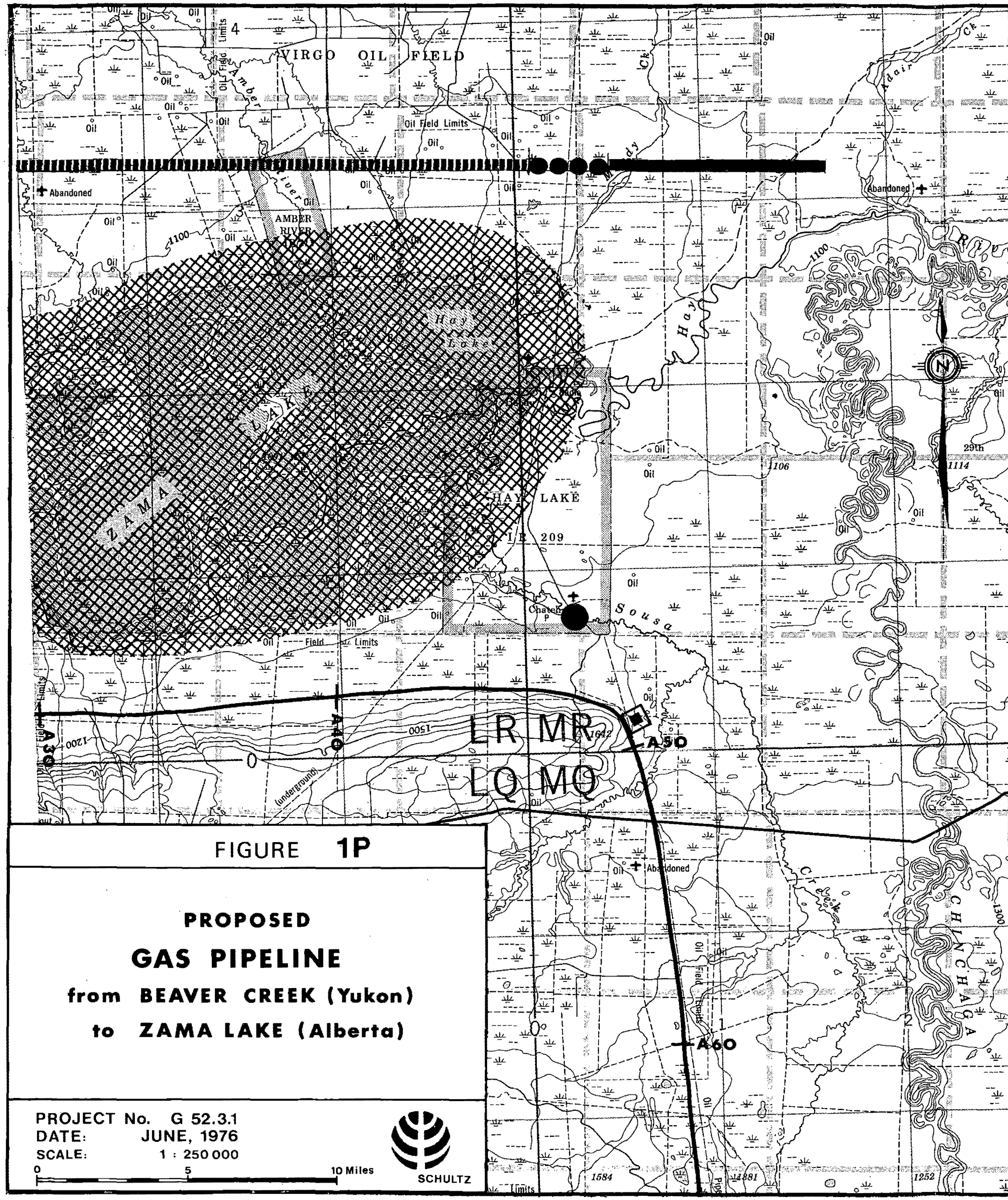


FIGURE 1P

PROPOSED
GAS PIPELINE
from BEAVER CREEK (Yukon)
to ZAMA LAKE (Alberta)

PROJECT No. G 52.3.1
DATE: JUNE, 1976
SCALE: 1 : 250 000
0 5 10 Miles

SCHULTZ

POTENTIAL IMPACT
LEGEND

PROPOSED ROUTE OF PIPELINE
GENERAL PROPOSED ROUTE OF PIPELINE
EXISTING ALASKA HIGHWAY
PROPOSED RE-ALIGNMENT OF ALASKA HIGHWAY

FISHERY RESOURCES

MIGRATION ROUTE (M)
EXISTING OR POTENTIAL SPAWNING AREA (S)
RECREATIONAL FISHERY (R)
DOMESTIC FISHERY (D)
COMMERCIAL FISHERY (C)
SPORT FISHING CAMP

WILDLIFE RESOURCES

GRIZZLY RANGE OR DENNING AREA
THINHORN SHEEP RANGE
CARIBOU RANGE
WATERFOWL
MIGRATORY MOVEMENTS

MISCELLANEOUS

INTERNATIONAL BIOLOGICAL PROGRAM ECOLOGICAL RESERVE (IBP 67)
NATIONAL PARK
ARCHAEOLOGICAL SITE A
HISTORICAL SITE H
RECREATION ZONE
DEVELOPMENT CONTROL ZONE
COMPRESSOR STATION
PROCESSING PLANT
SETTLEMENT
MINE M

OVERALL RELATIVE SENSITIVITY

LOW
MEDIUM
HIGH