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AN ENVIRONMENTAL OVERVIEW OF RIVER  
BASINS IN THE YUKON TERRITORY

November, 1977

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**Inland Waters Directorate  
Pacific and Yukon Region  
Vancouver, B.C.**



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## TABLE OF CONTENTS

	List of Maps	iii
	List of Tables	v
	List of Figures	vii
	List of Appendices	viii
	Introduction	2
	History	6
I	Physical-Chemical	
	(A) Geographical Setting	10
	(B) Physiography	10
	(C) Geology	13
	(D) Glacial History	16
	(E) Permafrost	18
	(F) Soils	18
	(G) Climate	20
	(H) Hydrology	22
II	Biological	
	(A) Wildlife	48
	(B) Vegetation	54
III	Socio-Economic	
	(A) Mining and Minerals	58
	(B) Tourism and Recreation	86
	(C) Water Use	100
	(D) Fish and Fisheries X	117
	(E) Forestry	132
	(F) Agriculture	138
	(G) Transportation	140

	(H) The Physical Environment and Development in the Yukon	148
	(I) Secondary and Service Industries	150
	(J) Communities and Population Characteristics and Trends	155
	(K) Indians	165
IV	Data Deficiencies	171
V	Bibliography	202

List of Maps

Map #	Title	Page #
1	General Map of the Yukon Territory.	1
2	Location of the Yukon Territory in relation to Northwestern Canada and Alaska, U.S.A.	11
3	Physiographic subdivisions according to Bostock (1965).	12
4	Generalized geology adopted from Douglas and MacLean (1963), Tempelman-Kluit (1974) and G.S.C.O.F. Map 87.	14
5	Ice sources, glacial limits and flow patterns (Hughes 1972; Hughes, et al. 1969; Bostock 1966; Prest, et al. 1967).	17
6	Permafrost zones and subzones and mean annual air temperature isotherms adopted from Brown.	19
7	Extent and approximate depth of volcanic ash deposits (White River source). The eastern lobe was deposited about 1220 years B.P., the western lobe about 1900 years B.P. Adopted from Hughes, Rampton and Rutter (1972).	21
8.	Annual mean precipitation isohyets modified from Burns (1973).	23
9	Snow survey course locations Yukon Territory.	27
10	Major Drainage Areas of the Yukon.	31
11	Water Survey of Canada Gauging Stations and Water Quality Sampling Stations.	35
12	Isolines of Average Annual Runoff.	36
13	Migration Routes of the Porcupine Caribou Herds.	49
14	Ecoregions of Yukon Territory.	55
15	Forest regions adopted from Rowe (1972).	56
16	Present Mines, Potential Mine Sites and Major Mineral Areas.	63
16a	Pipeline Routes through the Yukon Territory.	85

Map #		Page #
17	Proposed Parks.	88
17a	Potential Park Themes.	90
18	Proposed IBP Ecological Reserves.	92
19	Archaeological Sites.	93
20.	Campsites.	96
21	Hydro Power Inventory.	105
22	Yukon Commercial Forest.	133
23	Yukon Territory Forestry Units.	134
24	Transportation Systems.	141
25	Indians of the Yukon.	166

List of Tables

Table #	Title	Page #
1	Yukon Temperature and Precipitation Statistics.	24
2	Yukon Lakes With Surface Area Five Square Miles or Greater.	37
3	Suspended Sediment Data.	41
4	Water Hardness in Major Yukon Rivers.	43
5	Maximum Discharge and Date.	46
6a	Mineral Production Chart 1966 to 1975.	59
6b	Mineral Production Graph 1965 to 1975.	60
7	Yukon Oil and Gas Information.	83
8	Historic Sites Priorities.	91
9	Campgrounds.	97
10a	Total Installed Capacity of Present NCPC Plants.	102
10b	Present Yukon Power System, Project Data for NCPC Hydro Plants.	103
11	Summary of Effects of River System Developments on Yukon Resources.	107
12	Water Use in Yukon Communities.	114
13	Fish Species of the Yukon Territory, Occurrence by Watershed.	118
14	Yukon Territory Watersheds Characteristics of Fishes and Fisheries.	121
15	Quantity and Value of Salmon Landed and the Number of Fishwheels in Operation, Commercial Fishery, Yukon Territory, 1964-1971.	127
15a	Quantity and Value of Freshwater Fish Catches and Number of Gill Nets in Operation, Commercial Fishery, Yukon Territory, 1964-1971.	128

Table #		Page #
16	Total Indian Population and Number and Percentage of Indian Population Affected by Subsistence Fishing, by Band, Yukon Territory, 1972.	129
17	Yukon Forests, Summary of Unit Areas.	136
18	Statistics on the Yukon.	152
19	Whitehorse Statistics.	153
20	Populations of Major Yukon Communities, 1966, 1971 and 1976.	156
21	Distribution of the Non-Indian Population by Age Group and Sex, Yukon Territory, 1971.	160
22	Community Population by Ethnic Origin, Yukon Territory, January, 1973.	161
23	Manpower Statistics, Yukon Territory, 1971-1972.	162
24	Distribution of Indian Population by Age Group and Sex, Yukon Territory, 1971.	168
25	Employment Status of Indians, Yukon Territory, 1972.	169

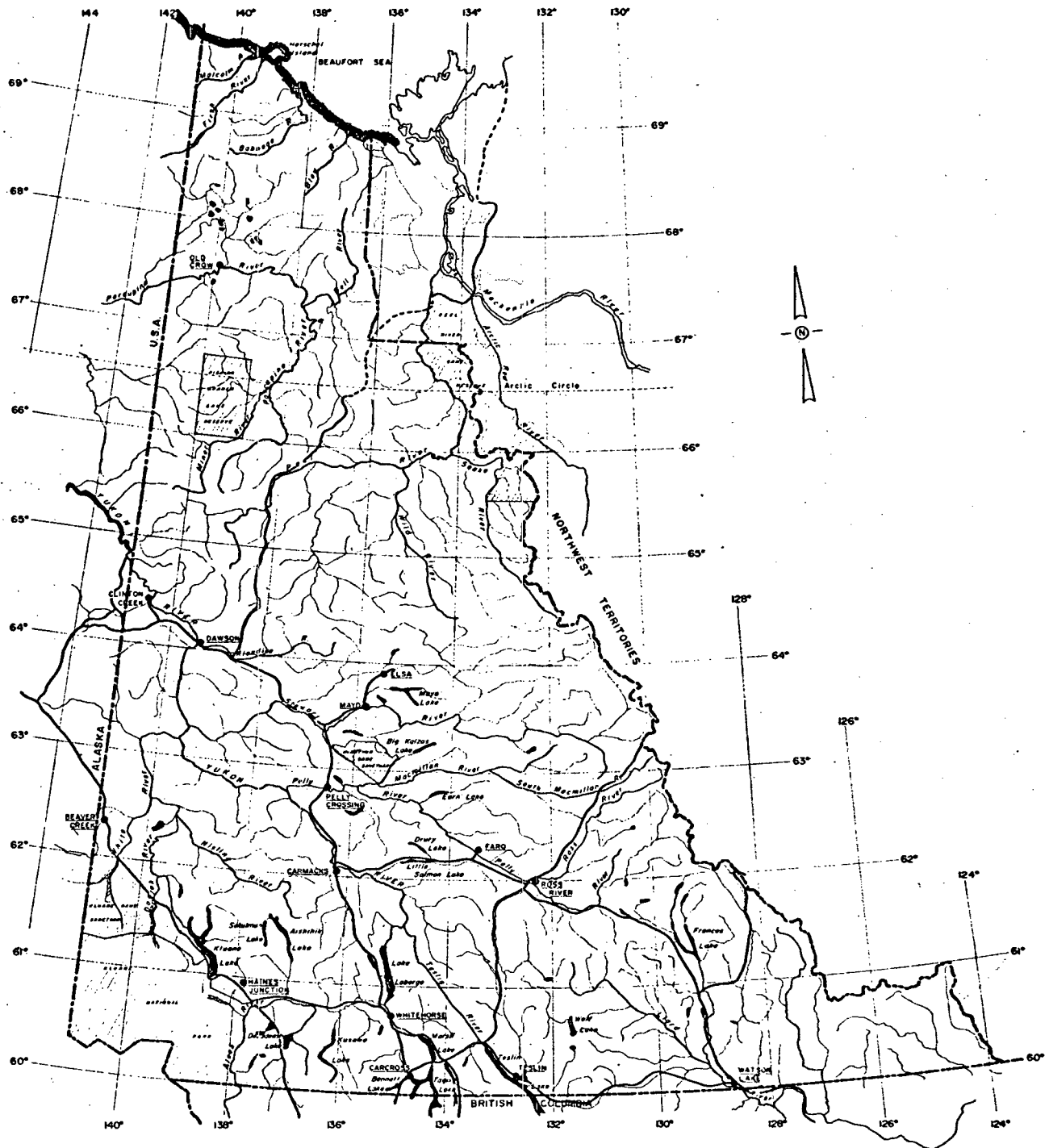
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List of Figures

Figure #	Title	Page #
1A	Whitehorse Copper Mines Ltd. Site Layout.	71
1B	Whitehorse Copper Mine Existing Water Balance.	72
2A	Anvil Mining Corp. Ltd. Site Layout.	75
2B	Anvil Mine Water Balance.	76
3A	United Keno Mines Site Layout.	79
3B	United Keno Hill Mines Integrated Water Balance.	80
4	Present Yukon Power Systems System Schematics.	101
5	Yukon Population Growth - Graphs.	158

List of Appendices

<u>Appendix #</u>	<u>Title</u>	<u>Page #</u>
I	Hydrographs for Selected Stations	179
II	Ice Thickness, Break-Up, Freeze Up	182
III	List of Titles of Relevant Reports, Not Listed in the Bibliography	191
IV	Agencies Contacted and/or Visited	200



MAP 1

GENERAL MAP OF THE YUKON TERRITORY

## INTRODUCTION

The purpose of this report is to provide an overview of environmental information on the major river basins in the Yukon Territory, with particular attention paid to the effects of present and future developments on water quality and use. The report is intended for use within the Inland Waters Directorate, and will serve as background research to the planning and management of water resources in the Yukon. This overview study was conducted under the direction of Dr. V. G. Bartnik, Environmental Impact Studies Coordinator, Water Planning and Management Branch, and was researched by undergraduate student Ms. Cathryn Paish. The preparation of the report was made possible by the acquisition of Ms. Paish's services under the 1977 Federal Summer Student Employment and Activities Program.

Wherever possible, areas of data deficiencies will be identified so decisions can be made within the Branch as to where further study is needed. Since most of the report is based on published information, the scope of the work will be limited to what is presently available. However, included in the bibliography are several reports now under preparation by other government or private agencies which may be of use to the Directorate for future studies.

Because of the size of the region being discussed, detailed information is limited and restricted to those topics that have, or may have the most pronounced effects on water use and quality, and have implications for management of the waters. At the present time, the following areas are of primary concern:

- (1) Construction of new hydro facilities to supply the increasing industrial and domestic demand for power.

- (2) Increasing development of the Yukon's number one industry, mining, and the resulting increase in power demand, water use and water pollution.
- (3) Development of the Yukon's second industry, tourism and recreation, and the increasing demand for the preservation of the water resource in its natural state for future use as a tourism and recreation resource.
- (4) The recent interest in the Yukon as the major pipeline corridor for gas and oil from the north to southern Canada and the U.S., and the concomitant socio-economic and environmental problems including:
  - construction on permafrost and the preservation of the fragile northern environment.
  - preservation of the quality of waterbodies crossed by the pipeline.
  - social and economic impact of a "temporary" increase in population and money on the resident, and especially native populations of the Yukon.
- (5) Increasing domestic water use and waste disposal as a result of increasing population and the overloading of the existing domestic water supply systems in some communities.

The report is designed to summarize and review and thus make available information that can be used in more detail when more specific information is required.

#### Study Design

Physical-chemical, biological and socio-economic aspects of the Yukon's environment will be considered in this report. The following is a generalized outline of the topics to be covered:

I. Physical-Chemical: Description of the Yukon Territory

- (A) Geographical Setting
- (B) Physiography
- (C) Geology
- (D) Glacial History
- (E) Permafrost
- (F) Soils
- (G) Climate
- (H) Hydrology

II. Biological

- (A) Wildlife
- (B) Vegetation

III. Socio-Economic

- (A) Mining
- (B) Tourism and Recreation
- (C) Water Use
- (D) Fish and Fisheries
- (E) Forestry
- (F) Agriculture
- (G) Transportation
- (H) Physical Environment and Development
- (I) Secondary and Service Industries
- (J) Community and Population Characteristics and Trends
- (K) Indians

IV. Data Deficiencies

V. Bibliography

### History

This section deals with the history of the white man in the Yukon; native history could go back as far as 20,000 years when Asian tribes crossed over the Pacific Land Bridge into the unglaciated portions of the northern central Yukon.

The first white men in the Yukon were probably Russians, who established a fur trading industry with the Indians in the early to mid 1700's. American and British fur traders moved into the southern portions of the territory later that century. With the loss of the China fur market in 1824, the Russians lost interest in the Alaska-Yukon region and in 1840 they leased the Alaska Panhandle to the Hudson Bay Company. Anglo-American fur trading continued into the mid 1800's and resulted in the establishment of several settlements and the exploration of many of the navigable waterways.

In 1867, Alaska was sold to the Americans partly on speculation arising from stories of gold finds in the Yukon River Basin. The Russians did not want to administer a gold rush.

For the next 25 or so years, prospectors came to the Yukon in search of gold, and many of the unsuccessful ones turned to fur trading to support themselves.

### The Gold Rush

In August 1896, George Washington Carmack and two Indian companions staked a claim on the Klondike River. The claim turned out to be the "bonanza strike", and the gold rush was on.

During the next several years over 100,000 prospectors set out from the south to make their fortunes in the Yukon. Only a few of them completed the arduous journey. Some travelled via what is now the Skagway-Whitehorse rail route and then up the Yukon River to the Klondike gold fields. Others started from Bennett, B.C. and tried to make the journey by boat. The least successful were those that tried to reach the Yukon from northern Alberta by crossing the Mackenzie Mountains.

At the height of the Gold Rush, Dawson City had a population of about 40,000, and was the center of activity. The modern tourist industry thrives on the colorful stories of the characters of this town, and on the folklore and relics associated with the Gold Rush.

By 1902, the gold rush was virtually over, and most of the people associated with it had left. Over \$300 million worth of gold had been taken out, leaving behind an unstructured society with no alternate economic base. Few of the facilities erected for the gold rush were designed for permanence. Public services and materials had been handled on a "get in- get gold-get out" basis, and the federal government had given little incentive for other businesses to establish themselves, or for the Yukon to make any long-term contribution to Canada as a whole.

The larger mining companies that had established themselves during the Rush were expected to provide public services, and they continued to do so because the success of their operations depended on the welfare of the workers that lived there.

For the next 40 years, the economy of the Yukon (based mainly on low profile mining) stood at a standstill and the population stayed below 5000.

#### The Alaska Highway

In 1942-1943 the Alaska Highway was built as a wartime service route to the "northern frontier". Soon after its completion, the Canol pipeline, the distant early warning lines and their service roads were built.

The Highway had a longer lasting effect on the Yukon than the gold rush because it opened up the area to base metal exploration. Unfortunately the war roads were not designed with the Yukon's economic future in mind, and growth and development continued on an ad-hoc, unplanned basis. However, increased mineral explorations and developments helped stabilize the economy and growth did occur.

#### Recent History

By the early 1960's, mining companies and the Federal Government had realized the potential of the Yukon, and the need for a growth and development plan to enhance its long-term economic potential. Transportation systems were vital to continued exploration, and the Federal "Roads to Resources" program was initiated in the Canadian North to provide access to the most promising mineral areas. Much of the present transportation system developed from these roads.

Technological developments and government aid continued to

cater to the mining industry, as it does to a large extent today.

Recently, the problems of a single-base economy in the Yukon have come to light, and an effort is being made to broaden the Yukon's economic base by promoting the development of other resources, especially its scenic beauty and history in relation to tourism.

With the depletion of many natural resources in the south, interest in the north's resources is rising and exploration and development is proceeding faster than it ever has before.

However, the information base available on the north is too small to formulate feasible plans for northern development. This has been realized to a large extent, and has resulted in an information gathering rush that is almost an industry in itself. It is hoped that the development of the north will lead to its long-term socio-economic and environmental stability, rather than the short-term pay-offs that have characterized its past.

I. Physical-Chemical

Description of the Yukon Territory

(A) Geographical Setting (Map 2)

The Yukon Territory is located in the northwestern corner of Canada, and with an area of 536 325 km<sup>2</sup>, is a little over half the size of B.C. The Territory is bounded by land to the west, south and east, and has a very small northern coastline facing onto the Beaufort Sea. The "land-locked" nature of the Yukon has a pronounced effect on climate and access routes.

(B) Physiography (Map 3)

The Yukon Territory is a land of great natural beauty and unique landforms, still in a largely "natural" state due to the isolation of the area.

The most prominent features are the large rugged mountain ranges that transect the Territory in a northwest-southeast direction. Between the mountain ranges lie rugged, high elevation plains and plateaus, cut by a few wide river valleys and many deep narrow ones. The general elevation of the Territory decreases from the south to the north, grading from large southern mountain ranges to the rolling Arctic tundra of the Beaufort Sea Coastal Plains.

The Ogilvie Mountains divide the Yukon into two major plateau regions.

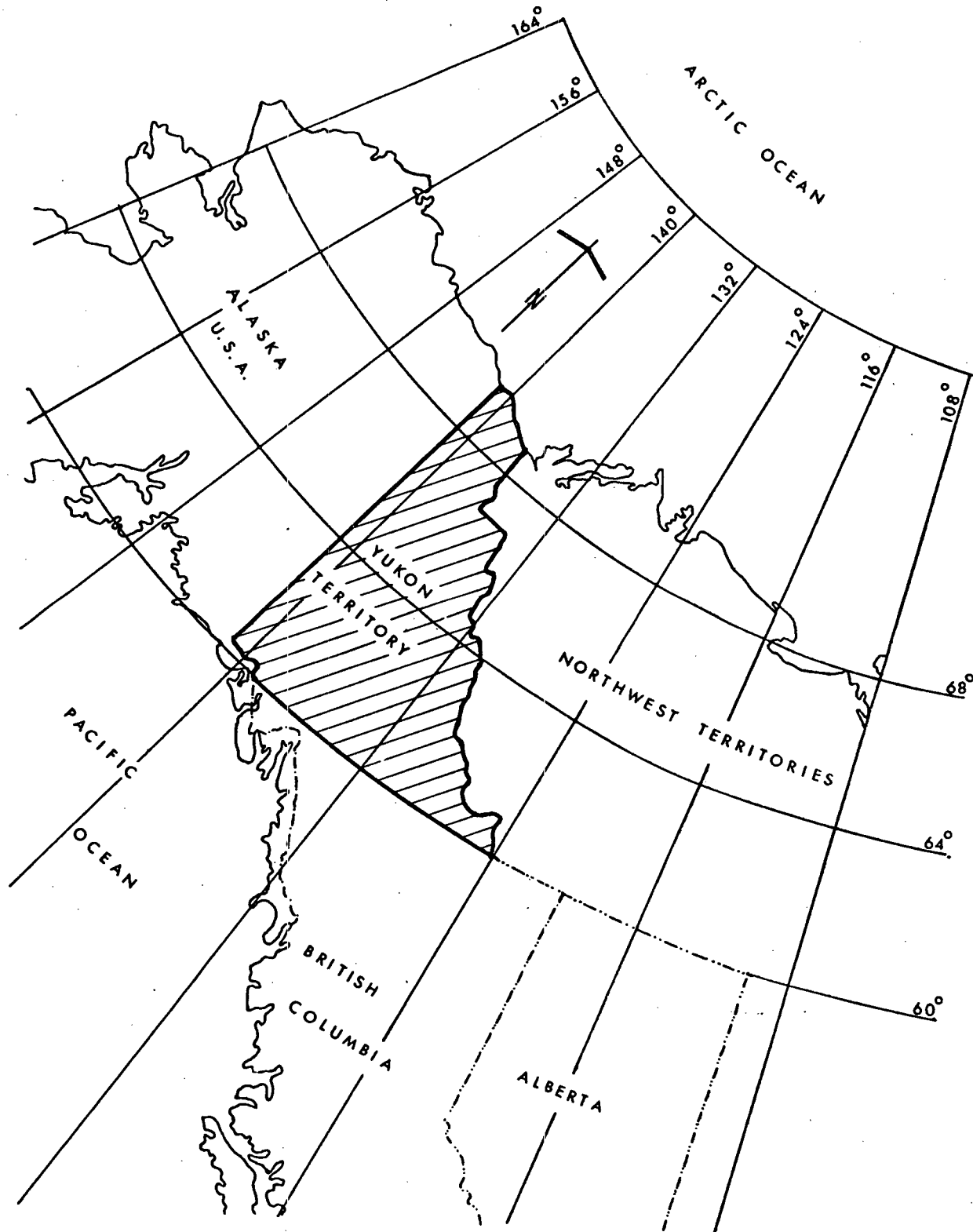
To the north lie the Porcupine and Peel Plateaus, located mostly within the Arctic Circle. In the far north are the British

482,769

186,398

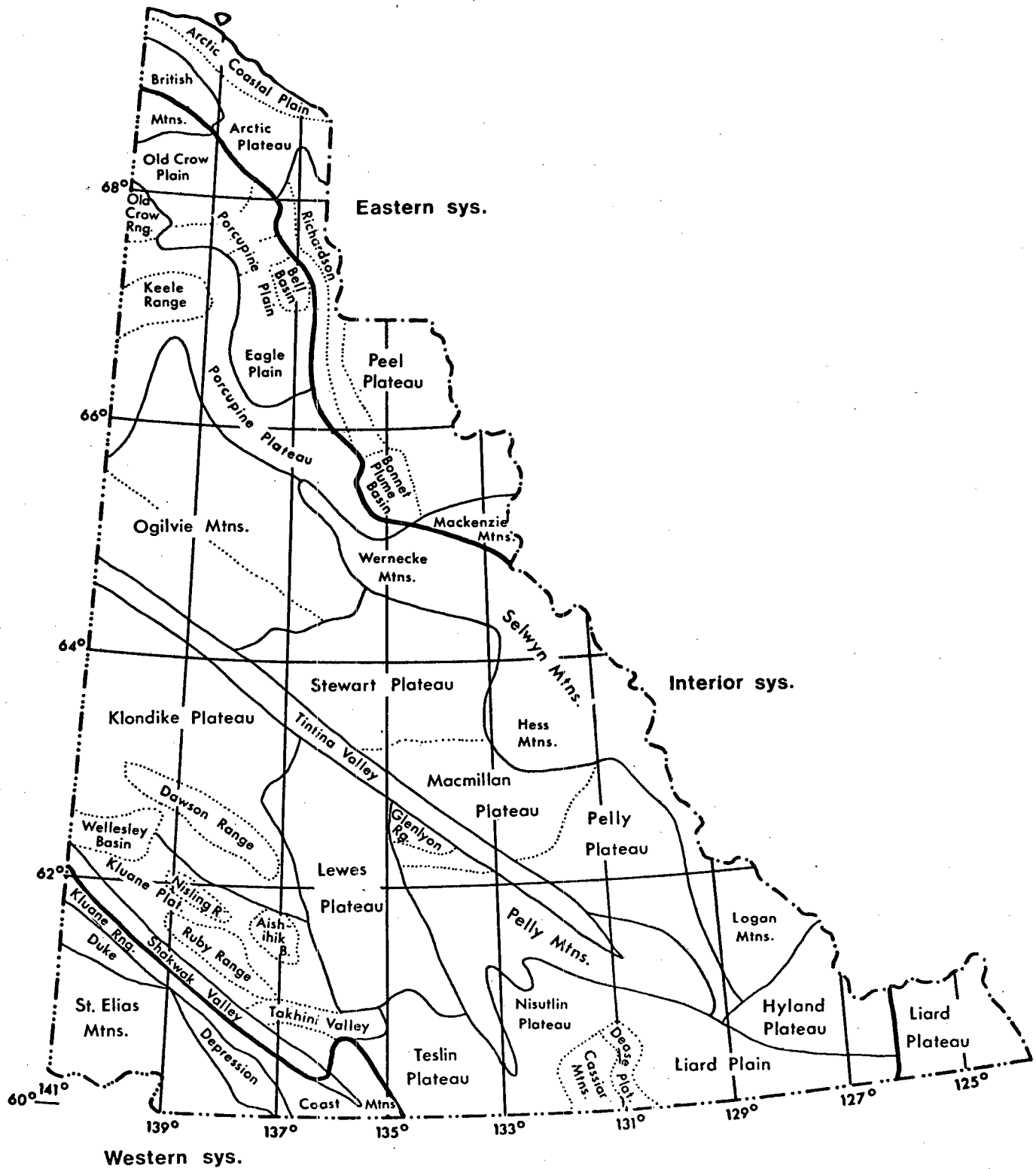
207,075

Yukon Area 207,076 sq mi



Map. 2. Location of the Yukon Territory in relation to northwestern Canada and Alaska, U.S.A.

Source: #12.



Map 3. Physiographic subdivisions according to Bostock (1965).

Source: #12

and Richardson Mountains, that grade down to the Beaufort Sea. This northernmost region is characterized by rolling Arctic tundra and permafrost geomorphology.

The area south of the Ogilvie Mountains is divided into several regions:

The south-central portion of the Territory is the major plateau region, and includes the Klondike, Macmillan, Pelly, Kluane, and Hyland-Liard Plateaus. These plateaus tend to be rugged and are often formed of small parallel ranges of hills and small mountains.

One of the world's most spectacular mountain ranges, the St. Elias Mountains, are located in the southwest corner of the Yukon. These high elevation, glaciated mountains include Mt. Logan, the highest mountain in Canada at 6050 m. Most of the range is now protected within the boundaries of Kluane National Park.

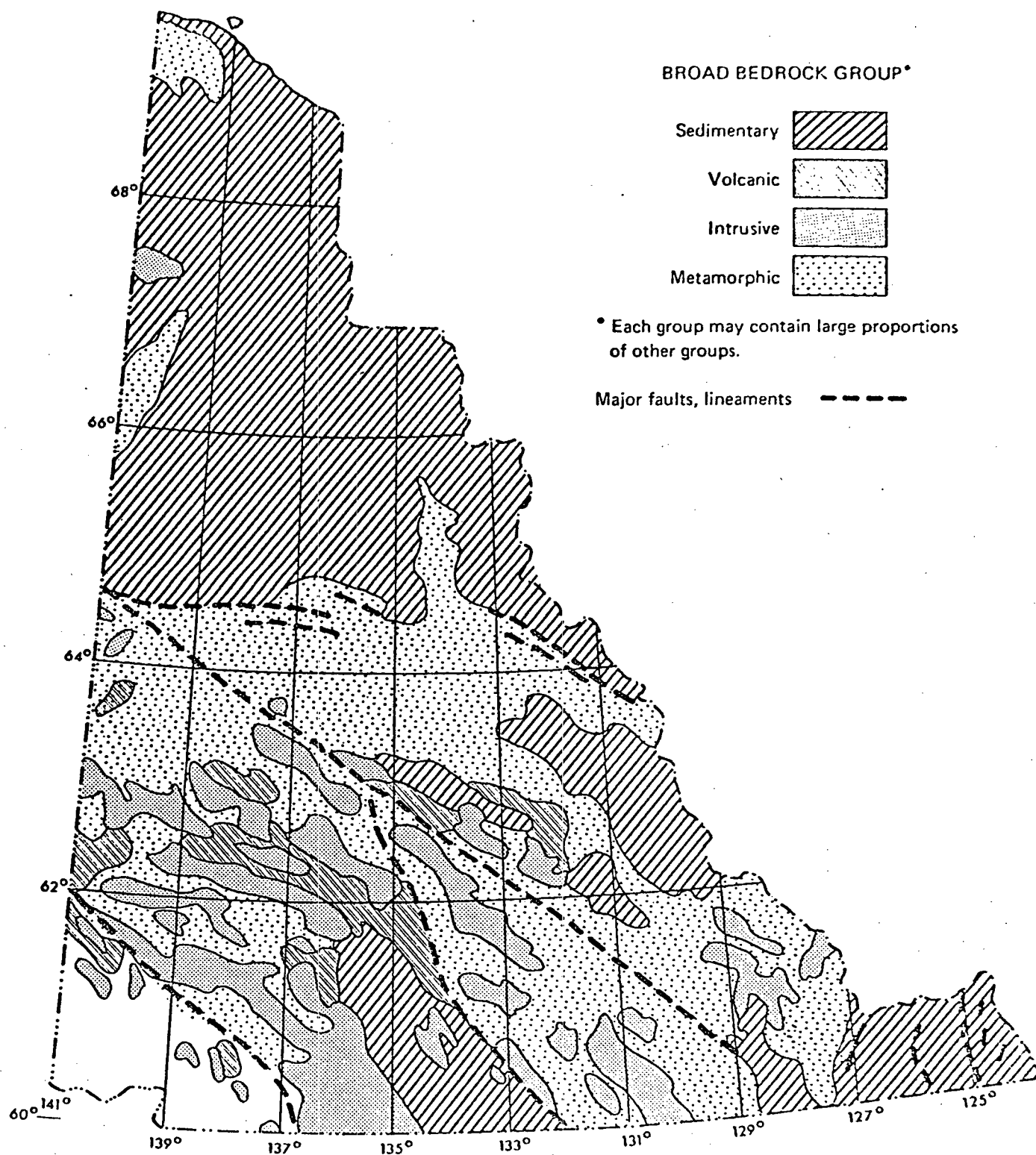
Just east of the St. Elias Range is a continuation of B.C.'s Coastal Mountains, the Dawson Range. These mountains separate Kluane and Aishihik Lakes and disappear near the Alaskan Border.

To the east, a continuation of the Rocky Mountains, the Selwyn Range, runs north to the 65th parallel, then veers west and grades into the smaller Wernecke and Ogilvie mountains.

Two conspicuous fault lines, the Tintina Trench and the Shakhwak Valley run in a northwest-southeast direction, parallel to the major adjacent mountain ranges (# 12 ).

(C) Geology (Map 4)

A brief examination of the geology of the area is



Map 4. Generalized geology adopted from Douglas and MacLean (1963), Tempelman-Kluit (1974) and G.S.C. O.F. Map 87.

Source: #12

important for the following reasons:

- (a) it gives a clearer picture of the physiographic nature of the region, which in turn plays a role in controlling the climate.
- (b) it provides the background information for the examination of the Yukon's number one industry, mining.

The Yukon Territory lies at the northwestern tip of the Canadian Cordilleran Region, a northwest trending belt about 800 km wide, composed largely of high mountains, high elevation plateaus and numerous transecting valleys. The Cordillera is divided into three major regions:

(1) The Western Region including the Coastal, Kluane and St. Elias mountains. Its western boundary runs roughly from Snag to Carcross, and the region is dominated by large intrusives of various origins.

(2) The Central Interior Region includes the major Yukon River plateaus and the interior mountains, with the western boundary following the Tintina Trench. The southwest Ogilvie, Wernecke, Hess, Logan, Pelly, Cassiar, Dawson, Nisling and Ruby Mountains and their intervening plateaus are characterized by large intrusives, while the surrounding rock is composed of a mixture of volcanic, sedimentary and metamorphic rocks.

(3) The Eastern Region is composed primarily of the Richardson, Mackenzie and Franklin extension ranges of the Rocky Mountains, but also includes the British Mountains, the Liard, Peel

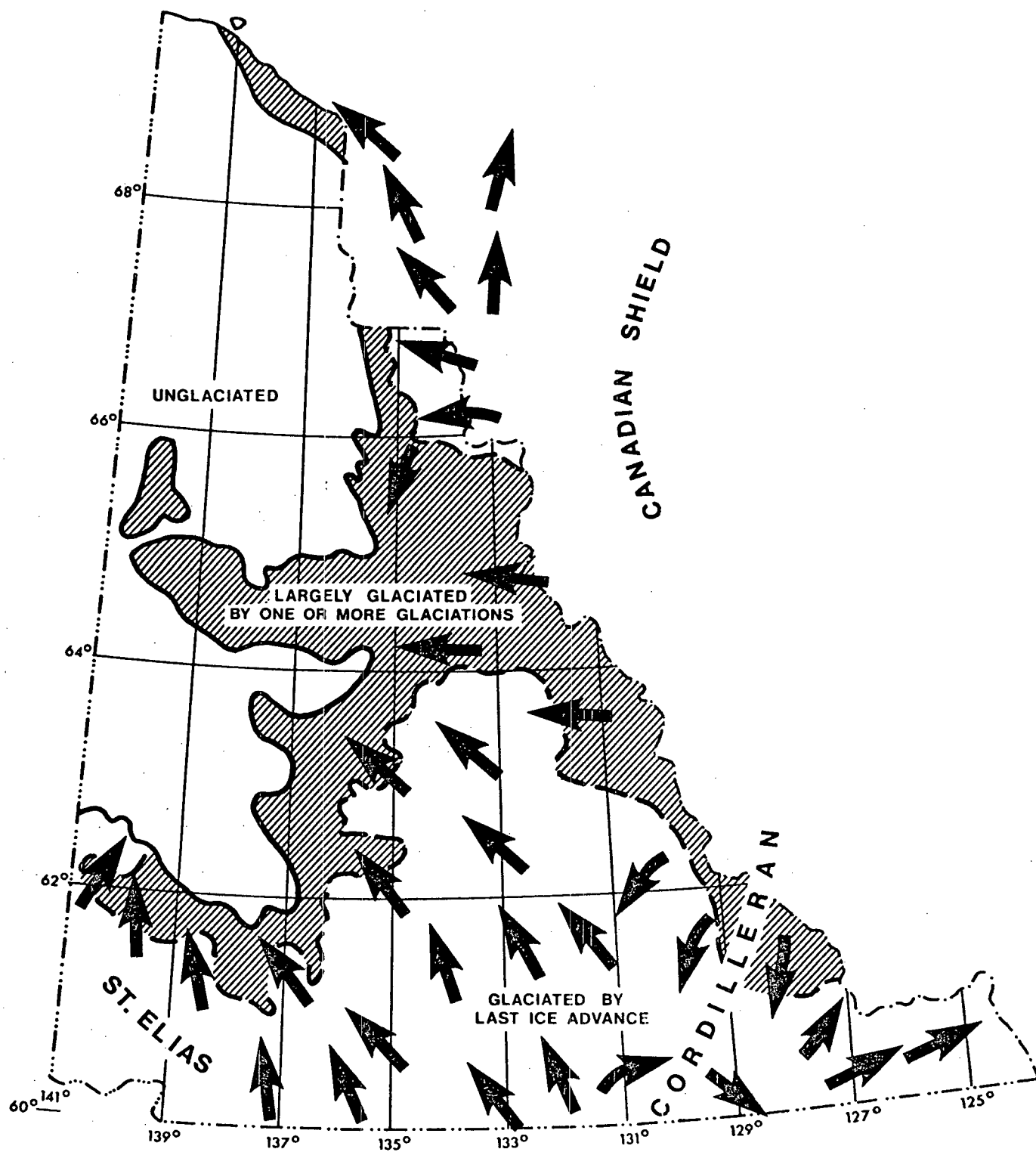
and Arctic plateaus, the Bonnet - Plume Basin and the Arctic Coastal Plains. The rocks are largely sedimentary, with some granitic outcrops and intrusions.

The Northern Cordillera is located on a geosyncline and is noted for its range and frequency of mineral bearing rocks, especially in the granitic intrusions in the south and southeast.

(D) Glacial History (Map 5)

The St. Elias-Cordilleran and Canadian Shield Ice advanced over most of the Yukon at least twice; about 40,000 years Before Present (B.P.) and again 13,000 to 14,000 years B.P. Map 5 shows that some areas remained unglaciated, giving the Yukon its mixture of glacial and aeolin-fluvial landforms. The non-glaciated regions may have served as land migration routes for various pre-historic tribes of men coming from Asia. The abundance of surficial gold placers found during the Yukon Gold Rush could also be due to the unglaciated nature of the area.

Modern glaciers exist in the St. Elias Range, and the cyclic advancement of these glaciers may be affecting the drainages of the Alsek and White Rivers. In 1974, the advancing Tweedsmuir Glacier in B.C. threatened to block the Alsek River completely (it had already caused major diversions in the river), but the force of the river knocked down the advancing ice front and it managed to stay on course (# 11 ). Recent information on the status of this glacier and the Alsek River was not located.



Map 5. . . Ice sources, glacial limits and flow patterns (Hughes 1972; Hughes, et al. 1969; Bostock 1966; Prest, et al. 1967)

Source: #12

(E) Permafrost (Map 6)

Permafrost is predominant in the soils of the northern third of the Yukon, and in high elevations throughout the rest of the Territory. Climate plays a major role in determining the extent of permafrost.

In the continuous zone, (map 6) permafrost is found in all places beneath the soil surface. It averages 100 m thick at the southern boundary, and increases in thickness to the north. (# 12 ).

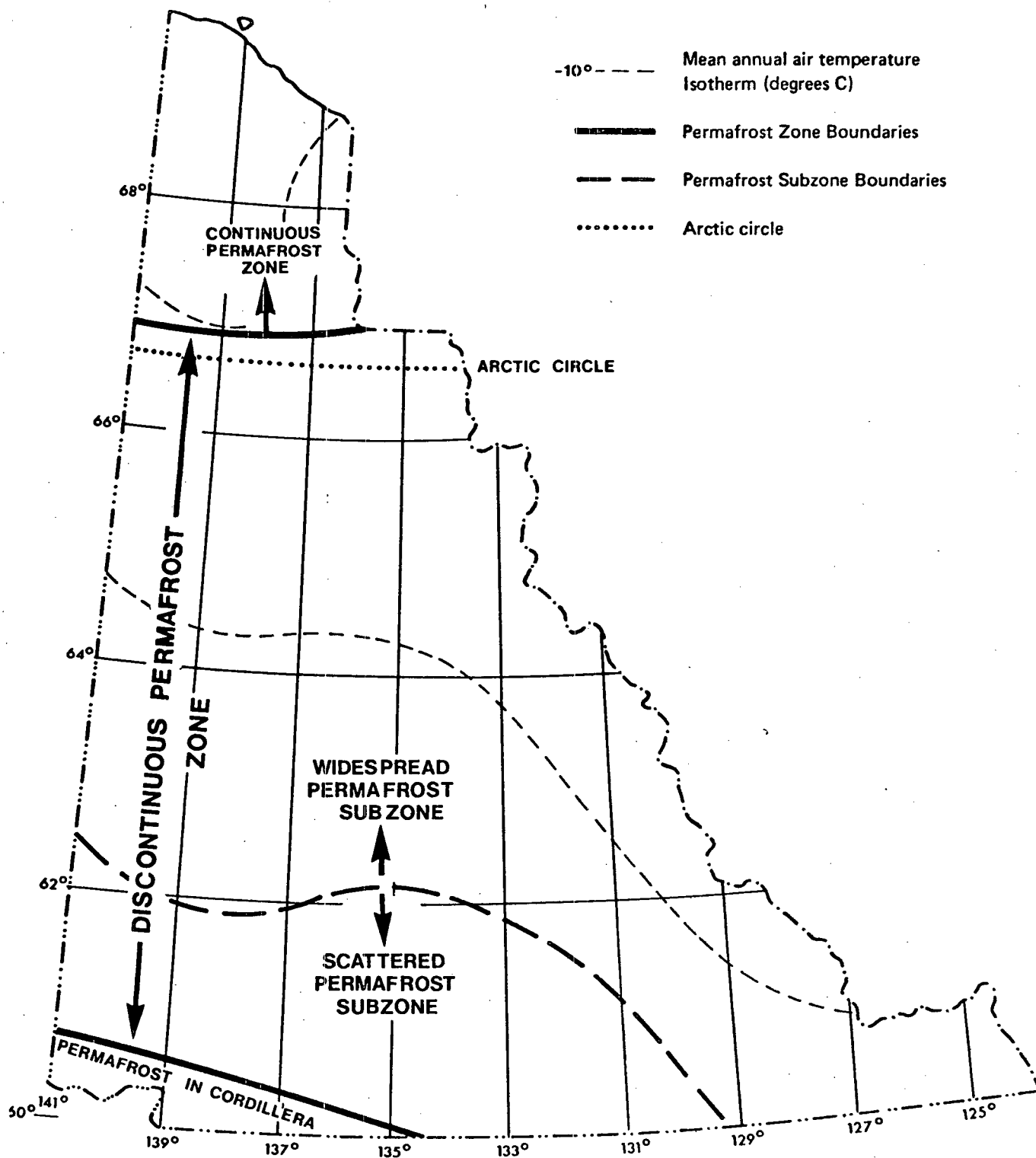
In the discontinuous zone, the permafrost may be patchy and/or seasonal, with or without an unfrozen interface zone between the active and permafrost layers.

Numerous geomorphological characteristics resulting from the action of permafrost dominate the northern landscape, e.g. hummocky land, potholes, polygonal patterns, thermokarst lakes etc.

Permafrost stops or slows down the seepage of precipitation and snowmelt into the ground, leading to rapid runoff in areas of permafrost at the time of melt and heavy precipitation (i.e. the Porcupine and Peel River drainages.), where summer flows are 300 to 400 times normal winter flows (# 7d ). Permafrost also causes considerable problems in construction of buildings and transportation routes, and affects the availability and accessibility of groundwater.

(F) Soils

Most of the Yukon's soils are poorly developed due to permafrost, lack of glacial and/or fluvial deposits and lack of



Map 6. Permafrost zones and subzones and mean annual air temperature isotherms adopted from Brown (in press).

Source: #12

vegetation in the colder areas. River valley alluvials in the southern Yukon are the primary source of good soils. Loess and volcanic ash (maps 5 and 7) contribute somewhat to the character of soils:

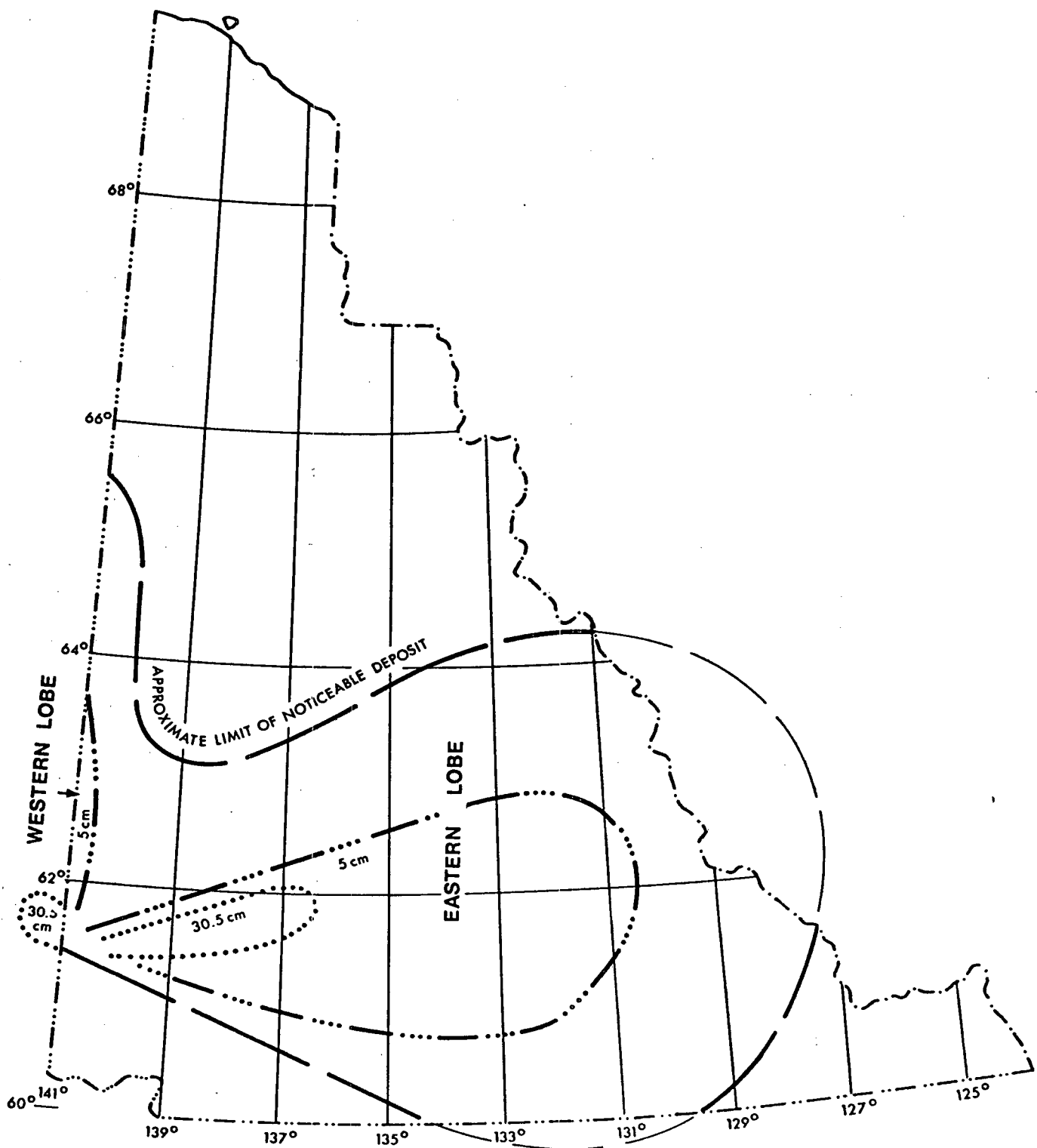
- loess is fine, silty, holds water well and freezes easily.
- volcanic ash varies in texture and is usually less effective in holding water.

In the southern Yukon, brunisols are prominent, with some podzols, regosols and gleysols present on floodplains. In the central and northern Territory, cryosols (soils associated with permafrost and arctic conditions) are predominant.

(G) Climate

The northern location and mountainous topography play major roles in determining the climate of the Yukon. The topography and prevailing air masses act together to form three general areas of climate:

- (a) In the southwest, the St. Elias Mountains cool and dry the warm, wet Pacific air that acts as the major climatic factor of the region.
- (b) Cold Arctic air acts primarily on the barren northern tundra, with partial modifying interference from the Richardson and British Mountains.
- (c) The large central portion of the Territory has a cold continental climate, dominated by the air masses moving in from the Northwest Territories. The Mackenzie-Selwyn-Ogilvie Mountains act as semi-permeable, modifying barriers to these air masses, giving the



Map 7. Extent and approximate depth of volcanic ash deposits (White River source). The eastern lobe was deposited about 1220 years B.P., the western lobe about 1900 years B.P. Adopted from Hughes, Rampton and Rutter (1972).

Source: #12

central Yukon an overall warmer climate than the Northwest Territories.

The mean annual temperature is below freezing, and the average annual rainfall is low, 250 to 380 mm. (a very arid climate; Map 8). Temperatures and rainfall vary however, from summer highs in the 30°'s Celcius to winter lows of -45° Celcius (Table 1). Precipitation can range from a few centimeters per year in the Arctic tundra to 1000mm or more per year in the St. Elias Mountains.

The overall climate is characterized by long, cold, dark winters with little precipitation to short, warm, light summers with slightly more precipitation.

The resulting short frost-free and growing seasons and limited daylight hours limit both forest and agricultural potential.

#### (H) Hydrology

##### (i) Sources of Information

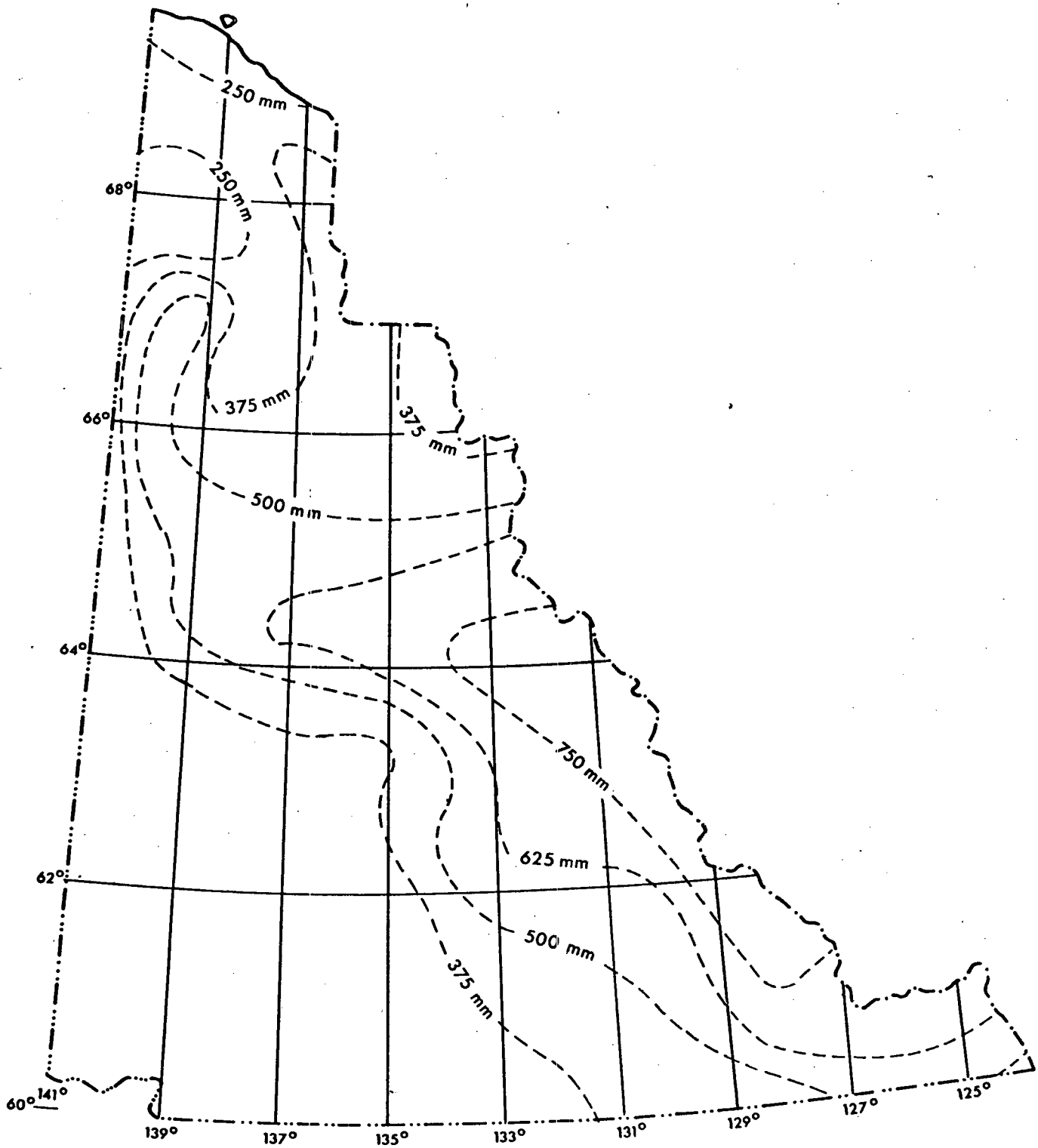
This section will outline the various agencies involved in water planning and management, the types of data collected and its availability.

#### Department of Indian Affairs and Northern Development (Whitehorse)

The duties of the Water Management Section of DIAND include:

- allocation of water use rights - water licensing.
- comprehensive planning, development and maintenance of water quality.
- maintenance of acceptable engineering standards for all works for the use of northern waters.

The instrument used by the Department is the Northern Inland



Map 8. Annual mean precipitation isohyets modified from Burns (1973).

Source: #12

Table 1

Yukon Temperature and Precipitation Statistics

	Lat.	Long.	Elev. (m)	Temp (°C)				Precip. (mm)	
				Annual	May-Sept	Jan.	July	Annual	June-Aug.
Haines Rd. M75	59°47'	136°36'	884	-3	6	-20	9	761	143
Watson Lake*	60°07'	128°49'	685	-3	11	-25	15	434	147
Carcross	60°11'	134°41'	661	-1	9	-19	13	226	69
Tuchita	60°55'	129°15'	759	-5	9	-31	13	605	155
Teslin*	60°10'	132°45'	701	-1	10	-20	13	326	99
Johnsons x	60°29'	133°20'	690	-3	9	-26	13	346	132
Whitehorse*	60°43'	135°04'	698	-1	11	-19	14	260	98
Haines Jct.*	60°45'	137°35'	599	-3	9	-21	12	281	90
Tungsten	61°57'	128°15'	1143	-6	7	-27	11	605	214
Ross River	61°59'	132°27'	698	-7	9	-35	13	253	102
Burwash	61°22'	139°03'	801	-5	8	-30	12	283	144
Anvil	62°22'	133°23'	1173	-4	7	-25	11	368	135
Carmacks	62°06'	136°18'	521	-5	10	-34	14	247	107
Ft. Selkirk*	62°49'	137°22'	437	-5	11	-30	15	276	113
Beaver Ck.	62°23'	140°53'	663	-7	9	-34	13	412	229
Mayo*	63°36'	135°53'	495	-4	11	-27	15	293	117
Dempster	64°27'	138°13'	991	-7	7	-28	11	453	157
Dawson City*	64°04'	139°26'	324	-5	11	-29	16	325	140
Old Crow	67°34'	139°50'	274	-10	8	-36	14	192	92
Shingle Pt.*	68°57'	137°13'	55	-10	4	-25	11	173	99
Komokuk B.*	69°35'	140°11'	9	-11	2	-24	7	125	71

Source: #12.

Waters Act, which provides outline regulations for licensing, pollution control and comprehensive planning. Under this act (implemented in 1972), all water users must obtain a license from the Territorial Water Board in Whitehorse, before any water use in the Yukon is allowed.

The water quality program operates a network of stations and has the following systems of operation:

(a) A surveillance network, designed to keep track of major mining operations, takes periodic (four to six times a year) water samples up and downstream of any development. All data is stored in the Naquadat computer system but no summaries or analyses of this information are available. Mining companies must provide monthly reports of pH, zinc, copper, suspended solids and other parameters that are affected as a result of the mining operation. This information is available in open files at DIAND in Whitehorse, and is being processed into the Naquadat computer system.

(b) Sampling of discharges of municipal sewage is conducted on a regular basis to check the effectiveness of community treatment systems. This information is not stored in Naquadat.

(c) Data-type information is collected in areas where there may be development, especially in mining. Only the most promising sites are surveyed, and the information is stored in Naquadat.

(d) Files are compiled on areas that appear to be "troublesome". (e.g. Tom Creek) due to apparently natural causes. For example,

a heavily mineralized stream could indicate a mineral outcrop in its drainage area.

(e) Sketchy data is being collected on the status of groundwater in the Yukon. From time to time, water quality tests are done on wells in use by various communities.

(f) Snowpack information is collected by the DIAND Waters Resources Section of Northern Natural Resources and Environment Branch, but it is available only in data form. A Snow Survey Bulletin is published monthly. Map 9 shows the locations of present sampling stations.

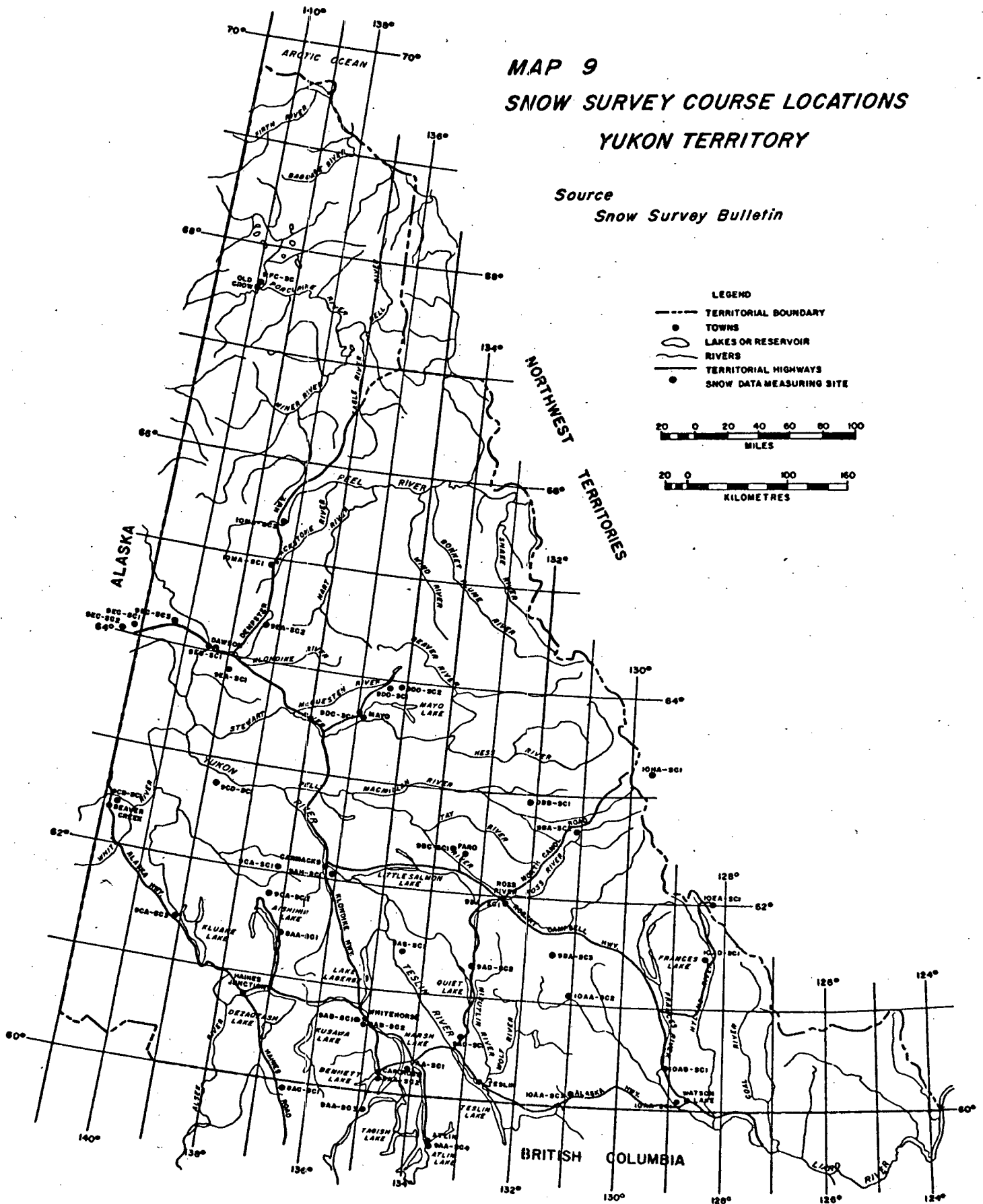
(g) The annual reports of mining companies operating in the Yukon are the best source of information on effluents and water quality associated with that industry. These reports are not published but are available in open files from the DIAND office, and from the companies involved, (see the section on mining).

The Waters Branch of DIAND hopes to compile and summarize much of the data stored in Naquadat once the system is fully operational in the Yukon.

In the Yukon, DIAND acts as a Territorial agency even though it is a Federal Department. The information collected is usually very site-specific, related to mining and municipal operations, and the direct effects that these developments have on the surrounding environment. Much of this work tends to overlap with work done by other Federal Agencies such as the Inland Waters Directorate and the Environmental

# **MAP 9** **SNOW SURVEY COURSE LOCATIONS** **YUKON TERRITORY**

Source  
 Snow Survey Bulletin



Protection Service.

#### Inland Waters Directorate

The Inland Waters Directorate operates most of the stream flow gauging stations as well as some water quality stations in the Yukon. The sampling network originated on a grid system, rather than sampling of representative river basins, because its primary purpose was to analyse water for high mineralization that might indicate potential mineral outcrops. When Water Survey of Canada was separated from Energy, Mines and Resources, stream flow gauges were established at sites most representative of the normal flows of that area. Most water quality samples were, and some still are, taken from flow gauge sites, however many of these sites may not be most representative of the water quality of that area.

Inland Waters Directorate publishes annual data summaries from all the gauges in operation as well as periodic data for various specific streams.

The information collected by Water Survey of Canada usually deals with broader based water bodies than the information collected by DIAND. Until recently, Inland Waters Directorate had not done intensive work in the Yukon because of the work that DIAND was doing there. However, with the ever increasing interest being shown in the potential of the Yukon, especially its power potential, Inland Waters Directorate is broadening its information base on the area.

#### Environmental Protection Service

The Environmental Protection Service in Whitehorse conducts a variety of studies related to both specific and general effects that

present and future developments have or may have on the biotic quality of the environment. Numerous publications based on these studies are available from the Environmental Protection Service office in Whitehorse.

Fisheries and Marine Service has conducted a number of studies on fish populations in the Yukon. Most of these studies are associated with present and proposed developments in power, transportation, mining and pipelines. They include observations and assessments of the physical and biochemical characteristics of the water bodies concerned, and are available from the Fisheries and Marine Service in Vancouver.

(ii) Hydrological Information

It is estimated that 50% of Canada's water resources are located north of the 60th parallel (# 4 ). The thousands of square kilometers of inland water resources of the Yukon are probably its most valuable resource of the future. Most industrial developments planned for the Yukon will depend on power supplied by one of its many waterways, and with the steadily increasing population of both tourists and residents, the demand for recreational, domestic and commercial fisheries use of water is rising. The future potential of the Yukon will depend on a workable integrated water use and protection system geared to handle all of these requirements.

This section covers physical hydrological information; water quality control and water use are discussed in following sections.

(a) The Major Drainage Basins

Map 10 shows the major drainage areas of the Yukon discussed in this report. In most discussions of drainage characteristics, the hydrology of the Stewart and Pelly River systems are included in the Yukon River system.

1. Yukon River

Length: 3680 km (Canada and U.S.)

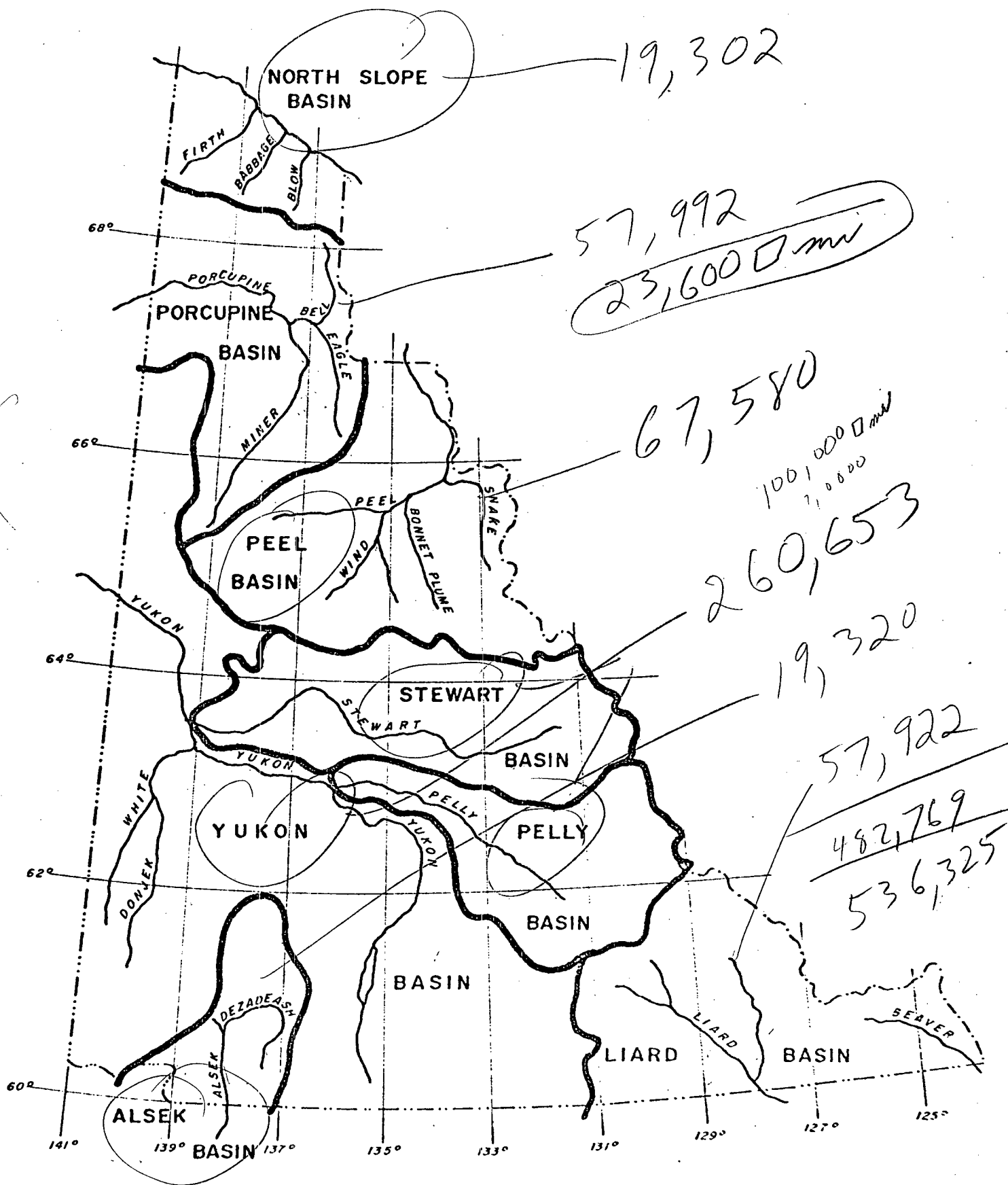
Drainage area: 260 653 km<sup>2</sup> (including Stewart and Pelly)

Percentage of Yukon drained: 54%

*2 km = 3861 m*

The Yukon River is the fourth largest river in North America and the major river system in the Yukon. Some of the system originates below the 60th parallel in northern British Columbia and the Alaskan panhandle. Its tributaries include the White, Donjek, Nordenskiold, Takhini, Teslin, Nisling, Pelly, Stewart, Macmillan, Klondike and Porcupine Rivers. Its headwaters include Bennett, Tagish, Atlin and Teslin Lakes in the Yukon, and glacier fed streams from the St. Elias Range. Other large lakes associated with the river include Kluane, Laberge and Marsh Lakes. The Yukon River runs northwest through the Yukon, enters Alaska just north of Clinton Creek and empties into the Bering Sea from Alaska.

Very little information is available on the general physical characteristics of the Pelly and Stewart Rivers. Each drain 7700-8000 square kilometers of the Yukon. The Pelly River is about 800 km long and runs along the Tintina Trench, and the Stewart River has its headwaters in the Selwyn Mountains and drains the Stewart Plateau.



Map 10. Major Drainage Areas of the Yukon.

Source: IWD

2. Alsek River

drainage area: 19 320 km<sup>2</sup>

percentage of Yukon drained: 4%

The Alsek River is located in the southwest corner of the Yukon. It has its headwaters in the Dezadeash Lake area of the Yukon, loops down to northwestern B.C. and drains into the Pacific from Alaska. Its tributaries include the Aishihik (site of a major power development), Dezadeash, Kiskawulsh and Dusty Rivers, and Aishihik, Sekulman (used as storage for the Aishihik dam), and Dezadeash Lakes. The rivers in this region are heavily silted due to glaciers in the area, and the Alsek river may be affected by silt or the advancing Tweedsmuir glacier (downstream of the dam ), (# 11 ).

3. Liard River

drainage area: 57 922 km<sup>2</sup>

percentage of Yukon drained: 12%

The Liard system drains the Logan and Cassiar mountains in the southeast corner of the Yukon. Its tributaries include the Rancheria, Meister, Frances, Hyland and La Biche Rivers in the Yukon, before it drains into the Mackenzie River in the Northwest Territories. Frances Lake is the only large lake in the area, though numerous small ones are present. The Liard Basin supports the only economically valuable forest resource in the Yukon and is an important recreational area.

4. Peel River

area drained: 67 580 km<sup>2</sup>

percentage of Yukon drained: 14%

The Peel River, characterized by wide channels, extensive mud banks and large post-precipitation runoffs, drains most of the Wernecke Mountains, northwest Ogilvie and southwest Richardson Mountains. Its tributaries include the Ogilvie, Blackstone, Hart, Wind, Bonnet, Plume and Snake Rivers and several small lakes in the Bonnet-Plume Basin. It runs east then north from its headwaters in the Peel Plateau area, and joins the Mackenzie River in the Mackenzie Delta, Northwest Territories.

5. Porcupine River

area drained: 57 992 km<sup>2</sup>

percentage of Yukon drained: 12%

The Porcupine River system drains the southern British, Western Richardson and northeastern Ogilvie Mountains. Its tributaries include the Rock, Eagle, Whiteston, Old Crow, Miner and Bell Rivers. Small to moderate sized lakes are abundant and are usually oriented in a northeast-southwest direction. Although the Porcupine River drains into the Yukon River at Fort Yukon, it is considered a separate basin because of its different climate and physiography. The Porcupine River has been called the warmest and most productive river in the Yukon because large areas of the river remain open all winter and are used extensively by fish populations (# 58).

6. North Slope Rivers

drainage area: 19 302 km<sup>2</sup>

percentage of Yukon drained: 4%

With headwaters in the British Mountains, this system

is composed of several rivers which flow north and drain into the Beaufort Sea. The Big Fish, Blow, Babbage, Firth and Malcolm Rivers are the main rivers, and numerous small lakes are found on the low level plains that slope down to the sea.

(b) Hydrological Characteristics

Many factors affect the drainage characteristics of Yukon river systems. The climate, especially the low precipitation and cold, is an important factor, along with local topography. Depending on the location; vegetation, permafrost, glaciation, lakes and ground-water all affect drainage characteristics.

1. Runoff Characteristics

Water Survey of Canada collects stream flow information from the hydrometric stations shown on Map 11.

Orographic uplift over the Selwyn Mountains results in higher than normal precipitation, leading to higher runoff in the headwaters of the Stewart, Pelly, Macmillan, Hess, Frances and Hyland Rivers.

A similar situation occurs in the southwest corner of the Yukon.

The average annual runoff in these areas is 355mm/year or 1 cfs/mi<sup>2</sup>.

The central plateau and northern systems have much lower precipitation and runoff; 25-50mm/year or .1 cfs/mi<sup>2</sup>. (Map 12.).

2. Lakes

The Yukon contains a large number of lakes. Table 2 lists those lakes with a surface area greater than 5 square miles. Most of

**WATER SURVEY OF CANADA  
GAUGING STATIONS  
AND  
WATER QUALITY SAMPLING STATIONS**

② Water Survey of Canada  
gaging stations, as  
listed in Appendix B.

▲ Water Quality Branch  
sampling stations

**NOTE :**

**- Source - 7d**

SCALE: 25 0 25 50 75 100 125 150 MILE

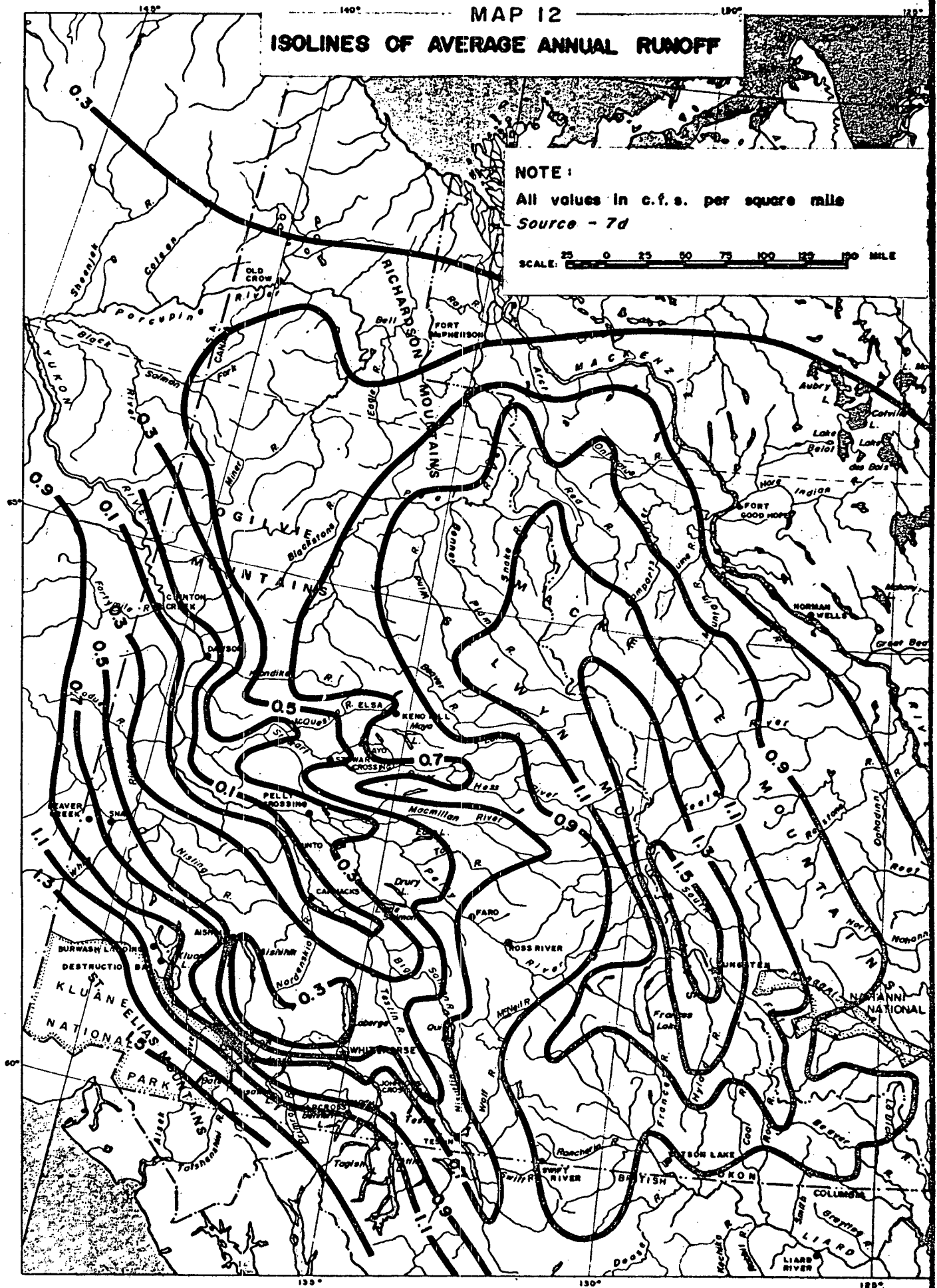


Table 2

Yukon Lakes With Surface Area Five Square Miles Or Greater

<u>Lake Name</u>	<u>Total Area</u>	
	<u>square miles</u>	<u>square kilometers</u>
Atlin Lake *	232	601
Kluane Lake	153	396
Teslin Lake*	147	381
Tagish Lake*	135	350
- Taku Arm	93	241
- Graham Inlet	14	36
- Windy Arm	7	18
Lake Laberge	78	202
Aishihik Lake	58	150
Kusawa Lake	54	140
Frances Lake	43	111
Marsh Lake	39	101
Mayo Lake	36	93
Bennett Lake*	36	93
Dezadeash Lake	30.0	77.7
Wellesly Lake	30.0	77.7
Wolf Lake	28.8	74.6
Little Salmon Lake	25.0	64.8
Quiet Lake	21.0	54.4

\*Lake partially in British Columbia

Table 2 con't

<u>Lake Name</u>	<u>Total Area</u>	
	<u>square miles</u>	<u>square kilometers</u>
Sekulmun Lake	19.7	51.0
Ethel Lake	17.6	45.6
Little Atlin Lake	16.0	41.1
Big Kalzas Lake	15.3	39.6
Kathleen Lakes	15.0	38.9
Earn Lake	14.4	37.3
Tatlmair Lake	11.8	30.6
Drury Lake	10.6	27.5
Fairweather Lake	8.7	22.5
Simpson Lake	8.6	22.2
Fortin Lake	8.0	20.7
Bates Lake	7.6	19.7
Finlayson Lake	7.6	19.7
Dianain Lake	7.5	19.4
Reid Lakes	7.4	19.2
Tin Cup Lake	7.3	18.9
Tilley Lake	7.3	18.9
Pelly Lakes	7.3	18.9
Janet Lake	7.2	18.6
McEvoy Lake	7.0	18.1
Morris Lake	6.8	17.6
Mush Lake	6.4	16.6
Watson Lake	6.0	15.5

Table 2 con't

<u>Lake Name</u>	<u>Total Area</u>	
	<u>square miles</u>	<u>square kilometers</u>
Nesutlin Lake	5.9	15.3
Long Lake	5.7	14.8
McQuesten Lake	5.4	14.0
Kloo Lake	5.0	13.0

Source: # 16 .

the large lakes are in the southern Liard, Yukon and Alsek River Basins.

### 3. Flow Variability

Appendix 1 contains sample hydrographs for the major rivers in the Yukon. All rivers show an annual runoff cycle reflecting climatic characteristics, storage effects and topography. Large lake storages tend to regulate flows (i.e. give a more regular hydrograph), as in the case of the Teslin River at Teslin Lake (9AE001), and the Kluane River downstream of Kluane Lake (9CA002). The Yukon River at Whitehorse has an "artificially" regular hydrograph due to hydro power water storage in the area.

The Pelly River (9BC002), Stewart River (0DC002), Liard River (10AA001), Dezadeash River (8AA003) and Wheaton River (9AA012) all show erratic runoff patterns characterized by short multiple peaks in the high runoff season. This pattern is usually associated with small basins that have a "flashy" character.

Most runoff occurs between May and October with most peak runoffs in June (the exception to this occurs in glacial regions, i.e. the peak month for the Kluane River is August).

Minimum flows occur from February to April.

### 4. Sediment (Table 3)

Water Survey of Canada collects sediment data and publishes it in an annual summary report, but no analyses of this data

Table 3  
Suspended Sediment Data

River	Gauge	Date	Suspended Sediment Concentration, ppm
Pelly	Pelly Crossing	Nov. 1970	11
	9-BC1	Jun. 1970	300, 355
		July 1970	166, 102
		Jan. to Mar 71	5, 3, 6
		May 1971	29-1, 260
		Jun 1971	210
		July 1971	61
		Aug. 1972	309
Yukon	Whitehorse	May to Nov 70	10 samples .9
	9AB1	Jan, Feb 1971	2
Yukon	Dawson	Jun 1971	354
	9EB1	Aug 1971	300
White	At Mouth	Jun 1972	136
Aishihik	9AA5	Jun 1972	249
Liard	Upper Crossing	May 1972	291
	10AA1		

Source: # 16 .

are available. The only reference to natural sedimentation problems encountered was for the Alsek and associated rivers where inland flowing glaciers were causing some problems (# 11 ).

#### 5. Water Quality

Water Quality Branch collects water quality data at various stations throughout the Yukon. The information is available in data for at the present time. Mining companies collect more detailed water quality data associated with present and possible future developments.

Table 4 classifies the major rivers according to their hardness. In general, the nutrient and mineral levels in undeveloped or unpolluted rivers is low. A summary table of water quality in major Yukon Rivers is available in bibliography #16.

#### 6. Groundwater

An estimated 88% of the residents in the Yukon depend on groundwater for drinking water for all or part of the year, and consumption appears to be increasing. In this section the physical characteristics of groundwater will be discussed. The use of this water is discussed in the "Water Use" section of the report.

Many excellent aquifers are found in areas once covered by glaciers. (Map 5), in the glacio-lacustrine sand-gravel and till sediments below thick alluvium and silt-clay deposits. These aquifers are usually found in valley bottoms, especially in fault-block valleys such as the Shikwak valley. Valley bottom aquifers are fed by nearby lakes and rivers.

Table 4

Water Hardness in Major Yukon Rivers

<u>Soft</u>	<u>Moderately Hard</u>	<u>Hard</u>
Wheaton River	M'Clintock	Pelly R. @ Ross R.
Yukon @ Whitehorse	Teslin	Pelly R. @ Pelly Crsg
Takhini	Big Salmon	Stewart @ Mayo
	Yukon @ Carmacks	Stewart @ Stewart Crsg
	Ross	Porcupine
	White	Peel
	Klondike	
	Yukon @ Dawson	
	Liard	
	Frances	

The rivers are overall slightly alkaline, with median values of pH ranging from 7.7 to 8.2.

Hardness as CaCO<sub>3</sub>, mg/l

0 - 60  
61 - 120  
121 - 180  
greater than 180

Name

Soft  
Moderately Hard  
Hard  
Very Hard

Source: # 16.

In non-glaciated areas, unconsolidated aquifers are found only on alluvial terraces and in river bottom alluvium.

Few bedrock aquifers exist in the Yukon but those that are in use produce water of excellent quality, i.e. the Keno Hill Hotel.

The presence and availability of groundwater in the Yukon depends on the geology, surface water and permafrost characteristics.

In relation to permafrost, groundwater exists:

- above permafrost in shallow, easily contaminated pools, available only in the summer.
- within permafrost in alluvium near rivers, in abandoned river channels and in glacio-fluvial material on the floors of wide river valleys (e.g. Pelly River). This water is usually connected to water above and below permafrost in adjacent areas.
- below permafrost, especially in discontinuous permafrost zones where the permafrost may be only several feet thick.

In the southern fringe of permafrost (map 6), groundwater movement occurs mainly in river valley bottoms and plains.

In the widespread zone, permafrost can severely limit the natural recharge of aquifers, and the only aquifers in use are those in river floodplains where soils are coarse and do not freeze easily.

In the continuous permafrost zone, springs that feed the Porcupine River remain unfrozen for most of the year, though very few communities exist in that area to use them.

## 7. Ice

Very little information is available on river ice in the

Yukon. Appendix II on River Ice Data is one of the few publications available on the subject.

Annual average freeze up occurs from the second week in October to the second week in November, and average break-up time is between April 29th and May 18th. Most river ice measurements are taken at Water Survey of Canada hydrometric stations and may not be representative of ice characteristics of the river in question. Many of the smaller streams freeze to the bottom in winter, and the average ice thickness in larger rivers varies greatly.

Unfrozen sections of large rivers are extremely important to overwintering fish, and only a few such areas are known and have been studied.

Ice jamming at break-up is a major cause of floods in the Yukon, and will be discussed further in the section on floods.

#### 8. Floods (Table 5)

Nearly all communities in the Yukon are situated on river flats and have been flooded at one time or another. Three types of floods occur in the Yukon:

- (a) Floods due to ice jamming on rivers, usually at spring break-up but occasionally during freeze up. This type of flood is common on the Yukon (at Dawson especially) and Porcupine Rivers. Damage can be extensive, but the flood is usually confined to short reaches of the river.
- (b) Floods due to exceptionally heavy snowmelt sometimes accompanied by rain; usually occurring a few weeks after break-up. This type of flood is characteristic of the Mayo and Ross Rivers.

Table 5

Maximum Discharge and Date

Year	Ross at Ross River 9BA-1	Pelly at Ross River 9BC-2	Pelly at Pelly x-ing 9BC-1	Stewart at Mayo 9DC-2	Stewart at Mouth 9DD-3	Klondike 9EA-3	Yukon at Dawson 9EB-1	Porcupine Below Bell 9EB-1	Porcupine Old Crow 9ED-1	Yukon at White Horse 9AB-1
1973	May 10 14,100	May 19 30,600		June 12 67,300				May 18 101,000	May 31 135,000	
1972	June 2 29,600	June 1 62,100	June 4 122,000	June 2 103,000	June 3 128,000	May 29 22,600	June 3 426,000	June 1 100,000e	June 1 121,000	Aug. 24 21,000
1971	June 13 13,900	June 12 32,400	July 1 76,600	June 14 93,200	June 16 98,200	June 11 16,800	June 16 269,000	Aug. 13 88,600	May 22 218,000	Aug. 23 22,700
1970	June 7 18,600	June 7 37,600	June 10 80,600	June 7 104,000	June 9 106,000	June 25 12,100	June 10 246,000	July 9 57,700	May 28 85,000	Aug. 11 14,100
1969	July 15 11,600	July 15 31,500	June 13 49,300	June 13 66,700	June 14 66,400	June 11 10,100	June 15 216,000	Aug. 26 23,500	Aug. 7 55,800	July 20 17,900
1968	May 23 15,800	May 23 34,400	May 25 70,900	June 14 73,900	May 29 78,900	May 21 12,600	May 26 257,000	June 25 24,600	June 2 158,000	Aug. 23 17,100
1967	June 5 18,000	June 2 51,600	June 5 106,000	June 4 97,400	June 4 101,000	June 2 14,500	June 6 347,000	--	June 5 158,000	Sept 25 18,600
1966	June 17 11,400	June 17 30,100	June 13 60,500	June 17 78,200	June 18 74,100	June 9 15,300	June 21 247,000	--	May 17 159,000	Aug. 3 16,200
1965	June 3 12,200	June 3 33,200	June 3 62,600	June 3 63,800	June 3 69,100	July 5 16,000	June 3 233,000	July 28 88,800	May 25 178,000	Aug. 2 16,100
1964	June 10 24,400	June 7 71,000	June 11 147,000	June 10 145,000	June 13 199,000	NO RECORD	June 11 526,000	June 6 178,000	June 4 237,000	Aug. 28 20,900
1963	May 25 17,200	May 25 42,300	May 28 87,900	May 25 85,700	NO RECORD		July 14 279,000	NO RECORD	May 18 194,000	Sept 20 21,500
1962	June 18 20,800	June 18 57,200	NOT AVBL.	NOT AVBL.			June 18 386,000		May 27 168,000	Aug. 27 19,000
1961	NO RECORD	June 11 53,400					June 13 357,000		June 5 76,000	Aug. 25 22,200
1960	NO RECORD	June 21 25,100					Aug. 1 230,000		NO RECORD	Aug. 16 19,700

- (c) Flash floods due to very heavy summer rain. This type of flood rarely affects larger rivers, but is common on small tributaries.

The following is a brief summary of flooding problems and protection measures in major Yukon communities:

The town of Dawson has been subjected to flooding about once every 10 years since 1898. In 1959, a dike was built and has been raised several times since then. At present the elevation of the dike is 1053.6 G.S.C. which is high enough to protect the town from a 100 year return period peak discharge, but not from a 100 year return period ice jam. (# 15). Dawson City is characterized by flood threats caused by ice jamming on the Yukon River.

Mayo is at present adequately protected by a dike. The town of Ross River however, has a dike in urgent need of repair and will not be sufficient to protect the town from any major flood (#15 ).

Old Crow has no adequate permanent flood protection scheme, and it would probably be uneconomical to construct one. The town relies on emergency evacuation in times of floods; ie. the large flood of 1964 - ref. # 15. )

Whitehorse is adequately protected by the dampening effect of the Marsh Dam reservoir, and by various dikes around the town. Regular winter flooding occurs on Whiskey and Moccasin Flats and Wells subdivision due to ice jamming.

Further detailed information on the flooding characteristics in the Yukon is available in the "Yukon Flood Study" by Fenco, however protection measures in the major communities may have been updated since the writing of the Fenco report.

## II. Biological

### (A) Wildlife

Very little information exists on the status of wildlife in the Yukon, with the exception of the Porcupine Caribou herd. This lack of information has been particularly noticeable in the recent Foothills pipeline hearing and will have to be remedied before environmental effects of pipelines or other developments can be fully understood. (# 21 ). The Canadian Wildlife Service has only just begun studies on wildlife in the Yukon, and these studies will probably not be completed for several years.

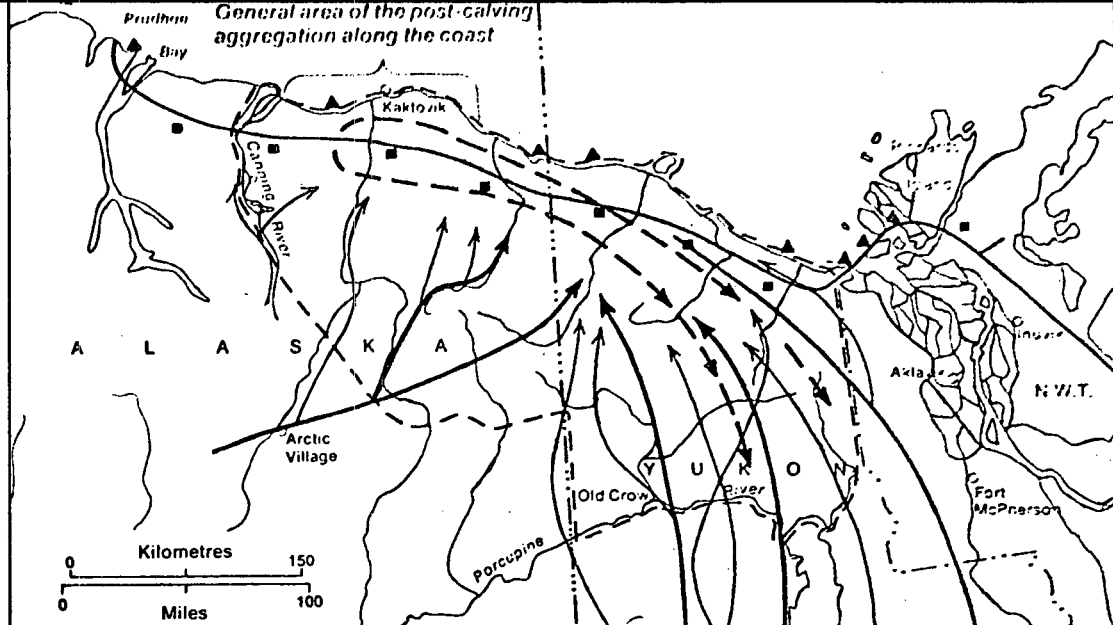
The Yukon possesses a rich and varied wildlife resource base, largely unaffected by man. Due to the harsh environment, fewer numbers of each species exist in the Yukon than in southern regions, however the Yukon does support a large variety of species. Big game species include barren ground and mountain caribou, moose, mule deer, elk, dall and stone sheep, mountain goat, grizzly, black and polar bear, wolf and cougar. A large variety of fur-bearing animals, upland game and migratory birds, and non-game species inhabit the entire Territory.

A few of the more important species and regions deserve special consideration:

(a) The Porcupine Barren Ground Caribou Herd is the most studied wildlife species in the Yukon. Map 13 shows the annual routes of migration taken by these animals from their summer calving grounds on the North Slope tundra, south to the boreal forests of the Porcupine-

**THE COASTAL ROUTE AND THE CARIBOU: GENERALIZED MOVEMENTS OF THE PORCUPINE CARIBOU HERD IN MAY, JUNE AND JULY**

- Principal calving area .....
- Spring migration .....
- Post-calving movement .....
- Arctic Gas Coastal route .....
- Compressor station .....
- Wharf/staging area .....
- Boundaries of existing Arctic National Wildlife Range in Alaska and proposed Northern Yukon Wilderness Park .....

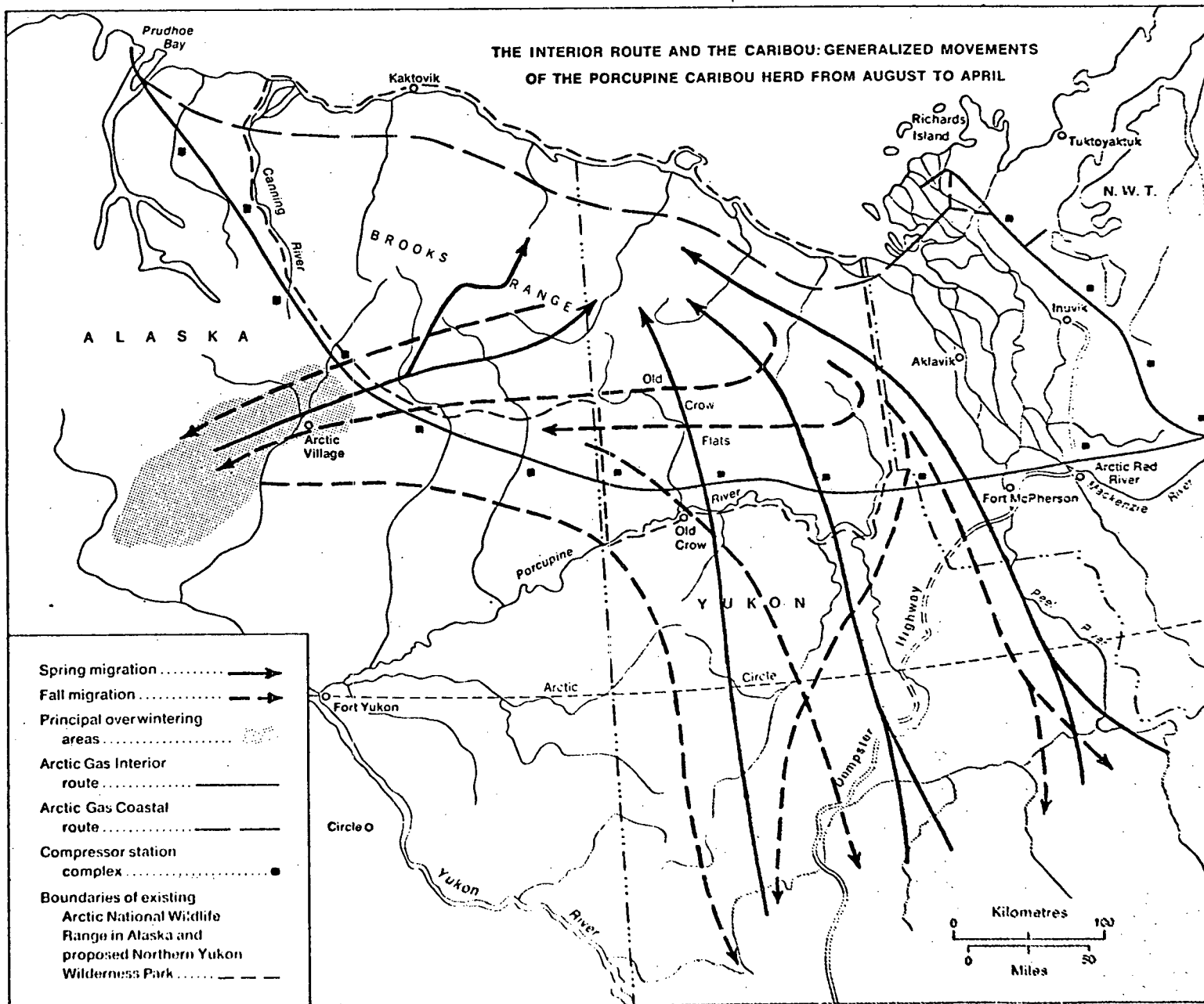


**MAP 13**

**SOURCE-20**

**MIGRATION ROUTES OF THE PORCUPINE CARIBOU HERDS**

**THE INTERIOR ROUTE AND THE CARIBOU: GENERALIZED MOVEMENTS OF THE PORCUPINE CARIBOU HERD FROM AUGUST TO APRIL**



Peel drainages or southwest into Alaska. The Porcupine Herd stands at about 110,000 animals and is one of the last great herds of this continent (#20). The people of Old Crow rely on the herd for sustenance.

The Dempster Highway, now under construction, crosses one of the migration routes of the herd, but the impact of this road on the herd is not yet known. The proposed Mackenzie Valley Pipeline would have been a major obstruction to the herd, but it is unlikely that this pipeline will go through.

The Arctic National Wildlife Range in Alaska has been set aside for the protection of these animals. A similar reserve has been proposed for the north slopes of the Yukon, but it is not yet in existence.

Old Crow Flats is a major breeding territory for thousands of migratory waterfowl. It supports an estimated 500,000 ducks, geese and swans. The Mackenzie Delta and Arctic Coast of the Yukon serve as nesting grounds for about 1/5 of the world's whistling swans, and the Yukon Coastal Plain and Mackenzie Delta serve as summer feeding grounds for tens of thousands of snowgeese (#20). The Canadian Wildlife Service is conducting studies on the habits of the Yukon's waterfowl populations, and a preliminary summary of their data is available in the IWD, Water Planning and Management library.

A number of rare and/or endangered species are found in the Yukon. Trumpeter swans, sandhill cranes (migratory nesting species), peregrine falcons, gyrfalcons and golden eagles use or inhabit various parts of the Yukon as permanent residence or as migratory

stopovers. Very little is known about the role that the Yukon habitats play in their life histories.

Until recently, research and information on the Yukons wildlife was almost non-existent. Aerial reconnaissance and land studies are ongoing and by the early 1980's a complete inventory of the wildlife resource of the Yukon should be available.

The Wildlife Resource: Economic Use and Potential

Consumptive utilization of the wildlife resource had been the mainstay of the native population until the arrival of the White Man. Many of the more isolated native communities still depend on hunting and fishing for sustenance, while many other Indians make or supplement their incomes by guiding and/or trapping.

Table of Economic Value of the Yukon's Wildlife Resource

(A) Consumptive Use of Wildlife

Contributed from resident hunters	\$ 600,000
Contributed from non-resident hunters	1,500,000
Sale of furs by trappers	500,000
Monetary value of wild meat & hides	1,000,000
Revenues collected for wildlife resource use	250,000
Total (tangibles)	\$ 3,850,000

(B) Non-consumptive Use of Wildlife

Contributed by non-resident hunters	1,200,000
Contributed by resident hunters	1,800,000
Contributed by tourists	4 to 5,000,000
Contributed by non-hunting Yukoners	No data available.
Total(intangibles)	6 to 7,000,000

Source: (# 25 )

(a) Hunting

In 1973, the total estimated income from resident and non-resident hunters was about \$2 million, and provided a considerable amount of temporary work for native people. The Game Branch estimates that the allowable harvest has not yet been utilized, and that more animals could be taken without damaging the big game resource. However, the harvest of animals is not even throughout the Territory, and heavy hunting has severely depleted some of the more accessible southern areas.

(b) Trapping

In 1973, there were 357 registered traplines with over 600 people (about 75% natives) employed. The 1973/74 fiscal value of furs sold by trappers was about \$ $\frac{1}{2}$  million. There is room for growth in this industry, but the uncertain market and isolated conditions of the Territory limit its potential.

(c) Non-Consumptive Values

With tourism as the Yukon's second major industry, non-consumptive recreational use of the wildlife resource will become increasingly important. It is very hard to quantify the aesthetic value of this resource, but it is obvious, especially in the light of increasing anti-hunting sentiments, that non-consumptive use of wildlife has potential, if it is integrated with other aspects of the tourism industry.

### Areas of Conflict

One of the major problems in wildlife management in the Yukon seems to be the lack of integration and cooperation between the Territorial Game Branch, the Federal Parks Branch, the Canadian Wildlife Service, and the tourism promotion industry. Federal Agencies, until recently, took next to no interest in the wildlife of the Yukon, and at the present time, studies are not well integrated with the work of the Territorial Game Branch (# 25 ). In view of the rapidly increasing tourism industry, the lack of an overall tourism policy and limited involvement of federal agencies geared to control natural resources will only retard the successful environmental management of the Territory's wildlife resource.

To date, environmental studies on proposed developments, (transportation, mining, power, etc.) have not included sufficient information on potential effects on the wildlife resource. Of particular importance is the preservation of : waterfowl habitat on Old Crow Flats; ungulate winter range in the watersheds of central and southern Yukon; established migration routes for land, air, and water migratory species, (often of international concern); and habitat of rare and endangered species.

The Sigma study on power development in the Yukon outlines site by site, effects that proposed hydro projects may have on wildlife in the areas concerned (refer to table 11 in the Water Use Section, p.107). Until a more comprehensive information base is available on the wildlife resource of the Yukon adequate planning and management is difficult.

(B) Vegetation (Maps 14 and 15)

"Ecoregions of the Yukon Territory" by E.T. Oswald and J.P. Senyk of the Canadian Forestry Service, provides a detailed region by region description of the vegetation (and geology, physiography, drainage, climate, glaciation and terrain features) for each of the Yukon's 22 ecoregions. The following description serves as only a very general summary of the vegetation.

The lower elevation terrain of the southern Yukon is heavily forested with conifers and hardwoods. As latitude and/or elevation increases, tree density decreases to the point of barren alpine or arctic tundra on high slopes and most far north plains.

The major species in the southeast region are white and black spruce. Larch, alpine fir, lodgepole pine, aspen, balsam poplar and birch are also common, but to the north and west, larch, fir and lodgepole pine disappear almost completely. Frequent forest fires in the south-central and south-eastern regions have replaced black and white spruce with lodgepole pine as the dominant species.

Most stands in the southwest include black and white spruce, (dominant), aspen, balsam poplar and paper birch.

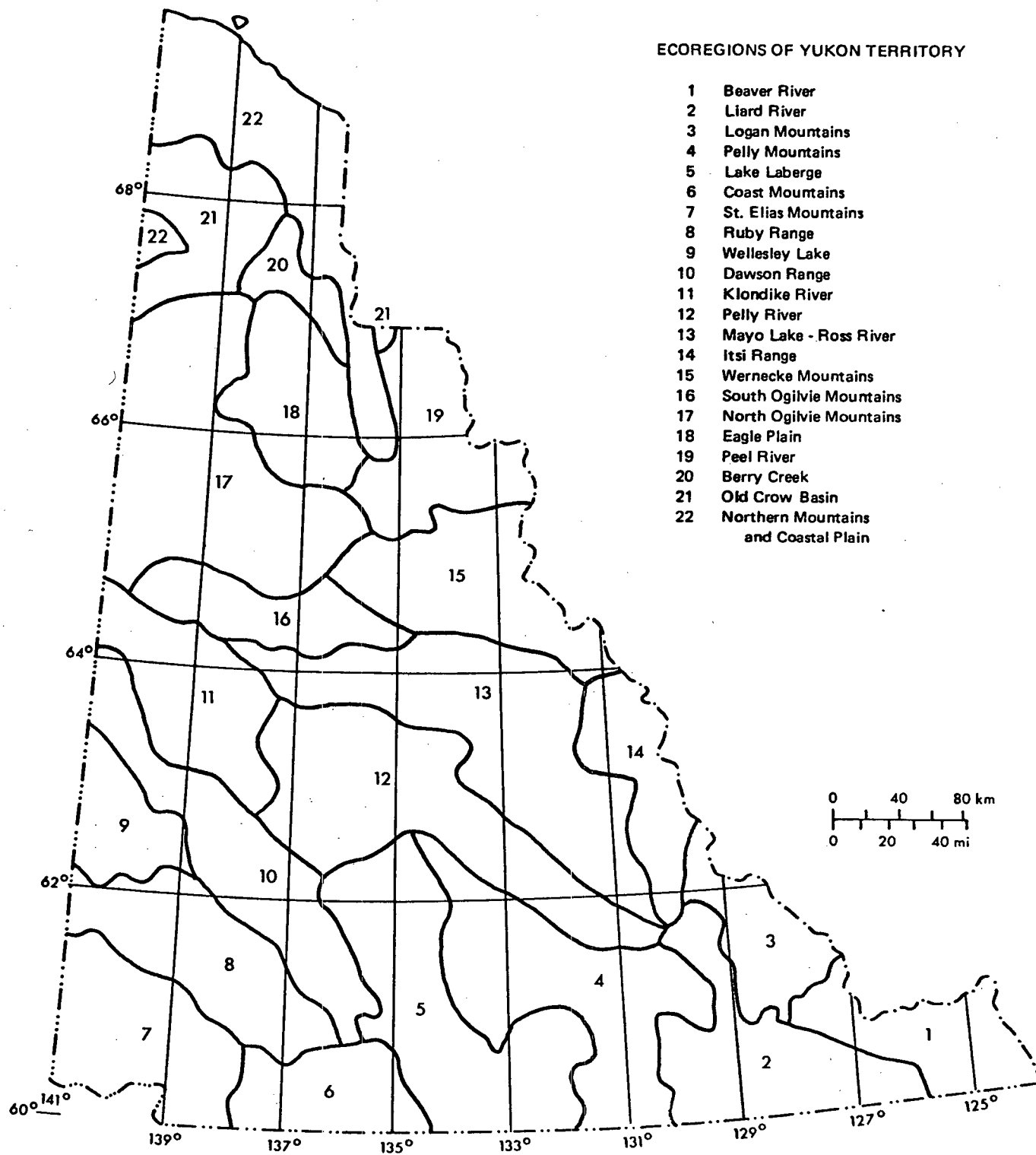
Alpine fir is the dominant alpine timberline species in the southeast and central Yukon, while white spruce replaces alpine fir to the north and west. Black and white spruce are dominant arctic treeline species.

Grasslands are prevalent only on the steep dry south slopes of the Yukon and Pelly Rivers.

Arctic tundra is characterized by low shrubs in the southern

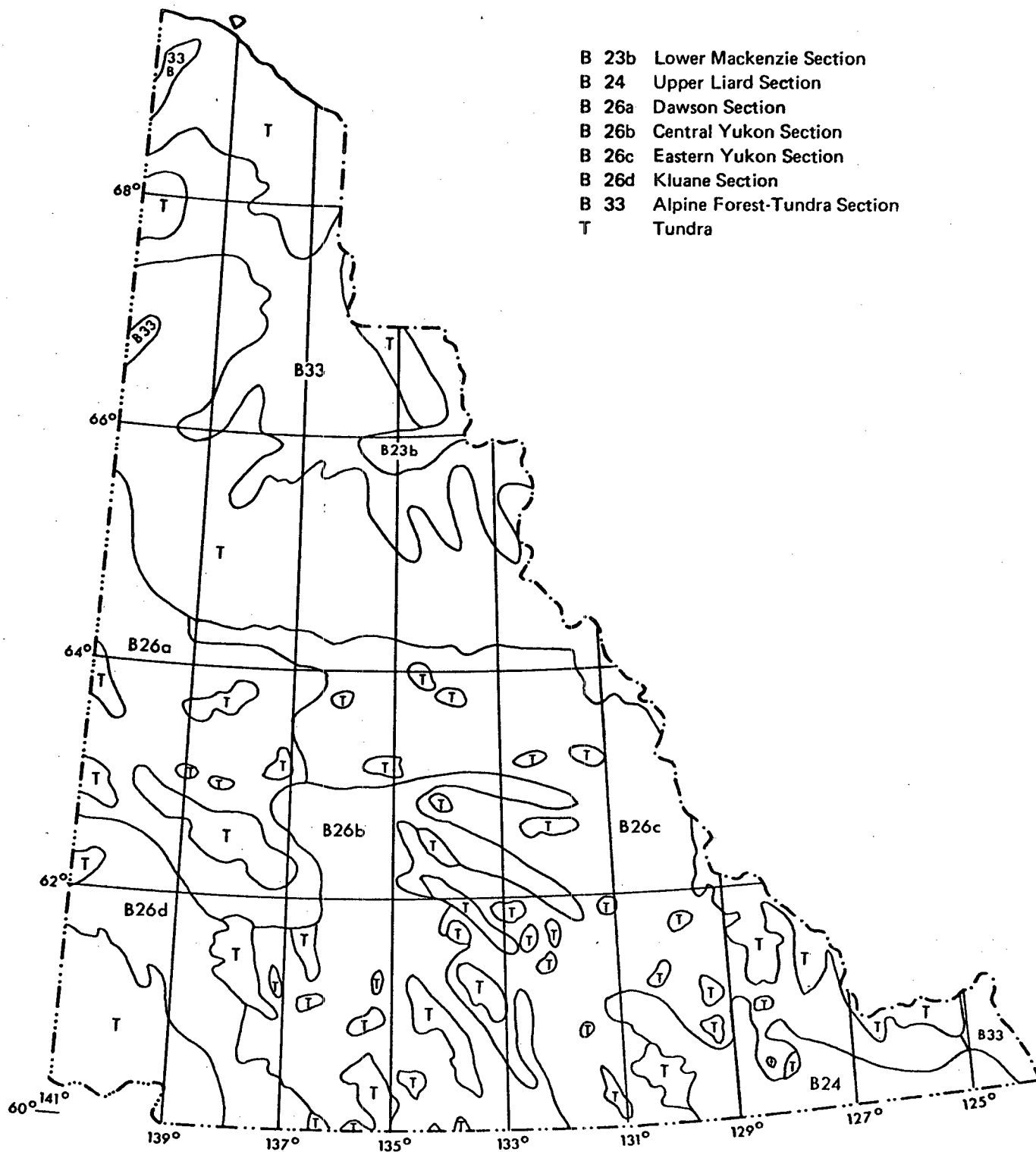
# ECOREGIONS OF YUKON TERRITORY

- 1 Beaver River
- 2 Liard River
- 3 Logan Mountains
- 4 Pelly Mountains
- 5 Lake Laberge
- 6 Coast Mountains
- 7 St. Elias Mountains
- 8 Ruby Range
- 9 Wellesley Lake
- 10 Dawson Range
- 11 Klondike River
- 12 Pelly River
- 13 Mayo Lake - Ross River
- 14 Itsi Range
- 15 Wernecke Mountains
- 16 South Ogilvie Mountains
- 17 North Ogilvie Mountains
- 18 Eagle Plain
- 19 Peel River
- 20 Berry Creek
- 21 Old Crow Basin
- 22 Northern Mountains and Coastal Plain



Map 14. Ecoregions of Yukon Territory.

Source: #12



Map 15. Forest regions adopted from Rowe (1972).

Source: #12

areas, grading to tussock fields of sedge or cottongrass further north. Some black spruce and larch may occur in tussock fields, but shrub, forb, lichen and moss-lichen communities are more common at higher elevations. The alpine regions are noted for their variety of beautiful flowering plants.

### III. Socio-Economic

#### (A) Mining and Minerals

Since the mid 1800's, mining has been the major industry in the Yukon and will probably continue as such in the near future.

D. Templeman-Kluit (Geological Survey of Canada) said, "..... the more relatively dominant the basic industry, the greater the sensitivity to change - for better or for worse". (# 42 ). This statement holds true for the mining industry in the Yukon.

In 1976, widespread strikes closed down the major mines in the Yukon resulting in a substantial depression in the overall economy:

- drastic reduction in use and revenue collected by the Yukon's one railway.
- losses of over \$200,000/month in revenue to N.C.P.C. when Cyprus Anvil Mines closed.
- loss to the Territory of over \$500,000 in fuel taxes.
- many workers left the Territory in search of work, resulting in further depression on the economy.

The economic impact of this strike demonstrated the need to build up supporting industries in the Yukon, but in the meantime, mining continues to be the most important industry. (Table 6, a & b).

In 1974, the industry employed about 17% of the work force and paid 25% of the Territory's total wages. From 1965 to 1975, over \$300 million in new mining capital has flowed into the Yukon (2/3 from outside and 1/3 from resident companies). The 1975 production per capita, (\$10,000) was more than twice that for B.C. or Ontario. Claims and drilling were up compared to previous years,

Table 6a

## Mineral Production Chart 1966 to 1975

Yukon Territory												(c)
Gold	\$ ounces	1,639,103 43,466	675,725 17,900	911,338 24,167	1,118,715 29,682	653,034 17,862	511,534 14,473	234,983 4,079	2,032,502 20,865	4,111,631 26,472	4,245,000 26,000	275,662,486
Silver	\$ ounces	5,868,217 4,194,580	6,701,756 3,869,374	4,806,384 2,077,987	5,182,166 2,685,060	7,845,312 4,240,709	8,966,417 5,747,703	8,331,575 4,988,967	15,342,856 6,073,973	26,800,905 5,789,783	29,434,000 6,516,000	205,523,995
Lead	\$ pounds	2,386,084 15,975,125	2,141,959 15,299,709	970,629 7,221,940	4,256,183 28,056,581	20,830,196 131,670,010	29,340,379 217,336,142	34,392,366 222,921,742	38,013,324 235,522,452	41,194,600 198,950,056	56,260,000 276,465,000	224,323,866
Copper	\$ pounds	3,409,779 7,167,919	3,409,779 7,167,919	5,097,157 10,597,000	7,645,623 14,866,077	9,148,995 15,760,000	2,709,696 5,132,000	890,286 1,748,093	14,791,665 23,186,245	15,571,426 20,086,720	11,580,000 18,160,000	62,366,410
Coal	\$ tons	46,390 5,670	15,791 1,912		6,039	10,908	21,026	18,435	19,601	17,027	17,104	2,567,132
Zinc	\$ pounds	1,729,027 11,450,510	1,373,151 9,476,945	748,206 5,306,429	5,035,385 33,062,280	24,845,216 155,964,948	39,003,342 233,134,144	45,241,287 237,225,560	61,167,027 253,321,575	60,899,995 174,498,553	95,159,000 253,757,000	270,677,876
Cadmium	\$ pounds	306,336 118,735	265,997 94,999	147,716 51,830	239,965 68,172	261,528 73,463	114,654 59,100	82,759 32,711	45,718 12,560	17,331 4,358	11,000 4,000	6,361,566
Asbestos	\$ tons	406,371 2,260	8,684,125 63,592	11,924,526 87,437	13,927,652 105,638	12,374,380 91,969	13,006,476 101,888	13,915,140 100,734	22,752,400 90,896	31,970,000 112,000	96,991,070	
Nickel	\$ pounds											9,206,393
Platinum	\$ ounces											475,031
Total	\$	11,975,757	14,900,529	21,365,555	35,402,563	77,511,933	93,020,402	106,502,067	150,667,311	171,348,268	228,659,000	1,154,155,816
(c) Cumulative Totals -- 1886 to December 31, 1975												

(c) Cumulative Totals -- 1966 to December 31, 1975

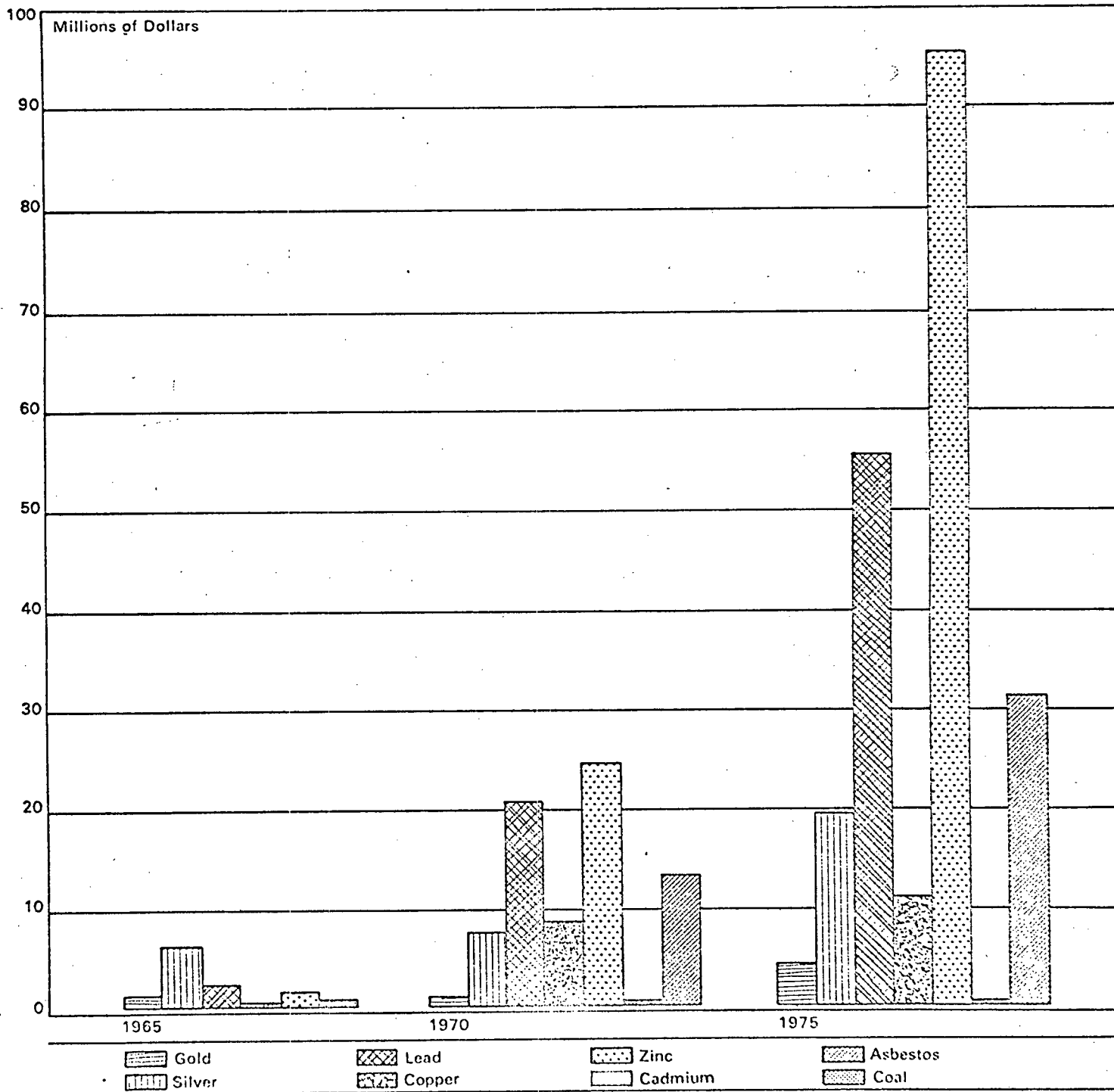
Source: #31.

Table 6b

Mineral Production Graph 1965 to 1975

Yukon Territory

Source: #31.



whereas in B.C. and Ontario, they were down. These developments continue despite an average of 50% higher exploration and development costs compared to elsewhere in southern Canada.

The Yukon tax formula for mining is probably the best in Canada, and it helps offset the high risks involved in exploration and development in this remote region. The increasing scarcity of the world's mineral supplies will probably serve to increase the value of the Yukon's mineral reserves, and thus promote the industry. However, critics have pointed out that the mining industry has two sides, and both must be considered in order to assess the industry's total value.

- (a) an industry of benefit and economic value to the Yukon, that provides productive employment and a general state of wealth and well being.
- (b) an industry that provides largely transient and temporary settlement, scarring of the landscape and permanent damage to the environment.

The fact remains that the Yukon would not exist as it does today (in a positive sense), if it were not for the mining industry. Many towns would not exist, the transportation network would be greatly reduced and the population would be about 2/3 of what it is now.

(i) A Brief History of Mining in the Yukon

The mining industry has evolved from brief intense searches for small deposits of valuable ores, to long term, methodical searches for large deposits of base minerals.

The mining industry began with the 'Gold Rush, which lasted four or five years but still remains as the identifying trademark of the Yukon. The Gold Rush was followed by about 50 years of lode mineral exploration for gold and silver. Following the construction of the Alaska Highway, base mineral searches began.

In the 1950's, large deposits of lead and zinc in the Tom and Vangorda areas indicated the real value of the Yukon's mineral resources. 1966 to 1967 marked the first "base metal rush" with large discoveries of lead and zinc at Swim and Faro; asbestos at Clinton Creek and copper at New Imperial. The second rush occurred in 1968-1970, with the discovery of low grade copper-molybdenum deposits in the Dawson Range. These finds are as yet uneconomical to develop. The third rush was marked by huge lead-zinc finds in the Howard's Pass-Summit Lake area of the Selwyn Range, in 1972. This discovery gave the Yukon a second solid lead-zinc base and with the discovery of the Grum deposit, made the area Canada's number-one lead-zinc district.

Each "rush" was characterized by large regional searches that rarely led to any substantial finds. Today, mineral exploration patterns have shifted to more economical methodical searches of the most promising areas.

#### (ii) Present Status of the Mining Industry

Map 16 shows the locations of the five operating mines in the Yukon today. The following table summarizes each mine.

# MAP 16

## PRESENT MINES, POTENTIAL MINE SITES AND MAJOR MINERAL AREAS.

SOURCE - B a

### LEGEND

- Potential mine sites (see text)
- Present mines;
  1. Cassiar Asbestos
  2. United Keno Hill
  3. Anvil
  4. Whitehorse Copper
- ▨ Major mineral areas
- ⊙ Present oil wells (Beaver River)

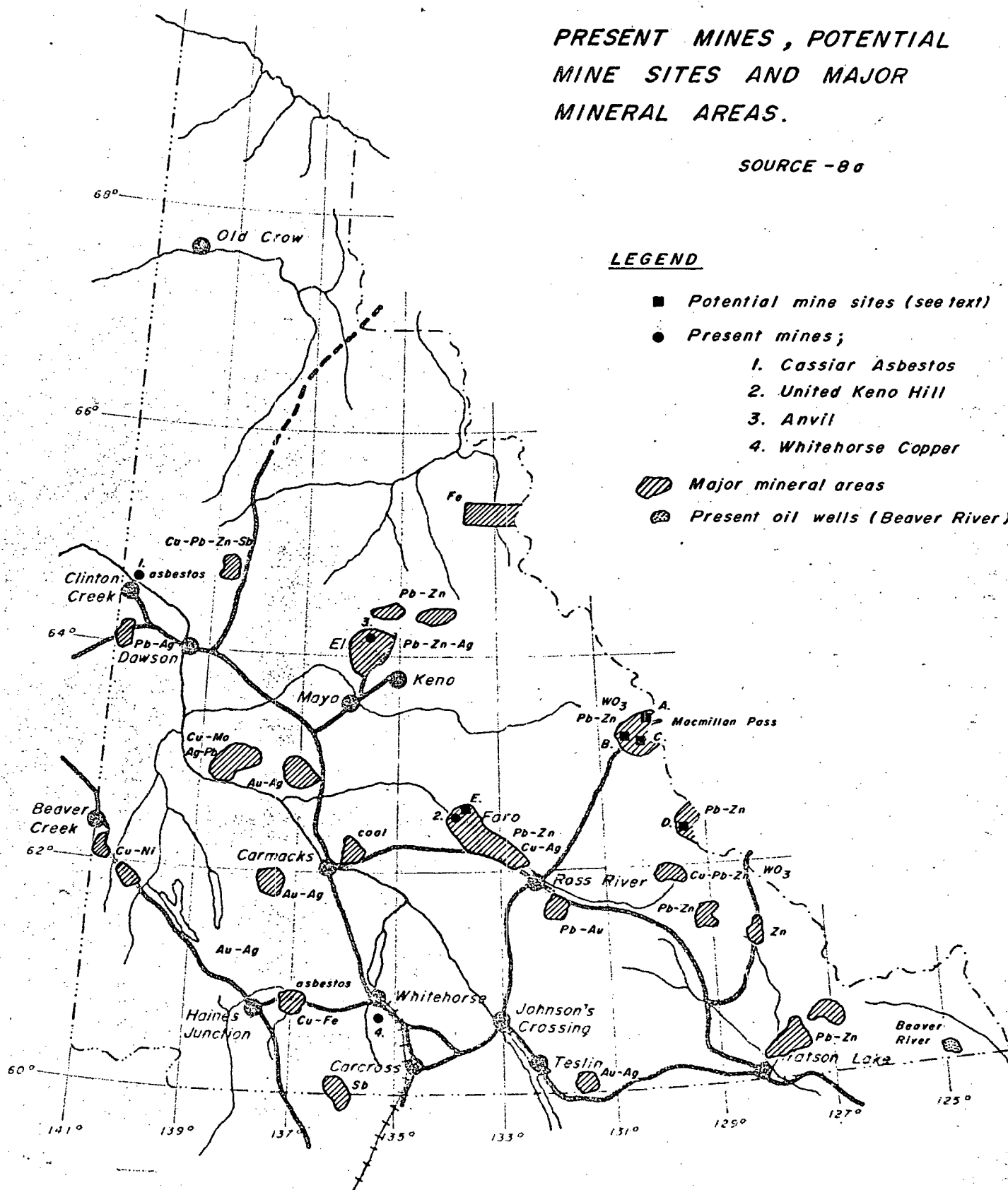


Table: General Information on Mines Presently Operating in the Yukon

1) Cassiar Asbestos Corporation Ltd.

starting date	1968
location	Clinton Creek with an office in Whitehorse.
products	asbestos
type of mine	open pit
method of extraction	refinery that produces asbestos fibre.
capacity	7500 Tons Per Day (TPD)
reserves	about 4,773,409 Tons (T)
employees	305

Note Cassiar mines is scheduled to cease operations in 1978.

2) Cyprus Anvil Mining Corp.

starting date	1969
location	near Faro
products	lead, zinc and silver
type of mine	open pit, multiple bench
method of extraction	conventional flotation circuit
capacity	10,000 TPD
reserves	46,400,000 T
employees	about 500

3) United Keno Hill Mines Ltd.

starting date	not located
location	Elsa
products	lead, zinc, gold and copper
type of mine	underground
method of extraction	conventional flotation circuit
capacity	400 TPD
reserves	208,231 T
employees	270

4) Whitehorse Copper Mines Ltd.

starting date	1972
location	near Whitehorse
products	copper, silver and gold
type of mine	underground
method of extraction	conventional flotation circuit
capacity	2200 TPD
reserves	3,568,000 T
employees	200

5) Tantalus Butte Coal Mines Ltd.

An underground and surface mine located near Carmacks, that supplies coal to Cyprus Anvil Mine for use in drying concentrates. The mine employs about 19 people and has a capacity of about 100 TPD.

Kerr Addison Mines Ltd. is conducting extensive explorations and has a lead-zinc mine under construction near Faro. At present, five people are employed.

Detailed information on the status of the Yukon's mining industry can be found in the annual publication "Mines and Minerals Activity North of 60", Bibliography # 31.

(iii) Explorations and Future Developments

The annual Geological Survey of Canada publication, "Yukon Mineral Industry Report" provides detailed site by site descriptions of all claims under active exploration and/or development in the Yukon. The following is a summary of the most important discoveries and

developments:

Map 16 summarizes the major mineral areas in the Yukon. Sites A, B, C, D, and E are the most promising ones, and will probably be in operation by the early 1980's.

Site	Product	Estimated Capacity, TPD
A. Mactung	Tungsten	1000
B. Jason	Pb/Zn	5000
C. Tom	Pb/Zn	3000
D. Howard's Pass	Pb/Zn	10,000
E. Grum	Pb/Zn	5000

The most important recent discoveries have been the huge Pb/Zn finds in the Howard's-MacMillan Passes areas in the Selwyn Mountains. This area contains the largest known reserves of lead and zinc in Canada.

Copper-molybdenum deposits have been found in the Lake Laberge-Whitehorse area and around Carmacks, but the finds are not large enough to warrant development.

Exploration of the Pelly Mountains will probably increase because of their geological similarity and association with the Selwyn Mountains.

Although coal is not yet in demand, substantial deposits exist in the Tantalus formation and in scattered locations throughout the central Yukon.

Native land claims have become a major issue in the Yukon and any claims on potential mineral lands will probably have to be settled before development can begin. (This applies to all resource developments).

Little information is available on projected water use for potential mines. Rough comparisons can be made between potential mines and present day mines of the same capacity. (See the section on Water Use and Pollution from Mining.)

An 800 TPD mine in the MacMillan Tungsten Property would use about 2415 gal./min. of which 109 gal/min. would be make up water. (# 39 ).

Any major developments in the mining industry will probably require a new power source. Since most of the major developments are in the southeast portion of the Territory, hydro developments will probably be as close to these sites as possible.

#### Smelting

Kaiser is considering Whitehorse as a site for a new aluminum smelter. A new power development would be essential to this project to supply the projected power needs of about 300 MW. The smelting process itself would not require water except for the use of cooling water in some auxiliary facilities. Most of the water will be used for domestic sanitary purposes in the plant.

Estimated potable water demand is 410,000 U.S. gal/day at first, increasing to 800,000 U/S. gal/day when the smelter is fully

operational. All water used would go through primary and secondary treatments before being discharged into the public sewer system.

Mineral supplies for the plant would be imported through Skagway. If approval is given, the project would take about seven years to complete, and would have a considerable socio-economic-environmental impact on the Yukon.

Several proposals have been made for smelters utilizing local ore, but until recently, the known ore reserves in the Yukon could not support such a development. The lead-zinc discoveries in the Selwyn Range may instigate further investigations into a local ore smelter, which would in turn, require a new power source.

(iv) Environmental Impact of Mining

This section will summarize the general environmental impacts of mining, with special emphasis on water use and pollution from base metal mines.

Mining causes overall aesthetic deterioration in the area of operation, often accompanied by far reaching effects caused by contamination of watercourses. Local effects include:

- abandoned exploration and mine sites often littered with man-made debris.
- large scale vegetation clearing, often larger than can be justified by the size of the operation.
- disturbance of local wildlife
- increased dust from roads and clearings
- added loss of vegetation from abandoned equipment, (gas leakage and leached substances from machine parts.).

Most ecosystems in the Yukon are less complex than those to the south, and brief local disturbances may have more pronounced, longer lasting effects than a similar disturbance in more temperate regions.

(a) Water Use and Water Pollution in the Mining Industry.

Detailed information on mine wastes is submitted monthly and annually by each mining company to DIAND. Most of this information is available in data form only, in open files and/or in the Naquadat computer. A few studies on water use and waste management in base metal mines have been published (see bibliography), although no published information on Cassiar Asbestos and Tantalus Butte Coal Mines

was located.

The three main sources of water contamination in base metal mine-mill developments are: mine water, process (mill) water, and surface drainage.

Contaminated mine water can originate from groundwater seepage through the mine, use and discharge of water, seepage from and through hydraulic backfill tailings and drainage through open pits.

Milling water may be fresh and/or recycled. The flotation-extraction method used by Yukon's base metal mines introduces chemical reagents, dissolved metals and solid wastes (tailings) into the water. This water must be treated before being released and/or held indefinitely in tailings ponds.

In areas of exposed sulphide bearing rocks, oxidation occurs leading to the formation of acids and the subsequent leaching of metals. Surface water passing over such areas becomes contaminated with acid and metals. This can occur in any exposed area, but is common around handling facilities, mill areas, haul roads, waste piles and ore stock piles.

Another source of water pollution is seepage of contaminated water from tailings ponds into nearby water bodies.

1. Whitehorse Copper Mines Ltd. (figs. 1a & b)

Whitehorse copper uses a conventional flotation circuit for extracting a single copper concentrate, with an efficiency of about 88%. Overall water requirements are about 8.64 Mlitres per day (Mld), (1.9 Mgd); 2 Mld, (.44 Mgd) is pumped from the Yukon River, .41 Mld,

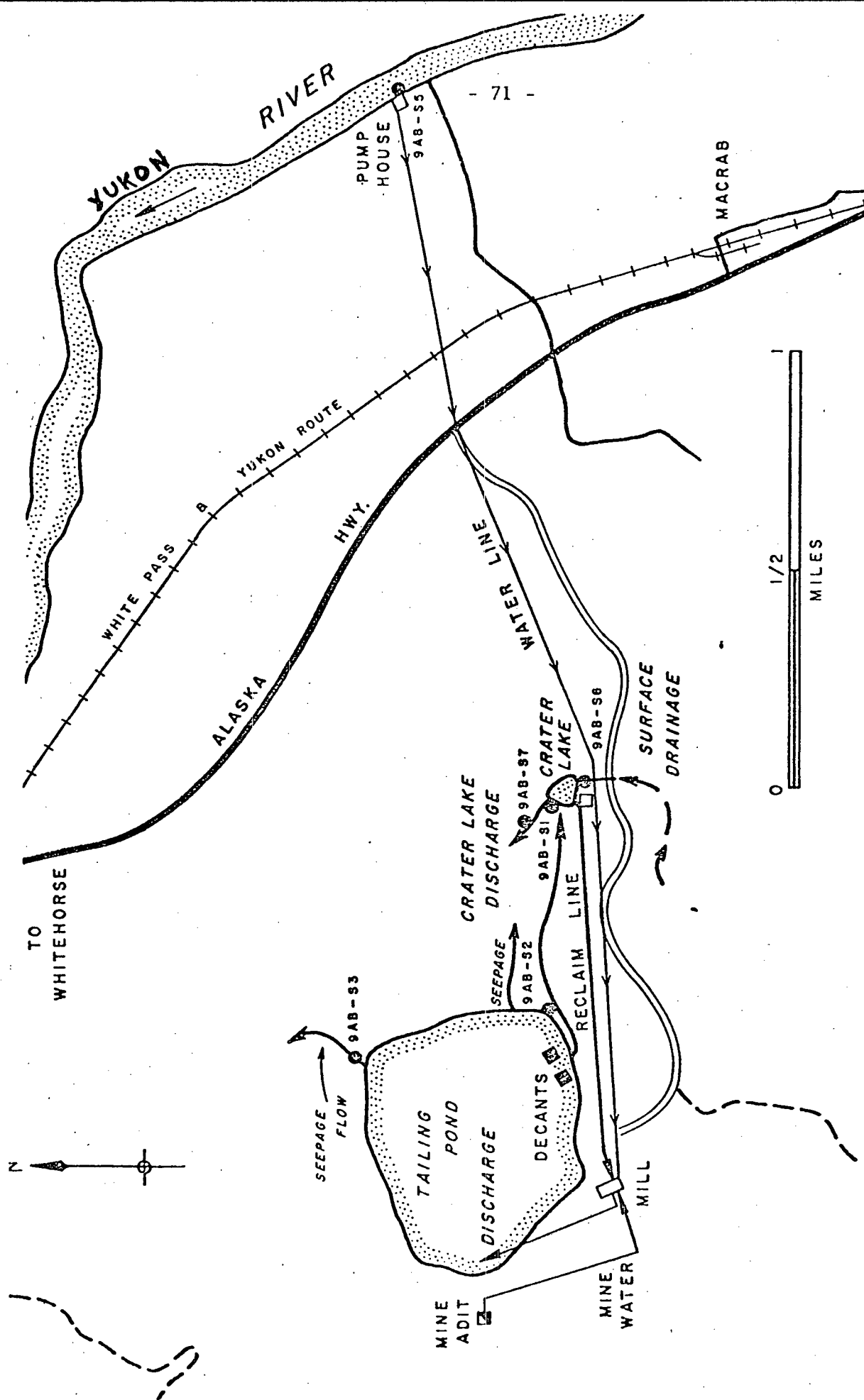


FIGURE 1A

# WHITEHORSE COPPER MINES LTD. SITE LAYOUT

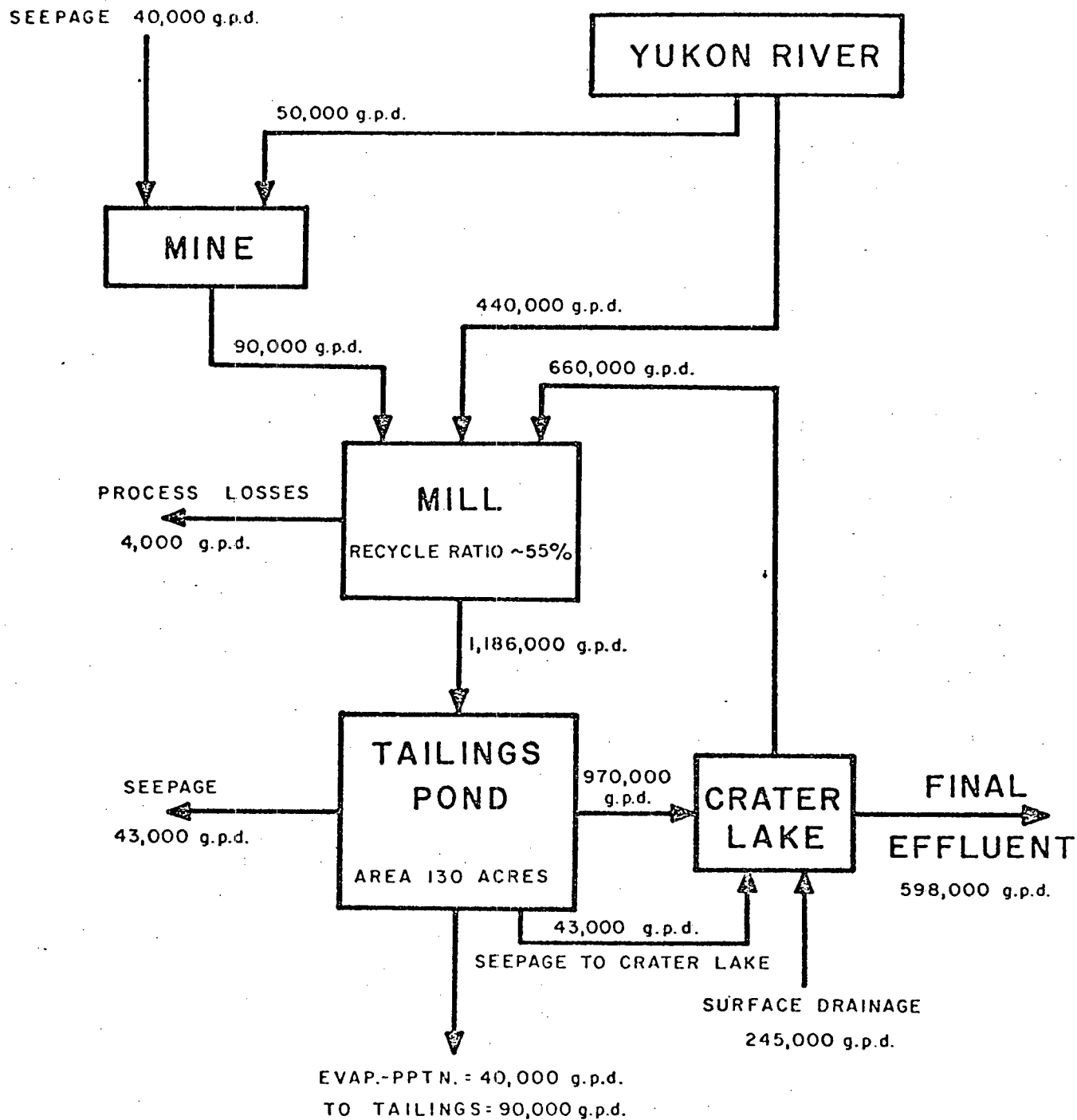


FIGURE 1B

Source:#37.

# WHITEHORSE COPPER MINE EXISTING WATER BALANCE

(.09 Mgd) comes from the mine, and 3 Mld (.66 Mgd) is recycled from the treatment system.

#### Mill Water

Average waste stream discharge is about 5.41 Ml (1.19 Mgal). The water is slightly alkaline and contains about 1706 Tonnes (1875 T) dry weight of tailings in slurried form. Mine tailings are not used for backfill, so the total volume of tailings is deposited in the tailings pond. At the present time, the tailings pond is stable and able to handle the waste, however, its treatment capability may decrease as potential storage volume decreases.

#### Mine Water

409,140 litres (90,000 gallons) of water per day is used without treatment in the mill. 188,184 litres (40,000 gallons) per day of this is from seepage into the mine. The water is alkaline with a low acid generation potential, a favourable condition from the standpoint of waste management.

#### Surface Drainage

Due to the silaceous/limestone composition of the host rock in the Whitehorse Mine area, problems associated with surface water contamination are unlikely. The amount of surface drainage into Crater Lake is unknown, and it is recommended that some of this potentially large runoff be diverted away from Crater Lake in case surface water contamination becomes a problem (# 37).

2. Anvil Mining Corporation Ltd. (figs. 2a & b)

Anvil Mine has experienced several water contamination problems stemming from the acid forming nature of the bedrock and seepage from the tailings pond.

A conventional lead-zinc extraction flotation circuit is used with recovery efficiencies of 77.5% for zinc and 87.5% for lead. Cyanide and copper containing reagents used in milling require special removal methods in the waste treatment process.

The mill requires 28 Mld. (6.0 Mgd) of water, which is pumped from Rose Creek. Very little internal recycling of water is done.

Mill Water

Water recycling is applied in three places:

- (i) dust collection system water
- (ii) water from various lead treatment machinery
- (iii) water used for zinc spraying

About 7890 Tonnes (8700 T) dry weight of tailings are released to the pond.

Mine Water

All water from the mine is pumped to the tailings pond via the old Faro Creek bed. This water is probably acidic and contains high sulphur and iron concentrations.

Surface Drainage

The Anvil Mine is situated on a hill, and drains in the direction of Rose Creek. Most of the contaminated drainage runs to the tailings pond, but some contaminated water flows into Rose Creek. In 1975, a breach of the tailings pond dyke occurred resulting in some

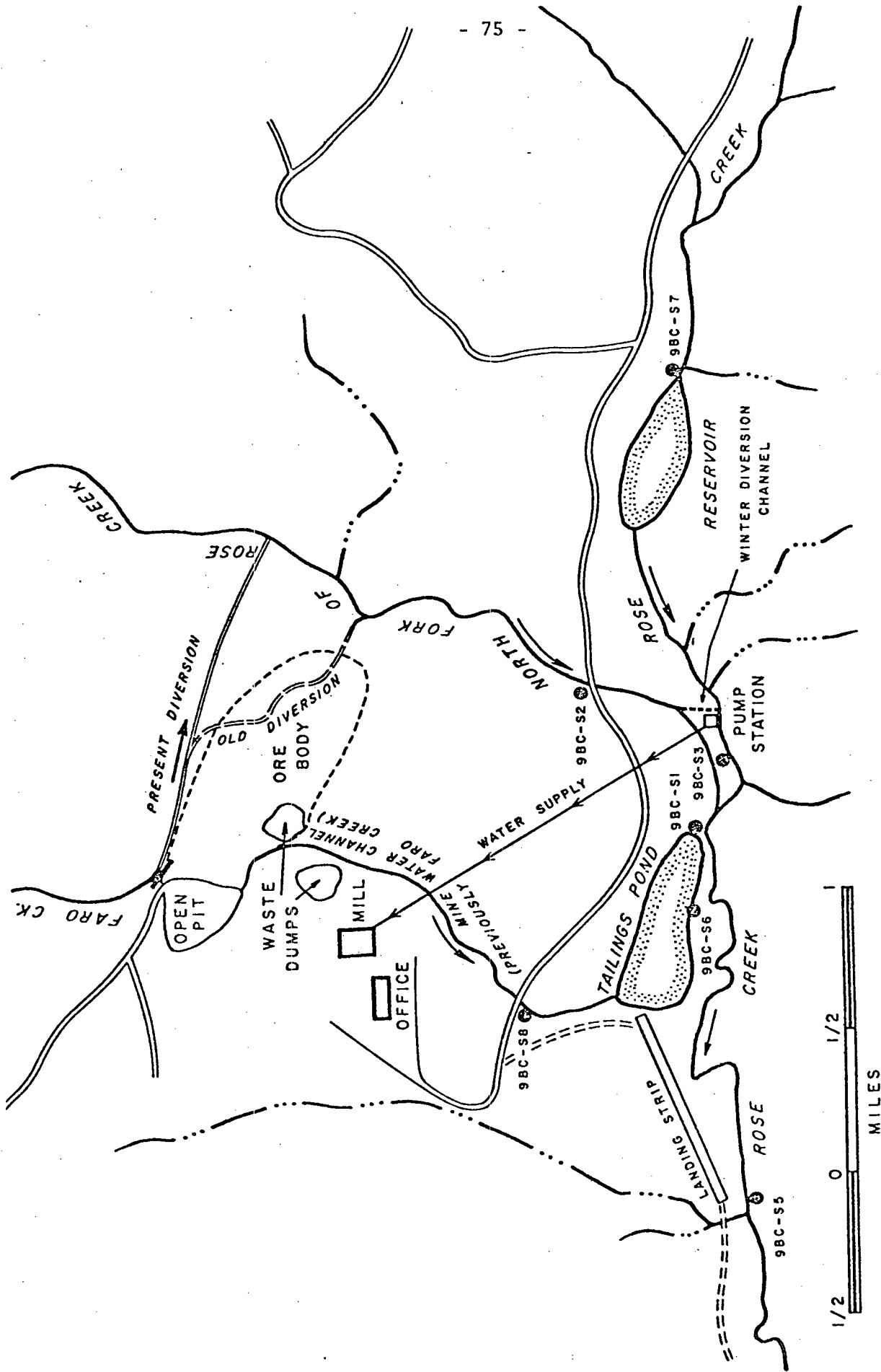


FIGURE 2A

Source: #37.

# ANVIL MINING CORP. LTD. SITE LAYOUT

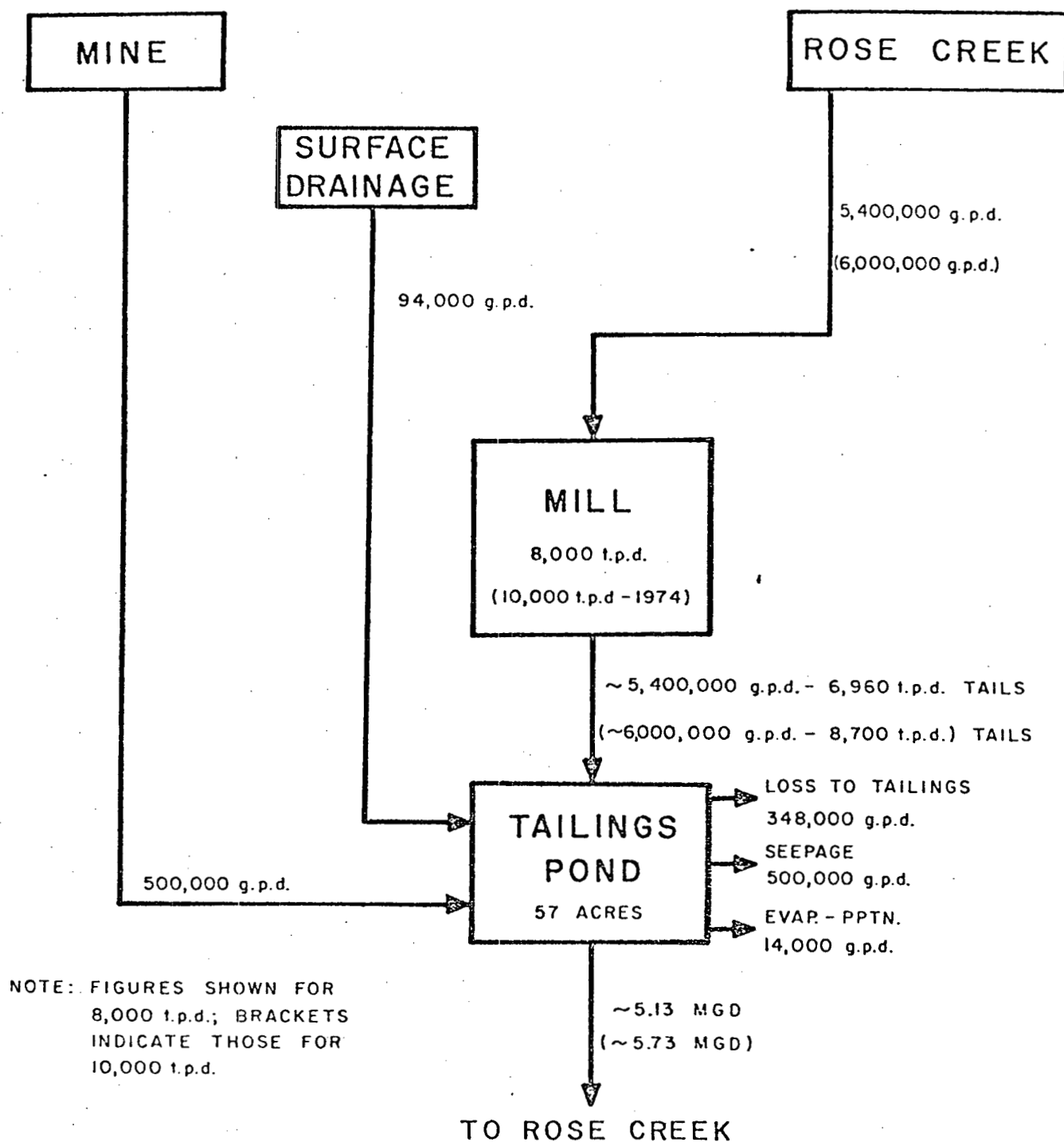


FIGURE 2B

Source: #37.

## ANVIL MINE WATER BALANCE

contamination of adjacent surface drainages before the breach was repaired.

#### Miscellaneous Waste

Sanitary waste is disposed of in septic tanks.

The Faro Creek diversion has experienced serious erosion problems resulting in high suspended solids levels in the North Fork of Rose Creek. This problem has been partially solved by structural modifications to the diversion channel.

#### Waste Disposal and Treatment

The Anvil tailings pond dam was constructed from tailings sand, and is considered unstable. In the event of a seismic disturbance, the tailings sand may liquify causing the dam to collapse. The tailings slime that would be released would cause irreparable damage to the local water systems.

The tailings pond is the only means of waste treatment at the Anvil Mine, and until recently it was not efficiently stabilizing oxidizable compounds or causing sedimentation of metals and slime. Structural modifications in the pond have partially solved this problem.

Another concern has been the leakage of acidic tailings through the dam and into Rose Creek. Structural modifications to the dam have partly solved the problem, but containment of wastes is going to be an expensive process once the mine ceases operations.

Several improvements will be needed to eliminate the major problems associated with the Anvil mine, including:

- increasing use of recycled water
- collection and treatment of tailings seepage
- identification and control of contaminated surface drainage
- stabilization of the tailings dam

### 3. United Keno Hill Mines (figs. 3a & b)

Keno Hill Mine uses a conventional flotation circuit to extract lead, zinc and silver. The use of cyanide-containing reagents necessitates special waste treatment methods.

No fresh water source is used in the mine. Of the 681 900 litres per day (150,000 gpd) of water required, 354 588 lpd (78,000 gpd) comes from internal recycling and 327 312 lpd (72,000 gpd) from the Elsa mine.

#### Mill Water

Two waste streams leave the Elsa Mill: 187 295 lpd (41,200 gpd) of water and 238 Tonnes per day (263 tpd) dry weight of tailings goes to the pond, and 141 016 lpd (31,020 gpd) of water and 47 Tonnes per day (52 tpd) of tailings goes to the Husky Mine for use as hydraulic backfill. The neutral pH of mill water requires alkaline treatment for removal of metals.

#### Mine Water

Most mine water is not acidic but does contain moderate to heavy concentrations of metals.

#### Surface Drainage

Because the drainage pattern of the area has not yet been

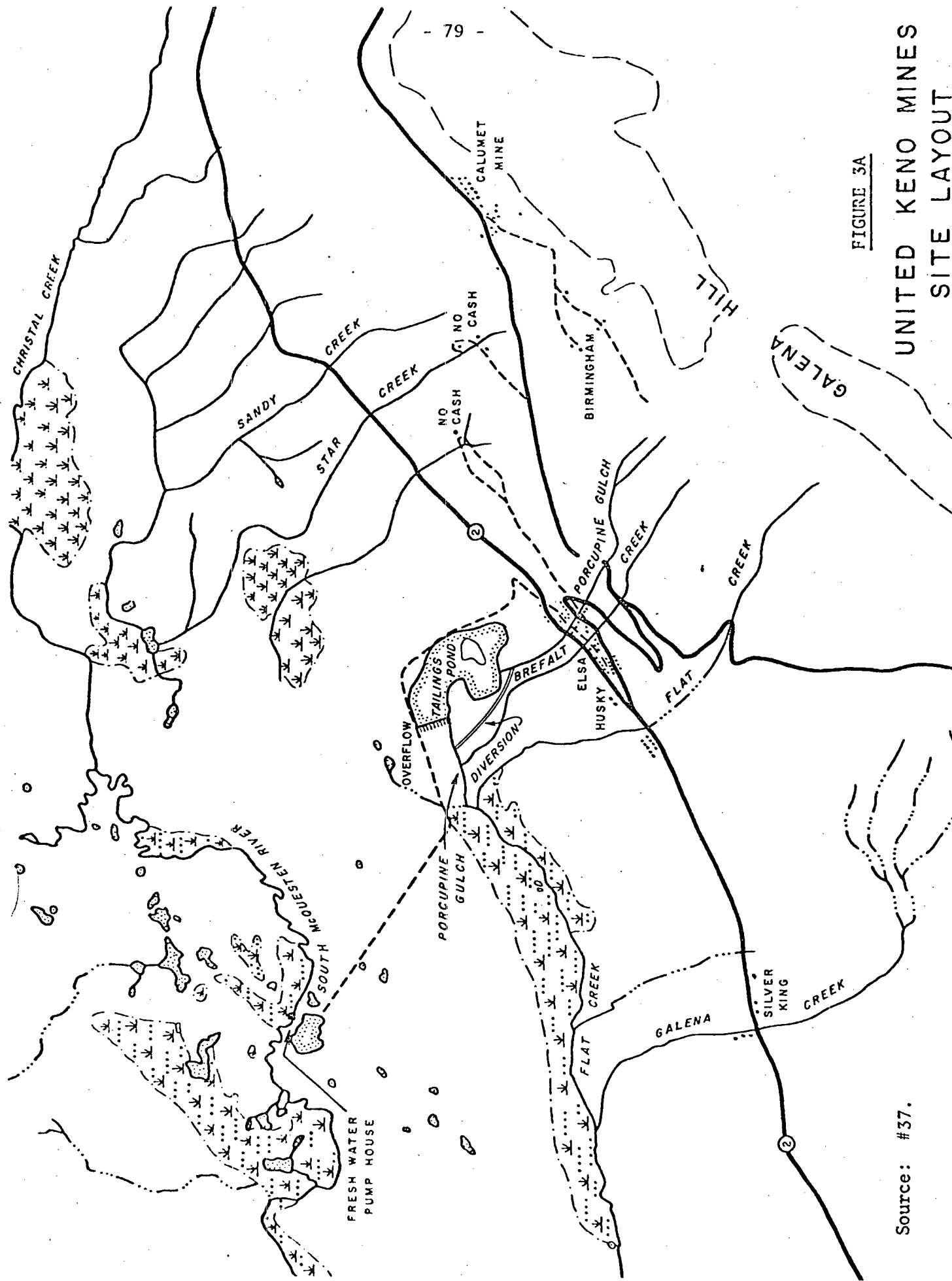


FIGURE 3A

# UNITED KENO MINES SITE LAYOUT

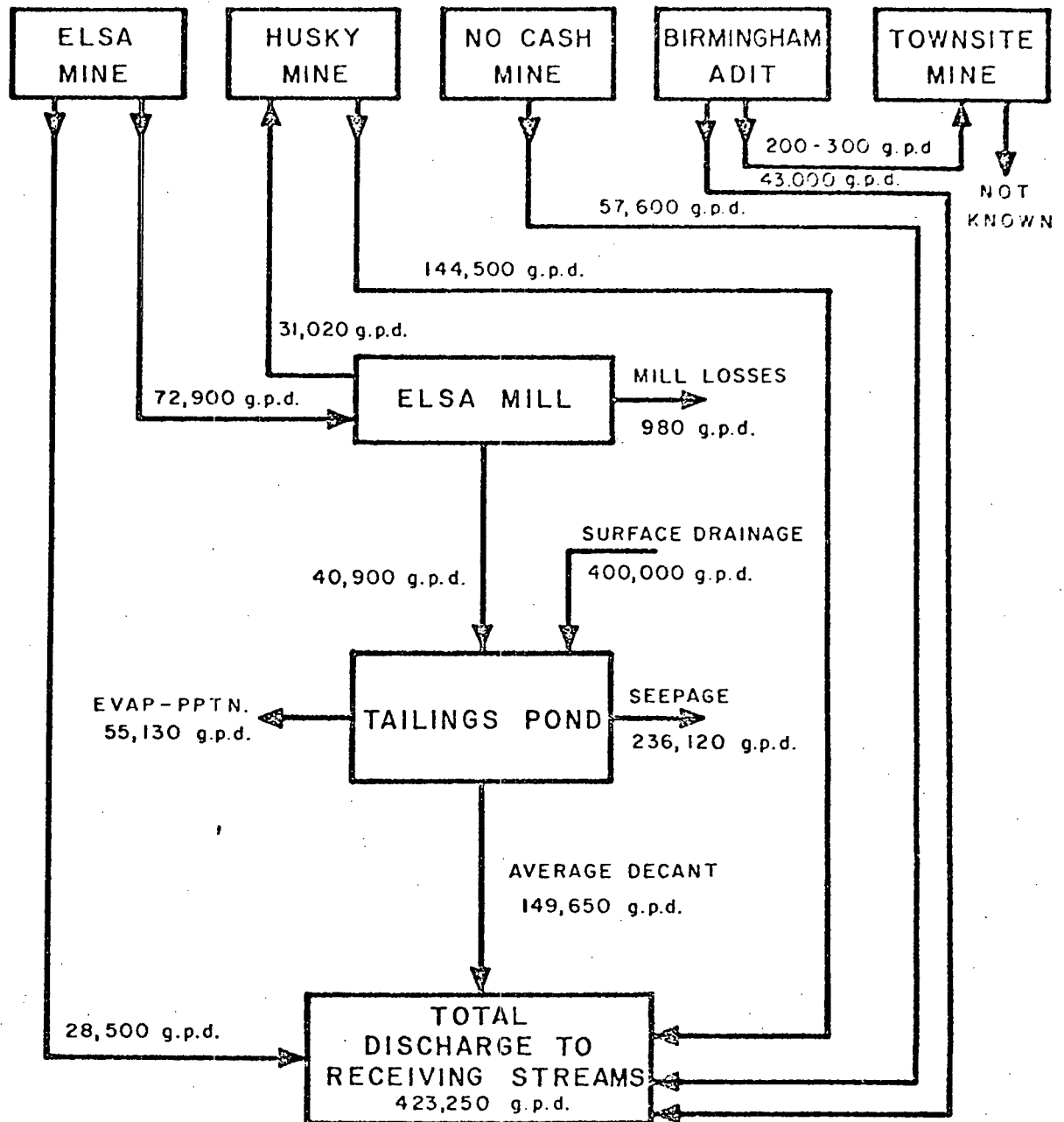


FIGURE 3B

Source: #37.

# UNITED KENO HILL MINES INTEGRATED WATER BALANCE

defined, many possible sources of surface contamination have not been identified. Contamination probably occurs in areas of waste piles, handling facilities and storage piles.

Porcupine Creek has been diverted away from the tailings area, and flows with Brefalt Creek through the Elsa mining area. Brefalt Creek is contaminated with sulphate, metals and sulphur solids, and is being diverted to the tailings pond for treatment.

The present drainage system does not effectively direct water into the treatment systems (# 37 ).

#### Waste Disposal and Treatment

About 1 090 320 lpd. (420,000 gpd) of mine water, high in metals and suspended solids is discharged without treatment. Approximately 227 Tonnes (250 tons) of tailings and 192 068 lpd. (42,250 gpd) of effluent are discharged for containment. The tailings pond has undergone recent structural modifications for stabilization, but the tailings are in need of further alkaline treatments to remove metals.

Several streams downstream of the mine show high turbidity, color and high metal content, probably due to contamination from the tailings pond and some other unknown sources. The lack of information on contamination sources is of primary concern in waste management at Keno Hill Mines. (# 37).

(v) Oil and Gas

All aspects of the Oil and Gas industry are administered by the Oil and Minerals Division, DIAND.

The oil and gas industry in the Yukon is small, with only one operating gas field (1975) at Beaver River. Several potential well sites have been discovered, but it is not yet economically feasible to put them into production. (table 7). Map 16 shows the location of the Beaver River Well operation.

Pipelines

The only pipeline in operation in the Yukon today is a four inch gas pipeline that parallels the White Pass and Yukon Route railway to Skagway. It is the last operating section of the old wartime Canol Pipeline.

Several major pipelines have been proposed for the Yukon, but it is beyond the scope of this study to go into them in detail. The reader is referred to the bibliography for an up-to-date list of information associated with the various proposals. A considerable amount of work has already been completed, but data gaps still exist concerning possible environmental impacts.

The following problems are of particular concern:

- construction on permafrost
- drainage disruption related to the characteristic shifting drainage patterns in small streams.
- effects of stream crossings of fish and other water life.
- disruption of land wildlife - especially migration routes

Table 7

Yukon Oil and Gas Information

**Yukon Territory  
Gas Discoveries**

Canada Southern et al North Beaver YT I-27	I-27-60- 10-124-00	Suspended	Extension Test Gas Well	Middle Devonian	Carbonate	24-03-63	29-09-64	AOF 1.5 MMCFD
Cance River Chance YT J-19	J-19-66- 10-137-30	Potential Gas & Oil	Gas & Oil Discovery	Chance and Permo Penn Alder	Sandstone & Lime- stone	14-12-67	17-02-68	DST 6.52 MMCFD
Pan Am Beaver River YT G-01	G-01-60- 10-124-15	Gas Well	Gas Producer	Mississippian & Nahanni	Sandstone & Carbo- nate	12-06-68	10-03-69	AOF 6.77 MMCFD AOF 39.54 MMCFD
Socony Mobil WM Chance YT G-08	G-08-66- 10-137-30	Potential Oil Well	Gas & Oil Discovery	Lower Cret.  Carbonif- erous Hart River	Sandstone  Sandstone	04-12-64	15-02-65	DST 3.3 MMCFD 1180' oil
Socony Mobil WM Birch YT B-34	B-34-66- 10-136-45	Potential Gas Well	Gas Discovery	Carbonif- erous Hart River	Sandstone	04-03-64	06-08-65	DST 7.3 MMCFD
Socony Mobil WM Blackie YT No. 1 M-59	M-59-66- 00-137-00	Potential Gas Well	Gas Discovery	erous Hart River Carbonif- Miss. Dev.	Sandstone	11-12-63	27-03-64	DST 2.9 MMCFD
WM Chance YT No. 1 M-08	M-08-60- 10-137-30	Potential Gas or Oil Well	Gas & Oil Discovery	Cretaceous  Carbonif- erous Miss. Dev.	Sandstone  Sandstone Sandstone	30-05-59	25-05-60	11/64" Chok 5 MMCFD 10.5 bbl/d

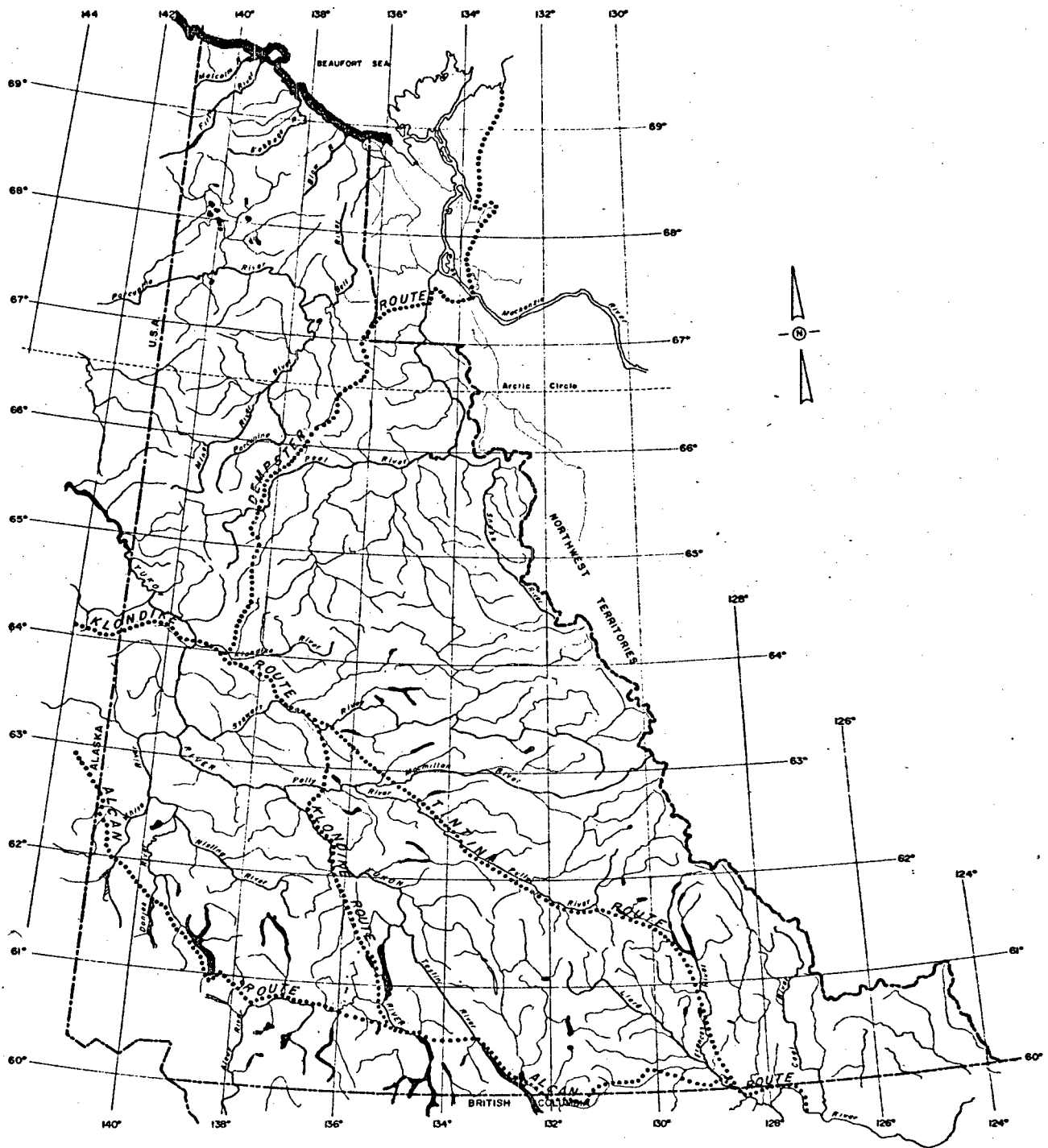
Source: #45.

of big game species

- socio-economic effects on native peoples, and Yukon communities

The Mackenzie Valley pipeline was the first major pipeline proposal for the Canadian north, and a substantial amount of socio-economic and environmental research has been done in connection with it. However, since this proposal no longer seems viable, the routes outlined in Map 16a hold the most potential for development. The Alaska Highway route has received the most attention recently.

Studies done in association with pipeline proposals have supplied a substantial amount of recent general information on the Yukon, but a lot more information is required before meaningful predictions can be made about socio-economic and environmental impacts related to construction and resource developments.



MAP 16a

PIPELINE ROUTES THROUGH THE YUKON TERRITORY

(B) Tourism and Recreation

Tourism is the Yukon's second major industry and although it is seasonal, its steady growth is helping to balance out the uneven growth pattern of the mining industry.

The Yukon's two important tourist attractions are its unspoiled wilderness and its gold rush history. Most tourism is concentrated on the major roads, especially on the "gold rush loop" from Skagway to Whitehorse, Dawson and Anchorage with connecting ferry systems between Alaska and B.C. ports to the south.

The Parks and Reserves system in the Yukon is still in its infancy, with the only protected areas being Kluane National Park, McArthur Game Sanctuary, Fishing Branch Game Reserve and part of the Peel River Game Reserve (refer to Map 1).

(a) Wilderness Resources

The Yukon consists largely of vast undeveloped wilderness areas often untouched by man. About 90% of all recreational activity is concentrated in valley bottoms, centered on the major water bodies. Big game hunting, mountain climbing and animal study are the only significant upland activities.

Many rivers are accessible and large enough for boating, and most water bodies provide excellent fishing. The Yukon River is the most valuable tourist water body, and in 1972 an estimated 2500 people travelled from Whitehorse to Dawson by boat. (The numbers have probably increased since then.)

The use of rivers for recreation is discussed in more detail in the Water Use section and the Sports Fishery is discussed in the Fish and Fisheries section.

The wildlife of the Yukon provide an important consumptive and non-consumptive resource, as discussed in the section on Wildlife.

(b) Parks and Reserves

Map 1 shows the location of existing parks and reserves in the Yukon. Good protective representation of the Yukon's wilderness features does not yet exist. The growing demand of Yukon residents for accessible reserved recreational areas, and the rising importance of the tourist industry has lead to the Department of Tourism's proposal of a Territorial Parks Plan geared to protect important features of the Yukon. (Map 17 ).

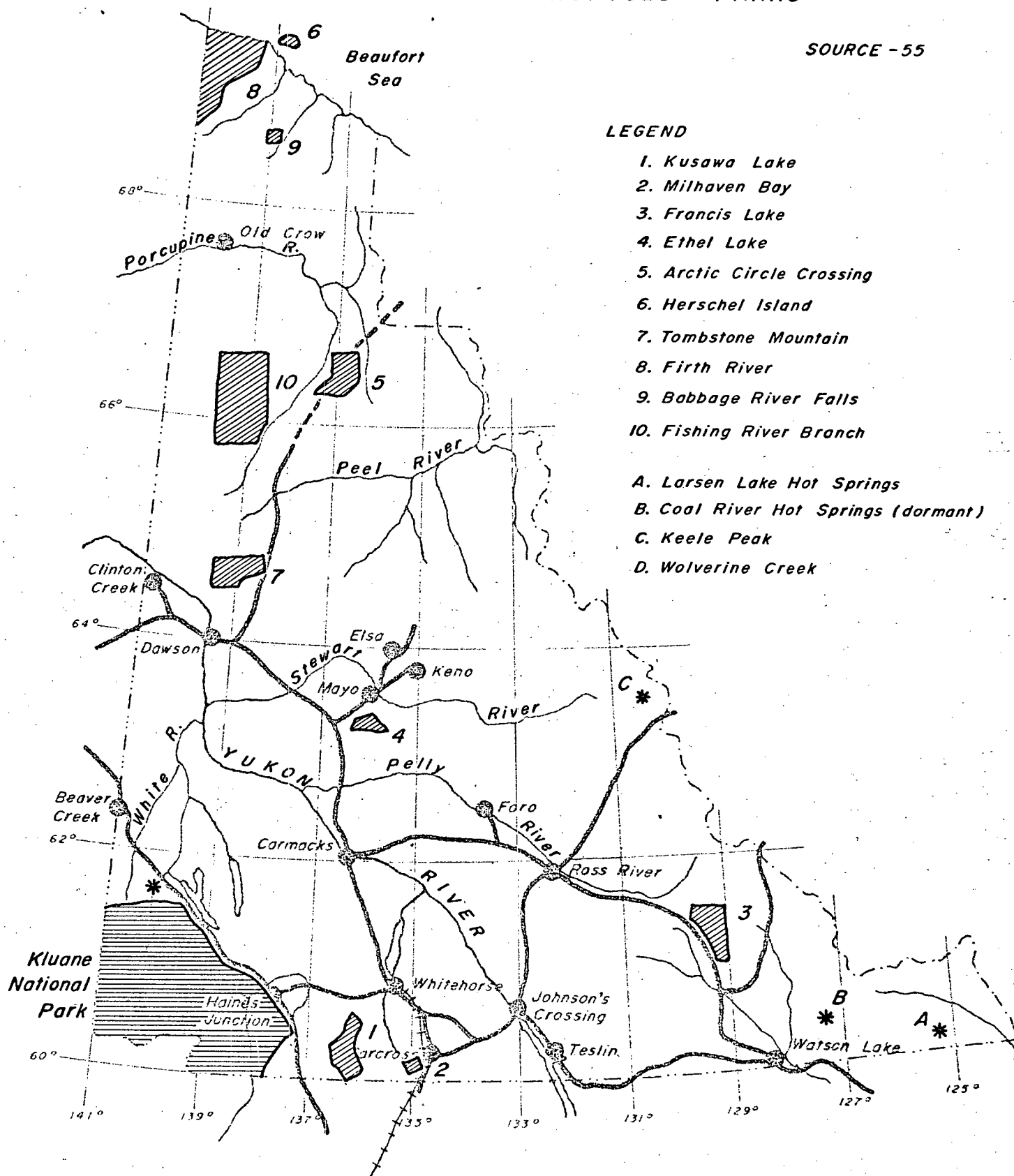
An important aspect of this parks plan is the "multiple use concept" on which it is based. Under this plan, resource protection within Parks would range from total protection, to extensive integrated resource sharing with various industries. In this way, non-conflicting resource development and/or use would not be eliminated from areas set aside for recreational use. The multiple use concept is closely related to the lack of a diversified economic base in the Yukon, and is designed to promote the expansion of the Yukon's economic base while at the same time, preserve its wilderness character. The major problem will be in deciding which resource uses are compatible, but the Yukon is in the favourable position of being able to plan and and develop a model parks system without the burden of having to

# PROPOSED PARKS

SOURCE - 55

## LEGEND

1. Kusawa Lake
  2. Milhaven Bay
  3. Francis Lake
  4. Ethel Lake
  5. Arctic Circle Crossing
  6. Herschel Island
  7. Tombstone Mountain
  8. Firth River
  9. Babbage River Falls
  10. Fishing River Branch
- 
- A. Larsen Lake Hot Springs
  - B. Coal River Hot Springs (dormant)
  - C. Keele Peak
  - D. Wolverine Creek



integrate a large number of previous unplanned systems.

The untouched wilderness character of the Yukon is of particular value for scientific study. The Yukon is one of the few areas left in the world where the study of natural ecosystems is possible. Map 18 shows proposed IBP (International Biological Program) reserves selected to preserve landmark ecosystems for scientific study. The Sigma report briefly describes the characteristics of each area and the reader is referred to this report for further information.

(c) Historic Resource

The Yukon tourist industry depends heavily on its gold rush history, but interest in its archeological and fur trading past are of growing importance.

Table 8 summarizes most of the historically important sites, and map 17a integrates these sites in four proposed systems: the Hudson Bay Co. Trade System (HBC); the Gold Rush System; the Campbell Trading System; and the Haines Junction System. These systems, if integrated into the Parks and Tourism industry, would provide basic themes upon which plans for preservation and restoration, and tourism promotion and use could be based.

Map 19 shows the areas of archeological interest in the Yukon. Of primary importance are the sites in the Old Crow area which indicate that people did migrate from Asia to the ice free areas of the Yukon before or during the last glaciation. Some relics appear to date back 20,000 years. Other sites in the south-central and southeast portions of the Territory contain relics from Indian tribes that inhabited the

MAP 17a

POTENTIAL PARK THEMES

SOURCE - 56

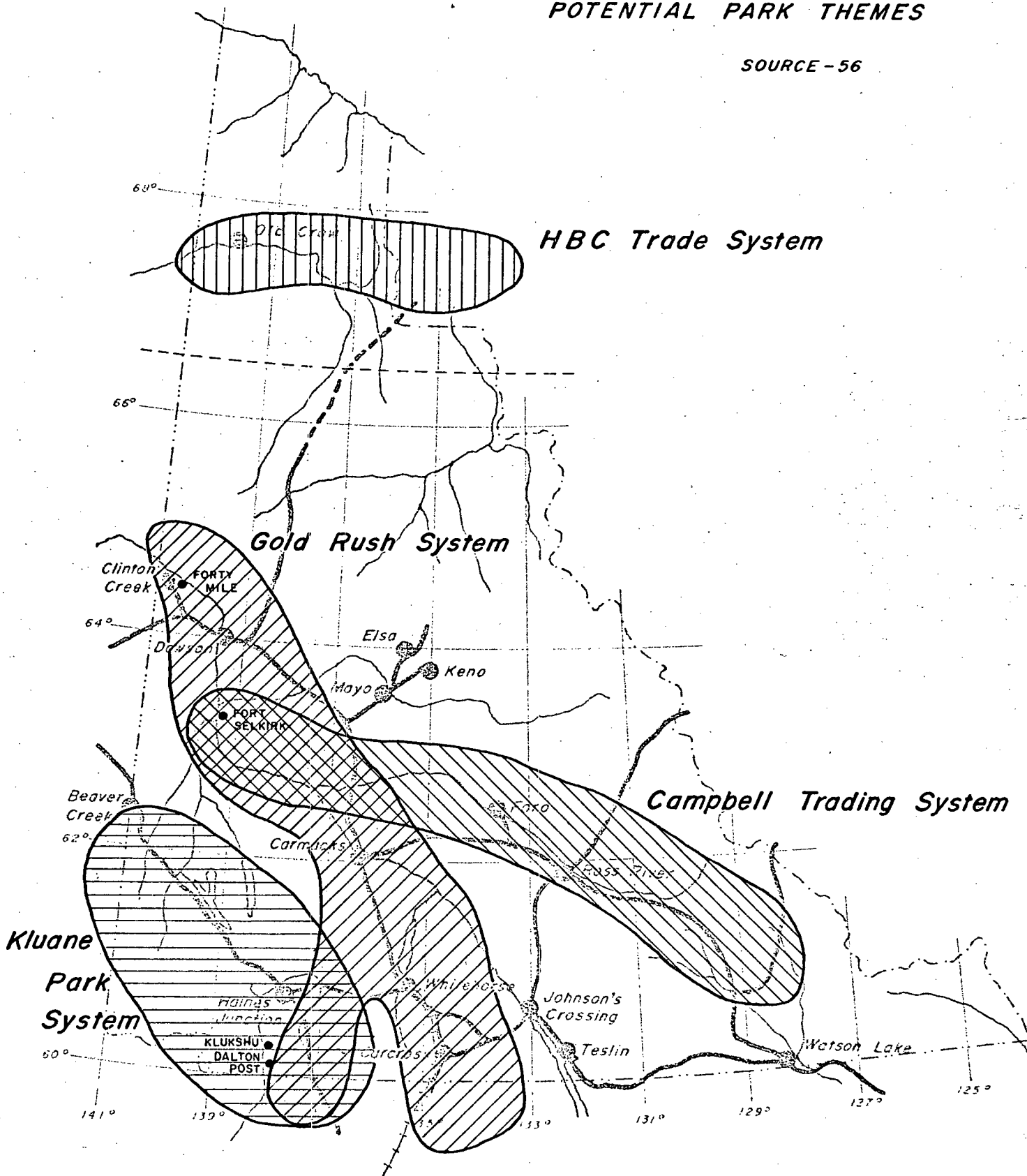


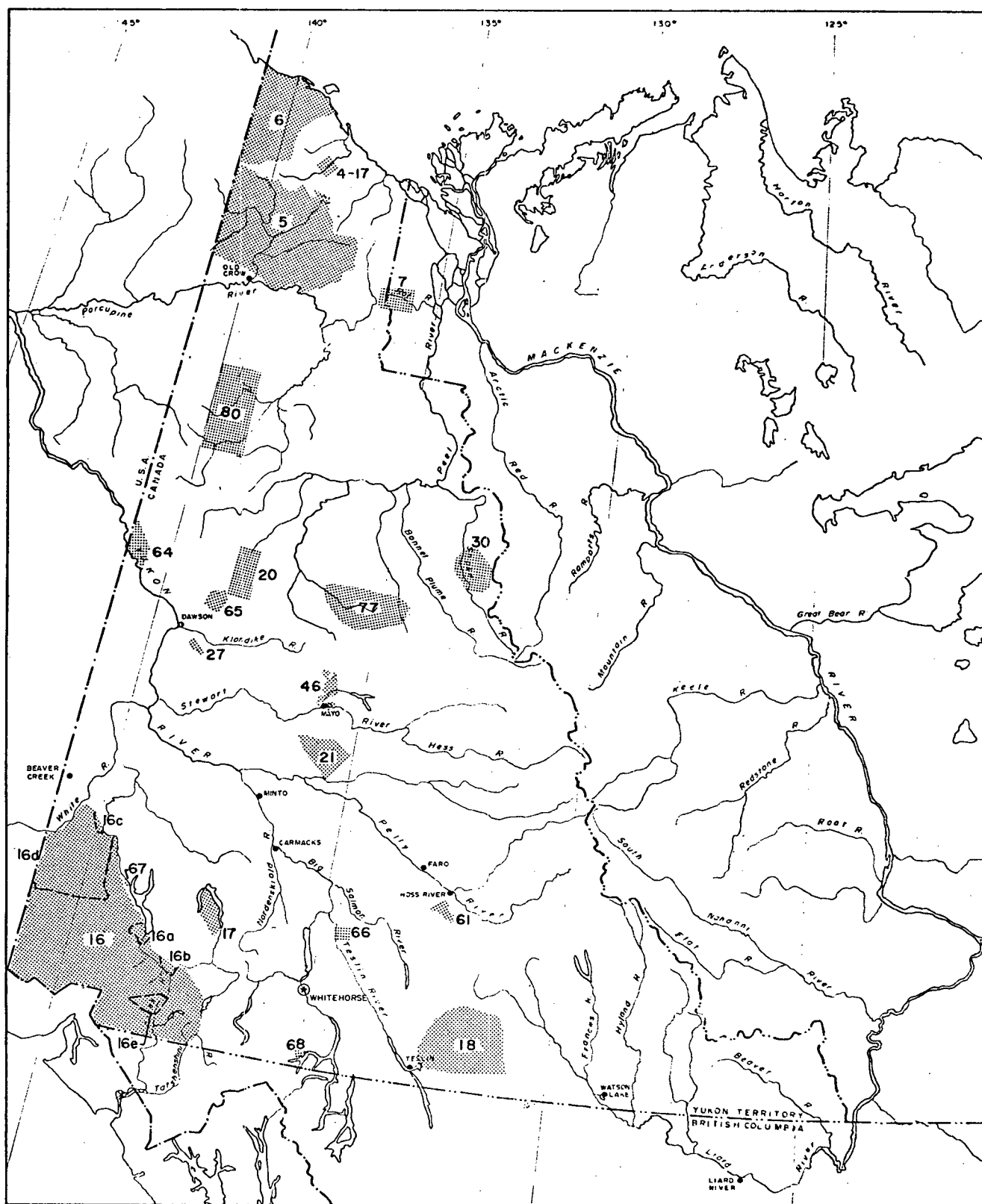
Table 8

## Historic Sites Priorities

**Source: #56.**

[illegible]

PROPOSED IBP ECOLOGICAL RESERVES



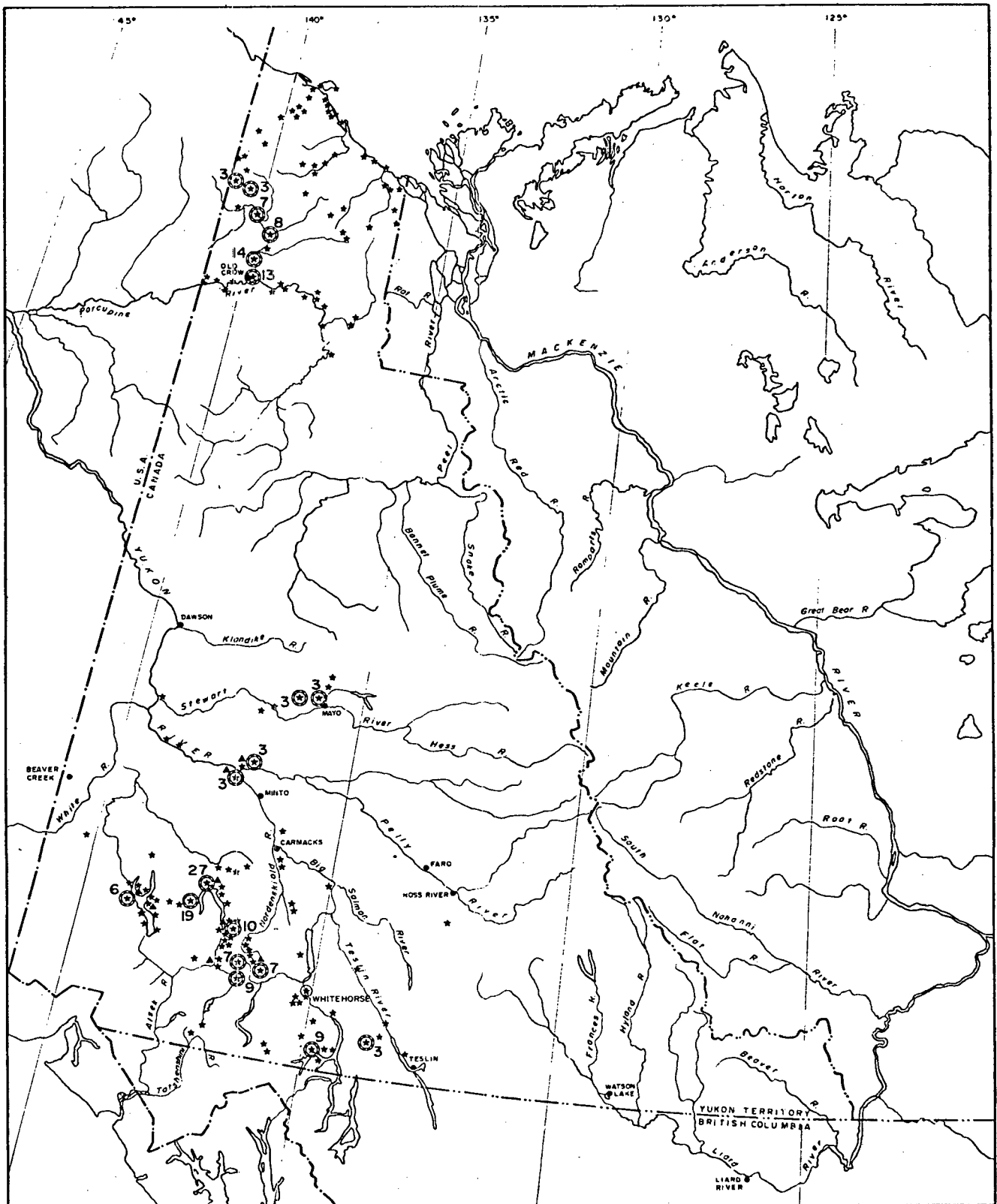
NOTE:

1. INFORMATION OBTAINED FROM CANADIAN COMMITTEE FOR IBP AND LAND USE MAPS.
2. NUMBERS USED ARE IBP REFERENCES.

Source: #7d

Map 19.

ARCHAEOLOGICAL SITES



LEGEND:

- ▲ LARGE STRATIFIED SITES
- KNOWN ARCHAEOLOGICAL SITES
- ⑨ NINE KNOWN ARCHAEOLOGICAL SITES

Source: #7d

NOTES:

1. INFORMATION OBTAINED FROM ARCHAEOLOGICAL SURVEY FOR SOUTH AND FROM PIPELINE STUDY FOR NORTH
2. NO EXPLORATION HAS BEEN MADE NORTH AND EAST OF TESLIN AND YUKON RIVERS AND SOUTH OF PORCUPINE RIVER

area before the arrival of white men.

At the present time, archeological finds are primarily of scientific interest, but they could be integrated into the overall tourist industry. Care must be taken to prevent unlawful removal of artifacts; a problem of increasing importance as access to remote areas becomes available to more people.

The fur trading industry played an important role in opening up the Yukon. Relics of fur trading settlements are found along the major waterways, especially the Porcupine-Peel and Yukon River systems.

The Gold Rush era provides the basis upon which a large part of the tourism industry depends. The major tourist transportation routes; from the south B.C. coast via ferry to Skagway, train to Whitehorse, road to Dawson and then into Alaska or back to B.C., is centered around the towns and country associated with the Gold Rush. The Gold Rush System Park plan, if implemented, would work towards restoring and preserving the character and relics of the era. Restoration of buildings is ongoing in Dawson City and Whitehorse, and much of the tourist activity in these major towns revolves around the Yukon's Gold Rush history.

#### (d) Tourist Services

Tourism is the Yukon's second major industry, with a revenue of about \$25 million a year. About 75% of the tourists arrive by car, 15% by air and 10% by bus, but the Parks Branch hopes to increase the number of package tours by bus.

The seasonal nature of the industry poses a problem in accommodation, especially in Whitehorse and Dawson. Hotels are usually fully booked during the tourist season but almost vacant during the winter. It is economically difficult to run a successful hotel operation based on four or so months of revenue, but the fact remains that if the Yukon's tourist industry is to grow, more seasonal accommodation will be required.

Map 20 and table 9 show the locations and status of campsites in the Yukon. The campsites are of excellent quality but are usually very crowded during the summer months.

Gold Rush tours and wilderness camping are heavily promoted in the Yukon, but provision for preservation of the resources used does not exist. Little attempt is made to integrate the Gold Rush tours with fishing, wilderness camping and hiking, wildlife observation etc., so full use of the tourism resources are not being made.

Planning for Parks and Tourism is essential, because in the near future, conflicting resource developments are going to threaten the quality and quantity of resources available to tourists and residents. Lack of workable plans and goals for the recreation and tourism industry will weaken arguments for preservation of tourist and recreational resources.

Table 11, in the Water Use Section, summarizes the effects that proposed power developments would have on tourism and recreation resources. It is very likely that several power projects will be implemented in the near future, it is a matter of deciding which will be the least detrimental to the environment and most beneficial to the economy.

MAP - 20

CAMPSITES

SOURCE - Yukon House

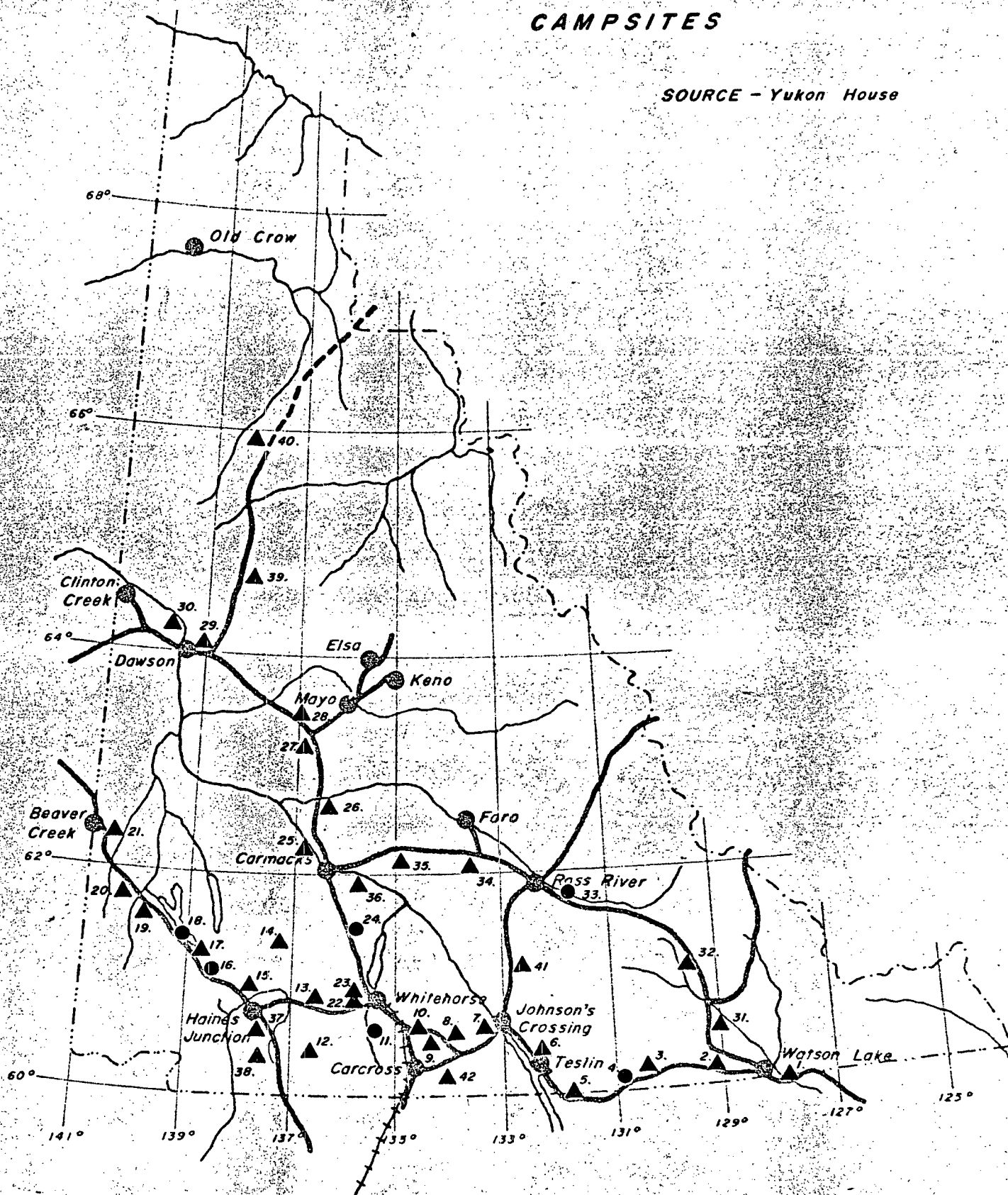


Table 9

Campgrounds

#	Name	Services Available
1.	Watson Lake	45 spaces, well water, dump stn.
2.	Big Creek	30 spaces, fishing.
3.	Rancheria River	30 spaces, dump stn., fishing.
4.	Swift River	10 spaces, lunch stop, fishing.
5.	Morley River	30 spaces, fishing.
6.	Teslin Lake	30 spaces, dump stn., fishing, boating.
7.	Squanga Lake	30 spaces, dump stn., fishing, boating.
8.	Judas Creek	30 spaces.
9.	Marsh Lake	30 spaces, well water, dump stn., fishing, boating, beach.
10.	Wolf Creek	60 spaces, dump stn., 12 miles from Whitehorse.
11.	Jackson Lake	20 spaces, turn left for 7 mi., lunch stop, fishing, easy drive to Whitehorse.
12.	Kusawa Lake	40 spaces, turn left for 15 miles, to Kusawa and Takhini R. campsites, boating, fishing, beach, boat ramp.
13.	Mendenhall Creek	30 spaces.
14.	Otter Falls	10 spaces, turn right for 17 mi. to Otter Falls campground, scenic area.
15.	Pine Creek	30 spaces, well water, dump stn., fishing.
16.	Sulphur Lake	10 lunch stop sites, boating, fishing.
17.	Kluane Lake	40 spaces, dump stn., scenic area, boating, fishing.
18.	Goose Bay	10 lunch stop sites, boating, fishing.
19.	Burwash Flats	30 spaces, well water.
20.	Lake Creek	30 spaces, well water.
21.	Snag Junction	20 spaces, dump stn., fishing.
22.	Lake LaBerge	60 spaces, well water, dump stn., fishing, boating, beach.

Table 9 con't

23.	Fox Lake	50 spaces, dump stn., fishing, boating, beach.
24.	Twin Lake	10 lunch stop sites, fishing, boating.
25.	Tachun Creek	40 spaces, fishing.
26.	Minto Landing	10 lunch stop sites, fishing.
27.	Ethel Lake	20 spaces, fishing boating.
28.	Moose Creek	50 spaces, fishing.
29.	Klondike	50 spaces, 12 miles to Dawson City.
30.	Yukon River	20 spaces, across river from Dawson City.
31.	Simpson Lake	20 spaces, fishing, boating, beach.
32.	Frances Lake	20 spaces, fishing, boating, beach.
33.	Ross River	20 lunch stop sites.
34.	Fisheye Lake	15 spaces, fishing, swimming, no boating.
35.	Drury Creek	20 spaces, fishing, boating.
36.	Little Salmon	20 spaces, fishing, boating, beach.
37.	Kathleen Lake	20 spaces, fishing, boating, beach, boat ramp.
38.	Dezadeash Lake	12 lunch stop sites, fishing, boating, boat ramp.
39.	Tombstone	10 stalls, fishing.
40.	Ogilvie	10 stalls, fishing 1 mile.
41.	Quiet Lake	10 spaces, fishing, boating.
42.	Tagish Bridge	30 spaces, well water, dump stn., all facilities, boating, fishing from bridge.

Source: "Hospitality Yukon". A brochure available from "Yukon House" in Vancouver.

New mining and transportation developments will increase access into areas previously not used by tourists, (e.g. the Dempster Highway and access roads to the MacMillan Pass area). The impact of increased access can only be guessed at since little research has been done on the subject. For example, there appears to be no plans for protecting historic artifacts and the fragile northern environment of the Porcupine River Basin from recreationists using the Dempster Highway.

In summary, the tourism and recreation industry in the Yukon is becoming increasingly important in stabilizing the fluctuating mining economy.

However, the lack of an integrated workable plan for development and preservation of tourism and recreation resources may put the industry in an unfavourable position when decisions on general resource development in the Yukon are made.

(C) Water Use

Only a small portion of the Yukon's vast water resources are being used at the present time for power, industry and domestic purposes. The future development of industry in the Yukon may well depend on its ability to obtain efficient and economical power. Construction of transportation routes and pipelines are important present and potential industries, and the impact of these developments on the water resource constitutes a form of water use. However, the increasing demand for the water resource in its natural state for fisheries, recreation and tourism must be taken into consideration.

This section will concentrate on direct use of water for power, domestic and recreation purposes. The use of and effects on water by mining, construction and fisheries are discussed elsewhere in this report.

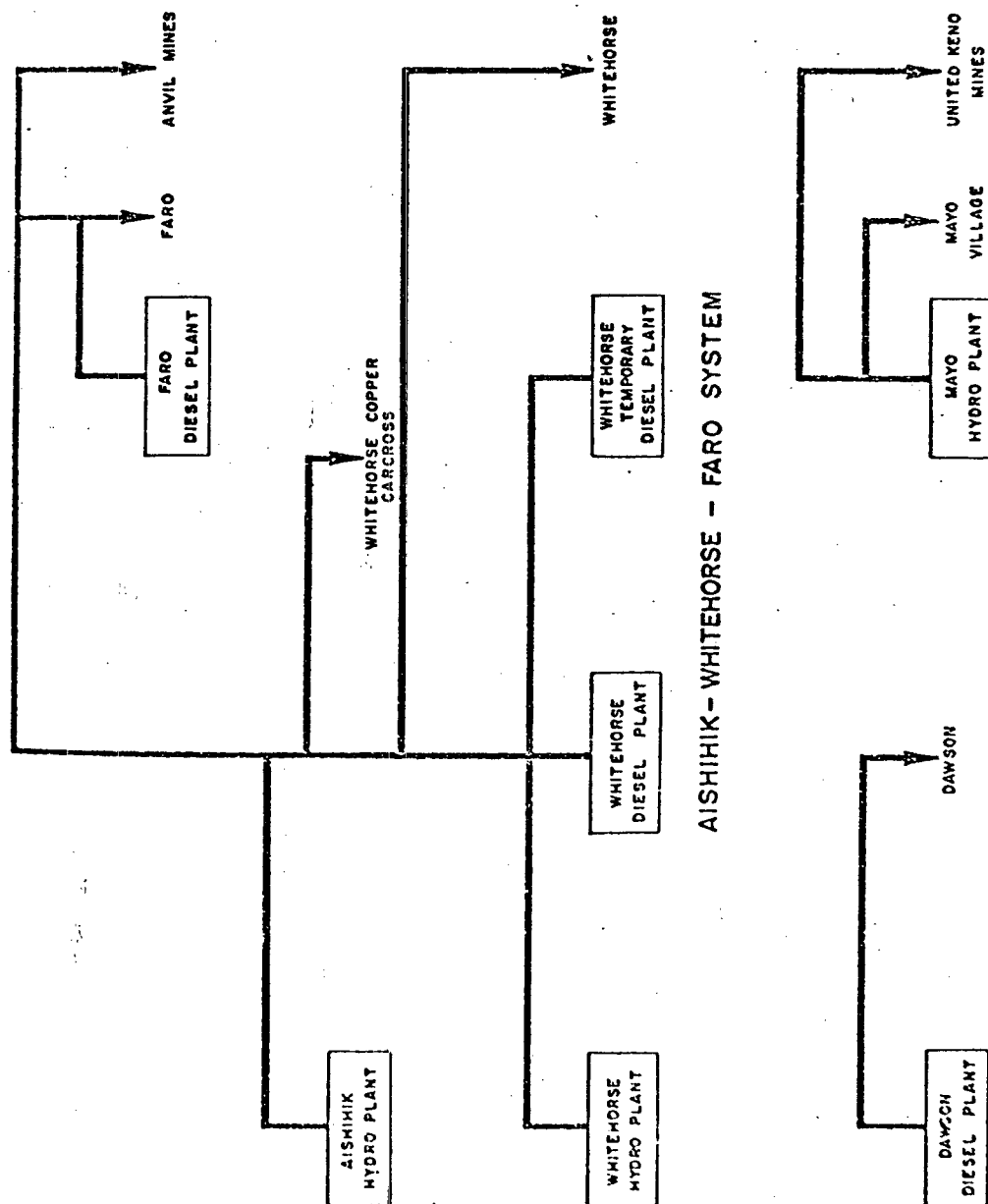
(i) Power

The present power system in the Yukon is limited but adequate for the demand. 80% of the power is generated and supplied by the Northern Canada Power Commission, a federal crown corporation responsible for power in the Yukon and Northwest Territories. The remaining 20% is supplied by the Yukon Electric Company, a subsidiary of a major international utility. It operates a distribution system in Whitehorse based on power purchased from the N.C.P.C. and also operates a number of small diesel power plants in several Yukon communities.

Figure 4 and table 10 show the present system's organization

Figure 4

# PRESENT YUKON POWER SYSTEMS SYSTEM SCHEMATICS



AISHIHIK - WHITEHORSE - FARO SYSTEM

DAWSON SYSTEM

MAYO SYSTEM

The NCPC system is shown in addition to the NCPC system, Yukon Electrical Company has diesel plants at the following communities and transmission lines from Whitehorse to Carcross and from Destruction Bay to Burwash Landing.

- Watson Lake
- Swift River
- Teslin
- Ross River
- Pelly Crossing
- Stewart Crossing
- Old Crow
- Haines Junction
- Destruction Bay

Source: #37.

Table 10a

Total Installed Capacity of Present NCPC Plants

Whitehorse	Hydro	20.0
Whitehorse	Diesel	18.2*
Aishihik	Hydro	31.0
Faro	Diesel	<u>5.1</u>
Total interconnected system:		<u>74.3</u>
Mayo	Hydro	5.1
Dawson	Diesel	<u>1.5</u>
Total Installed Capacity		<u><u>80.9 MW</u></u>

\* Excludes 7.5 MW of temporary diesel capacity  
installed since 1973.

Source: # 7c.

Table 10b

## Present Yukon Power System

## Project Data for NCPC Hydro Plants

PLANT	UNIT	GENERATORS (kw/unit)	TURBINES (HP/unit)	RATED HEAD (ft)	RATED DISCHARGE (cfs)	LIVE STORAGE (acre-feet)	ANNUAL FIRM ENERGY AT PLANT (GWH)	FULL SUPPLY LEVEL	TAILWATER LEVEL
WHITEHORSE	3	#1 - 5,870 #2 - 5,870 #3 - 8,250	#1 - 7,500+ #2 - 7,500+ #3 - 11,000+	63	4,600	900,000	149	2,143	2,000
MAYO	2	#1 - 2,240 #2 - 2,840	#1 - 3,000 #2 - 3,800	110	610	250,000	44	1,900	1,700
AISHIHIK	2	#1 - 15,500 #2 - 15,500	#1 - 21,000 #2 - 21,000	620	700	475,000	*	2,972	2,343

## NOTE

\* The annual firm energy at the plant has not yet been established but is of the order of 100 GWH

Source: # 7c .

and capability.

The following is a brief summary of the hydro plants now in operation:

(a) The Whitehorse Plant is located on the Yukon River at Whitehorse Rapids (map 21). When completed in 1958, it had a capacity of 11 MW. Since then a 9 MW power unit has been added, bringing the hydro capacity to 20 MW. An 18 MW diesel plant is located in a nearby building.

The Whitehorse hydro system supplies Anvil Mines via 225 miles of 138 kv transmission lines. The Sigma study states that a further 20 MW unit is planned for the near future.

The Marsh Lake dam provides flow regulation and a live storage of 900,000 acre-feet at an elevation of 2151.

(b) The Mayo Plant is located about 8 km (5 mi.) from Mayo town on the Mayo River. 250,000 acre-feet of live storage is provided by the Mayo storage dam, and the power plant has an installed capacity of 5.1 MW.

(c) The Aishihik Plant is the most recent addition to the Yukon's power system. It is the first underground hydro development

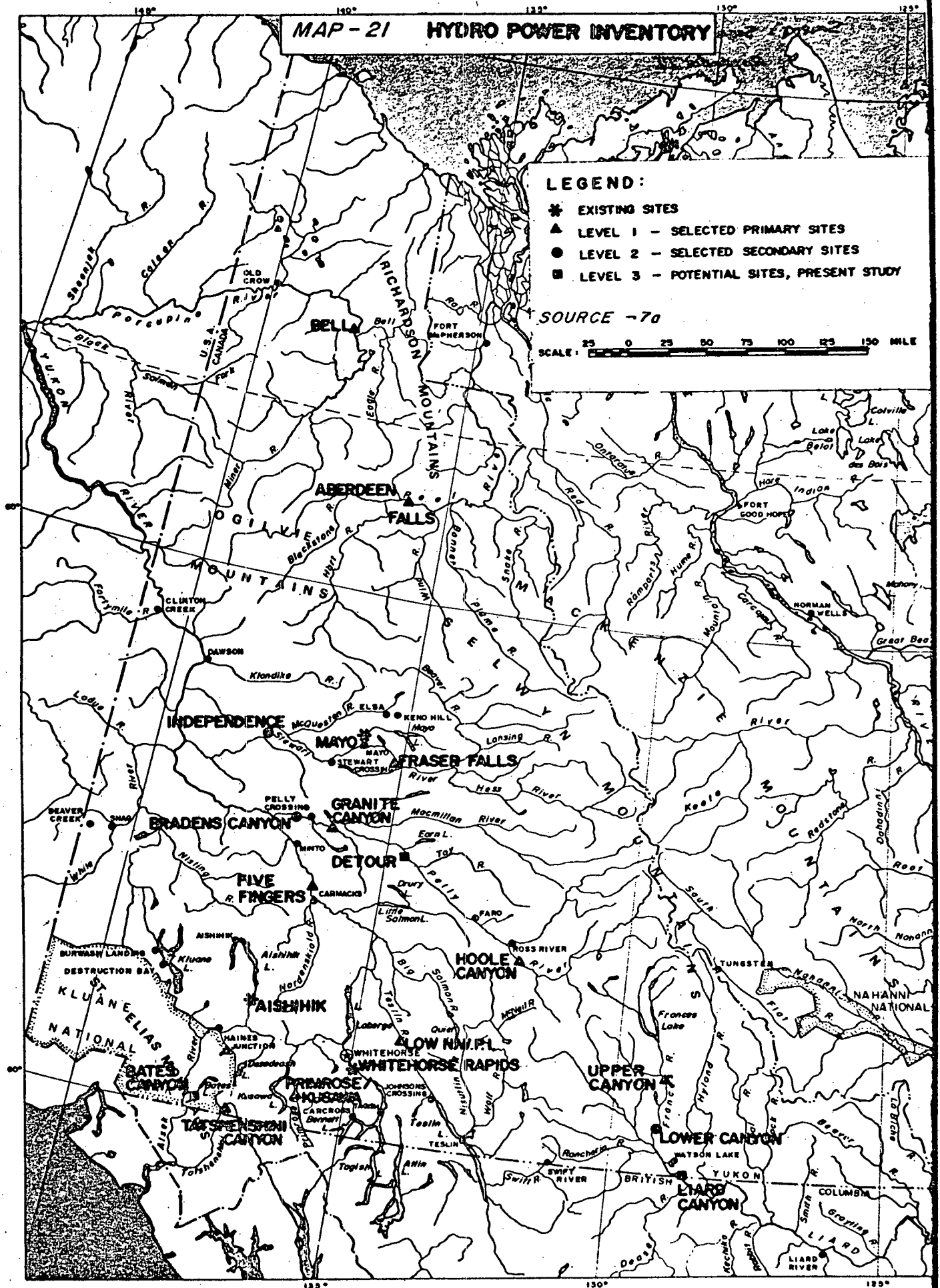
# MAP - 21 HYDRO POWER INVENTORY

## LEGEND:

- \* EXISTING SITES
- ▲ LEVEL 1 - SELECTED PRIMARY SITES
- LEVEL 2 - SELECTED SECONDARY SITES
- LEVEL 3 - POTENTIAL SITES, PRESENT STUDY

SOURCE - 70

SCALE: 25 0 25 50 75 100 125 150 MILE



north of the 60th parallel in the western world, and on its completion in 1975, it had an installed capacity of 31.5 MW. Natural storage is provided by Sekulmann, Aishihik and Canyon Lakes. Flow is regulated by two control structures at the outlets of Aishihik and Canyon Lakes. An 18 m (60 ft.) concrete fishway allows fish to move from the downstream to the upstream side of the main control dam. Power from the system is fed to Whitehorse via Takhini along 138 kv transmission lines.

#### Power Potential

The wild rivers of the Yukon possess an enormous potential for power production. However, the use of rivers for power will have a detrimental effect on many other potentially economically valuable aspects of the environment. Table 11 and Map 21 summarize the major potential power sites and the effects that development would have on other resources.

#### Load Projections

The mining industry uses over half of the power produced in the Yukon. With the steadily increasing population, residential-commercial demand is rising. Yukoners use more power per capita than any other Canadian province, which is understandable in the light of the harsh climate; winter nights over 15 hours long and daily winter temperatures well below freezing.

Any major industrial development in the Yukon will probably require a new major power installation, for example:

- a smelter would require 50 to 100 MW

Table 11

# SUMMARY OF EFFECTS OF RIVER SYSTEM DEVELOPMENTS ON YUKON RESOURCES

PROJECT	RIVER	RESERVOIR AREA	FISH	WILDLIFE	FOREST	RECREATION	HISTORY SPECIAL FEATURES	SCIENTIFIC ARCHAEOLOGICAL	COMMUNITIES	COMMENTARY
1 PRIMROSE/KUSMAA	PRIMROSE	13 sq. mi. including 7 sq. mi. of existing lakes	Local effects only	Minimal effects	No commercial loss	1. High quality wilderness area. Water component has low value 2. Access roads and power-line would affect part values at Kusama Lake	None	None known	None	Project with probably the least environmental effects
2 LOW MHP	TESTLIN	170 sq. mi. including 150 sq. mi. of existing Testlin Lake	1. Loss of spawning areas for chum and chinook in river 2. Impact on lake fishery due to raising by 15 ft.	1. Loss of average quality moose winter range 2. Loss of waterfowl nesting sites 3. Changed shoreline at Misutlin Bay would affect migrating waterfowl	Loss of good alluvial sites along river, mainly carrying hardwood at present	1. Loss of 50 miles of wild river with good scenic rating suitable for family use 2. Loss of 10 miles of beach on river and lake	None	1. Wolf Lake BHP Reserve reaches present shoreline at Misutlin Bay. Shoreline would be altered 2. Archaeological sites exist along lake	1. Relocation not required at Testlin or Johnsons Crossing 2. Loss of salmon fishery at Johnsons Crossing and Testlin	1. Raises level of Testlin Lake by 15 ft. which does not flood lakeshore communities or much of Alaska Highway, but floods land in British Columbia 2. Dam is only 60 ft. high and use of a fish ladder is possible
3A HOOLE CANYON	PELLY	4 sq. mi.	Local effects only if built after Granite Canyon. The existing fish camp at the Canyon will already be redundant	1. Loss of 4 sq. mi. of average moose winter range 2. Loss of 12 miles of riparian habitat 3. Changes to Tintina Trench waterfowl migration route	4 sq. mi. of alluvial site which cannot be exploited at present	Loss of 12 miles of wild river on a major recreation route with a good scenic rating	Loss of most of Hoole Canyon	None known	Minor loss of hunting and trapping area	No comment
3B PELLY LAKES	PELLY	22 sq. mi. including 14 sq. mi. of existing lakes	Local effects only if built after Granite Canyon	1. Loss of 8 sq. mi. of average moose winter range 2. Loss of 1 sq. mi. of wetlands 3. Loss of 48 miles of riparian habitat	Loss of wildlife habitat	Loss of 12 miles of wild river and 36 miles of lakeshore. In a scenic setting	None	Probable archaeological sites	1. Loss of Pelly Lakes village which is occupied seasonally 2. Minor loss of hunting and trapping area	No comment
4A LOW GRANITE CANYON	PELLY	95 sq. mi.	1. Elimination of salmon runs in Upper Pelly 2. Downstream impact moderate	1. Loss of 45 sq. mi. of average moose winter range in Pelly valley and 50 sq. mi. of above average in Macmillan valley 2. Loss of riparian and wetland habitat 3. Changes to Tintina Trench waterfowl migration route	Major loss as Pelly and Macmillan valleys contain much merchantable softwood	Loss of 43 miles of wild river along Pelly and 40 along Macmillan. Pelly is a major recreation route. Both valleys have good scenic ratings	None	1. Possible effect on McArthur BHP Reserve due to loss of winter range 2. Archaeology not known	1. Loss of hunting and trapping values in Macmillan valley 2. Loss of salmon fishery at Ross River	No comment
4B HIGH GRANITE CANYON	PELLY	200 sq. mi.	1. Elimination of salmon runs in Upper Pelly 2. Downstream impact moderate	1. Loss of 100 sq. mi. of average moose winter range in Pelly valley and 100 sq. mi. above average in Macmillan valley 2. Major loss of wetland and riparian habitat 3. Changes to Tintina Trench migration route	Major loss as Pelly and Macmillan valleys contain much merchantable softwood	Loss of 60 miles of wild river along Pelly valley and 78 miles along Macmillan valley. Pelly River is a major recreation route. Both valleys have good scenic ratings	None	1. Possible effect on McArthur BHP Reserve due to loss of winter range 2. Archaeology not known	1. Major loss of hunting and trapping values in Macmillan valley 2. Loss of salmon fishery at Ross River	1. The project with most damage to forestry 2. Possible flooding of some mining claims
5A LOW FRASER FALLS	STEWART	70 sq. mi.	1. Elimination of present intermittent salmon runs above Fraser Falls 2. Downstream impact moderate	1. Loss of 70 sq. mi. of above average moose winter range 2. Major loss of wetland and riparian habitat 3. Loss of critical waterfowl habitat at Horseshoe Slough	Sites are productive but mainly growing hardwoods	Loss of 35 miles of wild river. Stewart River is a major recreation route and has a good scenic rating	Loss of Fraser Falls, 3 mile Rapids, and 5 mile Rapids	1. Possible effect on McArthur BHP Reserve due to loss of winter range 2. Archaeology not known	Loss of hunting and trapping above Fraser Falls	No comment

# SUMMARY OF EFFECTS OF RIVER SYSTEM DEVELOPMENTS ON YUKON RESOURCES

PROJECT	RIVER	RESERVOIR AREA	FISH	WILDLIFE	FOREST	RECREATION	HISTORY SPECIAL FEATURES	SCIENTIFIC ARCHAEOLOGICAL	COMMUNITIES	COMMENTARY
58 HIGH FRASER FALLS	STEWART	145 sq. mi. including 20 sq. mi. in Hess valley	1. Elimination of present intermittent salmon runs above Fraser Falls 2. Downstream impact moderate	1. Loss of 145 sq. mi. of above average moose winter range 2. Major loss of wetland and riparian habitat 3. Loss of critical waterfowl habitat at Horseshoe Slough	Sites are productive but mainly growing hardwoods	Loss of 60 miles of wild river along Stewart and 10 miles on Hess including a fine canyon. Stewart River is a major recreation route and has a good scenic rating	Loss of Fraser Falls, 3 mile rapids, 5 mile rapids, and Hess Canyon	1. Possible effect on McArthur IBP Reserve due to loss of winter range 2. Archaeology not known	Major loss of hunting and trapping above Fraser Falls.	No comment
6A LOW FIVE FINGERS	YUKON	14 sq. mi.	Interferes with all fish movement on Upper Yukon system	Minor loss associated with riparian habitat	No commercial loss	1. Loss of 18 miles of scenic river 2. Changes required to Gold Rush Park concept	1. Historic sites at Carmacks flooded 2. Five Fingers Rapids with historic significance altered by dam construction	Archaeological sites near Carmacks flooded	Relocation of Carmacks required	Project which is most injurious to fish, and least injurious to wildlife
6B HIGH FIVE FINGERS	YUKON	43 sq. mi.	Interferes with all fish movement on Upper Yukon system	Loss of riparian habitat and some moose winter range	Minor commercial losses	1. Loss of 48 miles of scenic river including 6 miles on Little Salmon and 5 miles on Hordenstold River 2. Changes required to Gold Rush Park concept	1. Historic sites at Carmacks flooded 2. Five Fingers Rapids with historic significance altered by dam construction	Archaeological sites near Carmacks and at Little Salmon flooded	1. Relocation of Carmacks required 2. Relocation of 30 miles of Dawson Highway and reconstruction of Carmacks bridge required 3. Flooding of lower levels of Tantalus coal mine 4. Loss of salmon fishery	1. Project which is most injurious to fish 2. Affects coal resources at Tantalus mine
7 UPPER CANYON	FRANCES	125 sq. mi. including 53 sq. mi. of existing Frances Lake	1. Stock available from Frances Lake to cottonize reservoir 2. Downstream effects likely to be significant due to river regulation	1. Loss of wetland habitat affecting moose, waterfowl and trapping 2. Changes to waterfowl migration route	Minor commercial losses	1. Change of character of scenic lake 2. Loss of 13 miles of lake beach 3. Loss of 35 miles of wild river, including rivers at head of Frances Lake, with high scenic rating 4. Loss of bank values	1. Fort Frances flooded 2. Loss of Upper Canyon	No known archaeological site	1. Major loss of trapping and hunting areas 2. Loss of seasonally occupied native villages	No comment
8 TATSHEHSHINI/STAGE 1	TATSHEHSHINI	39 sq. mi. at Dezadeash Lake including 31 sq. mi. of existing lake, and 10 sq. mi. at Tatshehshini River. Level at Dezadeash Lake raised 20 ft.	1. Eliminates salmon run in Tatshehshini River 2. Diversion is unfavorable for whitefish in Dezadeash system 3. Downstream effects due to diversion of Dezadeash River	1. Loss of wetland habitat in Dezadeash valley 2. Changes in swan staging areas in Dezadeash Lake 3. Elimination of salmon in Tatshehshini River critical for grizzly	Loss of wildlife habitat	1. Scenic character of Dezadeash Lake changed 2. Loss of 6 miles of beach 3. The significant flow reduction in Dezadeash River due to diversion affects 28 miles of scenic canoe river	1. Dalton Post and Westcabin flooded. Partial flooding of the Dalton Trail	1. No known archaeological site except at Westcabin 2. Unusual type of whitefish in Dezadeash Lake	1. Loss of Klushu fishery 2. Relocation required of settlement at southern end of Dezadeash Lake 3. Trapping loss in Dezadeash River valley due to reduced flow by diversion	No comment
9 ABERDEEN FALLS	PEEL	Not available	1. The dam blocks access to spawning and rearing areas for whitefish 2. River regulation causes severe downstream effects	1. Broken ice on reservoir endangers caribou in spring migration 2. Loss of valley bottom affects moose and endangers raptor population	Loss of wildlife habitat	Loss of 28 miles on Peel River and 10 miles on Hart River. Peel is rated as the most scenic wild river in the Yukon	Loss of Aberdeen Falls	None known	1. Changes to fishery and trapping at Fort MacPherson 2. Losses of caribou affect Old Crow and Fort MacPherson	Peel River canyons are exceptionally scenic and wild river status is probable
10 BELL	PORCUPINE	About 500 sq. mi.	Blockage at dam site may threaten salmon population of Porcupine River. Regulation of river flows will affect all other fish varieties adversely	1. Broken ice on reservoir endangers caribou in spring migration 2. Loss of winter range in valley reduces moose population	Loss of wildlife habitat	Loss of 132 miles of wild river including 56 on Bell, 48 on Porcupine, 48 on Eagle River. The Bell-Porcupine forms a major recreation route	Loss of Lapierre House and major portion of northern Hudson Bay Trading route	Affects IBP Reserves in Fishing Branch River, McDougal Pass and Old Crow Flats	1. Blockage of salmon passage to fishing branch River spawning grounds, and losses of caribou affect Old Crow and Fort MacPherson 2. Loss of trapping opportunities for Old Crow	1. Reservoir storage reduces flood risk at Old Crow 2. Environmentally the scheme is disastrous 3. Oil and gas leases flooded

SUMMARY OF EFFECTS OF RIVER SYSTEM DEVELOPMENTS  
ON YUKON RESOURCES

PROJECT	RIVER	RESERVOIR AREA	FISH	WILDLIFE	FOREST	RECREATION	HISTORY SPECIAL FEATURES	SCIENTIFIC ARCHAEOLOGICAL	COMMUNITIES	COMMENTARY
11 BRADENS CANYON	PELLY	22 sq. mi.	No significant impact after Granite Canyon constructed	1. Loss of average moose winter range 2. Loss of riparian habitat	Good alluvial sites mainly of softwood	Loss of 24 miles of scenic wild river on a major recreation route	Loss of Bradens Canyon	None known	1. Pelly Crossing flooded 2. Relocation of Dawson Highway required over Bradens Dam	No comment
12 INDEPENDENCE	STEWART	195 sq. mi.	1. Eliminates salmon in Upper Stewart 2. Downstream effects not expected to be very adverse	1. Good beaver habitat in McQuesten valley 2. Average moose winter range in valley bottom	Good alluvial sites in lower valley but little merchantable timber	Loss of 102 miles of scenic wild river on Stewart and 30 miles on McQuesten. Stewart River is a major recreation route	Loss of Mayo	1. Affects IBP Reserve for Mayo swampland 2. Some archaeological sites are known in lower valley	1. Mayo, Stewart Crossing and McQuesten flooded 2. Flooding of 44 miles of Dawson and Mayo highways 3. Domestic fishery, hunting and trapping affected	No comment
13 LOWER CANYON	FRANCES	34 sq. mi. including 9 sq. mi. of existing lake	Local effects only especially if built after Upper Canyon	1. Loss of good summer wetlands for moose near Simpson Lake 2. Changes to waterfowl migration route	No significant commercial loss	1. Loss of 25 miles of scenic wild river on a major recreation route 2. Loss of 4 miles of beach on Simpson Lake with reduction of its appeal	Loss of Lower Canyon	None known	1. Loss of 12 miles of Campbell Highway 2. Loss of hunting and trapping opportunities	No comment
14 TATSHEEN/IN/STAGE 2	TATSHEEN/IN	59 sq. mi. of which 51 sq. mi. is the existing Kusama Lake	1. Could introduce Yukon River drainage system parasites, fish, etc. into Alsea drainage 2. Could impair spawning opportunities in Kusama Lake	Loss of 2 sq. mi. of wetlands at south end of Kusama Lake	No commercial loss	1. Loss of 13 miles of beaches on Kusama Lake 2. Reduction in potential of highest rated area close to Whitehorse	None known	Diversion of Kusama Lake may affect unusual whitefish type in Dezadeash Lake	1. Reduces part potential of Kusama Lake 2. Floods outcrops Camp on west shore	1. Not enough understanding of effect on fisheries of diversions 2. Baites Kusama Lake by 20 ft.
15 DETOUR	PELLY	27 sq. mi.	Local effects only if built after Granite Canyon	1. Loss of riparian habitat affecting trapping 2. Loss of average winter range for moose	Good alluvial sites, some merchantable softwood	Loss of 56 miles of scenic river on a major recreation route	None known	None known	Loss of trapping and hunting opportunities for Ross River	No comment
16 LIARD CANYON	LIARD	55 sq. mi.	Effects of blockage by Liard Dam on fish migration are uncertain	1. Major loss of good summer range for moose 2. Major loss of wetlands 3. Changes to waterfowl migration route and staging areas	Major loss of productive sites	Loss of 38 miles of scenic wild river including 8 miles on Frances River. The latter is a major recreation route	Parts of Liard Canyon lost	None known	1. Community of Upper Liard flooded 2. Alaska Highway would require re-routing	1. Little known about fish 2. Downstream effects not yet known
17 BATES CANYON	BATES	8 sq. mi. in Bates valley, and 29 sq. mi. at Dezadeash Lake including 31 sq. mi. of existing lake	Local effects only since fish passage on Bates River is blocked by natural falls	Changes may affect waterfowl population and will reduce riparian habitat	Minor loss of softwood around Bates Lake	1. Loss of natural values of Bates Lake, a highly rated area 2. Loss of 6 miles of beach on Bates Lake	Not known	Loss of low level land in a major IBP Reserve	1. Relocation of farms at south end of Dezadeash Lake required 2. Loss of National Park values	No comment

- a pulp mill would require about 20 MW
- an aluminum smelter would require about 300 MW
- compressor stations for the proposed gas pipeline will probably be run on hydro power rather than diesel or gas

By the early 1980's, five new mines will probably be in operation (see the section on mining), and will require more power than is presently available.

Any major industrial or mining development will bring people, resulting in either expansion of existing towns or creation of new ones, resulting in increased domestic power demand.

Construction of a pipeline would bring in a large number of temporary workers and equipment, all requiring some sort of power.

With these potential developments in mind, the question is not whether there will be a new power development, but where it will be.

The Sigma report details a number of potential power sites involving most of the major waterways in the Yukon. The N.C.P.C. have chosen the following four sites as the most promising prospects:

River Valley	Site	Dam Height	Reservoir Area	
Yukon	Five Fingers	28 m (95 ft)	39 km <sup>2</sup>	(15 sq mi)
Pelly	Granite Canyon	48 m (160 ft)	283 km <sup>2</sup>	(90 sq mi)
Stewart	Frances Falls	42 m (140 ft)	181 km <sup>2</sup>	(70 sq mi)
Frances	Upper Canyon	48 m (160 ft)	324 km <sup>2</sup>	(125 sq mi)

A fifth undisclosed site is a definite possibility if the Kaiser Corporation decides to build an aluminum smelter in Whitehorse.

The actual site chosen will depend on several factors:

- the pattern of industrial development that takes place
- environmental considerations, especially fisheries, forestry and recreation.
- approval/disapproval of the residents of the Yukon
- economic feasibility.

Integration of power development with other major uses of the Yukon's water resource is necessary to ensure the preservation of, and economic gain from this important resource.

(ii) Recreational Use

With tourism as the Yukon's second most important industry, the use of water resources for recreation is of primary economic and aesthetic concern.

Most of the rivers and lakes in the Territory support abundant fish populations (discussed in more detail under "Fish and Fisheries"), and are used extensively by residents, natives and tourists. Many of the waterways provide excellent canoe and boat access into remote regions, and others are accessible by foot and road. Early traders and gold seekers used the waterways as their main transportation routes to inland trading posts and gold fields, and the banks of some rivers are scattered with historic relics and abandoned settlements of fur-trading and gold seeking explorers.

Except for a power development at Whitehorse, the 600

Canadian miles of the Yukon River are free of obstruction and interference by man. The entire route of the River is rich in the history of the Gold Rush, and abandoned settlements are common along its banks.

Although not particularly unique in its scenic character, the Yukon River is the most accessible of the navigable rivers in the Yukon, the closest to major population centers, and it supports a wide variety of natural scenic features. The headwaters of the River, Bennett, Tagish, Marsh, Taku and Arm Lakes are particularly attractive.

The Pelly, MacMillan and Ross Rivers are tributaries of the Yukon River. They are characterized by recently burned banks and unattractive abandoned mining sites and roads, but support an abundance of wildlife. The lower MacMillan River has very limited access, and the Pelly and Ross Rivers are not as easily reached as the mainstem Yukon River.

The Stewart, Big Salmon and 60 Mile Rivers are not very navigable, and not particularly unique in scenery.

The Teslin and Nisutlin River Basins support excellent scenic variety and large populations of Canada Geese and moose.

Although the Klondike River is rich in relics from the Gold Rush, most of its natural beauty and original drainage has been destroyed by miles of tailings that line the river valley.

The Peel-Ogilvie River system in the northern Yukon provides about 400 km (250 mi) of navigable canoeing and boating water. It supports spectacular canyon topography, challenging waters and scenic diversity and a variety of fish and wildlife communities.

The Wild Rivers Survey of 1971 recommended that the Yukon, Ogilvie-Peel and several other river systems be set aside for preservation as scenic parks (# 58 ). Such a plan has not yet come into effect - probably because conflicting uses of these rivers have not been fully explored.

(iii) Domestic Water Use

Water for domestic use comes from groundwater wells and surface water bodies. About 88% of Yukon residents use groundwater for drinking and the overall quality of groundwater is high. (Table 12).

Mining towns, major centers and government communities usually have water delivered by a central pipe system.

In communities without piped water, most white areas have individual pipe systems or water delivered by truck on a regular basis.

The availability and quality of water in many native communities is below minimum standard (no indoor plumbing, no regular water delivery). The poor quality of some native housing may prevent the installation of a piped system. The native communities of Burwash Landing, Carcross, Carmacks, Old Crow, Pelly Crossing, Teslin and Upper Liard have inadequate water supply systems. (# 59 ).

Detailed water use studies have been completed for most communities in the Yukon, and are available from the Territorial Government, Department of Public Works in Whitehorse. Only a very brief summary of the major problems is given in this report.

Table 12

WATER USE IN YUKON COMMUNITIES

Community	Population*	Ground Water Supply	Surface Water Supply	Daily per Capita Use (Gal./ day)	Comments
Beaver Creek	120	X		60 e	private wells
Burwash Landing	67	X		30 e	community well
Carcross	199	X	X	60 e	private wells
Carmacks	350	X		60 e	private wells
Champagne	64	X	X	20 e	private wells
Clinton Creek	700 e		X	130 e	-
Dawson	762	X		800-2000	2 city wells
Destruction Bay	108	X		60 e	private and community wells
Elsa	529		X	60 e	-
Faro	863	X		200	2 town wells
Haines Junction	183	X		60 e	private wells, but building town system
Keno	50	X		30 e	community well
Mayo	479	X		900	3 town wells
Old Crow	173		X	30 e	-
Pelly Crossing	89	X	X	40 e	private wells
Ross River	317	X		70 e	town well and private wells
Tagish	100 e	X		30 e	private wells
Teslin	350	X	X	50	private wells, lake supply
Watson Lake	597	X		60	private wells, new town system
Whitehorse	13,000 e	X	X	70 e	6 city wells, winter use only
Total	19,100				

Water quality problems exist in the following communities:

- a) Carcross - organic contamination of the wells and lake water
- b) Beaver Creek - contamination of groundwater wells
- c) Teslin - very high mineral content and possible organic pollution of the lake water
- d) Mayo - siltation and periodic drying out in some wells due to an uncontrolled increase in hookups

The priorities recommended for improving the water system in the Yukon include:

- " - Piped community water system in Teslin, Haines Junction and the main community at Carcross.
- Trucked water delivery in Burwash Landing, Pelly Crossing, Upper Liard and the Native Villages at Carcross and Carmacks.
- Revamping of the water system at Mayo.
- Extension and revamping of piped water system in Ross River.
- Upgrading existing water system in Whitehorse including leak detection program and meter installation. Extension of piped water system to unserviced areas of Porter Creek."

(# 59 ).

#### Sewerage and Sewage Disposal

In towns with a good water supply system, waste disposal is usually adequate: either by a community piped system, or individual disposal systems. However, in several communities with individual systems, overcrowding, poor soil and permafrost have caused some leakage problems into nearby freshwater sources.

The native villages of Burwash Landing, Carcross, Carmacks,

Pelly Crossing, Ross River, Teslin, Upper Liard and Destruction Bay all have water contamination problems. Dawson City and Mayo have no treatment facilities and raw sewage is emptied into adjacent water bodies (# 59 ).

Recommended priorities for improvement are:

- " - Piped sewerage system for Ross River, Teslin, and the main community at Carcross.
- Sewer interceptor, lift station and sewage screening facilities at Dawson City.
- Additional anaerobic lagoon at Faro.
- Construction of sewage treatment facilities at Mayo.
- Addition of two anaerobic lagoons and one aerobic lagoon to the existing sewage treatment facilities at Watson Lake.
- Primary sewage treatment facilities for central Whitehorse, piped sewage treatment in Porter Creek, and modification to existing sewerage systems throughout Whitehorse. "

(# 59 ).

(D) Fish and Fisheries

The inland waters of the Yukon support a varied and valuable fishery resource. Table 13 lists the main species available in the Yukon; the most important species are: salmon in the Yukon and Porcupine Rivers; whitefish, lake trout, and pike in major lakes; and Arctic grayling, the most abundant fish found in rivers and streams.

The Yukon fishery differs from that of more temperate regions. The cooler climate and resulting lower nutrient availability slows overall productivity and, in turn, extends the period required for fish to reach maturity.

Northern ecosystems are characterized by a smaller variety of species resulting in less complex food webs and more direct energy pathways. This "simple and direct" nature of northern ecosystems makes them more vulnerable to minor interference than more complex systems to the south.

Many small waterways freeze to the bottom in the winter and are available to fish only during late spring and summer. These small streams are very important to fish because of the high concentration of benthic food they produce after freshet. Because of this, they are a major rearing habitat for most migratory fish. Large rivers are less productive and serve primarily as migration routes and overwintering areas.

Northern lakes are not as productive as those in more temperate regions. Although lakes have fewer nutrients and shorter productive seasons than small streams, most lake species are permanent

Table 13

## Fish Species of the Yukon Territory

## Occurrence by Watershed

Common Name	Scientific Name	Upper Yukon	Lower Yukon	Porcu- pine	Peel	Upper Liard	Alsek	North Slope
Arctic char	<u>Salvelinus alpinus</u> (Linnaeus)				*			*
Arctic cisco	<u>Coregonus autumnalis</u> (Pallas)				*			*
Arctic grayling	<u>Thymallus arcticus</u> (Pallas)	*	*	*	*	*	*	*
Arctic lamprey	<u>Lampetra jabonica</u> (Martens)			*				
Boreal smelt	<u>Osmerus eperlanus</u> (Linnaeus)							*
Broad whitefish	<u>Coregonus nasus</u> (Pallus)	*	*	*	*			*
Burbot	<u>Lota lota</u> (Linnaeus)	*	*	*	*	*	*	*
Chinook salmon	<u>Oncorhynchus tshawytscha</u> (Walbaum)	*	*	*			*	*
Chum salmon	<u>Oncorhynchus keta</u> (Walbaum)	*	*	*	*			
Coho salmon	<u>Oncorhynchus kisutch</u> (Walbaum)	*	*	*			*	*
Dolly Varden	<u>Salvelinum malma</u> (Walbaum)				*	*	*	*
Flathead chub	<u>Platygobio gracilis</u> (Richardson)				*			
Fourhorn sculpin	<u>Myoxocephalus quadricornis</u> (Linnaeus)							*
Humpback whitefish	<u>Coregonus clupeaformis</u> (Mitchill)	*	*	*	*		*	*
Inconnu	<u>Stenodus leucichthys nelma</u> (Pallas)	*	*	*	*		*	*
Lake chub	<u>Souesius plumbeus</u> (Agassiz)	*	*	*	*		*	*

Table 13 con't

Common Name	Scientific Name	Upper Yukon	Lower Yukon	Porcu- pine	Peel	Upper Liard	Alsek	North Slope
Lake cisco	<u>Coregonus artedii</u> (LeSeur)	*						
Lake trout	<u>Salvelinum namaycush</u> (Walbaum)	*	*			*	*	*
Least cisco	<u>Coregonus sardinella</u> (Valenciennes)	*	*	*	*			*
Longnose dace	<u>Rhinichthys cataractae</u> (Valenciennes)					*		
Longnose sucker	<u>Catostomus catostomus</u> (Forster)	*	*	*	*	*	*	*
Mountain whitefish	<u>Prosopium williamsoni</u> (Girard)						*	
Ninespine stickleback	<u>Pungitius pungitius</u> (Linnaeus)			*	*			*
Northern pike	<u>Esox lucius</u> Linnaeus	*	*	*	*	*	*	*
Pygmy whitefish	<u>Prosopium coulteri</u> (Eigenmann and Eigenmann)	*						
Pond smelt	<u>Hypomesus olidus</u> (Pallas)			*				*
Rainbow trout	<u>Salmo gairdneri</u> Richardson	*	*				*	*
Round whitefish	<u>Prosopium cylindraceum</u> (Pallas)	*	*	*			*	*
Slimey sculpin	<u>Cottus cognatus</u> Richardson	*	*	*	*	*	*	*
Sockeye salmon (kokanee)	<u>Oncorhynchus nerka</u> (Walbaum)						*	
Spoon head sculpin	<u>Cottus ricei</u> (Nelson)				*			
Trout-perch	<u>Percopsis omiscomaycus</u> (Walbaum)			*	*			
White sucker	<u>Catostomus commersoni</u> (Lacepede)			*		*		

Source: #61.

residents and many other fish use lakes as overwintering areas.

(i) Fishes (Table 13)

Arctic grayling is the most abundant species in the Yukon, and is found in most water bodies. It is an important sport and sustenance fish.

All species of salmon except pink (O. gorbuscha) are found in the Yukon. The largest spawning populations of chum (about 150,000) are found in the Porcupine River and some of its tributaries. The Upper Yukon River and some of its tributaries support the valuable commercial populations of chum and chinook.

Lake trout and whitefish are important commercial and sport lake species, and northern pike, though less abundant, is a prized game fish.

Rainbow trout have been successfully introduced to parts of the Upper Yukon River and have become a popular sport fish.

(ii) Fisheries of the Major River Basins (Table 14)

The Fisheries and Marine Service has published a number of detailed reports on the Yukon fishery resource, but information is still lacking on species other than salmon. Information deficiencies include: critical spawning/rearing/feeding areas, overwintering and migration waters, food, mortality and growth characteristics. Information on the productivity of most streams and lakes is also lacking.

Table 14

YUKON TERRITORY WATERSHEDS  
CHARACTERISTICS OF FISHES AND FISHERIES

WATERSHED	NUMBER OF FISH SPECIES	MAJOR SPECIES	POPULATION SIZES	DOMESTIC USE *	RECREATIONAL USE **	COMMERCIAL USE
UPPER YUKON	18	Chinook Chum Lake trout Whitefishes	Total Escapement: 29,000 chinooks 40,000 chums Others unknown	~70% of total Yukon use	68% of total Yukon use	>80% of Yukon lake fishery
LOWER YUKON	16	Chinook Chum Lake trout Whitefishes		~7% of total Yukon use		>80% of Yukon sal- mon fishery
LIARD (FRANCES)	8	Arctic grayling Whitefishes	Unknown	Unknown	18.9% of total Yukon	Unknown
ALSEK (TATSHENSHINI)	16	Sockeye Chinook Coho Lake trout Whitefishes	Escapement: 2,000 sockeye Others unknown	>2% of Total Yukon use	6.1% of total Yukon	Unknown
PEEL	18	Whitefishes Arctic char	Unknown, but likely large	At Fort McPherson: greater than total domestic catch in Yukon Territory		None known
PORCUPINE	18	Chum	Escapement: 115-120,000	~17% of total Yukon	3.5% of total Yukon	Very minor
NORTH SLOPE	16	Arctic char Arctic grayling	Totals unknown	likely negligible	0.1% of total Yukon	None at present

\* based on number of individual people supported (from Boland, 1973, Table 3)

\*\* from Sinclair and Sweltzer, 1973

Source: #7d.

1) Upper Yukon River, Upstream of Pelly River Confluence.

About 18 species of fish inhabit this region, the most important of them being the spawning populations of chinook and chum salmon. Chinook are known to spawn in the Takhini River near the outlet of Kusawa Lake, Yukon River at the outlet of Marsh Lake, Richie River and Wolf Creek. The area supports major commercial fisheries and recreational and sustenance fisheries throughout.

Experimental stocking of cutthroat trout in 1958 has proved reasonably successful.

Present stress on this system comes from sewage and power developments in the Whitehorse area.

2) Lower Yukon River, Downstream of Pelly River Confluence

Between 16 and 18 species of fish have been identified in this region, with chinook salmon as the most important species. Chinook spawn in late summer and fall in the Pelly River at the outlets of Pelly Lake, in some areas of the Ross and Stewart Rivers, at the outlet of Niddery Lake, in the White River, Donjek River and Kluane River and Lake outlets.

Small domestic and commercial fisheries exist in the Pelly system. The Stewart system supports a moderate domestic and recreational fishery, and there is an important commercial fishery on Kluane Lake. Salmon are fished commercially on the mainstem Yukon River between Dawson City and the Alaskan border, and the Bering Sea fishery depends on the spawning success of salmon from this region.

Present stress is exerted on this system by continual disturbance (maintenance-construction) along the Alaska Highway, and from stream control operations on tributaries to Kluane Lake: bulldozing of stream areas and dyke construction in an attempt to control braided stream channels from washing out sections of the Alaska Highway. (#46 ).

3) Liard River System

A total of 24 species (no salmon), have been identified in this important recreational area. The extent of commercial and domestic fisheries is unknown, but Lake trout, Arctic grayling and Dolly Varden support a very important recreational fishery. Much more information is needed on this area.

4) Alsek River , (including the Dezadeash and Tatstenshini Rivers).

16 species of fish including sockeye, chinook and chum salmon are found in this area. Dezadeash Lake supports two unique sibling species of Lake trout of scientific interest. (# 7d). Important native sustenance fisheries exist on Klukshu and Aishihik Rivers and Kathleen and Dezadeash Lakes support a substantial recreation fishery.

The effects of the recently completed Aishihik dam on the fish in the area have not yet been fully researched. Probable effects include deterioration of Arctic grayling and suckers in Giltana Creek, inhibition of invertebrate drift - a major supply of food to fish (# 68 ), and bank and bottom erosion of various small tributaries in the area.

5) Porcupine River System

Of the 18 species of fish inhabiting the area, the spawning populations of chum are the most important. Sections of the Porcupine River remain unfrozen throughout the winter, providing valuable over-wintering areas for many fish. No commercial fisheries exist and recreation use is light. The salmon are an important source of food to the residents of Old Crow.

6) Peel River System

Whitefish, inconnu, Arctic and least ciscoes are the most important of the 18 species of fish that have been identified in this area. The Peel River serves as a migration route for spawning populations of char and ciscoe.

Commercial and recreational use are slight, but the lower reaches of the system support a significant domestic fishery.

7) North Slope Rivers System

The northernmost rivers support about 16 species of fish, with Arctic char and grayling being the most important. Groundwater springs along rivers provide clues to ice-free over-wintering areas in the rivers. Little information is available on fisheries because of the harsh climate and resulting minimal human use. (Some studies were done in connection with the Mackenzie Valley pipeline but they were not located for this report).

(iii) Economic Value of the Fishery Resource

The fishery resource of the Yukon is used in three ways: commercially, sports fishery (including domestic) and Native (usually sustenance).

Sports Fishery

The variety, generous creel limits and unspoiled scenery attract many resident and non-resident sports fishermen to the Yukon.

Several local businesses and several thousand people are involved commercially full and part time with the non-resident sports fishery.

Recreational fishing is valuable to residents as well; an estimated 60% participate in the sport. For example, in 1972 about 3000 people attended the Tagish Fishing Derby; this represented about 15% of the Yukon's population at that time. (# 61 ).

The Yukon River and its tributaries support about 68% of the Yukon's recreational fishery, and the Liard provides about 19%.

Commercial Fishery

At the present time the Yukon commercial fishing industry is small, but it has potential for growth. The industry employs mostly part-time fishermen, and most of the catch goes to local markets. The industry is divided into two sections:

- (a) salmon fishery (chinook, chum and some coho) - summer
- (b) lake fishery - lake trout and whitefish, all year.

80% of the commercial fishing occurs along the Yukon River and its associated lakes. About 10% of the salmon comes from the Pelly and Porcupine Rivers.

Fishwheels are used to catch most of the commercially fished salmon along the Yukon River above Dawson. Below Dawson the salmon are no longer commercially valuable. Table 15 shows the commercial value of salmon from 1964 to 1971.

Laberge, Teslin, Atlin, Bennett and Kluane Lakes are the most important commercial fishery lakes. Summer gillnetting and winter ice fishing are the most common methods used to take whitefish, lake trout and some grayling. Table 15a shows the lake fishery catch and value from 1964 to 1971.

#### Sustenance Fishery

About 15-20% of the Yukon's Native people benefit from the sustenance fishery, and most Natives make use of the license free fishing at some time or other. The native fishery is important not only for food, but as a traditional and vital part of the Yukon Native people's heritage. Table 16 summarizes the Native catch by band, in 1972.

The most important sustenance fishery is probably that of the Old Crow people, who fish for migrating salmon in the Porcupine River. Their catch makes up a substantial portion of their annual food supply.

#### Summary and Potential Conflicts

The Yukon supports a valuable sports fishery concentrated in

Table 15

QUANTITY AND VALUE OF SALMON LANDED AND THE  
NUMBER OF FISHWHEELS IN OPERATION,  
COMMERCIAL FISHERY, YUKON TERRITORY, 1964 - 1971

<u>Year</u>	<u>Chinook Salmon pieces</u>	<u>Landed Value \$000</u>	<u>Chum Salmon pieces</u>	<u>Landed Value \$000</u>	<u>Fishwheels</u>
1964	3,500	12.4	3,500	4.0	5
1965	2,600	10.4	3,900	2.9	5
1966	4,000	16.0	4,400	6.6	5
1967	2,200	8.8	3,300	7.0	6
1968	2,200	8.8	400	1.0	6
1969	1,600	6.4	2,300	4.5	5
1970	2,600	10.4	2,500	5.9	7
1971	3,200	17.8	1,800	2.3	5
Average	2,700	11.4	2,800	4.3	5.5

Source: #61.

Table 15a

QUANTITY AND VALUE OF FRESHWATER FISH CATCHES  
AND NUMBER OF GILL NETS IN OPERATION  
COMMERCIAL FISHERY, YUKON TERRITORY, 1964 - 1971

<u>Year</u>	<u>Lake Trout</u> <u>lbs.</u>	<u>Landed</u> <u>Value</u> <u>\$000</u>	<u>Whitefish</u> <u>lbs.</u>	<u>Landed</u> <u>Value</u> <u>\$000</u>	<u>Gill Nets</u>
1964	19,000	5.7	21,000	5.3	28
1965	10,700	3.2	15,200	3.8	28
1966	21,700	7.1	17,800	5.3	40
1967	17,300	6.9	10,500	4.1	45
1968	13,600	4.8	8,900	3.6	43
1969	10,500	4.0	11,100	4.2	47
1970	7,800	3.1	11,800	4.1	41
1971	3,800	1.5	3,400	1.0	60
Average	13,000	4.5	12,500	3.9	41.5

Source: #61.

Source #61.

Table 16

TOTAL INDIAN POPULATION AND NUMBER AND PERCENTAGE OF INDIAN  
POPULATION AFFECTED BY SUBSISTENCE FISHING, BY BAND, YUKON TERRITORY, 1972

<u>Band</u>	<u>Total Population</u>	<u>Total No. of Families</u>	<u>No. of Families Engaged in Fishing</u>	<u>Total No. Individuals in Fishing Families</u>	<u>Percentage of Total Population Effected by Fishing***</u>
Aishihik	71	30	1	6	8.4
Carcross	83	32	3	6	7.2
Carmacks	238	74	11	59	24.8
Champagne	106	63	1	1	0.9
Dawson	177	69	4	14	7.9
Mayo	182	65	6	**	**
Old Crow	191	74	13	67	35.1
Ross River	137	56	17	73	53.3
Selkirk	300	111	9	23	7.7
Teslin Lake	246	104	15	45	18.3
Whitehorse	571	66	19	90	15.8
Atlin-Teslin	167	70	1	1	0.6
Liard River	576	187	**	**	**
Kluane	94	49	4	14	14.9
<b>TOTAL</b>	<b>3,139</b>	<b>1,050</b>	<b>104</b>	<b>399</b>	<b>16.8</b>

\*\* Data not available.

\*\*\* Total population excluding Mayo and Liard River bands where data was incomplete.

the Yukon and Liard River basins. The value of the sports fishery will increase as tourism and access routes increase. Although the commercial fishery is small, it supports a number of people, provides a local food source and probably has potential for some development.

The native sustenance fishery is valuable not only as a source of food, but as a part of the heritage of the Yukon's native people.

Any resource development that involves the use of or interference with inland waters will affect the fish resource.

Table 11 summarizes the effects that potential hydro developments will have on the fishery resource.

In general, a power development changes the waterway in question from a flowing system to a still system. This leads to major changes in the vegetative and biochemical nature of the habitat, resulting in a different type of food web. Productivity is altered, and this in turn affects the types of fish that can survive. The final result may range from a shift in species abundance to total destruction of the fish resource in that area. Other effects include: blockage of migration routes, interference with flow (smoothing of the hydrograph), which may affect the fish's ability to choose the correct migration route and time, and changes in water quality and temperature.

Little information is available on the effects of operating mines on local fish populations. Pollution resulting from ineffective treatment facilities will effect fish, but specific reference to this problem was not located. Similarly, no published information is available on the effects of logging on the fish resource.

The Liard region sustains important forestry and recreation resources, and care will have to be taken in their development to avoid destructive conflicts.

In several communities, sewage has caused local pollution problems, but no information of its effect on local fishes was located.

In general, little information is available on industry and community pollution as it relates to fish. Several studies on future hydro, pipeline and transportation developments discuss potential effects on fish, but a complete inventory of the Yukon's fish resource and its potential does not seem to exist at the present time.

(E) Forestry (Map 22)

The forestry industry in the Yukon is not well developed at the present time, though there is considerable potential for an economically valuable industry in the southeastern portion of the Territory.

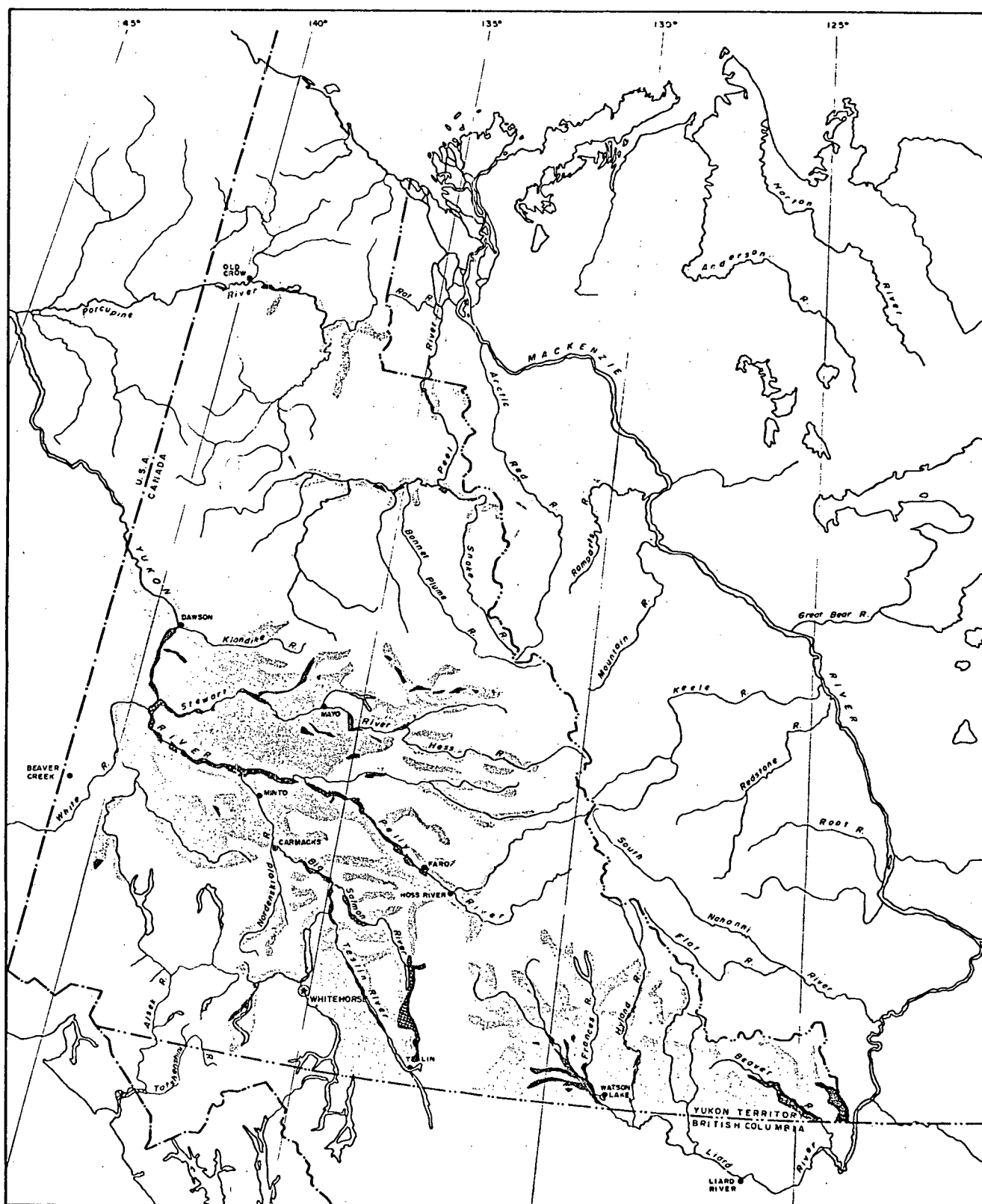
Forests north of the Ogilvie mountains have little economic value. Their major uses are food and shelter for wildlife and limited use by local residents. The forests south of the Ogilvies are of better quality and a marginal forestry industry utilizes them at present. Upland stands support small trees with potential for pulpwood, and alluvial lowland sites support larger trees, some of which are harvested for sawlogs.

There are five forestry units in the Yukon. (Map 23).



- (a) The Klondike Unit where usable timber is limited and no viable operation is possible at the present time.
- (b) Almost 2/3 of the Alsek Unit consists of barren land and although the area is readily accessible, it is of little use for forestry.
- (c) The Teslin Unit supports a considerable amount of pulp-sized timber and is accessible by water.
- (d) The Pelly Unit supports many good alluvial stands of saw log sized timber.
- (e) The Liard Unit is the most important unit in the Territory and contains about 60% of the usable timber.

The harsh environment of the Yukon inhibits tree growth. The long, cold winters, dry conditions, short growing season, permafrost

YUKON COMMERCIAL FOREST



LEGEND:

-  SAW TIMBER
-  SMALL TIMBER

SCALE 25 0 25 50 75 100 125 150 MILE

NOTE:

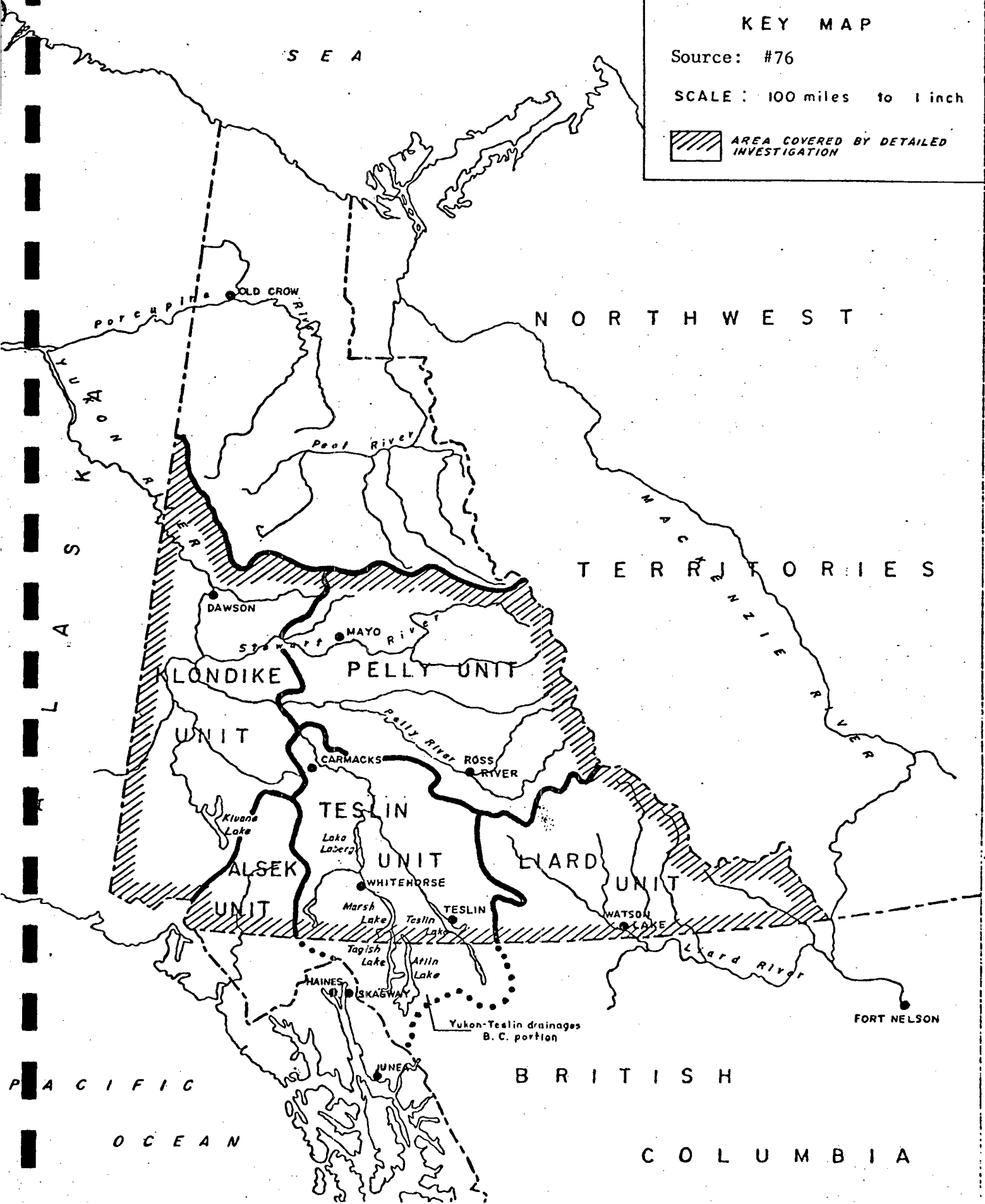
1. INFORMATION TAKEN FROM EMR MAPPING AND YUKON FOREST SERVICE

Source: #7d

FORESTRY UNITS.

Source: #76

 AREA COVERED BY DETAILED INVESTIGATION



and poor soil fertility produce slow growing stands of poorer quality than those of similar size to the south (B.C.). Fires have burned over most of the southern Yukon in the past 100 years, so most of the present day stands are composed of small trees. The most common commercial species are white spruce and black poplar, which range from 20 to 45 meters (60 to 140 ft), when mature.

Present operations are concentrated around Mayo, Granite Canyon and Watson Lake. There are two sawmills in the Yukon:

- a small mill at Mayo that supplies board for local use.
- a larger mill at Granite Canyon, operated by Acorn forest Products on an irregular basis, following fluctuations in local demand and the small export market, (sawlogs to the U.K. and Alaska).

Yukon Forest Products Ltd., Upper Liard Logging Co., Prophet River Spruce and Frontier Lumber have cutting rights in the Watson Lake area, and employ about 30 to 40 men on an irregular basis, depending on the market (table 17).

#### Potential

Most of the construction lumber used in the Yukon is imported, but with a growing population and an increasing demand for better housing, the cost of imported lumber is becoming a problem. The aim of the Yukon forest industry is for a self-sustaining system, able to supply the needs of the Yukon, and possibly engage in a small export operation.

The quality, quantity and availability of timber in the Yukon

Table 17

Source: #7d.

YUKON FORESTS  
SUMMARY OF UNIT AREAS

Forest Type	Forest Areas in 1000 Acre Units					Total Area All Units	Percent of Total Area
	Unit						
	Klondike	Alsek	Teslin	Pelly	Liard		
Softwood-alluvial (mostly sawtimber)	158	16	100	271	305	805	1.0
Softwood-upland (mostly pulpwood)	227	62	1,338	1,587	3,047	6,261	7.6
Softwood-upland (young growth)	151	61	1,337	1,058	2,031	4,638	5.7
Total Productive	536	139	2,775	2,916	5,383	11,749	14.4
Scrub (including hardwood)	9,803	1,369	6,923	13,754	5,744	37,593	45.8
Total Forested	10,339	1,508	9,698	16,670	11,127	49,342	60.1
Burns (25 percent potentially productive)	1,058	24	1,867	995	818	4,762	5.8
Barren	10,802	2,887	3,847	4,712	2,822	25,070	30.6
Water and Swamp	890	156	719	663	492	2,920	3.5
TOTAL AREA	23,089	4,575	16,131	23,040	15,259	82,094	100.0

probably could not support a large forestry industry, but it could support more than the present operation. The most promising areas for development are the Teslin, Nisutlin, Liard and Francis River Basins.

#### Forestry and Water Resources

No information pertaining to logging methods was located while researching this report, so it is difficult to assess the effects that logging has on the drainage characteristics and water quality of the areas affected. No published information was located on sawmill operations or wastes and effluents associated with that industry in the Yukon.

Table 11 generalizes the effects that various hydro developments would have on the forestry resources in the Yukon.

Developments on the Porcupine and Pelly Rivers would decrease the available forest habitat for wildlife. Development on the Pelly-MacMillan system upstream of Granite Canyon would flood potentially valuable softwood stands. Flooding of the Liard area would eliminate portions of the most economically valuable forest areas of the Yukon.

(F) Agriculture

The areas of the Territory that have commercial agricultural potential are confined to small regions of favorable soil and climate in a few river valleys in the southern Yukon. Agriculture in the rest of the Territory is limited by the severe climate characterized by short growing and frost free seasons, inadequate rainfall, permafrost, rough terrain and poor soil fertility. Grazing lease lands are in poor condition and there is frequent competition between wildlife and domestic animals.

Two wide end-to-end lacustrine plain valleys which stride the Alaska Highway from Whitehorse to Haines Junction, form the best potential agricultural area in the Yukon. These valleys are about 128 km (80 miles) long and include deposits from the Alsek, Dezadeash and Takhini Rivers. The total area of about 119 070 hectares (294,000 acres) can be divided into the following regions:

Takhini-Dezadeash Valleys	89 100 hectares	(220,000 acres)
Yukon River & Tributary Valleys	24 300 hectares	(60,000 acres)
Tagish and Little Atlin area	3240 hectares	(8,000 acres)
Dawson area	2430 hectares	(6,000 acres)

Fertilization, irrigation and careful farming techniques will be required in all areas in order to produce crops. Only crops that can survive short frost free and growing seasons will be successful.

Present farms use crude flooding irrigation methods utilizing runoff from nearby lakes. Although the water supply is good, lack

of money and knowlege seems to restrict the use of more efficient systems. Sprinklers are sometimes used to offset frost damage.

Most Yukon agriculture consists of small market gardens or private gardens. Commercial operations have been hampered by lack of knowlege of the conditions, distance from good soils to markets, and very high operating costs.

Domestic animals can be grazed only on leased land. Use of land for grazing is strictly regulated and no "improvements" (e.g. water development or clearing) are permitted, (# 79 ). In 1974, about 28,350 hectares, (70,000 acres) were under lease - about 12 to 16 hectares (30 to 40 acres) per head. The grazing season is very short, and most livestock has to be fed (and sometimes sheltered) over the winter. Conflicts between domestic and wild grazing animals have arisen in several areas.

Agriculture in the Yukon has not been very successful due to harsh environmental conditions, lack of farming knowlege related to northern environments, high costs due to isolation, and restrictive government legislation. Local and federal governments have not supported agriculture attempts, however farming and gardening by individual families for private use is popular (# 79).

(G) Transportation

Until the early 1960's, transportation routes in the Yukon were constructed on an ad-hoc basis, catering primarily to mineral exploration and development. Building of an efficient transportation system has been hampered by the rugged topography, especially the large mountain ranges which generally run at right angles to desired transportation routes.

Road systems provide the primary means of transportation. The Yukon has only one small railway and no economically navigable coastline. Several inland water routes are navigable (used mostly by recreationists), and most of the towns and villages are serviced by small planes. Helicopters are used for mineral exploration and preliminary surveying, wildlife research, government research and general access to areas not accessible by other means.

Most tourists and locals come to and travel in the Yukon by automobile (car, recreational vehicles and bus). The airlines are used primarily for business trips, and the railway is used for ore transport and some tourist traffic.

The present traffic network is based in Whitehorse, but Watson Lake, Haines Junction, Carmacks and Dawson City are becoming more active as transportation centers as the importance of tourism increases. (Map 24 ).

(i) Roads

Before 1940, the transportation system in the Yukon was limited to a few old Gold Rush roads from Whitehorse to Dawson City, winter

MAP - 24

TRANSPORTATION SYSTEMS

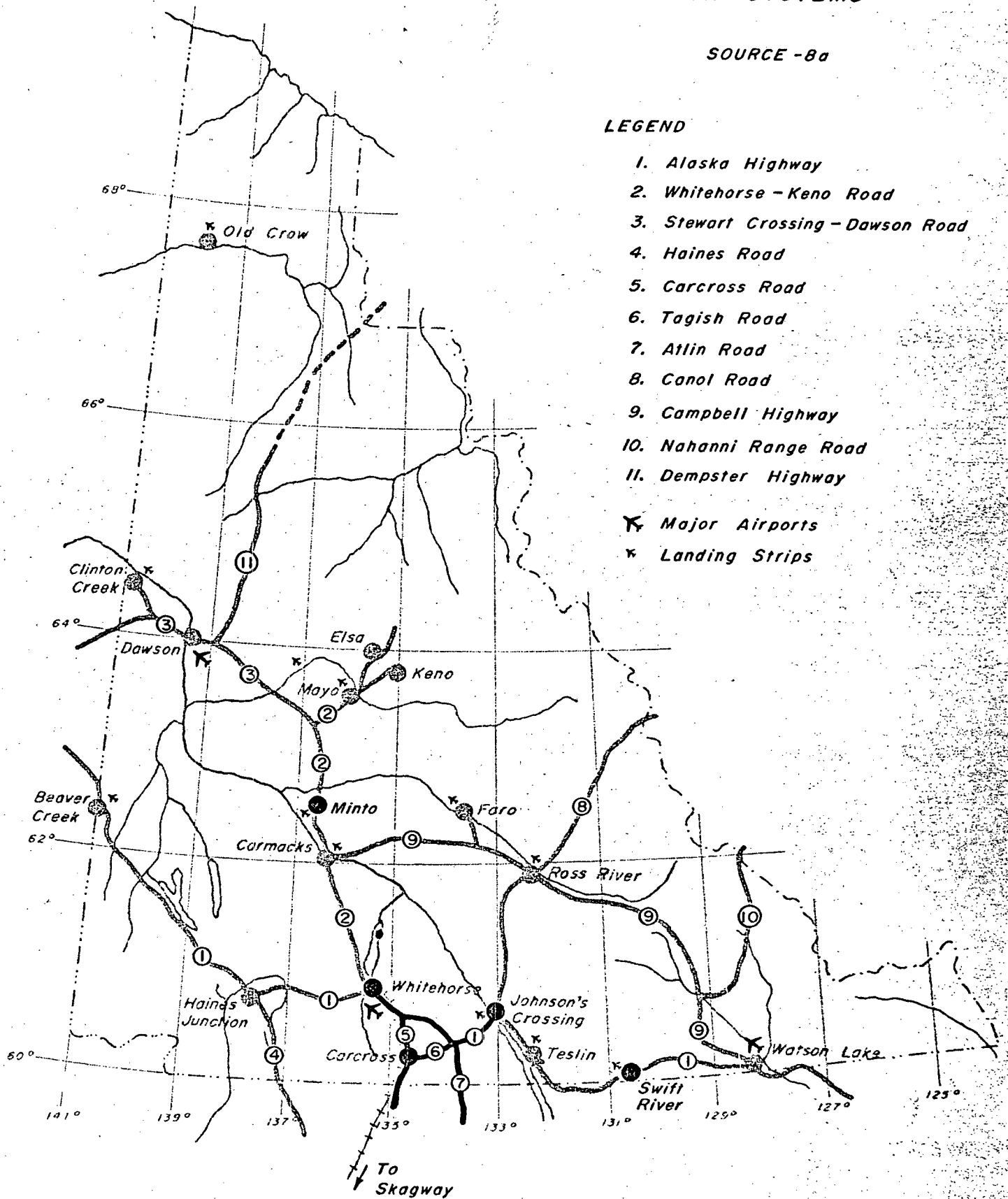
SOURCE - 8a

LEGEND

1. Alaska Highway
2. Whitehorse - Keno Road
3. Stewart Crossing - Dawson Road
4. Haines Road
5. Carcross Road
6. Tagish Road
7. Atlin Road
8. Canol Road
9. Campbell Highway
10. Nahanni Range Road
11. Dempster Highway

✈ Major Airports

✈ Landing Strips



snow roads, limited water transportation on the Yukon River and the White Pass-Yukon Route railway.

In 1942-1943 the 2458 km (1525 mi.) Alaska Highway was constructed and after the war the 1005 Canadian km. (625 mi), became Canadian responsibility. The Alaska Highway was instrumental in opening up the Yukon for mining exploration and settlement, and led to the establishment of a low grade resource road network through parts of the southern and south central Territory. Some of these resource roads were later developed into better quality communication roads, but on a largely ad-hoc basis, with no policy plans for future development.

In 1951, the 455 km (283 mi) Klondike Highway to Mayo was completed, followed in 1955 by an extension to Dawson.

In 1956, the first Northern Road Policy was formulated, in which \$10 million per year for 10 years was allocated to Northern Canada for road development. The policy was concerned primarily with resource development, but was revised in 1965 to include provision of access to northern communities.

By 1969 most of the major Yukon communities were linked by all-weather roads. Most new roads were built on speculation to provide access to promising mineral areas, and because mineral exploration was proceeding very quickly, the road policy was revised in 1971 to include conservation measures.

The major roads in the Yukon are:

- the Alaska Highway
- the Klondike Highway
- the Robert Campbell Highway

- Haines Road, which is the only road link from mainland Yukon to the Alaskan panhandle and a Pacific port.
- Canol Road - summer use only
- Dempster Highway - under construction

The 671 km (417 mi) Dempster Highway from Dawson City to Arctic Red River, NWT, when completed will be the first road providing a link from the 60th parallel to the Arctic Circle.

Its short term function will be to provide access to the area for resource and industrial development, but in the long run it will serve as a communications road for tourists and locals. The route is rich in scenic and geographical diversity, prehistoric, native, fur and Gold Rush history.

The road intersects a major migration route of the Porcupine Caribou Herd, but its effects on the herd are unknown at the present time. The region is particularly sensitive to environmental damage caused by construction, but increased access may cause a more serious problem. Removal of historical artifacts, disruption of the physical environment (e.g. litter), interference with wildlife, and increased fire hazard will be of major concern.

Most Yukon roads are all-weather gravel, except within the city limits of major communities. Dust is a problem in the summer, especially on well used tourist roads (Alaska Highway, Klondike Highway, and Robert Campbell Highway), and millions of dollars are spent each year on dust control and road maintenance. Water tank trucks used for wetting down the highways draw water from river crossings.

The Alaska Highway is in a continual state of repair, and is not an economical route for mineral transport. The Robert Campbell Highway between Ross River and Carmacks, and the Klondike Highway to Whitehorse have been modified to handle 201 600 kg (90,000 lb.) loads and serve as the export route for ore from Anvil mines.

#### Ongoing and Future Developments in Roads

Construction on the Dempster Highway and on extensions and improvements on the road from Haines Junction to Skagway are ongoing. Proposed projects include further reconstruction and paving of the road from Haines Junction to Haines and further paving of the Alaska Highway, at a projected cost of \$225 million over 10 years.

Construction of a pipeline will probably require many service roads, which may later be reconstructed into more permanent roads.

Exploration for mineral resources is a thriving industry in the Yukon, and is often accompanied by the construction of low grade resource roads, which are usually too rough for regular automobiles.

Several trucking firms operate in the Yukon, providing an adequate service at rates slightly higher than those in southern Canada.

Zinc concentrates (Mayo), asbestos fibre (Cassiar) and lead-zinc concentrates (Anvil and Clinton Creek) account for most of the 453 500 tonnes (500,000 tons) moved per year. Most products are brought to Whitehorse and then travel by rail to the port of Skagway.

where they are shipped south. Products for consumption come in via Skagway or through Watson Lake along the Alaska Highway.

(ii) Railways

The 177 km (110 Mi.) narrow gauge White Pass Yukon Route from Whitehorse to the port of Skagway is the only railway operating in the Yukon at the present time. Its major cargo is freight, including mine products and goods for local consumption, but it also serves as an important tourist-passenger route in the summer. The rail line was upgraded in 1973 to enable it to handle Anvil Mine products, and its present capacity is about 1 814 000 tonnes (2,000,000 tons) of cargo per year.

The rail system is adequate for the present demand, and could handle up to three times its 1974 load. Several proposals have been made for expansion of the old and/or construction of new rail systems in the Yukon, but new rail systems should be planned to replace road traffic because the demand is not great enough to support extensive rail and road transport (# 83 ).

The proposals include:

- (a) Leaving the system as it is and concentrating on an expanded road service.
- (b) Expanding and upgrading the present system which would be less expensive than construction of a new system. Converting the present narrow gauge line to regular gauge would be pointless unless a connection with another route is planned.

(c) New routes:

- the proposed route from Dease Lake to Watson Lake has been shelved because of high costs.
- An Alaska-Yukon route has been proposed by the Alaskan and U.S. governments, which would run from Fairbanks along the Alaska Highway to Tetlin Junction, down the White and Yukon Rivers to Carmacks and then along the Tintina Trench to Watson Lake. The route would require the completion of the Dease Lake extension. The project would cost about \$1 billion and would place 914 km (568 mi) of track through the Yukon, but the proposal is still in preliminary stages at the present time.
- Development of the Grum deposit near Faro would substantially aid in justifying a rail extension to Faro. The extension would involve 190 miles of track at a cost of about \$100 million.

(iii) Air Service

The Yukon is linked with continental air routes by regularly scheduled flights from Whitehorse to Edmonton or Vancouver. A regular service is also in operation between Juneau, Alaska and Whitehorse.

A number of small plane and helicopter companies operate in the Yukon, offering their services to remote communities, government and private businesses.

(iv) Summary

Until recently the transportation system in the Yukon had catered almost exclusively to mineral development. The communication transport system developed to a large extent, by upgrading resource

development roads.

The transportation policy used in the Yukon still caters largely to resource development, but it helped to organize and establish a fairly complete communications network as well.

Resource development (mining and hydro in particular), will probably require new access roads, as will any pipeline construction.

In any northern resource development, care must be taken to protect fragile northern environments, which are usually very susceptible to disturbances of any kind. Special consideration should be given to water crossings, construction on permafrost, interference with wildlife migration routes and protection of the environment once access is available.

(H) The Physical Environment and Development in the Yukon

The physical environment of northern Canada imposes limitations on development not experienced in the south. It is true that every region has its physical environment problems, but those of the north are more widespread, more difficult to overcome and have more of an effect on general development than physical environment problems experienced in the rest of the developed areas of Canada.

The major obstacles are harsh climate, (especially permafrost), rough topography and physical isolation.

Climate and permafrost pose major problems in construction and maintenance, but many northern industries, especially mining, have developed technologies to handle these conditions, which lower operating costs in the long run. The harsh climate necessitates more protective and often specialized living conditions which usually require more fuel.

The rugged topography of the Yukon limits construction of transportation routes and thus inhibits expansion. The limited access associated with its physical isolation from major trade centers results in higher overall costs for most goods, and a higher cost of living.

Because of the high cost of development in the Yukon, its economy has depended on those industries that could afford the risk of exploration and development. Until recently, the mineral industry has been both the economic backbone and major expansion-development force in the Yukon. Since the early 1970's, explorations associated with pipeline developments have helped open up undeveloped areas of the

Yukon, and if a pipeline is built, it will probably broaden the exploration-development base further.

The fragility of the northern environment poses special problems in development. The simple and direct energy pathways and uncomplicated food webs of northern ecosystems are very susceptible to minor disturbances (disturbances that would probably have little effect on more complex systems). The lack of experience in dealing with northern ecosystems poses special problems because people, especially northern residents, are no longer willing to operate on a "let's see what happens and fix it next time" basis. It is generally believed that the northern environment would not be able to handle "trial and error" development. Because of this philosophy, development is often delayed while exhaustive impact studies are carried out. Lack of experience in northern development often renders these studies academic but they are valuable in that they broaden the information base on which decisions can be made.

In summary, development in the Yukon must be viewed in the light of the special problems imposed by the physical environment. At the present time, the lack of an adequate information base and the lack of special technologies required for northern development are the major obstacles to economic expansion in the Yukon.

(I) Secondary and Service Industries

Included in this section are trade industries, utilities, public services, transportation services and manufacturing. These industries provide relatively stable employment for about 74% of the work force, even though most depend on the fluctuating mining industry as a major source of business.

In 1966, Carr observed that the service-trade industries were weak due to limited markets and high costs, but he predicted that the Yukon was on the verge of increased economic growth which would strengthen secondary industries.

The Yukon has expanded considerably since 1966, and the major towns have strengthened their secondary industries to keep pace with the increasing population. Whitehorse is the center of trade and service industries in the Yukon. The construction industry in Whitehorse is expanding with the building of new hotels, a new Territorial Government Building, several new office and commercial buildings and housing. In Dawson City and Whitehorse, restoration of old buildings plays a role in the construction industry.

Whitehorse is the center for Federal and Territorial Governments and a large section of the local labour force is employed by these agencies.

Merchandizing is not as specialized in Whitehorse as in other trade centers of similar size in southern Canada.

At the present time the Yukon could not support a large service and manufacturing sector and because of its isolation and harsh physical environment, development of a strong secondary industry

base will be slow. However, the continued increase in the Yukon's population will lead to an increase in secondary industry activity, which in turn will lead to a greater demand for local resources, especially water and recreation resources.

Tables 18 and 19 summarize the staticstics on the Yukon and Whitehorse.

Table 18

# STATISTICS ON THE YUKON

## THE LAND

The Yukon Territory is located in the northwestern section of North America and extends to the Arctic Ocean. It is bordered on the south by British Columbia, on the east by the Northwest Territories and on the west by the State of Alaska.

Total Area ..... 186,000 square miles  
Forest Lands ..... 26,944,000 acres

Principal Rivers: The Yukon River, The Teslin, Pelly, Stewart, White, Donjek, McQuestin, Nisutlin, Ross, Klondike, Peel, Porcupine, Wind and Snake.

Principal Lakes: Kluane Lake, Lebarge, Dezadeash, Bennett, Marsh, Aishihik, Tagish, Teslin and Frances.

Mountain Ranges: St. Elias, Cassiar, Pelly, Selwyn, Ogilvie, Richardson, British Mountains.

Highest Peak: Mt. Logan, Canada's highest, 19,850 feet.

## THE GOVERNMENT

Unlike the Canadian provinces, the Yukon is administered as a Territory. Chief executive is the Commissioner. There is an elective Territorial Council of twelve members which performs much the same functions as a provincial legislature.

## THE PEOPLE

Population 1977 ..... 21,416  
1967 ..... 14,750

Principal Communities: Whitehorse, capital of the Yukon, Faro, Dawson City, Watson Lake, Elsa, Calumet, Mayo, Teslin, Carmacks, Old Crow, Haines Junction, Carcross.

## TRANSPORTATION

Railways: White Pass and Yukon Route, Skagway, Alaska to Whitehorse.

Airlines: Canadian Pacific Airlines, two flights daily to Vancouver and Edmonton. Transair, three flights weekly from Winnipeg, Yellowknife and Whitehorse. Northward Airlines, semi-weekly to Mayo, Dawson City and other settlements. Wein Air Alaska, three flights weekly but daily in June, July and August to Fairbanks and Juneau.

Bus: Canadian Coachways Ltd., daily summer service from Dawson Creek, B.C. to Whitehorse (twice weekly during winter).

Highways: Alaska Highway, 1,523 miles from Dawson Creek, B.C., through the Yukon to Fairbanks, Alaska; a number of territorial roads, some for summer traffic only.

Seaport: Tidewater at Skagway, Alaska, connecting with rail to Whitehorse.

## NET VALUE OF COMMODITY PRODUCTION

Construction .....	1976 .....	\$19,960,801
	1966 .....	\$19,000,000
Electric Power Generated .....	1976 .....	306,000
(Thousand Kilowatt Hours) .....	1966 .....	110,209
Fishing .....	1976 .....	\$54,585
	1966 .....	\$34,000
Forest Products .....	1976 .....	\$1,300,000
	1966 .....	\$414,800
Mining .....	1976 .....	\$138,500,000
	1966 .....	\$11,976,000
Trapping .....	1976 .....	\$403,543
	1966 .....	\$64,900

## BUSINESS ACTIVITY

Labour Force .....	1976 .....	10,400
	1966 .....	7,500
Average Weekly Earnings .....	1976 .....	\$300.24
	1966 .....	\$124.16
Salaries and Wages .....	1976 .....	\$92,500,000
	1966 .....	\$28,658,000
Retail Trade .....	1976 .....	\$56,998,000
	1966 .....	\$21,696,000
Tourism .....	1976 .....	\$25,000,000
	1966 .....	\$7,047,734
Alcoholic Beverage Sales .....	1976 .....	\$8,129,000
	1966 .....	\$2,541,000
Vehicle Registrations .....	1966 .....	18,339
	1966 .....	7,710
Fishing Licences Issued		
(Angling) Residents .....	1975-76 .....	8,792
	1965-66 .....	2,543
Non-Residents .....	1975-76 .....	4,637
	1965-66 .....	5,104

## COMMUNICATIONS

The Canadian National Telecommunications provides facilities for residential, public long distance telephone and commercial telegraph throughout the Yukon. There are two radio stations at Whitehorse; one CBC and one private. CBC Radio also serves Dawson City, Mayo, Elsa, Clinton Creek, Faro, Carmacks, Beaver Creek, Destruction Bay, Haines Junction, Teslin, Swift, Watson Lake, Fort Nelson and Cassiar, B.C. by micro wave. Live TV via Satellite Anik.

Number of Radio Stations .....	2
Number of T.V. Stations .....	2
Number of tri-weeklies .....	1
Number of bi-weeklies .....	1

## EDUCATION

Schools .....	1975-76 .....	23
	1965-66 .....	22
Teachers .....	1975-76 .....	283
	1965-66 .....	165
Pupils .....	1975-76 .....	5,315
	1965-66 .....	3,335

Table 19

Whitehorse Statistics

Population 1977.....	14,600
Population 1967.....	8,150
Income 1976.....	\$85,162,000
Income 1966.....	\$15,160,000
Trading Area Population 1977.....	25,000
Trading Population, 1976.....	16,500
Trading Area Income, 1976.....	\$141,000,000
Trading Area Income, 1966.....	\$30,690,000
Construction 1976.....	\$17,400,799
Construction 1966.....	\$2,105,201
Assessment 1977.....	\$86,491,240
Assessment 1967.....	\$20,325,865
Retail Trade 1976.....	\$39,500,000
Retail Trade 1966.....	\$16,500,000
Industrial Plants 1977.....	4
Industrial Plants 1967.....	4
Manufacturing (Value) 1976.....	\$131,069,000
Manufacturing (Value) 1966.....	\$11,976,000
Manufacturing Payroll 1976.....	\$30,309,300

Industrial Sites:

(a) Total Acreage.....	343
(b) Unoccupied Acreage.....	16
(1) Acreage Serviced.....	343

Transportation Facilities:

Rail .....	White Pass & Yukon Route
Highways.....	Alaska Highway and Yukon Highway System

Table 19 con't

Airports..... 1  
Truck Service.....5 lines

Utility Services

Electricity.....Yukon Electrical Co. Ltd.  
Gas.....Canadian Propane Ltd.

Raw Materials

Copper, Asbestos, Silver, Gold, lead, zinc, timber and furs.

Communications

Radio Stations .....CKRW & CFWH  
T.V. Stations.....WHTV & CBC TV  
Newspapers - Tri Weekly; Mon., Wed., Fri.....Whitehorse Star  
                  - Bi Weekly.....Yukon News

Recreational Facilities

Parks.....2  
Golf Courses.....1  
Beaches and Resorts.....4

Source #8a.

(J) Communities and Population Characteristics and Trends

Map 1 and Table 20 show the locations and populations of the major communities in the Yukon. Table 20 shows the comparable 1972 figures, and figures 5a, b, & c predict the population trends for the near future. Population and labour analyses of the 1976 census are not yet available, so this discussion uses mostly 1972 information.

Most Yukon communities date from the Gold Rush or the Alaska Highway construction periods. A few native villages date back much further to pre-white or prehistoric times, e.g. Old Crow, Aishihik Village and Klukshu. Several other communities were formed recently when mines went into operation.

Migration patterns tend to be erratic, responding strongly to economic opportunity, mining in particular. Many towns were born with the opening of a mine and unless a sound secondary economic base was established, died when the mine ceased operation.

Yukon communities are small in comparison to communities that perform similar functions in other Canadian provinces.

Whitehorse is the transportation, trade, government center and capital of the Yukon. About 60% of the Yukon's population resides in the vicinity of Whitehorse.

Most other communities are based on a single local industry; Dawson City is an important tourist center, as is Haines Junction now that Kluane National Park is established. Watson Lake is a transportation and lumbering center and caters to recreation fishermen and campers in the Liard area. Clinton Creek, Faro, Elsa, Mayo, and Ross River are mining towns. Most other communities are either

Table 20  
Populations of Major Yukon Communities,  
1966, 1971 and 1976

<u>Settlement</u>	<u>1966</u>	<u>1971</u>	<u>1976</u>
Whitehorse*	4,771	11,217	13,311
Faro	-	863	1,544
Dawson	742	762	838
Watson Lake	554	553	808
Mayo	479	381	448
Caramacks	311	348	NI
Teslin	324	340	241
Ross River	173	317	NI
Elsa	529	298	NI
Upper Liard	148	219	NI
Old Crow	218	206	NI
Carcross	199	188	NI
Haines Junction	195	183	268
Pelly Crossing	137	141	NI
Beaver Creek	114	120	NI
Watson Lake Airport	77	89	NI
Destruction Bay	64	82	NI
Keno Hill	144	79	NI
Flat Creek	1	71	NI
Burwash Landing	69	57	NI
Stewart Crossing	28	43	NI
Quill Creek	2	35	NI
Swift River	40	33	NI
Carcross Junction (M. 904)	--	29	NI
Johnsons Crossing (M. 837)	--	24	NI
Mile 5, Klondike Highway	--	21	NI
Kloo Lake (M. 1035)	--	20	NI
Iron Creek	28	19	NI

---

\*Denotes change in boundaries since 1966

NI: No Information Available

Table 20 con't

Tuchitua Lake	--	17	NI
Squanga Lake (M. 850)	--	17	NI
Windid Lake	--	16	NI
Millerville	18	16	NI
White River (M. 1169)	8	15	NI
Lower Rancheria (M.687)	6	14	NI
Jakes Corner (M. 866)	6	14	NI
Mile 2, Klondike Highway	--	13	NI
Champagne (M. 974)	--	13	NI
Dominion Creek	5	12	NI
Eagle Creek	--	12	NI
McCabe Creek	--	12	NI
Mile 3, Klondike Highway	--	12	NI
Mile 1019	21	12	NI
Donjek	13	11	NI
Cowley	11	11	NI
Other	4,870	1,042	4,378
	<hr/>	<hr/>	<hr/>
TOTAL	14,382	18,388	21,836
	<hr/>	<hr/>	<hr/>

Source: # 5 .

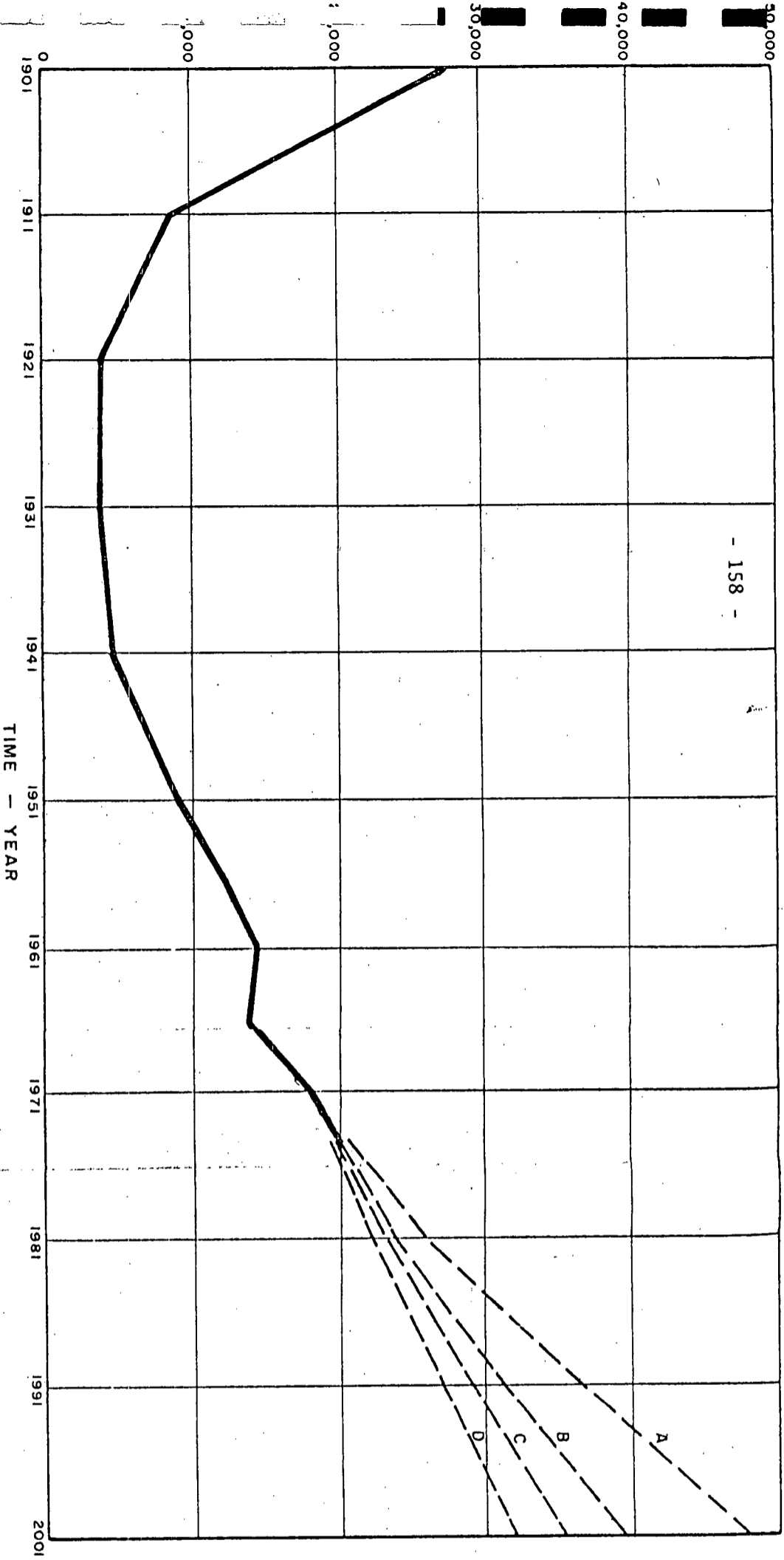
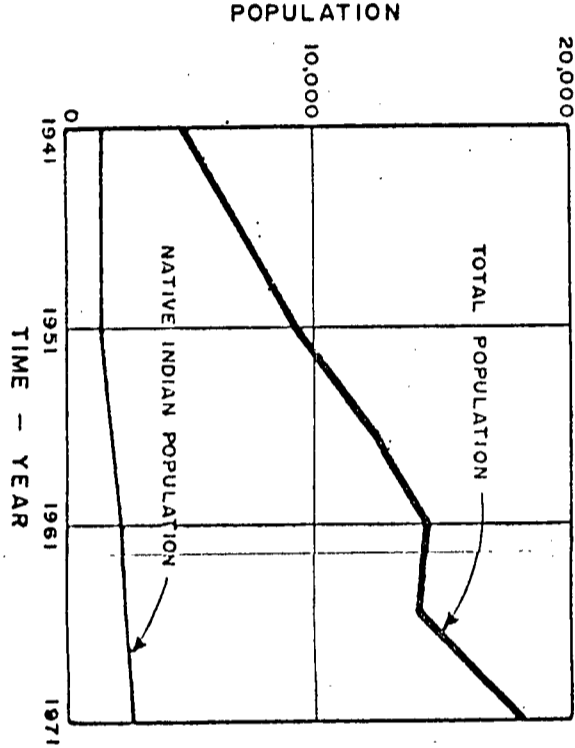
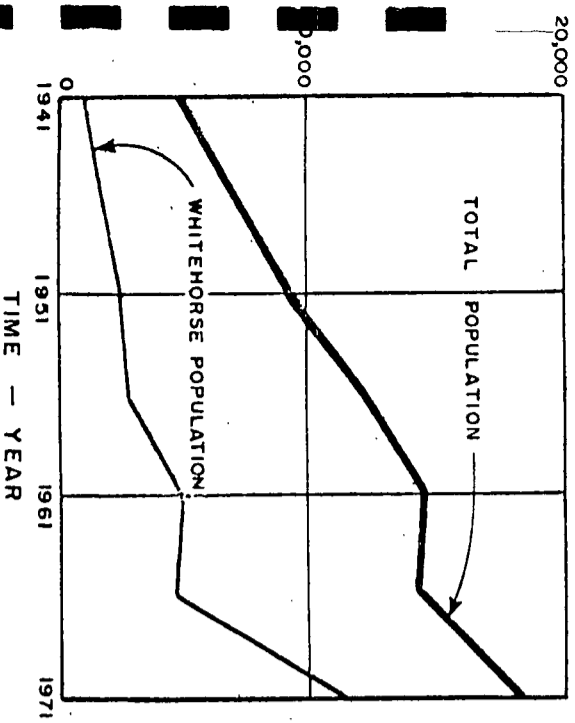


FIGURE 5  
YUKON POPULATION GROWTH

Source: #5.

POPULATION RECORD AND PROJECTIONS



Title and fertility assumption	Assumed total fertility rate for Canada by 1985	Migration assumptions	
		International (Net gain of population each year)	Interprovincial (Gross movement of people each year)
Projection A: High fertility	2.60	100,000	450,000
Projection B: Medium fertility	2.20	60,000	435,000
Projection C: Low fertility	1.80	60,000	435,000
Projection D: Low fertility	1.80	60,000	218,000

The mortality assumption is the same for all projections.

SOURCE: STATISTICS CANADA

POPULATION OF WHITEHORSE RELATIVE TO THE TOTAL YUKON POPULATION

NATIVE INDIAN AND TOTAL YUKON POPULATION

SUMMARY OF FERTILITY AND MIGRATION ASSUMPTIONS UNDERLYING PROJECTIONS A, B, C AND D, CANADA 1972 - 2001

old mining towns, native communities or population clusters on main transportation routes.

The native village of Old Crow may have originated in prehistoric times, as one of the first villages of Asian migrants. Today, the native people depend on salmon, caribou, moose and muskrat for food and support. The isolated nature of the village has enabled its inhabitants to retain, to a large extent, their traditional way of life.

#### Population Characteristics

An understanding of the demographic nature of Yukon communities is essential in planning for future developments. 1976 population breakdowns are not yet available, but Tables 21 and 22 give some idea of age-sex-race distributions in major Yukon communities.

Recent labour information on the Yukon was not located, but table 23 gives some idea of the labour situation. The work force in major operations is predominantly white and male, but more and more women have entered the labour force in recent years.

The major problem in the Yukon labour picture is the transient, temporary and/or seasonal nature of many jobs. Most mining operations are more or less temporary and even if the community established because of them can survive when the mine closes, the mine workers must move to areas where mine work is available. Transient workers supply a considerable part of the labour force especially in the summer when government and mining surveying and research is carried out. The harsh winter climate severely limits the availability of winter work in surveying and research.

Table 21

Distribution of the Non-Indian Population by Age Group  
and Sex, Yukon Territory, 1971

<u>Age Group</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Percentage by Age Group</u>	
				<u>Yukon Territory</u>	<u>Canada (All Ethnic Groups)</u>
				(%)	(%)
0 - 4	907	867	1,774	11.2	8.4
5 - 9	995	906	1,901	12.0	10.5
10 - 14	853	785	1,638	10.4	10.7
15 - 19	591	600	1,191	7.5	9.8
20 - 24	821	822	1,643	10.5	8.8
25 - 34	1,770	1,356	3,126	19.8	13.4
35 - 44	1,208	793	2,001	12.7	11.7
45 - 54	792	598	1,390	8.8	10.6
55 - 64	468	303	771	4.9	8.0
65 - 69	119	50	169	1.0	2.9
70+	121	73	194	1.2	5.2
Total	8,645	7,153	15,798	100.0	100.0

Source: #5.

Table 22.

Community Population by Ethnic Origin,  
Yukon Territory, January 1973

<u>Community</u>	<u>Indian</u>	<u>Métis</u>	<u>Other</u>	<u>Total</u>
	<u>#</u>	<u>#</u>	<u>#</u>	<u>#</u>
Whitehorse	560	260	10,397	11,217
Faro	4	11	848	863
Dawson City	120	55	587	762
Watson Lake	68	27	458	553
Mayo	70	30	281	381
Clinton Creek	5	3	373	381
Carmacks	200	20	128	348
Teslin	160	22	158	340
Ross River	140	11	166	317
Elsa	15	9	274	298
Upper Liard	189	7	23	219
Old Crow	152	36	18	206
Carcross	46	35	107	188
Haines Junction	70	17	96	183
Pelly Crossing	121	8	12	141
Beaver Creek	5	--	115	120
Watson Lake Airport	12	--	77	89
Destruction Bay	2	2	78	82
Keno Hill	1	4	74	79
Flat Creek	--	2	69	71
Burwash Landing	32	23	12	67
Stewart Crossing	12	3	28	43
Quill Creek	1	1	33	35
Swift River	3	--	30	33
Carcross Junction (Mile 704)	--	4	25	29
Johnsons Crossing (Mile 837)	4	2	18	24
Mile 5, Klondike Highway	--	--	21	21
Kloo Lake (Mile 1035)	16	4	--	20
Iron Creek	1	1	17	19
Tuchitua Lake	1	3	13	17
Squanga Lake (Mile 850)	6	6	5	17
Winded Lake	--	--	16	16
Millarville	8	2	6	16
White River (Mile 1169)	--	--	15	15
Lower Rancheria (Mile 687)	4	--	10	14
Jakes Corner (Mile 866)	7	--	7	14
Mile 2, Klondike Highway	--	--	13	13
Champagne (Mile 974)	5	5	3	13
Dominion Creek	--	--	12	12
Eagle Creek	--	--	12	12
McCabe Creek	7	1	4	12
Mile 3, Klondike Highway	--	--	12	12
Mile 1019	3	--	9	12
Donjeck	--	--	11	11
Cowley	2	2	7	11
Other undesignated or unassigned	400	100	542	1,042
Total Yukon	2,452	726	15,210	18,388

Source: #5.

Table 23

Manpower Statistics,  
Yukon Territory  
1971-72

<u>Industry</u>	<u>Employers</u>	<u>Employees</u>
1. Banks	9	112
2. Municipalities & Cities	6	113
3. Communications	3	202
4. Construction	75	297
5. Contractor	150	682
6. D.E.W. Line	3	27
7. Diamond Drilling	12	82
8. Engineering	11	43
9. Game Guide	20	86
10. Garage	42	336
11. Hairdressing	4	21
12. Hotels and Lodges	76	582
13. Janitor Service	12	30
14. Landscape Gardening	1	3
15. Laundries	5	24
16. Lumbering	14	77
17. Manufacturing	7	39
18. Merchant	95	680
19. Mineral Exploration	165	745
20. Mining	18	1,237
21. Office Workers	22	32
22. Optometrist	1	2
23. Printing	3	8
24. Private Clubs	6	45
25. Restaurants and Catering	40	277
26. Schools	2	3
27. Security Police	1	2
28. Territorial Government	1	1,234
29. Theatres and Amusements	9	64
30. Transportation	100	963
31. Utilities	3	55
32. Federal Government	<u>1</u>	<u>1,033</u>
	<u>916</u>	<u>9,136</u>

Source: #5.

Wage information should be available from the Manpower center in Whitehorse. No recent information is included here.

#### Economic Development and Population-Labour Trends

Any major development in the Yukon will drastically affect the population. The effects of mineral developments have already been discussed, but because mining is the Yukon's major industry, the effects of its development on the population and labour characteristics should be stressed.

Any major construction project, e.g. pipelines or hydro developments, would probably employ a largely transient labour force because of the specialized skills required for the job. This factor is of major importance in discussions on the planned Alaska Highway Pipeline. It is being argued that because the pipeline is going to have such a profound effect on the socio-economic and environmental character of the Yukon, Yukoners should be able to benefit as much as possible from it; including the right to be trained in the specialized jobs required for its construction and maintenance.

Large fluctuations in population due to a transient labour force tend to have a negative effect on the overall economy of the area, because of the readjustment required once the population returns to normal.

Social effects of a transient population (on native populations in particular) are also important. This was a major argument in the Berger Report on the Mackenzie Valley Pipeline, and was one of the reasons why the pipeline should not go through. Little work has been done on the social effects that major developments would have on

the people of the Yukon. Social aspects of major northern developments are important because the relatively small resident populations characteristic of northern areas are more likely to be adversely affected than large populations where social effects could be absorbed with less disturbance. (This argument is analagous to the "simple" character of northern ecosystems).

(K) Indians

Until recently the rights of the Yukon Native people were not taken into consideration by explorers and resource developers. Today however, the Yukon's Indians are demanding restitution and compensation for past, present and future developments that utilize or affect their claimed lands.

History

Some of the native people of Northern Canada migrated from Asia about 20,000 years ago. Artifacts of this migration have been found in the Old Crow area. The modern Indians of Canada's north may be descended from these original migrants, or from tribes that invaded the north at a later date.

Most Yukon Indians belonged to the northern branch of the Athapaskan language group. Considerable mixing occurred between southern Athapascans and coastal Tlingit peoples, who were middlemen in Russian-Indian fur trading. Much of the Tlingit lifestyle was absorbed by southern Athapaskan groups, and these "Tlingitized" Athapascans became trade middlemen between southern white people and inland Indian tribes (Kaska, Tutchone, and Han; Map 25).

By the time white people ventured into the Yukon, there was little differentiation between most Yukon Indian groups.

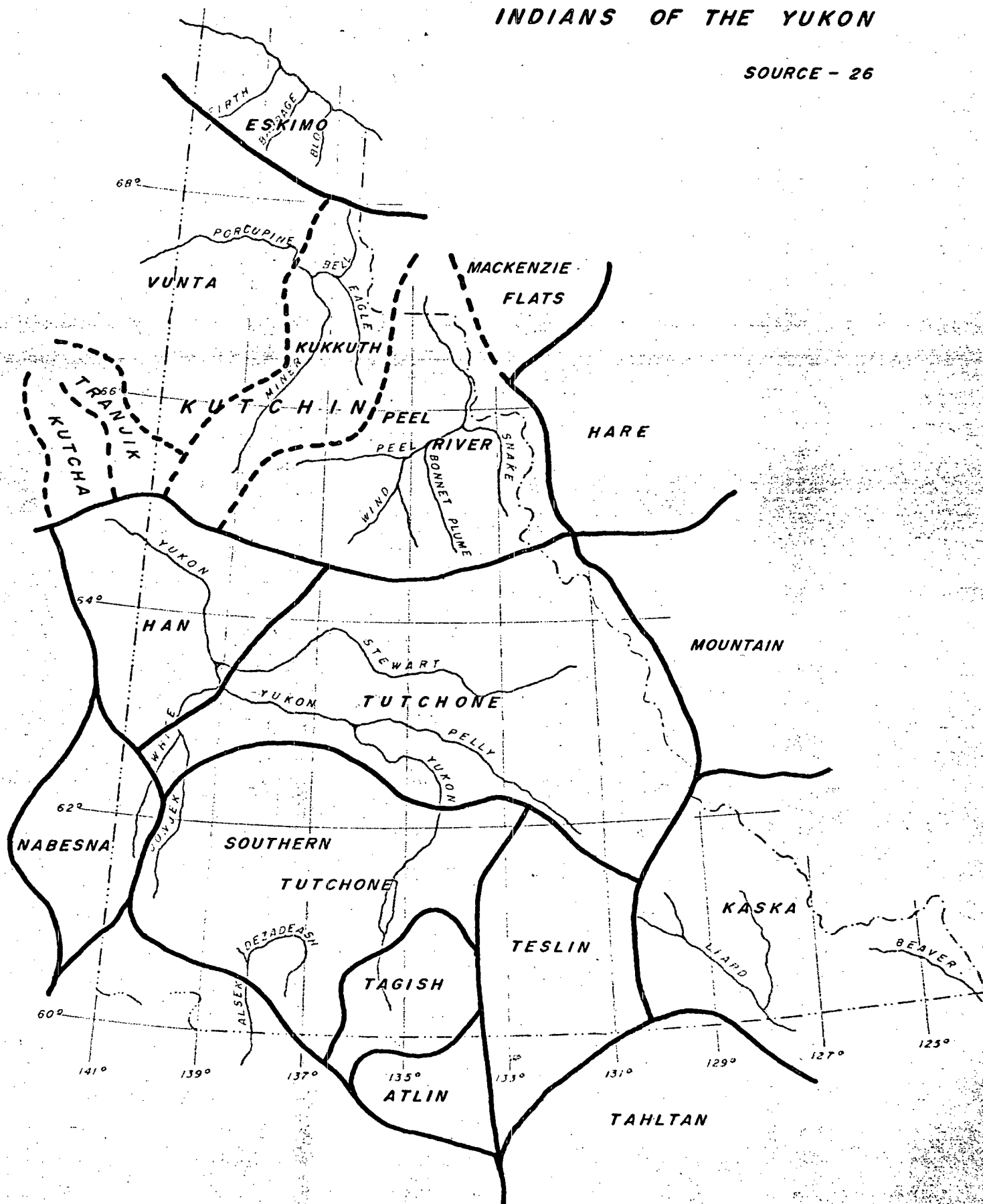
The Indians played a vital role in the Yukon fur trade, but the Gold Rush had a more pronounced effect on their culture and way of life.

The White gold seekers paid little attention to the rights

MAP - 25

INDIANS OF THE YUKON

SOURCE - 26



of Indians in relation to the gold fields. Some Indians were employed as mine labourers and others traded furs and goods with the white gold miners. Information on the Indian people from the end of the Gold Rush to the present was not located. Tables 24 and 25 give age-sex distributions and employment status data for Yukon Indians.

Present Status

In 1900, six packets of land were set aside for exclusive use by Indians. These areas are called reserves and are under the auspices of the Indian Act.

Band	Reserve
Whitehorse	Lac Laberge
Carcross	Carcross
Teslin	Nisutlin
	Teslin
Mayo	Mcqueston
Dawson	Moosehide

The Indian Act protects the native rights of the Indians living on the reserves, and prohibits unauthorized outside use or development of reserve land or resources. The act provides compensation to Indians for any use, developments or effects on reserve land resulting from outside developments.

Land has also been set aside for Indian use, but is not under the auspices of the Indian Act. The land is owned by the Crown, but is used by Indians for sustenance and living area. Compensation is not provided to the Indians if the land is affected by non-native development.

Table 24

Distribution of Indian Population by Age Group  
and Sex, Yukon Territory, 1971

<u>Age Group</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Percentage by Age Group</u>	
				<u>Yukon Territory</u>	<u>Canada</u> <u>(All Ethnic Groups)</u>
				(%)	(%)
0 - 4	180	160	340	13.1	8.4
5 - 9	205	185	390	15.1	10.5
10 - 14	155	170	325	12.5	10.7
15 - 19	115	135	250	9.7	9.8
20 - 24	95	110	205	7.9	8.8
25 - 34	160	180	340	13.1	13.4
35 - 44	125	135	260	10.0	11.7
45 - 54	85	95	180	6.9	10.6
55 - 64	75	70	145	5.6	8.0
65 - 69	25	30	55	2.2	2.9
70+	55	45	100	3.9	5.2
Total	1,275	1,315	2,590	100.0	100.0

Source: #5.

Table 25

Employment Status of Indians, Yukon  
Territory, 1972

Band	Potential Labour Force <sup>1</sup>	Less Unemploy- ables	Employ- able Work Force	Employed			
				Full Time	Season- ally Full Time	Part Time	Unem- ployed
Whitehorse	# 193	# 76	# 117	# 17	# 21	# 42	# 37
Liard	131	46	85	8	12	18	47
Selkirk	117	38	79	12	11	18	38
Teslin	114	46	68	9	22	24	13
Carmacks	97	30	67	17	18	12	20
Old Crow	87	30	57	7	10	20	20
Mayo	64	28	36	7	6	13	10
Dawson	63	20	43	6	8	6	23
Champagne	59	13	46	11	18	7	10
Ross River	53	23	30	4	7	9	10
Kluane	40	11	29	4	10	4	11
Carcross	<u>30</u>	<u>5</u>	<u>25</u>	<u>4</u>	<u>7</u>	<u>7</u>	<u>7</u>
Total	1,078	370	<u>708</u>	<u>111</u>	<u>156</u>	<u>188</u>	<u>253</u>
			100%	16%	22%	26%	36%

<sup>1</sup>Potential labour force refers to the total working age population (18-55 years of age).

Source: #5.

Detailed information on the locations of Yukon Indian bands can be found in the Indian Land Directory, Yukon Region, bibliography # 81 .

#### Indian Land Claims

Indian land claims, present and future, play a major role in the socio-economic development of the Yukon.

At the present time, Yukon Indians are demanding that their land claims be settled before any pipeline is built. The Canadian government has requested from the U.S. that a considerable amount of money be paid to the residents of the Yukon before the pipeline is built, to compensate for socio-economic and environmental effects. How much of this money was to go to the native people was not stipulated.

The Indian people are concerned not only with the loss of their land, but with the loss of their traditional way of life and cultural heritage associated with "living off the land". They are also concerned about the cultural and social effects that increased development and subsequent influx of non-Indians will have on their way of life. This was a major argument in the Berger Report, and applies equally well to all Indians in the north.

#### IV. Data Deficiencies

The purpose of this section is to identify areas of information deficiencies that could become the topics of future studies by the Inland Waters Directorate.

Recent government and private interest in Northern Canada has resulted in a considerable amount of data collection, surveying and research being conducted in the Yukon at the present time. Because of this, some of the data and information deficiencies mentioned in this section may be under study at the present time. There is a great deal of information on the Yukon in raw data, unpublished and published forms, and only a portion of it was encountered during the course of this study. It is possible that some areas of information deficiencies mentioned in this section have been researched, but were not located.

##### I. Physical-Chemical Environment

(a) Ecoregions of Yukon Territory, by E.T. Oswold, 1977, was the only report found that contained a complete description of the physical characteristics of the Yukon. The emphasis in this report is on vegetation as it relates to other physical parameters.

(b) Geological Survey of Canada has published several geological reports on specific areas in the Yukon (usually associated with promising mineral areas), but no overall geological survey was available.

(c) Recent information on the St. Elias glaciers in relation to the Alsek and associated rivers was not located. 1974 information indicated that these rivers might be subjected to heavy sedimentation, siltation and possible obstruction by ice downstream of the Aishihik dam. Recent information on this situation might be important in relation to the Aishihik dam and Alsek basin fishery.

(d) Although there is a considerable amount of information available on permafrost in the Yukon, more detailed sampling is required, especially in relation to the types of permafrost present.

It is difficult to assess the amount of hydrology information available because:

- studies are carried out by several different agencies, who are not always aware of what the other has done, is doing or plans to do.

- a great deal of information is available in data form only, in the Naquadat and Watdoc computer systems and various office files. Most of this data base has not been analysed or summarized.

Areas of data deficiencies include:

(e) Lack of summary information on the characteristics of the major rivers and lakes in the Yukon - no single complete source of information on this topic was located.

(f) Very little information available on the status of groundwater in the Yukon. Since many Yukon communities rely on groundwater to some extent, this type of information is needed.

(g) Snowpack and rainfall data is available, but little correlation between this data and runoff has been made.

(h) There is an overall lack of published information on the hydrology of the Pelly and Stewart Rivers, and on physical characteristics of their basins.

(i) Information is required on siltation of rivers in the Alsek Basin, and on the effects that the Aishihik dam may be having on drainage and hydrology in the area.

(j) General information is needed on the Liard Basin in relation to wilderness recreation-tourism resources.

(k) The importance of the Porcupine River to the fisheries resource of the Yukon is not understood because of lack of information on the river's freezing characteristics.

(l) Some specific information on the North Slope River Basins was collected during work on the Mackenzie Valley Pipeline proposal, but little general hydrological information was found while researching this report.

DIAND and Fisheries and Environment Canada agencies, and various private agencies are currently conducting water resource studies in the Yukon, which may fill some of the data deficiencies mentioned. For example:

- the Department of Indian Affairs - Waters Branch hopes to begin analysis and summarization of some of the data stored in Naquadat in the near future.

- Environmental Protection Service in Whitehorse is conducting water resource studies in the areas of potential mineral developments, especially in the Selwyn Range. These reports should be available in the near future.

Most hydrological information encountered was available in data form only, and in most cases no summaries or analyses were located. A general summary of hydrological information was not available, and there is no indication of just how much of the Yukon's hydrological character has been studied. Therefore, the most important deficiency is the lack of a summary of the present status of hydrological information that is available.

The recent environmental assessment work conducted for the proposed Alcan Pipeline has served to commence a hydrological data inventory.

During research for this report, data and information deficiencies were encountered for sedimentation, water quality, freezing characteristics, flooding, bank and bottom data for most Yukon Rivers and northern rivers in particular.

## II. Biological

At the present time there is a general lack of information on the Yukon's wildlife resource. The Canadian Wildlife Service is conducting waterfowl studies at the present time and an interim report is available at the Inland Waters Directorate (File 412). However, a complete inventory of the Yukon's wildlife resource will not be available for several years.

## III. Socio-Economic

### Mining and Minerals

(a) Little information on projected water use for potential

mines was found (#43), and only one study on water resources in the vicinity of a potential mine was available (#39).

(b) Kaiser Ltd. supplied a very brief summary of water requirements for their proposed aluminum smelter (#36), but more detailed information is required.

(c) No information was located on water use and treatment for Cassiar Asbestos and Tantalus Butte Coal Mines, however, it may be available in data form in the Naquadat computer or from the individual mining companies.

(d) The available information on water use and treatment in base metal mines needs to be updated and presented in a summary form. Data only for water use and waste treatment, is available in Naquadat and from the individual mine companies.

(e) It is beyond the scope of this study to make specific recommendations for studies associated with proposed pipeline routes. Several detailed studies have been published and more are underway at the present time (#46,47,48,49). The section on pipelines summarizes the major information deficiencies associated with pipeline construction in the Yukon.

#### Tourism and Recreation

The tourism and recreation industry lacks not only an integrated, workable plan for development and preservation of tourism and recreation resources, but also a complete inventory of these resources.

Information is required concerning:

- (a) Updating and revision of the Wild Rivers Surveys in order to evaluate their recreation value in the light of increasing demand.
- (b) Evaluations of recreational values of the Yukon's major lakes.
- (c) General information on the tourism and recreational resources of the Liard Basin.
- (d) Summary-compilation of information on available access to the most valuable recreation areas.
- (e) Evaluation of overall tourist and recreation resources as they relate to other potential resource developments of the same resources, i.e. a rating system of tourism-recreation resources.

#### Water Use

(a) The Sigma report (#7 ) provides a comprehensive analysis of the present and potential power needs of the Yukon, however an updated summary of the present system is required. General information on environmental impacts of the five most likely sites may be being accumulated, but no such information was encountered during the course of this study.

(b) Detailed reports on domestic water use in most major communities are available from the Yukon Territorial Government, Department of Public Works, and the reader is referred to them for more information. Time constraints for this study did not permit perusal of these studies, so it is not possible to state data deficiencies in

domestic water use and treatment programs. Each report does contain recommendations for water use and treatment system improvements for the community that it deals with.

#### Fish and Fisheries

Fisheries and Marine Service is presently conducting several studies on the fisheries resource in the Yukon, although details of these studies were not available for this report. Data deficiencies in fisheries information include:

- (a) A complete inventory of the Yukon's fishery resource.
- (b) Life histories, feeding habits, spawning and rearing habits, and information on overwintering areas for most species other than salmon.
- (c) Information on the effects of mining, lumbering, hydro operations, and domestic treatment facilities on local fish populations.

#### Forestry

Very little information was available on the forestry industry. Data deficiencies include:

- (a) Logging practices.
- (b) Effects of logging on local water systems.
- (c) Water use and treatment in sawmill operations.

#### Transportation

Construction of roads will require environmental studies similar to those for pipeline construction, i.e. construction on

permafrost, water crossings and associated fish problems, interference with resident and migratory wildlife, and socio-economic impacts.

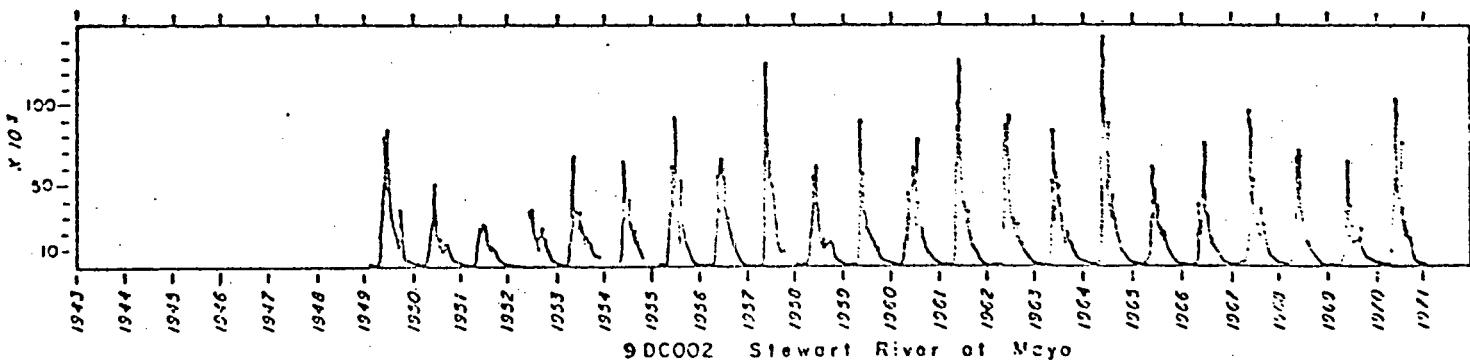
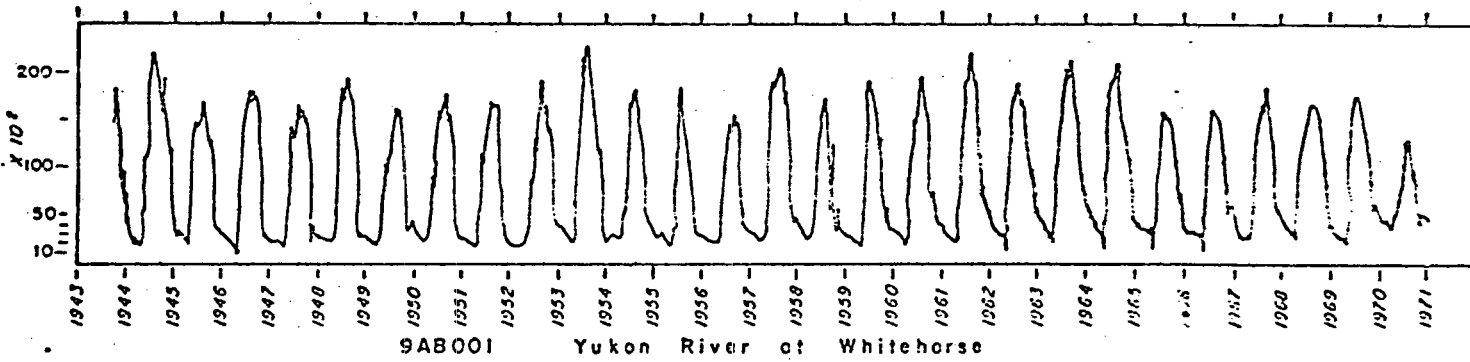
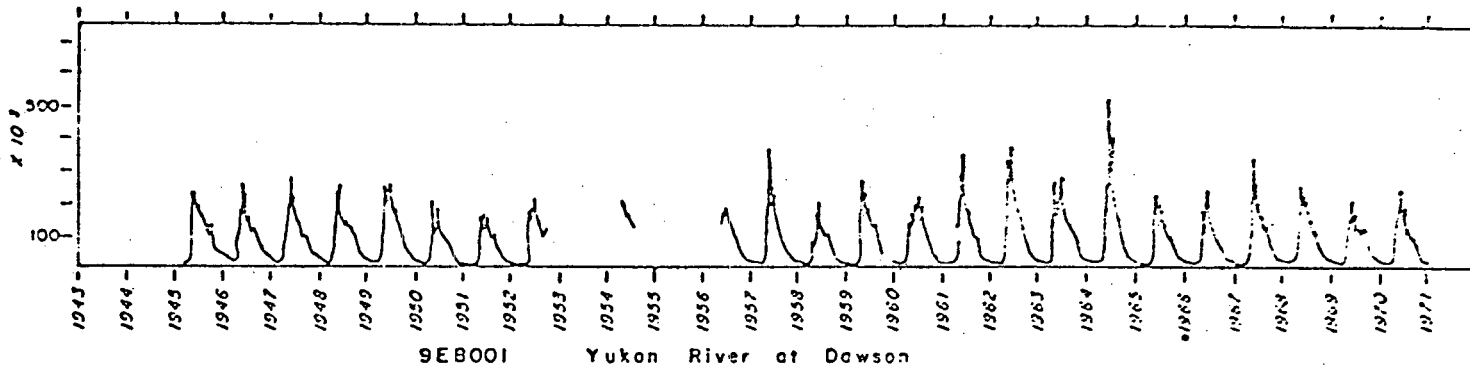
Social Aspects

(a) Until the 1976 Census Canada information is available, there is a general lack of up-to-date demographic and labour data and predictions for the Yukon.

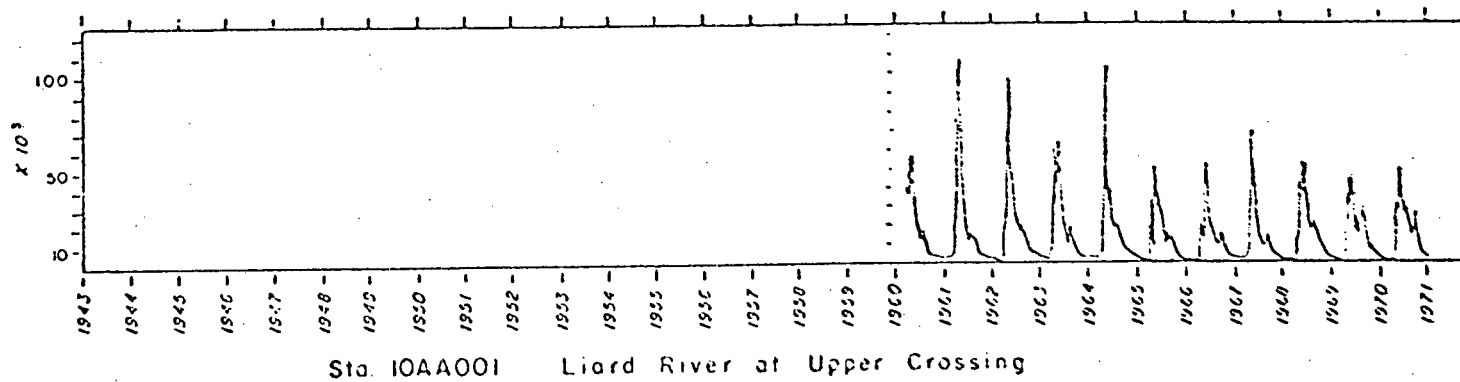
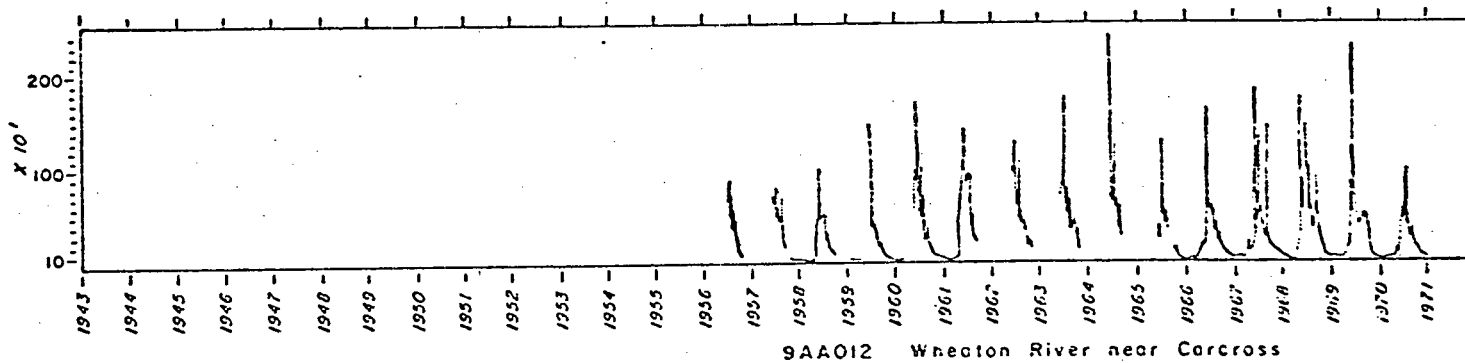
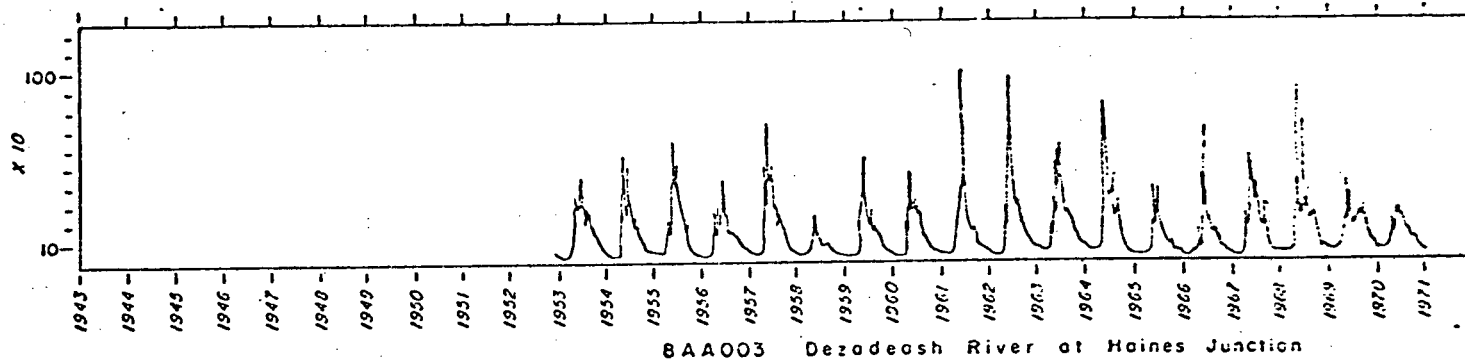
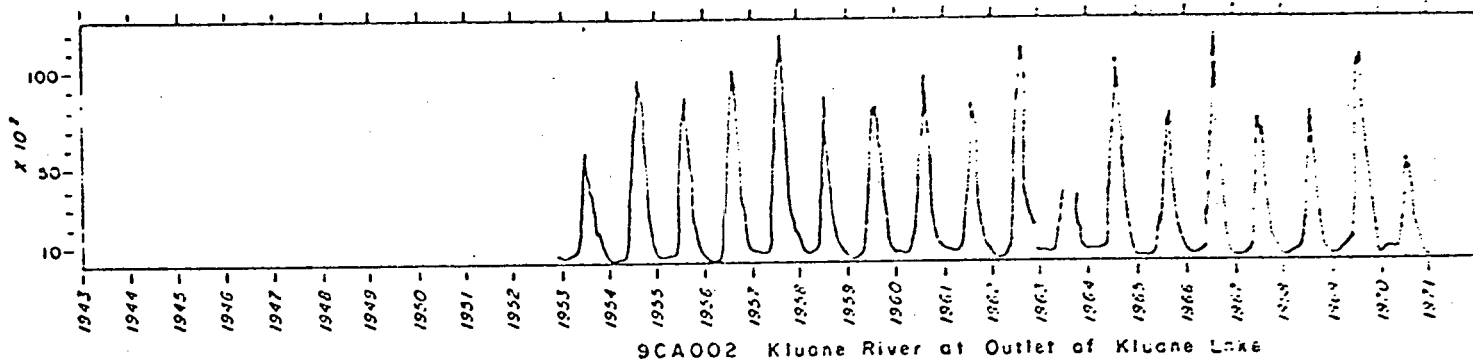
(b) Native land claims have become an important issue in the Yukon in relation to resource development and construction of transportation routes. The effects of proposed developments on water resources on claimed lands or developments that would indirectly affect water on claimed lands are included in these issues, and will probably require federal input.

Appendix I

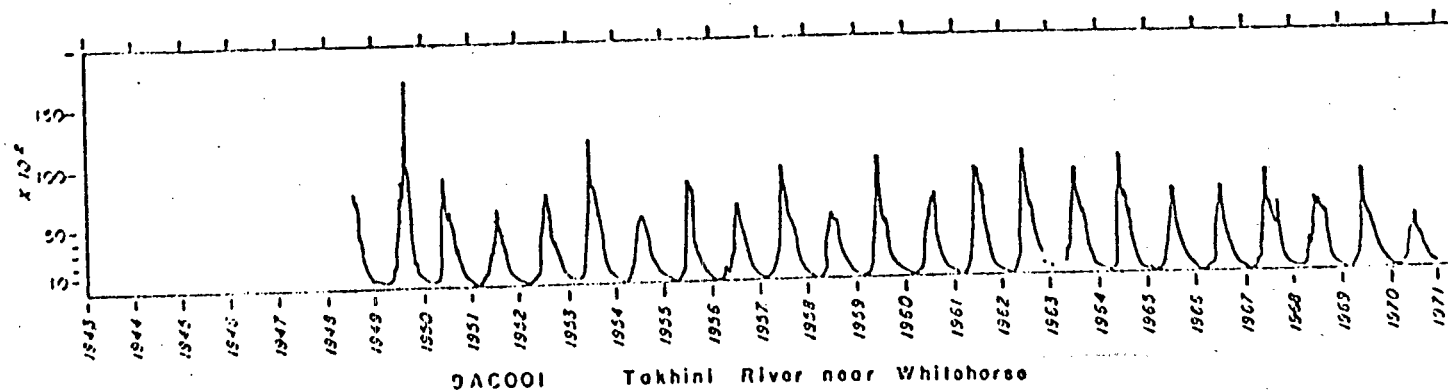
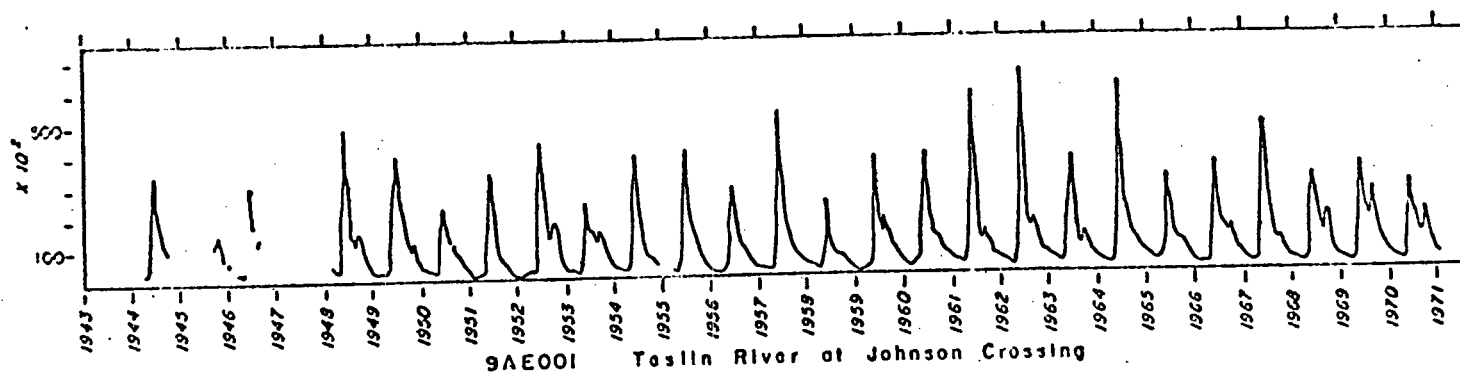
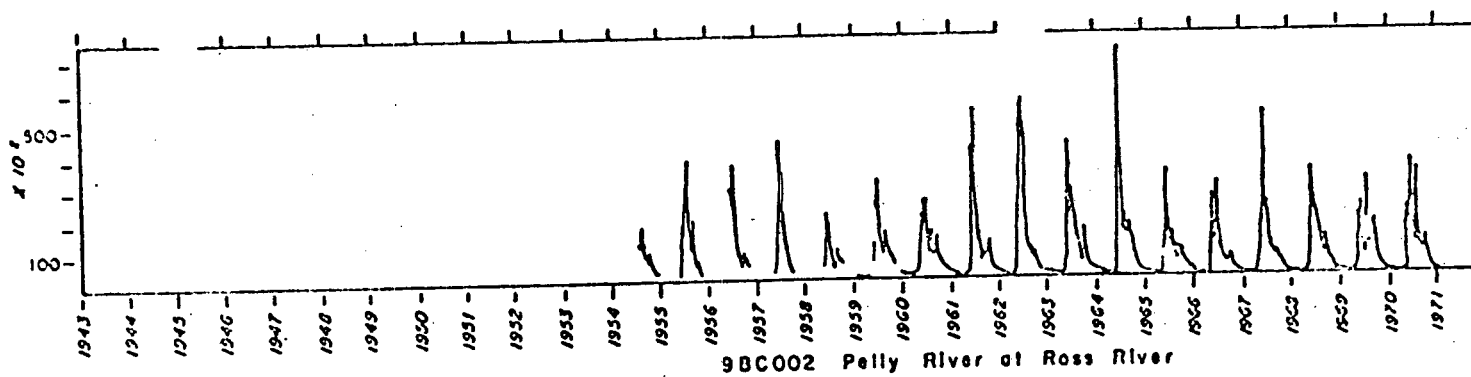
Hydrographs for Selected Stations



Note: All discharges in c.f.s.



Appendix I con't



Source: #16.

Appendix II

Ice Thickness, Break-Up, Freeze Up

Source: #14.

DATE	ICE THICKNESS IN FEET			NO. OF EVENTS	EARLIEST	AVE.	LATEST	NO. OF EVENTS
	MIN.	AVE.	MAX.					
<u>AISHIHIK RIVER</u> near WHITEHORSE								
Nov. 15	-	-	-	-				
Dec. 15	1.14	2.02	3.67	9				
Jan. 15	1.18	1.99	3.00	12	Apr. 25	May 11	May 25	18
Feb. 15	0.70	1.69	3.90	14				
Mar. 15	0.80	1.49	2.32	11	Oct. 10	Nov. 4	Nov. 24	19
Apr. 15	0.52	1.53	2.29	6	1951 -	1969		
<u>DEZADEASH RIVER</u> at HAINES JUNCTION								
Nov. 15	1.35	1.70	2.05	2				
Dec. 15	1.10	1.40	1.80	12				
Jan. 15	1.29	1.69	2.15	15	Apr. 17	Apr. 30	May 14	30
Feb. 15	1.15	1.89	2.60	12				
Mar. 15	1.35	2.21	3.03	9	Oct. 13	Oct. 28	Nov. 12	28
Apr. 15	2.80	3.16	3.53	2	1952 -	1969		
<u>LUBBOCK RIVER</u> near ATLIN								
Nov. 15	0.75	1.39	3.06	6				
Dec. 15	1.00	1.87	3.16	8	May 2	May 8	May 19	3
Jan. 15	1.50	2.52	3.26	10				
Feb. 15	0.70	2.92	4.05	8	Oct. 17	Oct. 27	Nov. 5	9
Mar. 15	3.18	3.60	3.95	5				
Apr. 15	4.75	4.75	4.75	1	1955 -	1969		

<u>DEZADEASH RIVER</u>	<u>at HAINES JUNCTION</u>				STATION 08AA003
Nov. 15	1.35	1.70	2.05	2	
Dec. 15	1.10	1.40	1.80	12	
Jan. 15	1.29	1.69	2.15	15	Apr. 17 Apr. 30 May 14 30
Feb. 15	1.15	1.89	2.60	12	
Mar. 15	1.35	2.21	3.03	9	Oct. 13 Oct. 28 Nov. 12 28
Apr. 15	2.80	3.16	3.53	2	1952 - 1969

<u>LUBBOCK RIVER</u>	<u>near ATLIN</u>				STATION 09AA007
Nov. 15	0.75	1.39	3.06	6	
Dec. 15	1.00	1.87	3.16	8	May 2 May 8 May 19 3
Jan. 15	1.50	2.52	3.26	10	
Feb. 15	0.70	2.92	4.05	8	Oct. 17 Oct. 27 Nov. 5 9
Mar. 15	3.18	3.60	3.95	5	
Apr. 15	4.75	4.75	4.75	1	1955 - 1969

<u>LUBBOCK RIVER</u>		near ATLIN
Nov. 15	0.75	1.39
Dec. 15	1.00	1.87
Jan. 15	1.50	2.52
Feb. 15	0.70	2.92
Mar. 15	3.18	3.60
Apr. 15	4.75	4.75

**WATSON RIVER near CARCROSS**

[illegible]

# YUKON RIVER at WHITEHORSE

Nov. 15	-	-	-	-	-	-
Dec. 15	0.70	1.25	1.65	3	-	26
Jan. 15	1.00	2.06	3.25	6	Mar. 27	May 28
Feb. 15	1.10	1.76	4.00	7		
Mar. 15	0.65	1.78	2.80	6	Oct. 27	Nov. 18
Apr. 15	1.50	1.72	1.95	2	1944 - 1969	Dec. 19

**M'CLINTOCK RIVER**

[illegible]

A3

STATION 09AB009

YUKON RIVER above FRANK CREEK

Nov. 15	-	-	-	-	-	-
Dec. 15	-	-	-	-	-	-
Jan. 15	1.30	1.70	2.00	Mar. 31	May 4	June 3 15
Feb. 15	1.70	2.15	2.45	Oct. 6	Nov. 11	Dec. 2 15
Mar. 15	1.80	2.42	2.90	1953 -	1969	
Apr. 15	2.08	2.50	2.80			

STATION 09AC001

TAKHINI RIVER at WHITEHORSE

Nov. 15	0.41	0.48	0.55	2
Dec. 15	0.88	1.30	1.68	13
Jan. 15	1.32	1.72	2.40	16
Feb. 15	1.32	2.05	2.58	15
Mar. 15	1.22	2.21	2.85	13
Apr. 15	1.15	1.94	2.45	6

STATION 09AE001

TESLIN RIVER near TESLIN

Nov. 15	-	-	-	-	-	-
Dec. 15	-	-	-	-	-	-
Jan. 15	-	-	-	Mar. 5	Apr. 11	May 19 18
Feb. 15	-	-	-	Oct. 29	Nov. 27	Dec. 18 18
Mar. 15	-	-	-	1949 -	1970	
Apr. 15	-	-	-			

STATION 09AF001

TESLIN RIVER near WHITEHORSE

Nov. 15	-	-	-	-	-	-
Dec. 15	-	-	-	-	-	-
Jan. 15	1.42	1.63	2.03	Apr. 15	May 7	June 3 12

A4

TESLIN RIVER near WHITEHORSE (cont'd)

Feb. 15	1.21	1.90	2.36	12		
Mar. 15	1.52	2.10	2.69	12	Oct. 22	Nov. 7
Apr. 15	2.05	2.18	2.31	2	1956 - 1969	Nov. 28
						11

BIG SALMON RIVER near CARMACKS

STATION 09AC001

Nov. 15	-	-	-	-		
Dec. 15	2.30	2.30	2.30	1		
Jan. 15	1.48	1.90	2.54	5	Apr. 15	May 13
Feb. 15	1.29	2.04	2.70	11		May 26
Mar. 15	1.50	2.40	3.00	8	Oct. 23	Nov. 19
Apr. 15	2.42	2.69	3.15	6	1954 - 1969	Oct. 31
						10

YUKON RIVER at CARMACKS

STATION 09AH001

Nov. 15	-	-	-	-		
Dec. 15	1.05	1.79	3.12	3		
Jan. 15	1.70	2.71	3.38	6	May 6	May 15
Feb. 15	2.40	2.89	3.50	15		May 28
Mar. 15	2.36	2.99	3.60	14	Oct. 25	Nov. 12
Apr. 15	2.12	2.85	3.20	7	1952 - 1969	Dec. 11
						18

ROSS RIVER at ROSS

STATION 09BA001

Nov. 15	1.22	1.22	1.22	1		
Dec. 15	1.40	1.50	1.60	4		
Jan. 15	1.40	2.06	2.80	6	May 1	May 14
Feb. 15	1.52	2.17	2.85	7		May 24
Mar. 15	1.67	2.31	2.86	8	Oct. 20	Nov. 5
Apr. 15	1.79	2.32	2.70	6	1960 - 1969	Oct. 27
						8

## STATION 09BC001

May 4	May 12	May 31	15
Oct. 15	Oct. 28	Nov. 11	14
1953	-	1969	

**STATION 09BC002**

May 31	May 11	May 23	11
Oct. 16 1959	Nov. 2 - 1969	Dec. 31	11

**STATION 09CA002**

Apr. 3	May 16	June 4	17
Oct. 28	Nov. 12	Dec. 10	17
1953	- 1969		

## STATION 09CD001

	May 9	May 13	May 15	4
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YUKON RIVER above WHITE RIVER (cont'd)

	Feb. 15	2.15	2.99	4.20	3	<del>Oct. 25</del>	Nov. 2	Nov. 12	4
Mar. 15	2.33	3.14	4.36	4		1966	1969		
Apr. 15	2.50	3.20	4.20	3					

**STEWART RIVER at MAYO**

[illegible]

KLONDIKE RIVER above BENANZA

Nov. 15	-	-	-	-	-	-
Dec. 15	1.40	1.68	1.96	2	May 3	May 6
Jan. 15	2.07	2.07	2.07	2		
Feb. 15	2.20	2.45	2.70	2	Oct. 11	Oct. 18
Mar. 15	2.40	2.62	2.98	4	1965	Oct. 28
Apr. 15	2.12	2.40	2.59	3	-	1969

YUKON RIVER at STEWART RIVER

[illegible]

**STATION 09FB001**

PORCUPINE RIVER below BELL RIVER

Nov. 15	-	-	-	-	-	-
Dec. 15	-	-	-	-	-	-
Jan. 15	1.47	1.47	1.47	1	-	-
Feb. 15	1.70	1.70	1.70	1	Oct. 18	Oct. 18
Mar. 15	1.92	2.48	3.05	2	1963	1969
Apr. 15	2.43	2.43	2.43	1	-	-

STATION 09FD001

# PORCUPINE RIVER at OLD CROW

Nov.	15	-								
Dec.	15	2.05	-	2.60	3.13	-	3	Apr. 30	May 18	May 30
Jan.	15	2.40		3.06	3.60		3			
Feb.	15	2.80		3.53	4.05		3	Oct. 8	Oct. 14	Oct. 17
Mar.	15	3.55		4.18	4.50		4	1961 -	1968	
Apr.	15	4.30		4.60	4.82		3			

## STATION 10AA001

# LIARD RIVER at UPPER CROSSING

[illegible]

## STATION 10AB001

FRANCIS RIVER at WAFEU

	Nov. 15	Dec. 15	Jan. 15	May 9	May 13	May 17	6
1	-	1.10	1.52	-	-	-	-
2	-	1.68	1.84	2.90	4	4	4
3	-	2.90	2.74	4	4	4	4

FRANCIS RIVER at WAFU (cont'd)

Feb. 15	1.56	1.95	2.57	5	Oct. 28	Nov. 2	Nov. 6	6
Mar. 15	1.70	2.05	2.41	5	1963 -	1969		
Apr. 15	1.98	2.46	2.70	4				

LIARD RIVER at LOWER CROSSING

STATION 10BE001

Nov. 15	-	-	-	-				
Dec. 15	1.56	1.95	2.50	3	Apr. 28	May 10	May 17	14
Jan. 15	2.65	2.73	2.80	2				
Feb. 15	2.77	3.17	3.90	3	Oct. 17	Nov. 6	Dec. 1	16
Mar. 15	2.65	2.93	3.13	5	1952 -	1969		
Apr. 15	3.20	3.33	3.55	3				

A8

PEEL RIVER above CANYON CREEK

STATION 10MA001

Nov. 15	-	-	-	-				
Dec. 15	2.76	2.76	2.76	1	Apr. 30	May 8	May 16	2
Jan. 15	2.40	2.40	2.40	1				
Feb. 15	2.39	2.45	2.50	2	Oct. 2	Oct. 10	Oct. 18	2
Mar. 15	2.31	2.60	2.80	3	1961 -	1969		
Apr. 15	-	-	-	-				

SNAKE RIVER above IRON CREEK

STATION 10MB001

Nov. 15	-	-	-	-				
Dec. 15	1.68	1.79	1.90	2				
Jan. 15	1.59	1.59	1.59	1				
Feb. 15	1.49	1.49	1.49	1				
Mar. 15	1.39	1.69	2.00	2	1963 -	1967		
Apr. 15	-	-	-	-				

Appendix III

List of Titles of Relevant Reports,  
Not Listed in the Bibliography

**HYDROLOGIC AND GEOMORPHIC  
CHARACTERISTICS OF THE  
SIXTY MILE RIVER  
(ABOVE MILLER CREEK)  
IN THE YUKON TERRITORY**

**PREPARED BY**

**DEPARTMENT OF INDIAN AFFAIRS  
AND NORTHERN DEVELOPMENT**

**NORTHERN NATURAL RESOURCES  
AND ENVIRONMENT BRANCH**

**WATER RESOURCES BRANCH  
YUKON TERRITORY**

**DECEMBER, 1976 .**

HYDROLOGIC AND GEOMORPHIC  
CHARACTERISTICS OF RIVERS  
AND DRAINAGE BASINS IN THE  
YUKON TERRITORY

PREPARED FOR

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS  
GOVERNMENT OF CANADA

SUBMITTED BY

northwest hydraulic consultants ltd.  
EDMONTON, ALBERTA

MARCH, 1974

**HYDROLOGIC AND GEOMORPHIC  
CHARACTERISTICS OF RIVERS  
AND DRAINAGE BASINS IN THE  
YUKON TERRITORY**

**PREPARED BY**

**DEPARTMENT OF INDIAN AFFAIRS  
AND NORTHERN DEVELOPMENT**

**NORTHERN NATURAL RESOURCES  
AND ENVIRONMENT BRANCH**

**WATER MANAGEMENT SECTION  
YUKON TERRITORY**

**MARCH, 1975**

**HYDROLOGIC AND GEOMORPHIC  
CHARACTERISTICS OF RIVERS  
AND DRAINAGE BASINS IN THE  
YUKON TERRITORY**

**PREPARED BY**

**DEPARTMENT OF INDIAN AFFAIRS  
AND NORTHERN DEVELOPMENT**

**NORTHERN NATURAL RESOURCES  
AND ENVIRONMENT BRANCH**

**WATER MANAGEMENT SECTION  
YUKON TERRITORY**

**MARCH, 1976**

RIVER AND DRAINAGE BASIN CHARACTERISTICS  
FIRTH RIVER AND BABBAGE RIVER  
YUKON TERRITORY

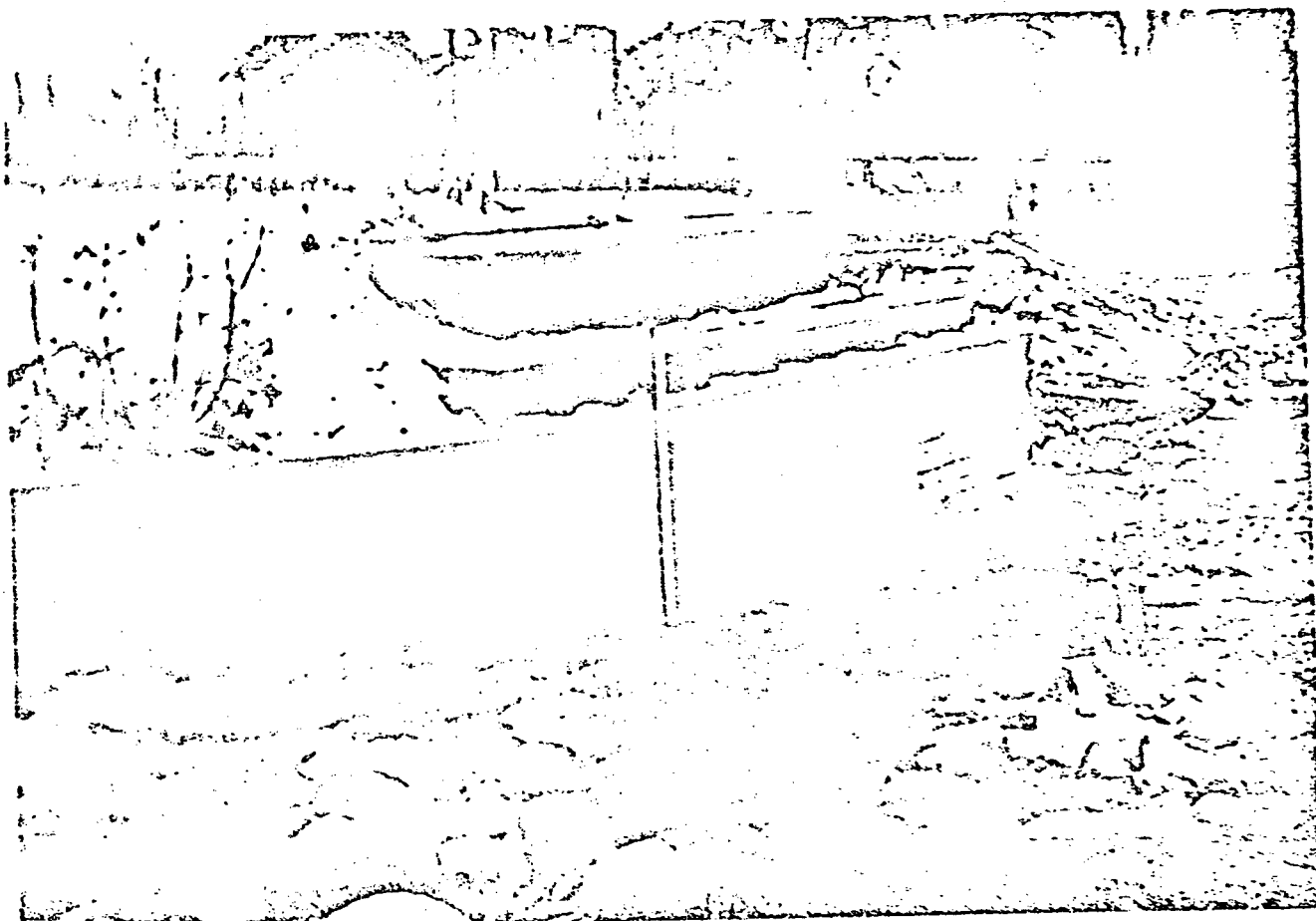
NORTHERN ENGINEERING SERVICES COMPANY LIMITED,  
Calgary, Alberta

Prepared For  
Department of Indian Affairs and Northern Development

December, 1976

Project: 4292

# SMALL-STREAM INVESTIGATIONS IN YUKON TERRITORY



PREPARED BY  
WATER RESOURCES SECTION  
NORTHERN NATURAL RESOURCES  
AND ENVIRONMENT BRANCH  
DEPARTMENT INDIAN AND NORTHERN AFFAIRS  
WHITEHORSE, YUKON TERRITORY

1975

DEPARTMENT OF INDIAN AFFAIRS  
AND NORTHERN DEVELOPMENT

CONTROLLER OF WATER RIGHTS  
YUKON TERRITORY

A STUDY OF  
HYDROLOGIC PHENOMENA IN  
YUKON TERRITORY

MARCH 1975

UNIES LTD

SPRING FLOOD FORECASTING  
FOR  
MAYO AND ROSS RIVERS, YUKON TERRITORY

FINAL REPORT

by

Jac P. Verschuren, Professor  
Dave Crawford, Graduate Student

Department of Civil Engineering  
The University of Alberta  
Edmonton, Alberta, Canada  
T6G 2G7

April 1976

Appendix IV

Agencies Contacted and/or Visited

Vancouver

1. British Columbia and Yukon Chamber of Mines.
2. Environment Canada, Fisheries and Marine Service
3. Environment Canada, Lands
4. Geological Survey of Canada,
5. Simon Fraser University Library
6. Statistics Canada Information Office
7. University of British Columbia Library
8. Vancouver Public Library, Robson-Burrard Branch

Whitehorse

1. Canadian Wildlife Service
- Department of Indian Affairs and Northern Development:
2. Forests
  3. Indian and Eskimo Affairs
  4. Parks Branch
  5. Oil and Gas Division
  6. Waters Branch
  7. Environment Canada, Environmental Protection Service
  8. Northern Canada Power Commission
  9. Yukon Archives
  10. Yukon Chamber of Mines

Appendix IV con't

Yukon Territorial Government:

11. Fish and Game Branch
12. Lands
13. Public Works
14. Tourism and Information

V. Bibliography for information sources

General Information

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  - a) Volume I : Final Report (IWD)
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4. Dept. of Indian Affairs and Northern Development, 1974: Canada North of 60, Revised 1974. (SFU)
5. Thibault, E., 1975: Socio Economic Overview Study - Yukon. (SFU)
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  - a) Main Report
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  - c) Appendix II. Hydrology
  - d) Appendix III. Social and Environmental Aspects
8. Trade and Commerce Magazine:
  - a) April 1977, pp 19-39 (IWD)
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General Description of the Yukon

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Hydrology

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17. Intera Environmental Consultants Ltd., 1975: Ground-water Management Study of the Yukon Territory. (IWD)
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Mining and Minerals

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#### Oil and Gas

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#### Pipelines

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47. Inland Waters Directorate, 1977: Alaska Highway Pipeline Investigations Preliminary Report, 1977. (IWD)
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#### Additional Sources - Pipelines

The Yukon Archives has the complete transactions of the Mackenzie Valley Pipeline Hearings plus a large collection of socio-economic and environmental studies done in connection with this pipeline.

These studies are published under the auspices of:

Environmental-Social Committee  
Northern Pipelines  
Task Force on Northern Oil Development

Local Universities have limited numbers of some of these studies.

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Water Use

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Environment Canada, Fisheries and Marine Service, Northern Operations Branch has prepared an Environmental Overview-type study of the Yukon, which should be available in early September.

F.F. Slaney and Co. Ltd. is preparing an "Environmental Atlas" of the Yukon, which should be ready in the Fall of 1977.