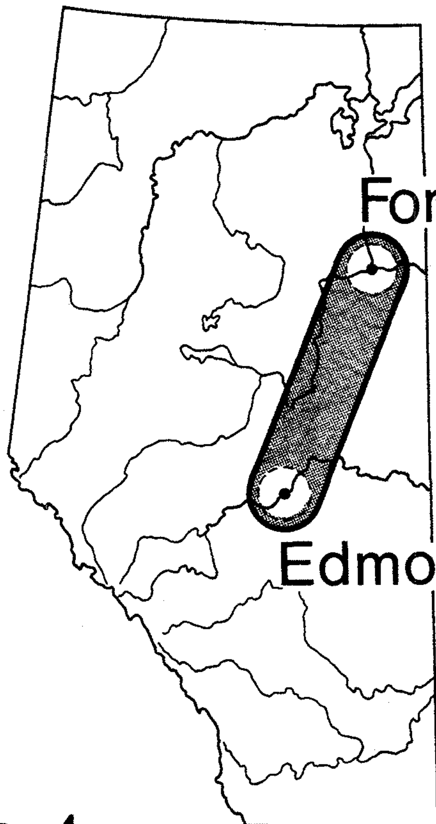
Athabasca Tar Sands Corridor Study



Volume 4 Appendix

Environment

general characteristics & conditions - part 2

prepared for

Alberta
ENVIRONMENT

by

bolter parish trimble ltd.
ducks unlimited (canada)
tom peters & associates
k.c. mackenzie associates ltd.
stewart weir stewart watson & heinrichs

march, 1974

edmonton, alberta

ATHABASCA TAR SANDS

CORRIDOR STUDY

VOLUME 4 APPENDIX

ENVIRONMENT

GENERAL CHARACTERISTICS AND CONDITIONS - PART 2

CHAPTER I Environment Characteristics and Conditions

Bolter Parish Trimble Ltd.

CHAPTER II Soils

Tom Peters & Associates

CHAPTER III Wildlife

Ducks Unlimited (Canada)
Stewart Weir Stewart
Watson & Heinrichs

CHAPTER IV The Human Settlement Pattern of the Expanded Study Area

K.C. Mackenzie Associates Ltd.

Prepared for:

Alberta
Environment

The Honorable
William Yurko

March 1974

Commissioned by:

Stewart Weir Stewart
Watson & Heinrichs

Edmonton, Alberta

PREFACE

This volume is an addition to "Volume 4 - Appendix - Environment - General Characteristics and Conditions Part I" and covers an additional area in the east-central part of the Province. Included is a chapter on Wildlife which summarizes the possible impacts of single and multiple rights-of-way on the birds and mammals in the study area.

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CORRIDOR STUDY

CHAPTER I

ENVIRONMENT CHARACTERISTICS AND CONDITIONS

Prepared for:

Alberta
Environment
The Honorable
William Yurko

By:

Bolter Parish Trimble Ltd.
Edmonton, Alberta

Commissioned by:

Stewart Weir Stewart
Watson & Heinrichs

CHAPTER I

ENVIRONMENT CHARACTERISTICS AND CONDITIONS

The following report has been prepared as a result of an extension of the field of study southwards from the North Saskatchewan River to Hardisty, hereinafter referred to as the Hardisty area. The basic information has been summarized and presented as an addition to the above mentioned volume in the series pertaining to the Athabasca Tar Sands Corridor Study sponsored by Alberta Environment. The report has been prepared on behalf of Stewart, Weir, Stewart, Watson and Heinrichs.

Climate

The climate of the Hardisty area is quite similar to that of the southern part of the study area reported in Volume 4 (pp 2-20). The main difference is found in the lower mean annual precipitation figures, which in the Hardisty area may range from 14 to 16 inches, well below the figures in the more northerly study areas (Figures 1 and 2). The mean annual temperature regime for Sedgewick is also shown in Figure 2.

The frequency and strength of winds for Vermilion are shown in Figure 3. The strongest winds originate from the N.W., while winds from the west, northwest and southeast predominate.

Hydrology

The major rivers in the Hardisty area include the Vermilion and Battle Rivers (Figure 4). The hydrographic information available for each of these rivers suggests that run-off rates are low.

Figure 21 in Volume 4 (p 32) indicates a mean annual run-off less than 1 inch and an F* factor of 12.5. Both rivers are subject to very low summer and winter flows with peak run-off during the spring snowmelt period. The 1971 flood peaks for the Vermilion and Battle Rivers and Iron Creek are shown in Figures 5,6 and 7. The mean monthly discharge values for Iron Creek at Hardisty and the Battle River at Forestburg (Figure 8) further exemplify the disproportionate seasonal variation in flow conditions.

These two basins are located in an extensive morainic plain with numerous sloughs, lakes and ponds. Each of the major river valleys are well entrenched in this undulating plain, and each of the major rivers are misfit to their respective valleys. The Vermilion River is especially notable for its extensive annual and persistent flooding problem. Careful crossing of this river would be necessary in order to minimize the impact on the existing flood problem. Both rivers have highly meandering water courses with a marked tendency for lateral erosion.

Any consideration for increasing bulk water usage in this area would have to consider the disproportionate seasonal flow and consider the possibility of storage and/or flow regulating procedures.

Environmental Impact on Stream Crossings

The absence of high run-off and high relief areas tends to minimize the potential for stream crossing disturbances. Channel slopes on the larger streams are small, which also tends to mini-

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* F is a run-off factor derived from $F = Q/A^{0.8}$ where Q is the peak flow and A is the drainage area.

mize the impact potential. The N.E. part of the Hardisty area has a relatively high drainage density (Figure 9). Where deep, main stream valleys of the Vermilion and more particularly the Battle Rivers occur within the high drainage density area the crossing of small tributaries have increased impact potential, especially in clay rich morainic areas. This subjective assessment would generally indicate less environmental sensitivity in the Hardisty area than further north. A locally sensitive area exists in the flood problem areas of the Vermilion River as mentioned above.

Similar physical constraints suggested in Volume 4 (p 53) may be inferred in the Hardisty area.

Fig. 1

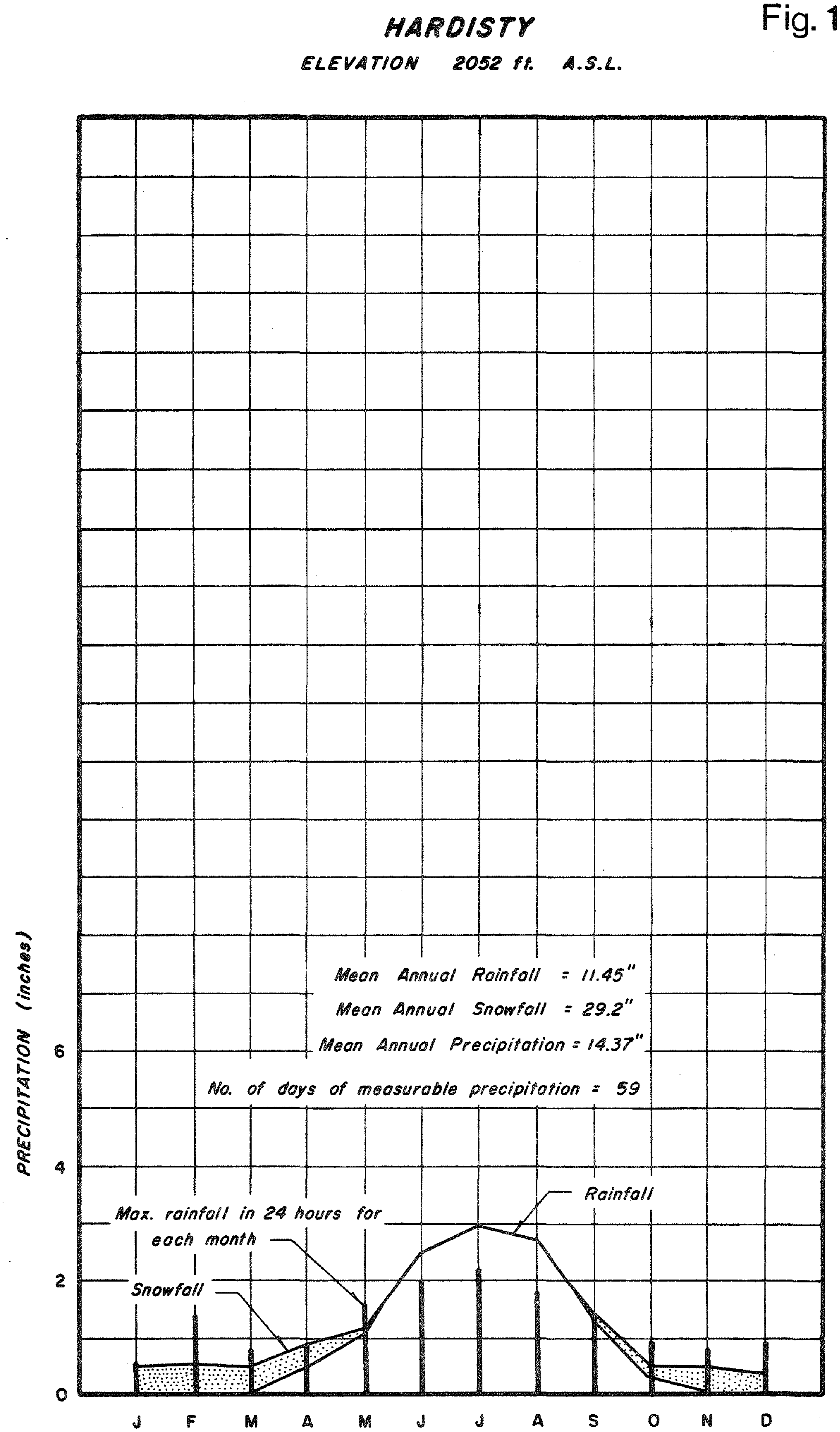

HARDISTY
ELEVATION 2052 ft. A.S.L.
Mean Annual Rainfall = 11.45"
Mean Annual Snowfall = 29.2"
Mean Annual Precipitation = 14.37"
No. of days of measurable precipitation = 59
Rainfall
Max. rainfall in 24 hours for each month
Snowfall
PRECIPITATION (inches)
0
2
4
6
J
F
M
A
M
J
J
A
S
O
N
D

Fig. 2

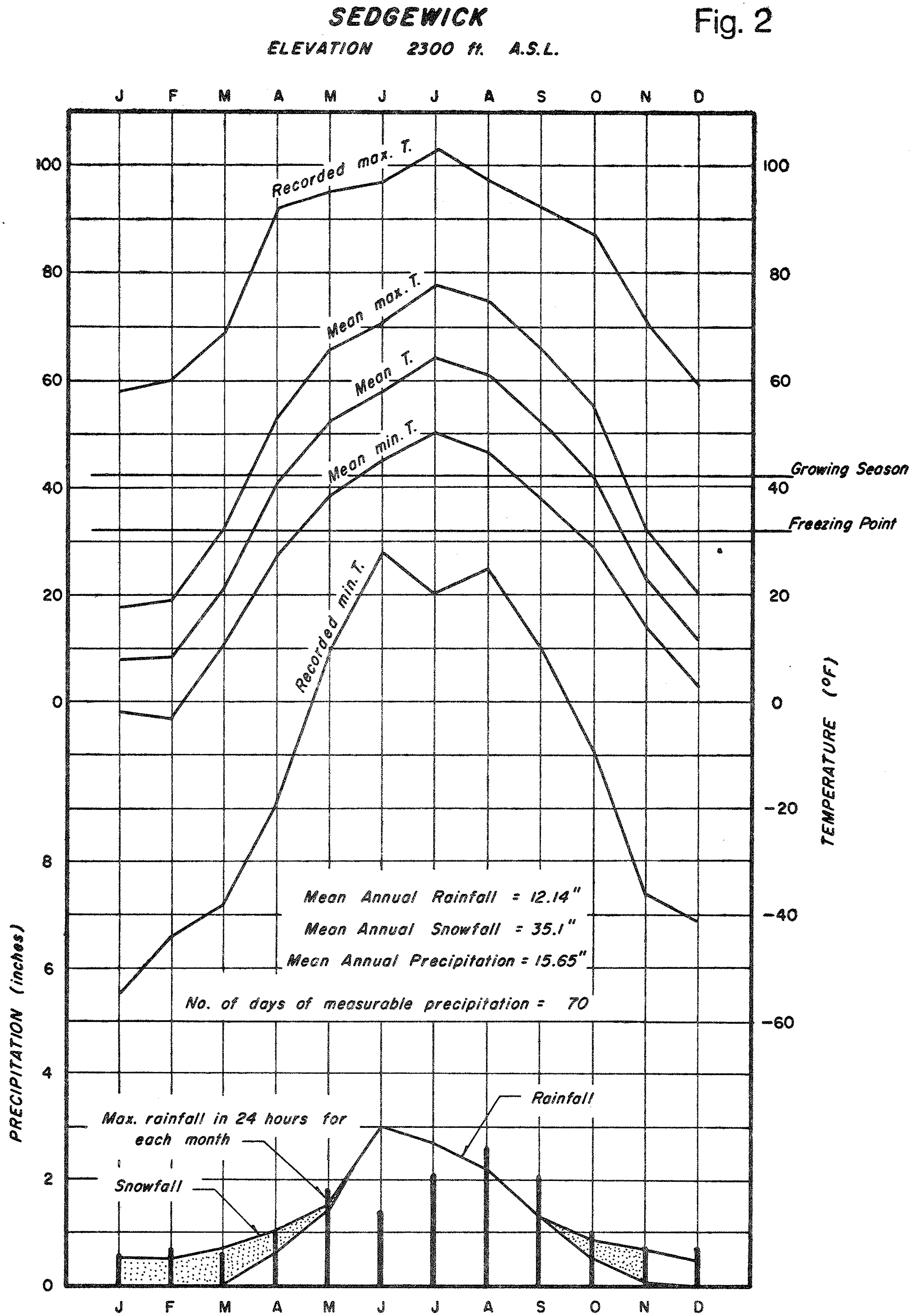
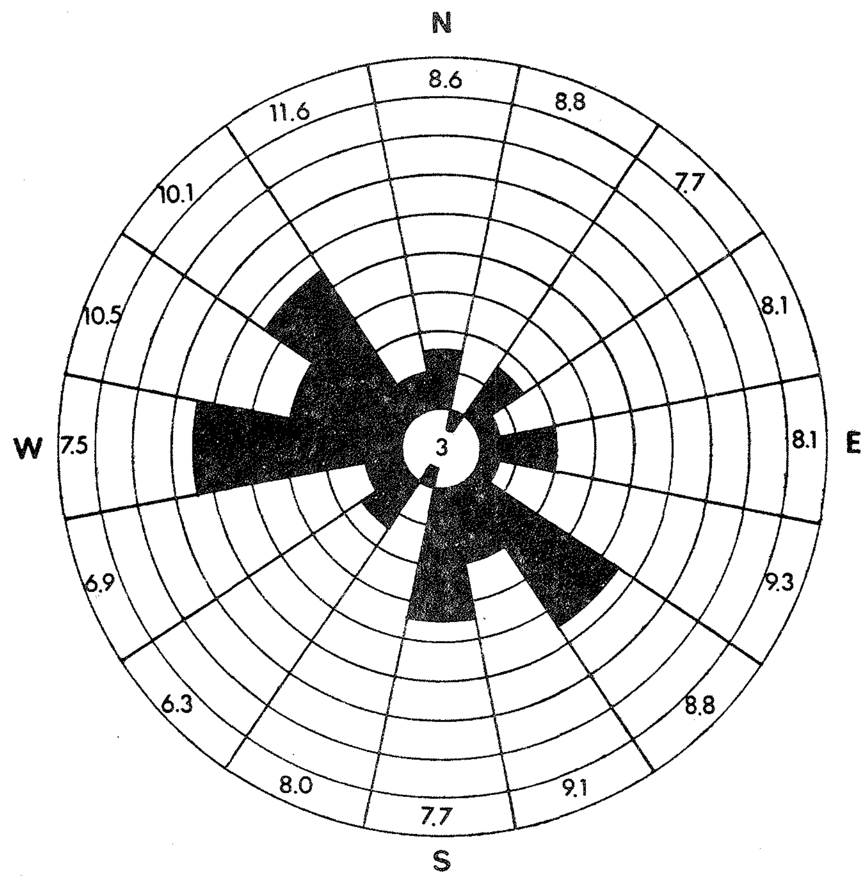
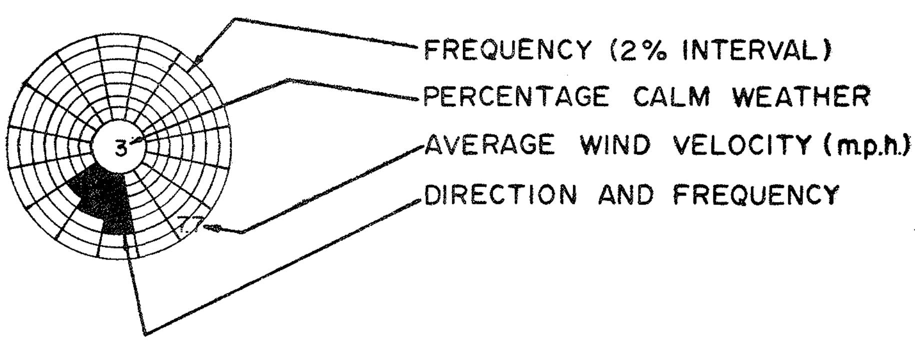

SEDGEWICK
ELEVATION 2300 ft. A.S.L.
J F M A M J J A S O N D
Recorded max. T.
Mean max. T.
Mean T.
Mean min. T.
Recorded min. T.
Growing Season
Freezing Point
100
80
60
40
20
0
-20
-40
-60
TEMPERATURE (°F)
8
6
4
2
0
PRECIPITATION (inches)
Mean Annual Rainfall = 12.14"
Mean Annual Snowfall = 35.1"
Mean Annual Precipitation = 15.65"
No. of days of measurable precipitation = 70
Max. rainfall in 24 hours for each month
Snowfall
Rainfall

Fig. 3

WIND FREQUENCY AND STRENGTH
FOR
VERMILION





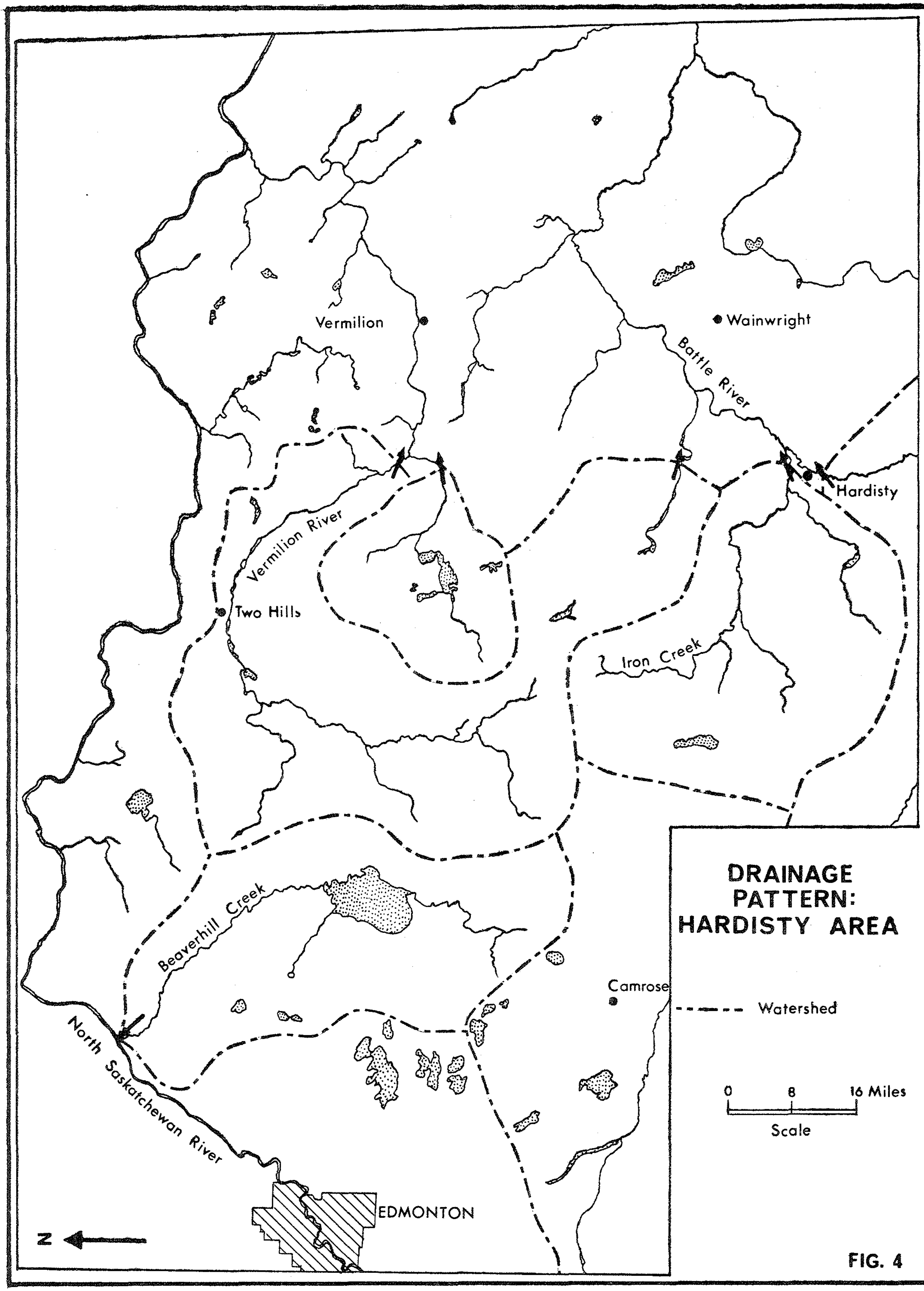
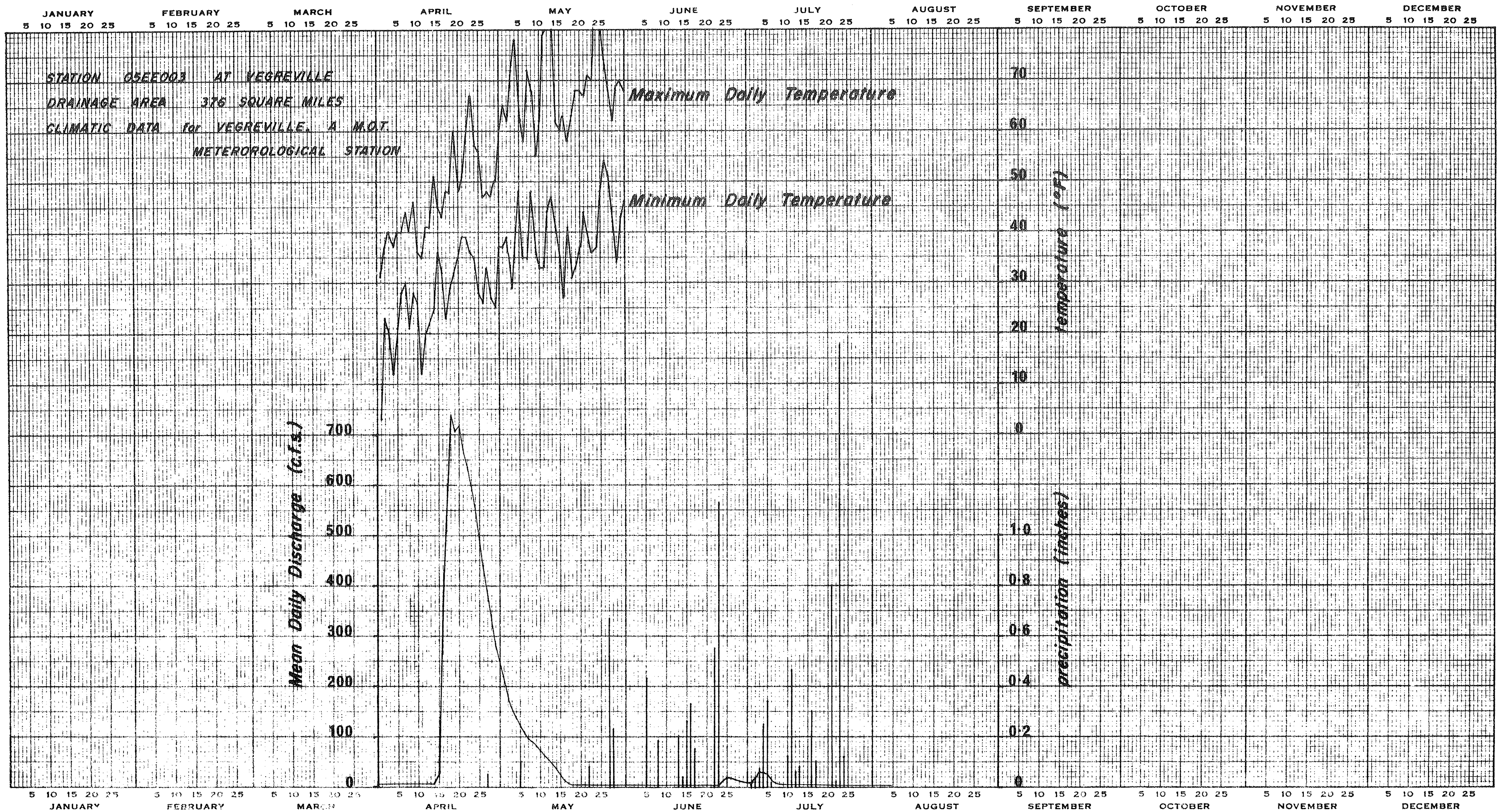

Vermilion
Wainwright
Battle River
Hardisty
Vermilion River
Two Hills
Iron Creek
Beaverhill Creek
Camrose
North Saskatchewan River
EDMONTON
N
DRAINAGE PATTERN: HARDISTY AREA
Watershed
0
8
16 Miles
Scale

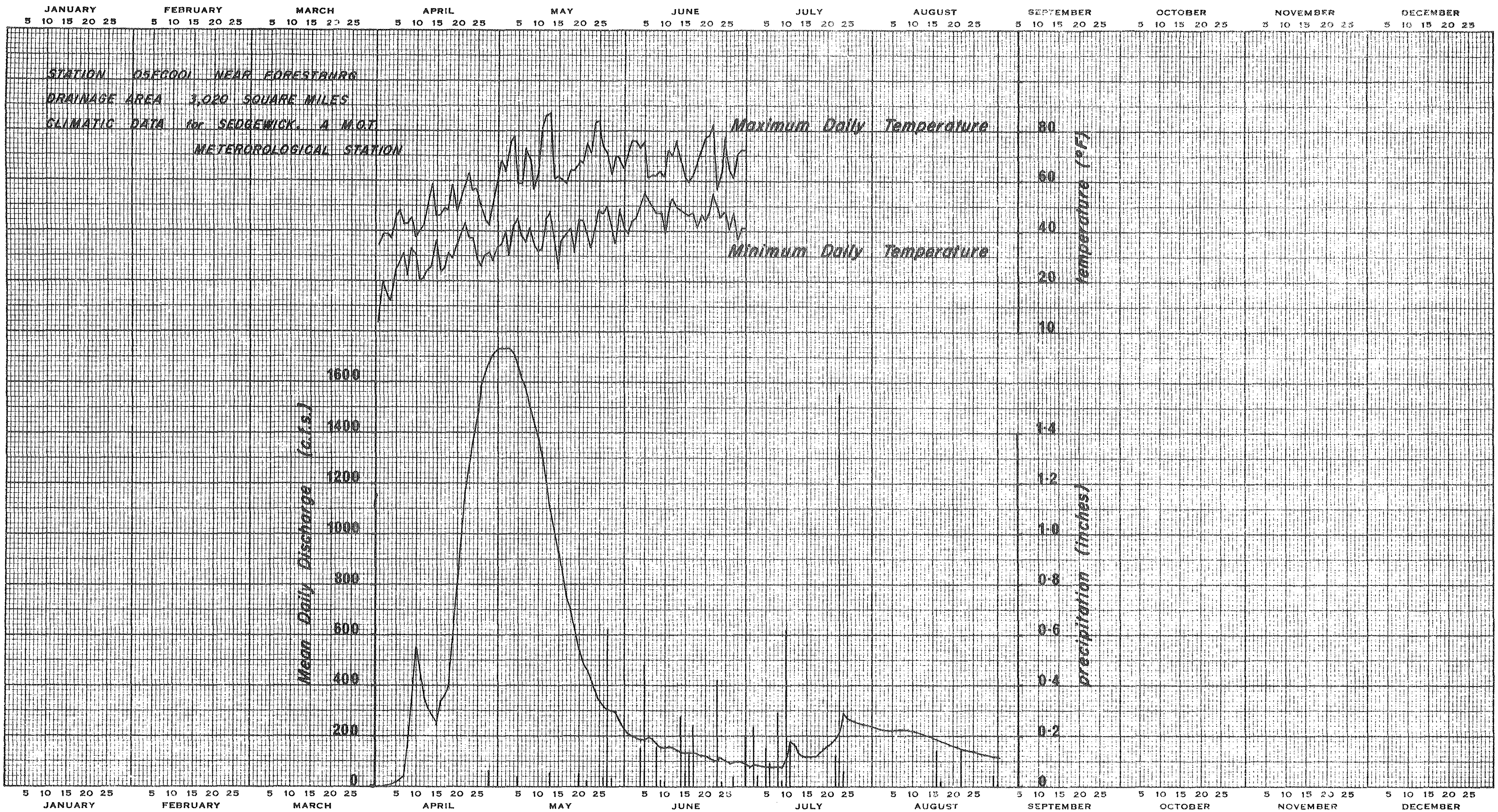
FIG. 4



VERMILION RIVER

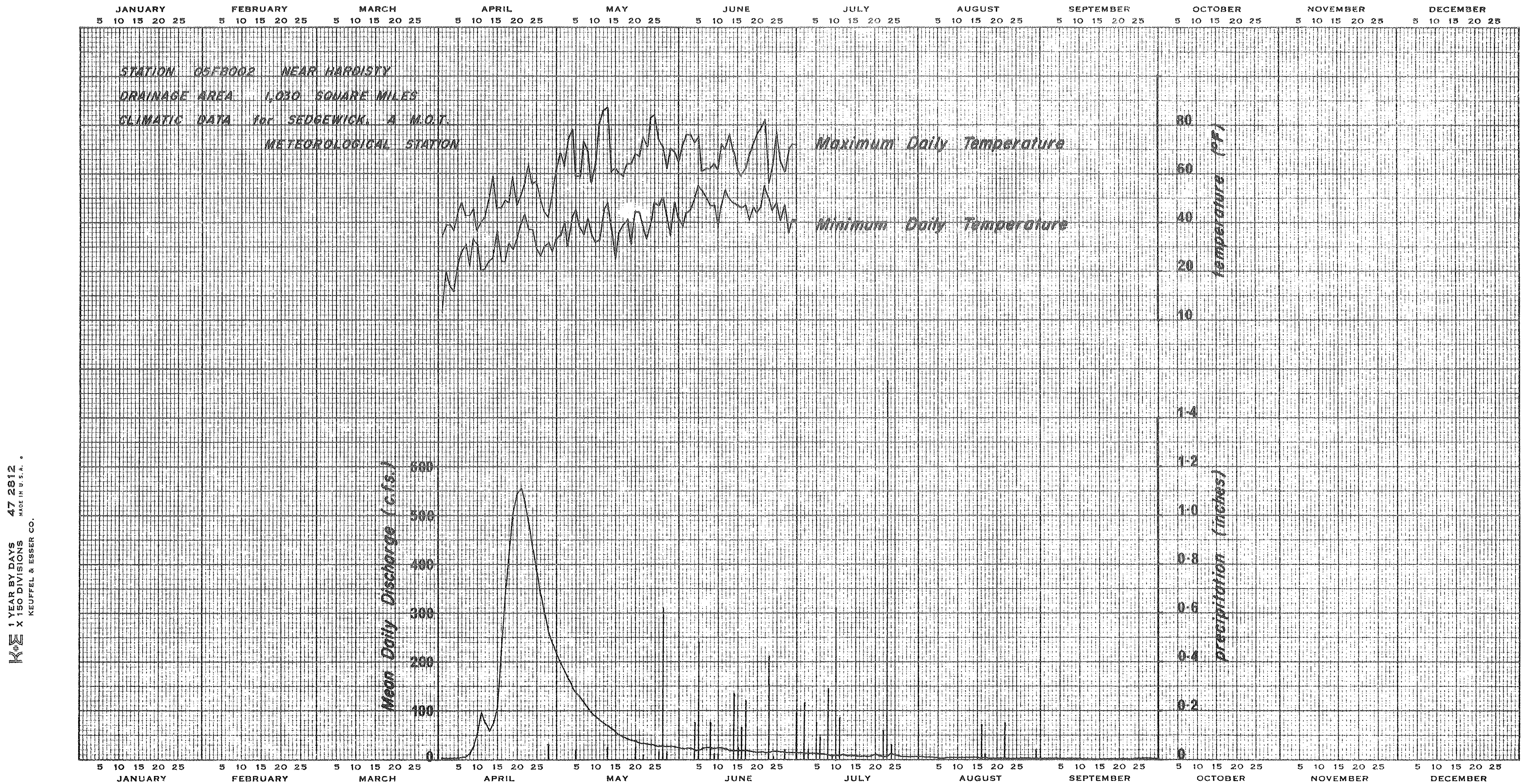
1971

Fig. 6



BATTLE RIVER

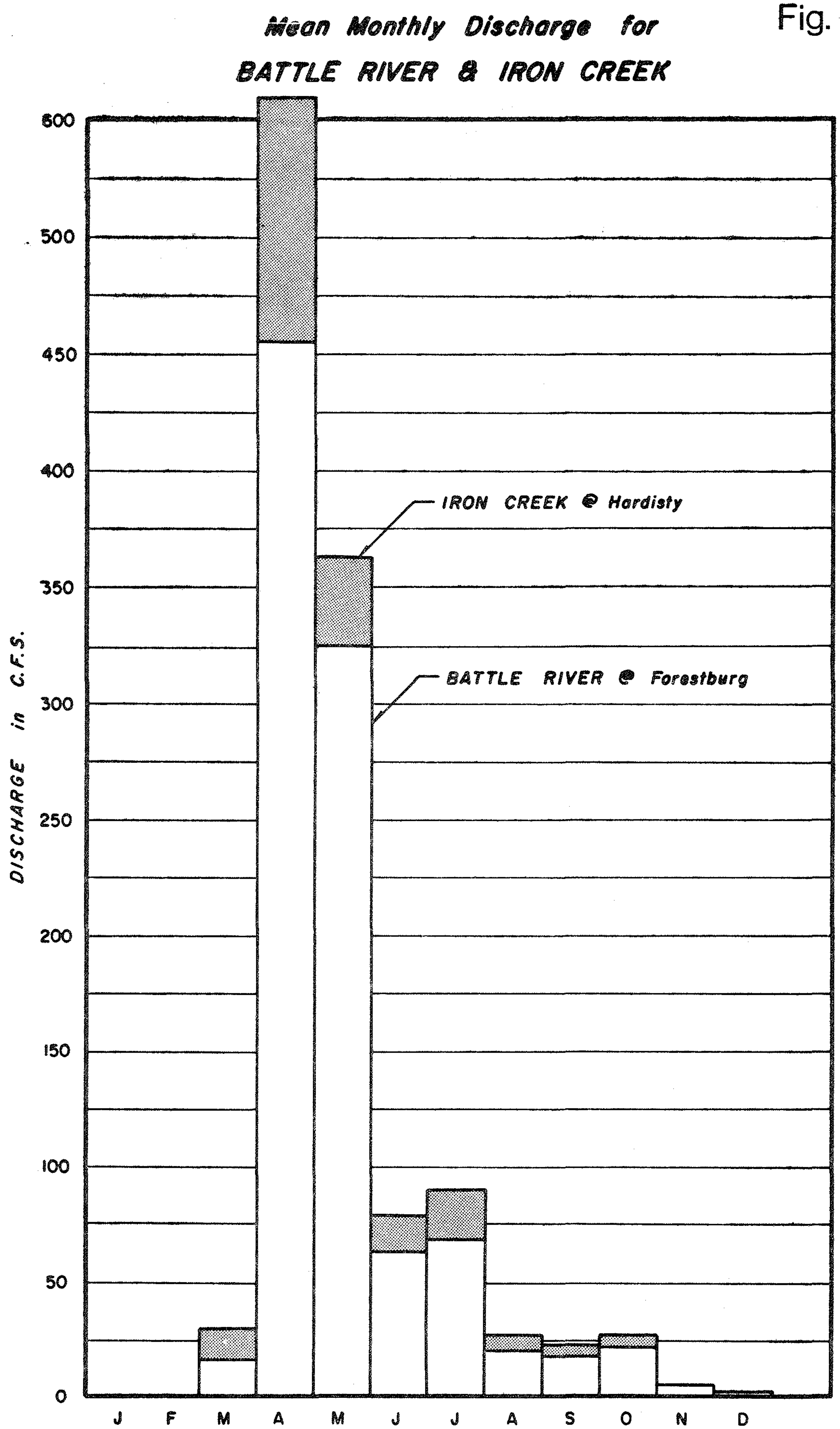
1971



IRON CREEK

1971

Fig. 8


Mean Monthly Discharge for
BATTLE RIVER & IRON CREEK
DISCHARGE in C.F.S.
600
500
450
400
350
300
250
200
150
100
50
0
IRON CREEK @ Hardisty
BATTLE RIVER @ Forestburg
J F M A M J J A S O N D

FORT McMURRAY
CHARD
CONKLIN
CALLING LAKE
WANDERING RIVER
LAC LA BICHE
ATHABASCA
BOYLE
COLD LAKE
BONNYVILLE
THORHILD
SMOKY LAKE
REDWATER
ST. PAUL
ANDREW
FORT SASKATCHEWAN
TWO HILLS
MYRNAM
EDMONTON
VEGREVILLE
Major Flood Problem Area
VERMILION
VIKING
CAMROSE
WETASKIWIN
WAINWRIGHT
KILLAM
HARDISTY
Alberta
ENVIRONMENT
ATHABASCA TAR SANDS
CORRIDOR STUDY
ENVIRONMENT SENSITIVITY MAP
MODERATE SENSITIVITY
1. High runoff sourse areas
2. Deep Valleys
3. High drainage density areas
4 Major flood & high density areas
HIGH SENSITIVITY
Combination of areas 1 & 3
Combination of areas 2 & 3
Wetlands
Lakes
Major Rivers
Highways
Railways
Pipelines
Powerlines 72 KV
138 KV
240KV
Prepared by: BOLTER PARISH TRIMBLE LTD.
STEWART WEIR STEWART WATSON & HEINRICHS
Scale: 1:500,000
(1" = 8 miles approx.)
No. 9
PREPARED FROM BASE MAPS PROVIDED BY CARTOGRAPHIC BRANCH, DEPARTMENT OF LANDS & FORESTS, ALBERTA

ATHABASCA TAR SANDS

CORRIDOR STUDY

CHAPTER II

SOILS

Prepared for:

Alberta
Environment
The Honorable
William Yurko

By:

Tom Peters & Associates
Edmonton, Alberta

Commissioned by:

Stewart Weir Stewart
Watson & Heinrichs

CHAPTER II

SOILS

This chapter on soils is an extension of the information gathered in Volume 4 - Appendix, Environment - General Characteristics and Conditions - Part 1. The three general routes looked at are Devenish to Hardisty, Tweedie to Vegreville and Tweedie to Drysdale Lake. (See Figure 10, Page 18.)

Route: Devenish to Hardisty

From Devenish south to east of Pinehurst Lake the soils are an intimate mixture of Organic, Gleysolic, Podzolic, Brunisolic, and Luvisolic (Gray Wooded) soils. The majority of the soils in this area are Organic and Gleysolic or wetland soils. The Podzolic and Brunisolic soils are found mainly in the sand areas which have dune-like topography. The Luvisolic soils are found on till material and this material is found on knobs of gently rolling to rolling topography.

This is a sensitive area from an environmental standpoint because of the predominence of wetlands and the sandy nature of many of the well drained soils.

The Pinehurst Lake to Beaver River portion of the corridor consists of Brunisolic soils of a sandy nature. The topography is more subdued, being undulating to gently rolling (slopes of 3 - 9 percent). There should be very few problems in the establishment of a corridor in this area.

From the Beaver River to Drysdale Lake the soils are mainly Dark Gray and Gray Luvisols developed on medium textured alluvial lacustrine material. The topography is level to gently rolling.

As with most Gray Luvisolic soils[1] the main problem here is the vegetating of the disturbed soil. As there is very little organic material in these soils, and the leached sandy nature of the upper horizons, establishment of vegetative cover is more difficult than on the Black Chernozemic soils. However, with proper cultivation and the seeding of legumes and grasses these soils can be rehabilitated fairly readily. This area is extensively cultivated for agricultural purposes.

South of Drysdale Lake to the North Saskatchewan River the soils and topography vary considerably. Adjacent to St. Paul there is a large area of Black Chernozemic soils on relatively level topography. Closer to the river the topography becomes rougher and Gray Luvisolic soils predominate. The upper surface of the soil profile may be quite sandy and gravelly in areas. This area adjacent to the river would be moderately sensitive to disturbance. The area adjacent to St. Paul is farmed extensively and would present relatively few problems in a corridor.

South of the North Saskatchewan River to Manville the proposed corridor passes through an undulating to rolling hummocky morain. The soils vary from Black Chernozemic to Gray Luvisolic and have a loam to clay loam texture. They are developed on glacial till. The low areas in the rolling hummocky moraine may be either peaty or intermittent sloughs. The problem in this area outside of the steep slopes is the variability in soils from the top of the knoll to the wet spots in the depressions. There is considerable acreage being farmed in this area.

From Manville south to Irma the topography is mostly rolling and it is called a hummocky moraine area. The soils are mainly

Black Chernozems of a loam texture developed on glacial till of a clay loam to loam texture. The level to gently rolling areas are cultivated whilst the rougher topography is usually left in pasture.

Topography is the main consideration in this area as it is quite complex. This area extends from Irma to near Hardisty. It is perhaps more rolling in nature with complex slopes. The soils are Dark Brown Chernozemic and have a loam to clay loam texture. They are developed on glacial till of a clay loam texture. Near Hardisty there are alluvial soils of a sandy loam to sand in texture. Here disturbance of these soils may be followed by soil drifting, otherwise in this portion of the corridor topography is the main feature to be considered.

<u>Route: Tweedie to Vegreville</u>

From Tweedie to the southeast corner of Lac La Biche the corridor passes through rolling land then it passes along the southern edge of Lac La Biche on gently rolling topography and south to a few miles north of the Amisk River. This area has Bray Luvisolic soils of a loam to clay loam texture. These soils are developed on glacial till of a clay loam to clay texture. This portion of the route has a fairly large agricultural settlement. From the Amisk River south to west of Vilna the topography is rolling and hilly. The soils are Gray Luvisols. The areas of concern are those of rough topography, rolling or steeper. With the Gray Luvisolic soils the usual precautions have to be taken to establish vegetation.

West of Vilna to the North Saskatchewan River the topography is more subdued. The soils are a mixture of Gray and Dary Gray Luvisols. However, just north of the river there is a very sandy area of Brunisolic soils. These soils are difficult to revegetate because of low nutrient status and low water holding capacity. They are very sugject to wind erosion.

From the North Saskatchewan River to Warwick the proposed corridor passes through a level to gently rolling area of Black Chernozemic soils. The soils are primarily developed on glacial till. At intervals there are areas of Solonetzic soils whose subsoil is quite saline. Relatively few problems would be encountered here.

In the area from Warwick to vegreville the route passes through a clay lacustrine area which follows the Vermillion River. The soils are Solonetzic[2] and have a very saline subsoil and groundwater is relatively close to the surface. Farther back from the river on slightly higher ground Solonetzic soils are developed on glacial till. Groundwater discharge areas are common in this area.

Route: Tweedie to Drysdale Lake

From Tweedie southeast to the Beaver River the corridor passes through a rough moraine area. The topography is ridgey, slopes are 9 - 15 percent, and the ridges are orientated in a northwest southeast direction as a rule. The soils are Gray Luvisols of a loam - clay loam texture developed on glacial till. There should not be many problems here as the corridor runs along the slopes rather than up and down and the usual precautions have to be taken in handling Gray Luvisolic soils.

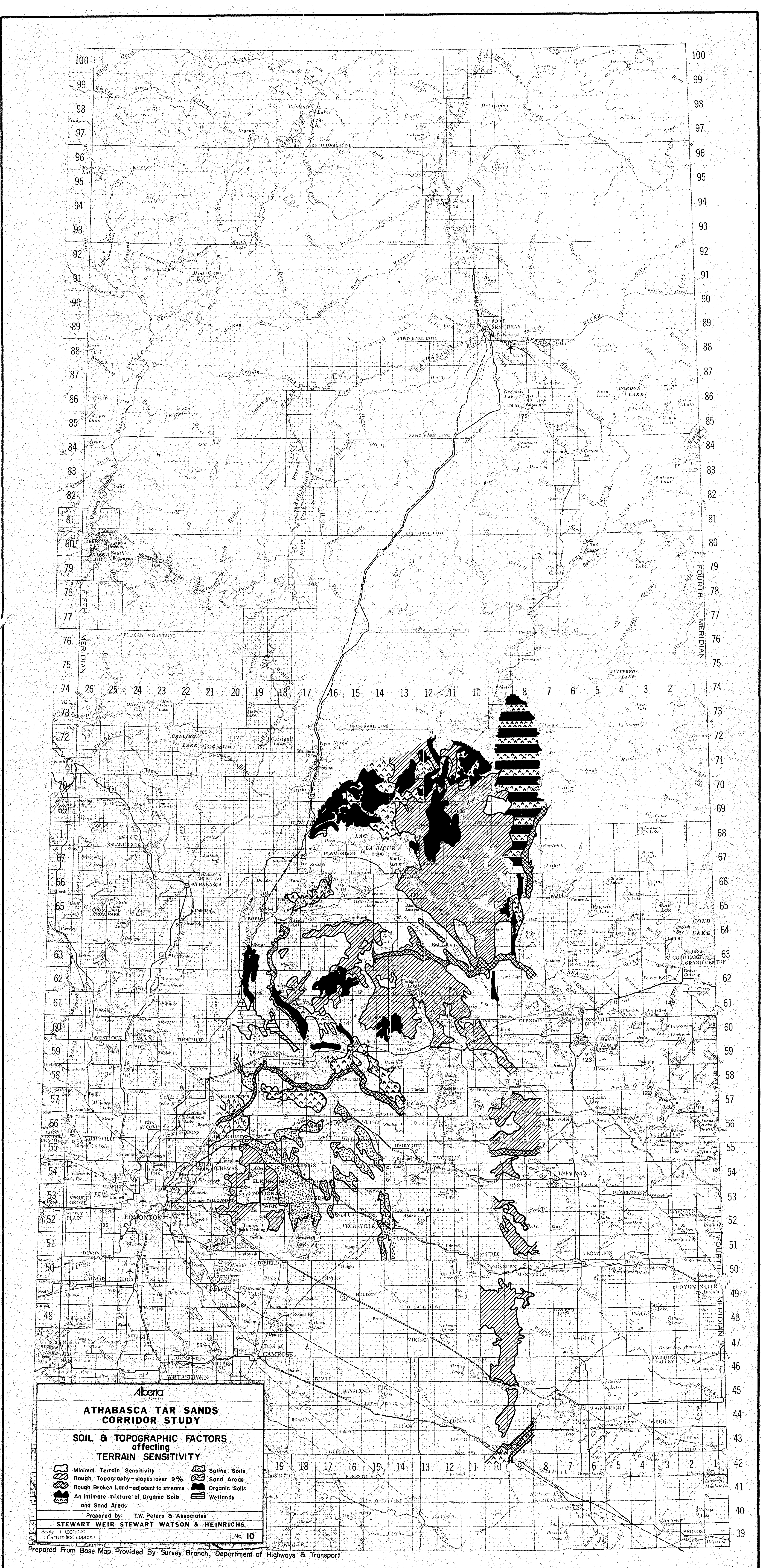
From Beaver River to Drysdale Lake the route follows a southeast direction. The topography is level to gently rolling. The soils are mainly Gray and Dark Gray Luvisols developed on glacial till and alluvial lacustrine deposits. The texture is mainly loamy.

This area is a fairly well settled agricultural area.

---

1. Gray Wooded Soils and Their Management. Bull. B-71-1 Dept. of Extension, University of Alberta. 1971.

2. Solonetzic Soils Technology and Management. Bull. B-73-1 Dept. of Extension, University of Alberta. 1973.



Prepared From Base Map Provided By Survey Branch, Department of Highways & Transport

ATHABASCA TAR SANDS

CORRIDOR STUDY

CHAPTER III

WILDLIFE

Prepared for:

Alberta
Environment
The Honorable
William Yurko

By:

Ducks Unlimited (Canada)

Stewart Weir Stewart
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Edmonton, Alberta

CHAPTER III

WILDLIFE

Since the printing of Volume 4 - Appendix, Environment - General Characteristics and Conditions - Part 1, Alberta Lands and Forests, Fish and Wildlife Division, and Ducks Unlimited (Canada) have supplied us with important information for the extended area of our study, i.e. Hardisty, Strome, Vegreville, St. Paul, Sedgewick, etc. They have also provided more recent information on the study area covered previously.

Birds and Mammals

In this study we are concerned primarily for those species which could suffer losses through destruction of habitat or harrassment of individuals. This might occur either during the corridor construction phase or later as a result of activities along the route or in previously inaccessible areas nearby. For endangered species such as the whooping crane or the peregrine falcon and others such as the woodland caribou, otter, wolverine, great blue heron, bald and golden eagles and white pelican which are becoming increasingly scarce, the proximity of the route to known nesting areas, migratory stopovers or home ranges must also be considered.

We have been confronted with the problem of assessing and comparing the possible impact of a corridor on birds and mammals in an area of Alberta where only limited data on the distribution of species exist. Nevertheless it has been possible to prepare a generalized matrix of the impact in the Urban, Agricultural, and Forested areas that might accrue to the two hundred and fifty-two (252) species of birds and sixty (60) species of mammals distributed within the study area. This information is presented in Tables 1 and 3 and summaries are contained in Tables 2 and 4.

We have utilized the information presented in Volume 4 of this series (Environment - General Characteristics and Conditions - part 1), in particular the wetlands map (p 176), waterfowl sensitivity map (p 188) and soils maps (pp 169-171). We have also used the Canada Land Inventory maps for ungulates and waterfowl and the information on distribution, habits of birds and mammals in the study area as described by Soper[1], Salt and Wilk[2], and Godfrey[3]. Information concerning the status of endangered species in the study area (Vol. 4, Chapter III) has also been considered.

Ducks Unlimited (Canada), courtesy of Mr. Ernie Ewaschuk, have supplied us with the transects of breeding pairs and broods for waterfowl in the extended region of the study. The table for these transects of breeding pairs and broods is given in Table 5, page 44 . Figure 11 , Lands Sensitive for Waterfowl, page 47 , shows the most recently determined sensitive areas of our study as well as the information contained in the map in the previous environmental volume, Volume 4, page 188.

As can be seen from Table 5, the most sensitive areas of waterfowl for breeding pairs are Willington, West of Viking and West of Lac Lacroix in the study area. Areas of sensitivity also of note are; Hairy Hill, Bruce, Hardisty, East of St. Paul, Beauvallon, Lavoy, North of Nadeau Lake and Bellis.

---

1. Soper, J.D. 1964. The mammals of Alberta. Department of Industry and Development, Edmonton. 402 pp.
2. Salt, W.R. and A.L. Wilk. 1966. The birds of Alberta (second ed., revised) Department of Industry and Development, Edmonton. 411 pp.
3. Godfrey, W.E. 1966. The birds of Canada. Nat.Mus.Canada, Bull.203, Biol. Ser. 73. 428 pp.

Alberta Lands and Forests, Fish and Wildlife Division, courtesy of Mr. William Hall and Mr. Al Bibaud, supplied us with data on the ungulates in the study area. These are the habitat and migratory habits of Moose, Elk, Deer, Caribou and Antelope in the area and possible effects the corridor would have by cutting their ranges.

Figure 12, Page 48, Lands Sensitive for Ungulates, shows the areas of sensitivity of specific species. The winter ranges for the ungulates are the most important to their survival especially at times of great snows, as was seen this year. The mammals have to make use of all the winter ranges in bad times and these should not be disturbed. Disturbing these areas will cause great losses in the herds. Ungulates, especially caribou are on a rigid time schedule and are known to keep to it. If a corridor bisects an area causing the herd to detour, it has been found that the caribou will calf along route instead of in the winter ranges, and in most cases the calf will die.

The most sensitive area to be avoided as seen on the map are the southeastern part of the study area, from Sedgewick to the Alberta-Saskatchewan border and as far north as the North Saskatchewan River. Along the N.A.R. the area from just north of Chard south to Behan where a caribou crossing exists is another area. The third most sensitive region is along the Athabasca River south from Fort McMurray. Along the highway three minor sensitive areas exist and only for short distances. These are Class 3 winter ranges which are only used in severe winters. These are where the highway crosses the House River, and Hangingstone River at Township 78, Range 15, and just south of Wandering River.

Following is a summary of the 1972/1973 Trap Returns in the study area. The data in this summary were gathered for us by the Wildlife Division of the Alberta Department of Lands and Forests. The figures are approximate - at the time of compilation, affidavits had not been received from some of the trappers for the 1973 season.

A total of 76,400 pelts were harvested during the 1972/'73 season for a total return to the trappers of $746,500. Returns were received for 426 traplines with a total of 555 registered trappers working these lines. The average revenue per trapper was $1,345 although this figure varied considerably from individual to individual.

Squirrels and muskrats were harvested in the greatest numbers, but the highest total revenue per species was realized by lynx ($321,350) and beavers ($162,060), with coyotes, mink, squirrels and muskrats following in that order. The low numbers of wolverines (3), martens (76), fishers (176) and otters (95) harvested in comparison with muskrats (11,100) reflect the relative scarcity of these four species in the study area.

Fisheries

Alberta Lands and Forests, Fish and Wildlife Division, courtesy of Dr. Martin Paetz and Mr. Dave Buckwald, have supplied us with additional data of the fisheries potential of streams, rivers and lakes covering the study area. This information is shown in Figure 13, Page 49.

Thus, combining from Volume 4, Appendix, Chapter I, page 35, additional watersheds and drainage basins of great importance (rated class 1 or high class 2) are:

1. <u>Clearwater River Watershed</u> (see on page 36 Vol.4 Part 1)

2. <u>Christina Watershed</u> - The Christina River has high sport fisheries potential and the entire watershed must be stressed.

The May River has few or minor limitations on sport fish production and probably acts as a fish passage route between Wappau Lake and Christina River. Jackfish River has excellent fish refugia and large, deep pools are common. Sunday Creek has good fisheries potential and Buck Creek has favorable fish habitat for two thirds of its length with the remainder at low fishery potential. Winefred River originates from Winefred Lake (a trophy lake) and for most of its length contains pool water. Christina Lake supports a small sports fishery for walleye and northern pike, a domestic fishery, and also a 10,000 pound commercial fishery. Kirby Lake in the Christina drainage system supports a good commercial fishery. On Christina Lake there is a sports lodge capitalizing on the lake trout.

3. <u>Calling River Watershed</u> - Calling River has many sections of good sport fisheries potential but the section near Calling Lake has poor fish refugia. Physical effects such as wind action have caused a marked effect on its productivity.

4. <u>Fawcett River Watershed</u> - Fawcett River has favorable pool to riffle frequences and gradient increases occurring over most of its length, thus giving it good sports fisheries and commercial fisheries potential. Rock Island Lake appears in satisfactory condition and offers the possibility of an excellent fishery. Fawcett Lake has good spawning facilities, i.e. separation of the fish species causing a very low incidence of *Triaenophorus*.

5.*Athabasca River Drainage Basin - The Lac La Biche, Tawatinaw and Pembina Rivers join the Athabasca system. These rivers have good sports fisheries potential. The area of Cross Lake Provincial Park also joins the Athabasca system.

6. North Saskatchewan River Drainage Basin - The White Earth and Redwater Rivers are part of the North Saskatchewan system. These also have good sports fisheries potential. Streams south and west of Beaver and Amisk Lake flow are also part of this system.

7. Churchill Drainage Basin - Jackfish and Marie Creek, Medley, Amisk, Sand and Beaver River, and Cold, Marie, Beaver and Amisk Lake contribute to the main Churchill drainage basin. Sand River is a tributary of the Beaver River. The sports fisheries potential is good in the above areas. May and Seibert Lakes are trophy lakes.

As can be seen from the above information and the sensitivity map, sensitive areas for streams, rivers and lakes as well as fisheries may be stated as:

1. Christina and Winefred Lakes and Rivers;
2. Lac La Biche east to Alberta-Saskatchewan border and south to St. Paul area;
3. The Athabasca River-Calling Lake area to Cross Lake Provincial Park;
4. Most class 1 and 2 areas since they can support a good commercial fishery.

Thus, any disturbance in these areas will have to be closely watched and environmental regulations strictly enforced during any construction on the streams and rivers. The lakes should

---

* The divide is the area between Lac La Biche and Smoky Lake with the Athabasca to the northwest, the North Saskatchewan to the south, and the Churchill on the east.

be avoided completely, timing and method of construction is important and gravel sources for construction purposes should be carefully scrutinized. Any permanent stream may be important as a grayling spawning area and therefore significant to grayling production.

Explanation of Tables

Tables 1 and 3 describe the possible environmental impact on birds and mammals within the study area. The study area has been divided into three parts: the urban and industrial fringe in the Edmonton area, the agricultural zone north of Township 68 (refer to Fig. 1, p 169 in Volume 4: Cultivated, Pasture and Wooded Lands) and the forest zone north of the agricultural area to Fort McMurray. The effect on wildlife of a multi-purpose single corridor (S) is compared to the effect of several corridors (M) in the urban and industrial fringe, agricultural and forest zones.

Symbols have been used to denote positive (+), negative (-) or neutral (o) effects on members of a species. A check (✓) has been added to indicate, where possible, a first choice among the three areas for a corridor. To illustrate, the American bittern, for example, is a common summer resident in the agricultural and forest zones. This bird prefers the borders of potholes and shallow lakes where cattails and other emergent plants are found. It is not apt to be found in the urban and industrial fringe; therefore a 'o' has been placed in the Urban categories. The construction of a road or pipeline will involve drainage of wetlands wherever these are encountered. Since a corridor may prove detrimental to members of this species by destroying suitable habitat, a negative (-) has been placed in the agricultural and forest zones. For the species, a negative (-) has been placed in both the 'S' and 'M' categories of the agricultural and forest zones. However, the multi-purpose single corridor (S) is preferred over the multiple corridors (M) because less disturbances to natural drainage will be required in the former.

Some 'o's have been added because members of a species do not occur in a particular area. For example, the willow ptarmigan winters only in the northern forests of our study area. Therefore, a 'o' has been placed in the urban and agricultural categories. Other 'o's have been added because although members of a species may be found in a particular zone, the corridor will not likely affect the bird of its habitat. To avoid confusion the checklists of birds and mammals occurring in the study area should be used for reference (Volume 4, Part 1, Chapter III, Tables 2,3). Another point worth mentioning is that although a species may be listed in the checklist as a common breeding bird in the northern forests, it will migrate through the agricultural zone on its way to and from wintering grounds in the south. This has been taken into consideration during preparation of the matrix. In addition, both the impact during the construction phase and the possible long-term effects have been considered.

Table 5 shows the results of 27 transects and one brood transect in the study area. Transects are areas of land 4 miles long and equalling one square mile. Brood transects are areas 24 miles long and equalling six square miles. These transects are samples which are censused annually to obtain an index of waterfowl population trends. The statistics were taken annually from 1966 to 1972 and the mean was calculated.

Table 1. Possible impact of single and multiple corridors on birds in the study area.

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
	Comparison of single, multiple corridors					
Common Loon	o	o	$\overset{\checkmark}{\circ}$	o	$\overset{\checkmark}{-}$	-
Arctic Loon	o	o	$\overset{\checkmark}{\circ}$	o	$\overset{\checkmark}{-}$	-
Red-throated Loon	o	o	$\overset{\checkmark}{\circ}$	o	$\overset{\checkmark}{-}$	-
Red-necked (Holboell's) Grebe	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Horned Grebe	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Eared Grebe	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Western Grebe	o	o	$\overset{\checkmark}{\circ}$	o	$\overset{\checkmark}{-}$	-
Pied-billed Grebe	o	o	$\overset{\checkmark}{\circ}$	o	$\overset{\checkmark}{-}$	-
White Pelican	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Double-crested Cormorant	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Great Blue Heron	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
American Bittern	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Whistling Swan	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Canada Goose	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
White-fronted Goose	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Snow Goose	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Blue Goose	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Ross' Goose	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Mallard	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-
Gadwall	o	o	$\overset{\checkmark}{-}$	-	$\overset{\checkmark}{-}$	-

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Pintail	o	o	✓	-	✓	-
Green-winged Teal	o	o	✓	-	✓	-
Blue-winged Teal	o	o	✓	-	✓	-
American Widgeon	o	o	✓	-	✓	-
Shoveler	o	o	✓	-	✓	-
Redhead	o	o	✓	o	✓	-
Ring-necked Duck	o	o	✓	-	✓	-
Canvasback	o	o	✓	o	✓	-
Lesser Scaup	o	o	✓	o	✓	-
Common Goldeneye	o	o	✓	-	✓	-
Barrow's Goldeneye	o	o	✓	-	✓	-
Bufflehead	o	o	✓	-	✓	-
Oldsquaw	o	o	✓	o	✓	-
Harlequin Duck	o	o	✓	-	✓	-
White-winged Scoter	o	o	✓	o	✓	-
Surf Scoter	o	o	✓	o	-	-
Ruddy Duck	o	o	✓	o	✓	-
Hooded Merganser	o	o	✓	-	✓	-
Common Merganser	o	o	✓	o	✓	-
Red-breasted Merganser	o	o	o	o	✓	-
Turkey Vulture	o	o	✓	o	o	o
Goshawk	o	o	✓	o	✓	-
Sharp-shinned Hawk	o	o	✓	o	✓	-
Cooper's Hawk	o	o	✓	o	o	o

Species	Urban		Agric.		Forest	
	S	M	S	M	S	M
Red-tailed Hawk	o	o	✓ o	o	✓ +	+
Broad-winged Hawk	o	o	✓ o	o	✓ +	+
Swainson's Hawk	o	o	o	o	o	o
Rough-legged Hawk	o	o	o	o	o	o
Golden Eagle	o	o	✓ o	o	o	o
Bald Eagle	o	o	✓ o	o	✓ -	-
Marsh Hawk	o	o	✓ o	o	+	✓ +
Osprey	o	o	✓ o	o	✓ -	-
Peregrine Falcon	o	o	o	o	✓ -	-
Pigeon Hawk	o	o	✓ o	o	✓ o	o
Sparrow Hawk	o	o	✓ o	o	+	✓ +
Spruce Grouse	o	o	o	o	✓ -	-
Ruffed Grouse	o	o	✓ o	o	+	✓ +
Willow Ptarmigan	o	o	o	o	+	✓ +
Sharp-tailed Grouse	o	o	o	o	+	✓ +
Ring-necked Pheasant	o	o	o	o	o	o
Gray (Hungarian) Partridge	o	o	o	o	o	o
Whooping Crane	o	o	✓ -	-	✓ -	-
Sandhill Crane	o	o	o	o	✓ -	-
Virginia Rail	o	o	✓ -	-	o	o
Sora Rail	o	o	✓ -	-	✓ -	-
American Coot	o	o	✓ -	-	✓ -	-
Semipalmated Plover	o	o	✓ o	o	✓ o	o
Piping Plover	o	o	✓ o	o	o	o
Yellow Rail	o	o	✓ -	-	✓ -	-

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Killdeer	o	o	o	o	o	o
American Golden Plover	o	o	o	o	o	o
Black-bellied Plover	o	o	✓	-	✓	-
Ruddy Turnstone	o	o	✓ o	o	✓	-
Common (Wilson's) Snipe	o	o	✓	-	✓	-
Whimbrel	o	o	✓ o	o	✓	-
Upland Plover	o	o	o	o	o	o
Spotted Sandpiper	o	o	✓	-	✓	-
Solitary Sandpiper	o	o	o	o	✓	-
Willet	o	o	✓	-	o	o
Greater Yellowlegs	o	o	o	o	✓	-
Lesser Yellowlegs	o	o	✓	-	✓	-
Knot	o	o	✓ o	o	✓ o	o
Pectoral Sandpiper	o	o	✓	-	✓	-
White-rumped Sandpiper	o	o	✓ o	o	✓ o	o
Baird's Sandpiper	o	o	✓	-	✓ o	o
Least Sandpiper	o	o	✓	-	✓ o	o
Dunlin	o	o	✓ o	o	✓ o	o
Long-billed Dowitcher	o	o	✓	-	✓	-
Stilt Sandpiper	o	o	o	o	✓	-
Semipalmated Sandpiper	o	o	✓	-	✓	-
Buff-breasted Sandpiper	o	o	o	o	o	o
Marbled Godwit	o	o	✓	-	o	o
Hudsonian Godwit	o	o	✓ o	o	✓ o	o

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Sanderling	o	o	o	o	✓–	–
Red Phalarope	o	o	o	o	✓–	–
Wilson's Phalarope	o	o	✓–	–	✓–	–
Northern Phalarope	o	o	✓–	–	✓–	–
Parasitic Jaeger	o	o	✓o	o	✓o	o
Long-tailed Jaeger	o	o	✓o	o	✓o	o
Glaucous-winged Gull	o	o	✓o	o	✓o	o
Herring Gull	o	o	✓o	o	✓o	o
California Gull	o	o	✓o	o	✓o	o
Ring-billed Gull	o	o	✓o	o	✓o	o
Mew Gull	o	o	✓o	o	✓o	o
Franklin's Gull	o	o	✓–	–	✓–	–
Bonaparte's Gull	o	o	✓o	o	✓–	–
Sabine's Gull	o	o	✓o	o	✓o	o
Forster's Tern	o	o	✓–	–	o	o
Common Tern	o	o	✓o	o	✓o	o
Caspian Tern	o	o	✓o	o	✓o	o
Black Tern	o	o	✓–	–	✓–	–
Domestic Pigeon (Rock Dove)	o	o	o	o	o	o
Mourning Dove	o	o	o	✓o	+	✓+
Black-billed Cuckoo	o	o	o	✓o	o	o
Great Horned Owl	o	o	✓o	o	✓+	+
Snowy Owl	o	o	o	✓o	+	✓+
Hawk Owl	o	o	o	o	✓+	+
Barred Owl	o	o	✓o	o	✓o	o

Species	Urban		Agric.		Forest	
	S	M	S	M	S	M
Great Gray Owl	o	o	o	o	✓ o	o
Long-eared Owl	o	o	✓ o	o	✓ +	+
Short-eared Owl	o	o	✓ o	o	+	✓ +
Boreal (Richardson's) Owl	o	o	o	o	✓ o	o
Saw-whet Owl	o	o	✓ o	o	o	o
Common Nighthawk	o	o	o	o	+	✓ +
Ruby-throated Hummingbird	o	o	o	✓ o	+	✓ +
Belted Kingfisher	o	o	o	o	✓ o	o
Yellow-shafted Flicker	o	o	o	o	o	o
Pileated Woodpecker	o	o	✓ o	o	✓ -	-
Yellow-bellied Sapsucker	o	o	o	o	✓ o	o
Hairy Woodpecker	o	o	✓ o	o	✓ -	-
Downy Woodpecker	o	o	o	o	✓ o	o
Black-backed Three-toed Woodpecker	o	o	o	o	✓ o	o
Northern Three-toed Woodpecker	o	o	o	o	✓ o	o
Eastern Kingbird	o	o	o	✓ o	+	✓ +
Eastern Phoebe	o	o	o	✓ o	+	✓ +
Say's Phoebe	o	o	o	✓ o	o	o
Yellow-bellied Flycatcher	o	o	✓ o	o	✓ -	-
Traill's (Alder) Flycatcher	o	o	o	✓ o	+	✓ +
Least Flycatcher	o	o	o	✓ o	+	✓ +
Western Wood Pewee	o	o	✓ o	o	+	✓ +
Olive-sided Flycatcher	o	o	o	o	✓ o	o
Hoyt's Horned Lark	o	o	o	✓ o	+	✓ +
Tree Swallow	o	o	o	o	+	✓ +

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Violet-green Swallow	o	o	o	o	o	o
Bank Swallow	o	o	o	o	o	o
Barn Swallow	o	o	o	o	o	o
Cliff Swallow	o	o	o	o	o	o
Purple Martin	o	o	o	o	o	o
Gray (Canada) Jay	o	o	o	o	o	o
Blue Jay	o	o	o	o	o	o
Black-billed Magpie	o	o	o	o	o	o
Common Raven	o	o	o	o	o	o
Common Crow	o	o	o	o	o	o
Black-capped Chickadee	o	o	✓ o	o	✓ –	–
Mountain Chickadee	o	o	✓ o	o	o	o
Boreal Chickadee	o	o	✓ o	o	✓ –	–
White-breasted Nuthatch	o	o	✓ o	o	o	o
Red-breasted Nuthatch	o	o	✓ o	o	✓ –	–
Brown Creeper	o	o	✓ o	o	✓ –	–
House Wren	o	o	o	✓ o	+	✓ +
Winter Wren	o	o	o	o	✓ –	–
Long-billed Marsh Wren	o	o	✓ –	–	✓ –	–
Short-billed Marsh Wren	o	o	+	✓ +	o	o
Catbird	o	o	o	✓ o	o	o
Brown Thrasher	o	o	✓ o	o	o	o
Robin	o	o	o	o	+	✓ +
Varied Thrush	o	o	✓ o	o	o	o
Hermit Thrush	o	o	✓ o	o	✓ –	–

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Swainson's Thrush	o	o	✓ o	o	✓ -	-
Gray-cheeked Thrush	o	o	✓ o	o	✓ -	-
Veery	o	o	✓ o	o	o	o
Mountain Bluebird	o	o	o	o	✓ +	o
Eastern Bluebird	o	o	o	o	o	o
Townsend's Solitaire	o	o	✓ o	o	o	o
Golden-crowned Kinglet	o	o	✓ o	o	✓ o	o
Ruby-crowned Kinglet	o	o	✓ o	o	✓ o	o
Water (American) Pipit	o	o	o	o	+	✓ +
Sprague's Pipit	o	o	o	o	+	✓ +
Bohemian Waxwing	o	o	o	o	✓ o	o
Cedar Waxwing	o	o	o	✓ o	+	✓ +
Northern Shrike	o	o	o	✓ o	+	✓ +
Loggerhead Shrike	o	o	o	✓ o	+	✓ +
Starling	o	o	o	o	o	o
Solitary Vireo	o	o	o	o	✓ o	o
Red-eyed Vireo	o	o	✓ o	o	✓ -	-
Philadelphia Vireo	o	o	o	o	+	✓ +
Warbling Vireo	o	o	✓ o	o	✓ o	o
Black and White Warbler	o	o	✓ o	o	✓ -	-
Tennessee Warbler	o	o	o	o	o	o
Orange-crowned Warbler	o	o	✓ o	o	✓ -	-
Yellow Warbler	o	o	o	✓ o	+	✓ +
Magnolia Warbler	o	o	o	✓ o	+	✓ +
Cape May Warbler	o	o	o	o	+	✓ +

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Black-throated Blue Warbler	o	o	o	o	o	o
Myrtle Warbler	o	o	o	✓o	o	✓o
Audubon's Warbler	o	o	✓o	o	o	o
Black-throated Green Warbler	o	o	✓o	o	✓–	–
Backburnian Warbler	o	o	✓o	o	✓–	–
Bay-breasted Warbler	o	o	✓o	o	✓–	–
Blackpoll Warbler	o	o	✓o	o	✓–	–
Pine Warbler	o	o	o	o	o	o
Palm Warbler	o	o	✓o	o	+	✓+
Ovenbird	o	o	✓o	o	✓–	–
Northern Waterthrush	o	o	✓o	o	✓–	–
Connecticut Warbler	o	o	o	o	+	✓+
Mourning Warbler	o	o	o	o	+	✓+
Yellowthroat	o	o	✓o	o	✓–	–
Wilson's Warbler	o	o	o	o	✓o	o
Canada Warbler	o	o	o	✓o	+	✓+
American Redstart	o	o	o	✓o	+	✓+
English (House) Sparrow	o	o	o	o	o	o
Bobolink	o	o	+	✓+	o	o
Western Meadowlark	o	o	+	✓+	o	o
Yellow-headed Blackbird	o	o	✓–	–	✓–	–
Redwinged Blackbird	o	o	✓–	–	✓–	–
Baltimore Oriole	o	o	✓o	o	+	✓+
Rusty Blackbird	o	o	✓o	o	✓–	–
Brewer's Blackbird	o	o	+	✓+	+	✓+

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Common Grackle	o	o	o	o	o	o
Brown-headed Cowbird	o	o	o	o	o	o
Western Tanager	o	o	✓ o	o	✓ –	–
Rose-breasted Grosbeak	o	o	✓ o	o	✓ –	–
Evening Grosbeak	o	o	o	o	✓ –	–
Purple Finch	o	o	o	o	o	o
Pine Grosbeak	o	o	✓ o	o	✓ –	–
Gray-crowned Rosy Finch	o	o	+	+	o	o
Hoary Redpoll	o	o	o	o	o	o
Common Redpoll	o	o	o	o	o	o
Pine Siskin	o	o	o	o	+	+
American Goldfinch	o	o	+	✓ +	+	✓ +
Red Crossbill	o	o	o	o	o	o
White-winged Crossbill	o	o	o	o	o	o
Savannah Sparrow	o	o	+	✓ +	+	✓ +
Leconte's Sparrow	o	o	✓ o	o	✓ –	–
Nelson's (Sharp-tailed) Sparrow	o	o	✓ o	o	✓ –	–
Vesper Sparrow	o	o	+	✓ +	+	✓ +
Slate-coloured Junco	o	o	o	o	+	+
Oregon Junco	o	o	o	o	o	o
Tree Sparrow	o	o	o	o	+	✓ +
Chipping Sparrow	o	o	o	o	+	+
Clay-coloured Sparrow	o	o	o	o	+	✓ +
Harris' Sparrow	o	o	o	o	+	✓ +
White-crowned Sparrow	o	o	o	o	+	✓ +

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
White-throated Sparrow	o	o	o	o	$\overset{\checkmark}{-}$	−
Fox Sparrow	o	o	o	o	+	$\overset{\checkmark}{+}$
Lincoln's Sparrow	o	o	$\overset{\checkmark}{-}$	−	$\overset{\checkmark}{-}$	−
Swamp Sparrow	o	o	$\overset{\checkmark}{-}$	−	$\overset{\checkmark}{-}$	−
Song Sparrow	o	o	o	o	+	$\overset{\checkmark}{+}$
McCowan's Longspur	o	o	o	o	o	o
Lapland Longspur	o	o	o	o	+	$\overset{\checkmark}{+}$
Smith's Longspur	o	o	o	o	+	$\overset{\checkmark}{+}$
Snow Bunting	o	o	o	o	o	o

Table 2. Summary of Table 1: Possible impact of single and multiple corridors on birds in the study area.

(a) <u>Urban and Industrial Fringe</u>

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	252	252
May improve conditions (+)	0	0
May be detrimental (-)	0	0
First choice between the 2 systems (✓) (where a choice could be made)	0	0

(b) <u>Agricultural Zone</u>

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	191	191
May improve conditions (+)	8	8
May be detrimental (-)	53	53
First choice between the 2 systems (✓) (where a choice could be made)	140	28

(c) <u>Forest Zone</u>

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	94	95
May improve conditions (+)	55	54
May be detrimental (-)	103	103
First choice between the 2 systems (✓) (where a choice could be made)	141	47

Table 3. Possible impact of single and multiple corridors on mammals in the study area.

Species	Comparison of single, multiple corridors					
	Urban		Agric.		Forest	
	S	M	S	M	S	M
Common Cinereous Shrew	o	o	o	o	+	+ ✓
Hayden Cinereous Shrew	o	o	o	o ✓	o	o
American Saddle-backed Shrew	o	o	o	o	o ✓	o
Dusky Mountain Shrew	o	o	o	o	+	+ ✓
American Water Shrew	o	o	o ✓	o	o ✓	o
Northern Pigmy Shrew	o	o	o	o	+	+ ✓
Little Brown Bat	o	o	o	o	+	+ ✓
Silver-haired Bat	o	o	o	o	o	o ✓
Pale Big Brown Bat	o	o	o	o	+	+ ✓
Hoary Bat	o	o	o	o	o	o
White-tailed Prairie Hare	o	o	o	o	o	o
American Varying Hare	o	o	o	o	+	+ ✓
Canada Woodchuck	o	o	o	o	+	+ ✓
Richardson Ground Squirrel	o	o	o	o	o	o
Striped Ground Squirrel	o	o	o	o	o	o
Franklin Ground Squirrel	o	o	o	o	o	o
Little Northern Chipmunk	o	o	o	o	+	+ ✓
Mackenzie Red Squirrel	o	o	o	o	+	+ ✓
Hudson Bay Flying Squirrel	o	o	o	o	+ ✓	+
Richardson Pocket Gopher	o	o	o	o	o	o

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
Canada Beaver	o	o	✓ o	o	✓ –	–
Boreal White-footed Mouse	o	o	o	o	o	o
Richardson Lemming Vole	o	o	o	o	✓ –	–
Athabasca Red-backed Vole	o	o	o	o	o	o
Prairie Phenacomys Vole	o	o	o	o	o	o
Mackenzie Phenacomys Vole	o	o	o	o	✓ –	–
Drummond Meadow Vole	o	o	o	o	+	✓ +
Chestnut-cheeked Vole	o	o	o	o	+	✓ +
Little Upland Vole	o	o	o	o	o	o
Northwestern Muskrat	o	o	✓ –	–	✓ –	–
House Rat	o	o	o	o	o	o
House Mouse	o	o	o	o	o	o
Hudson Bay Jumping Mouse	o	o	o	o	✓ +	+
Saskatchewan Jumping Mouse	o	o	o	o	o	o
Alaska Porcupine	o	o	o	o	✓ –	–
Prairie Coyote	o	o	o	o	o	o
Northwestern Coyote	o	o	o	o	o	✓ o
Northern Timber Wolf	o	o	o	o	✓ –	–
Saskatchewan Timber Wolf	o	o	o	o	✓ –	–
Northern Plains Red Fox	o	o	✓ o	o	o	o
British Columbia Red Fox	o	o	o	o	✓ –	–
American Black Bear	o	o	o	o	✓ –	–
Emperor Grizzly	o	o	o	o	✓ –	–
Hudson Bay Marten	o	o	o	o	✓ –	–
Alaska Marten	o	o	o	o	✓ –	–

Species	Urban S	Urban M	Agric. S	Agric. M	Forest S	Forest M
British Columbia Fisher	o	o	o	o	✓ –	–
Richardson Weasel	o	o	✓ o	o	✓ –	–
Least Weasel	o	o	o	o	✓ –	–
Prairie Long-tailed Weasel	o	o	o	✓ o	o	o
Hudson Bay Mink	o	o	o	o	✓ –	–
American Wolverine	o	o	o	o	✓ –	–
American Badger	o	o	✓ –	–	o	o
Northern Plains Skunk	o	o	o	o	o	o
Mackenzie Otter	o	o	o	o	✓ –	–
Canada Lynx	o	o	o	o	✓ –	–
Manitoba Wapiti	o	o	o	o	✓ –	–
Rocky Mountain Mule Deer	o	o	o	o	+	✓ +
Dakota White-tailed Deer	o	o	o	o	+	✓ +
Northwestern Moose	o	o	o	o	+	✓ +
Western Woodland Caribou	o	o	o	o	✓ –	–

Table 4. Summary of Table 3: Possible impact of single and multiple corridors on mammals in the study area.

(a) Urban and Industrial Fringe

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	60	60
May improve conditions (+)	0	0
May be detrimental (-)	0	0
First choice between the 2 systems (✓) (where a choice could be made)	0	0

(b) Agricultural Zone

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	58	58
May improve conditions (+)	0	0
May be detrimental (-)	2	2
First choice between the 2 systems (✓) (where a choice could be made)	6	2

(c) Forest Zone

	Multi-use single corridor	Multiple corridors
Not likely to affect (o)	23	23
May improve conditions (+)	16	16
May be detrimental (-)	21	21
First choice between the 2 systems (✓) (where a choice could be made)	25	16

Table 5. Indicated Breeding Pairs per Square Mile (refer to Map for Transects). Supplied by Ducks Unlimited (Canada).

TRANSECT	1972	1971	1970	1969	1968	1967	1966	$\bar{x}$
1	66	43	--	46	94	53	76	63.0
2	22	59	--	13	37	41	15	31.1
3	3	4	--	1	10	18	3	6.5
4	7	3	--	20	12	29	22	15.5
5	20	30	--	7	2	9	3	11.8
6	31	33	46	26	24	5	48	30.4
7	7	7	7	4	1	8	9	6.1
8	108	101	107	94	148	124	106	112.6
9	35	43	35	33	33	80	61	45.7
10	25	15	17	24	38	29	16	23.4
11	6	41	35	44	26	45	31	32.6
12	26	31	15	18	26	15	12	20.4
13	59	47	30	16	25	58	42	39.6
14	90	77	71	63	71	107	125	86.3
15	1	6	1	0	3	4	6	3.0
16	29	14	21	8	26	5	23	18.0
17	18	45	4	4	3	5	5	12.0
18	5	10	10	11	7	4	9	8.0
19	36	36	31	31	46	46	39	37.9
20	12	30	24	47	60	22	54	35.6
21	9	23	0	3	3	5	12	7.9
22	25	14	22	20	30	18	25	22.0
23	16	23	15	17	33	15	33	21.7
24	6	11	8	8	3	5	15	8.1
25	23	21	27	29	82	57	28	38.1
26	10	7	9	2	26	16	18	12.6
27	4	3	4	7	0	4	3	3.6
Kinsella Brood Transect								
1	5(1)*	7.2 (1.7)	3.2 (0.8)	9.8 (2.5)	12.0 (4.7)	19.0 (5.5)	-- (-)	--

*( ) Mallard broods

Multi-Use Single Corridor Vs. Multiple Corridors

The multi-use single corridor concept is preferred over the system of multiple corridors in both the forest and agricultural zones. The single corridor in these two zones is given first choice for the large number of waterbirds and the shy, secretive forest-dwelling birds, the waterbirds because of the smaller area of wetlands that would be affected by alteration of natural drainage and the latter because of less destruction of woodland habitat. By comparison, a much smaller percentage of mammalian species would likely be affected by a corridor in the agricultural zone. In the forest zone, however, the multi-use single corridor is preferred for 25 of the 60 species. The majority of these are semi-aquatic and/or extremely wary of human intrusion. The mammals which would benefit from a multiple corridor system in the forest zone favor clearings or the forest edge for feeding. These, such as squirrels, bats and chipmunks, are not particularly shy. Sixteen of the 60 species are included in this category.

Another major factor in favor of the multi-use single corridor is the fact that buffer strips between two single corridors which may be only 200 to 300 feet wide have been known to trap ungulates in drifting snow conditions, whereas, with a single corridor there would be more forested area preserved to help the ungulates survive even the worst conditions.

As for the fisheries potential, a multi-use single corridor is preferred over multiple corridors, but any corridor should avoid following drainage systems, e.g. Christina. River or stream crossings would be picked according to the least amount of damage that could accrue to the fisheries habitat for that river and/or stream. When a particularly bad area cannot be avoided a concentration of time, effort and money to prevent or minimize the anticipated damage is more easily and efficiently accomplished. Spreading the facilities will produce many separate ecological problems converging, overlapping or intensifying in many parts of the rivers and/or streams. Finance may not be available to control each of the separate problems sufficiently, especially from the liability point of view (refer to Volume 6 Chapter 7).

Prepared From Base Map Provided By Survey Branch, Department of Highways & Transport


Alberta
ENVIRONMENT
ATHABASCA TAR SANDS
CORRIDOR STUDY
LANDS SENSITIVE FOR UNGULATES
CLASS I NO SIGNIFICANT LIMITATIONS TO THE PRODUCTION OF UNGULATES
CLASS IW WINTER RANGES WITH NO SIGNIFICANT LIMITATION
CLASS 2W WINTER RANGES WITH VERY SLIGHT LIMITATION
CLASS 3W WINTER RANGES WITH SLIGHT LIMITATIONS
UNGULATE INDICATOR: A____ANTELOPE D____DEER M____MOOSE
C____CARIBOU E____ELK
DATA COMPILED FROM CANADA LAND INVENTORY MAPS
STEWART WEIR STEWART WATSON & HEINRICHS
Scale: 1:500,000
(1" = 8 miles approx.)
No. 12
Prepared From Base Map Provided By Survey Branch, Department of Highways & Transport
PORT McMURRAY
EDMONTON
FOURTH MERIDIAN
FIFTH MERIDIAN

Prepared From Base Map Provided By Survey Branch, Department of Highways & Transport

ATHABASCA TAR SANDS

CORRIDOR STUDY

CHAPTER IV

THE HUMAN SETTLEMENT PATTERN
of the
EXPANDED STUDY AREA

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Watson & Heinrichs

CHAPTER IV

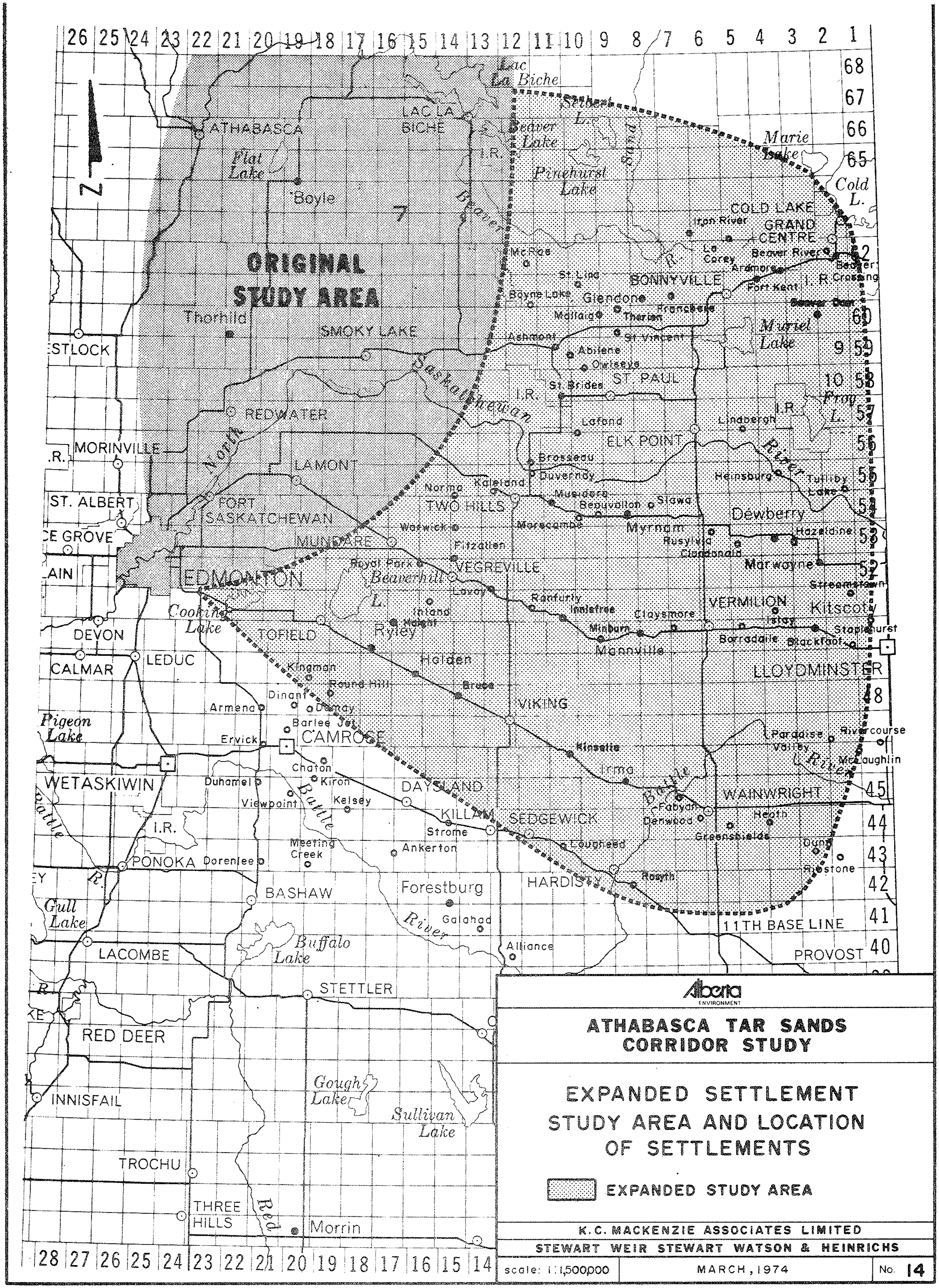
THE HUMAN SETTLEMENT PATTERN OF THE EXPANDED STUDY AREA

I. INTRODUCTION

This Chapter constitutes an expansion of the study area as defined in Volume V - Appendix, entitled "Effect Upon Human Settlement Patterns". The original study area was outlined on Drawing 1 of that report and included five regions for study purposes. The expansion of the original study area which is the subject of this Chapter represents an extension of the region which was designated as the settled agricultural region for study purposes in Volume V - Appendix.

Reference to Figure 14 in this Chapter outlines a portion of the original study area which lies within the settled agricultural region, and also delineates the expanded study area within which the human settlement pattern will be examined for the purposes of identifying potential pipeline corridor location constraints.

The general characteristics of the expanded study area are very similar to those of the settled agricultural region of the original study area. The area is largely agricultural in nature and this pattern of agricultural land use supports a pattern of service communities which vary in size according to the transportation and distribution function performed by by the community. The principal geographic features of the area include the relatively intense pattern of small lakes which occupy a band between Lac La Biche and Cold Lake, and



ORIGINAL STUDY AREA
ATHABASCA
LAC LA BICHE
Boyle
Thorhild
SMOKY LAKE
REDWATER
LAMONT
FORT SASKATCHEWAN
MUNDARE
EDMONTON
VEGREVILLE
TOFIELD
Ryley
Holden
VIKING
CAMROSE
WETASKIWIN
DAYSLAND
KILLAM
SEDGEWICK
HARDISTY
WAINWRIGHT
VERMILION
LLOYDMINSTER
Kitscoty
ST. PAUL
ELK POINT
BONNYVILLE
COLD LAKE
GRAND CENTRE
TWO HILLS
Myrnam
Dewberry
Mannville
Irma
Forestburg
STETTLER
RED DEER
LACOMBE
PONOKA
INNISFAIL
TROCHU
THREE HILLS
Morrin
DEVON
LEDUC
CALMAR
MORINVILLE
ST. ALBERT
BASHAW
PROVOST
11TH BASE LINE
North Saskatchewan
Battle River
Red
Beaver Lake
Pinehurst Lake
Marie Lake
Cold L.
Muriel Lake
Frog L.
Beaverhill L.
Cooking Lake
Pigeon Lake
Gull Lake
Buffalo Lake
Gough Lake
Sullivan Lake
Flat Lake
Alberta ENVIRONMENT
ATHABASCA TAR SANDS CORRIDOR STUDY
EXPANDED SETTLEMENT STUDY AREA AND LOCATION OF SETTLEMENTS
EXPANDED STUDY AREA
K.C. MACKENZIE ASSOCIATES LIMITED
STEWART WEIR STEWART WATSON & HEINRICHS
scale: 1:1,500,000
MARCH, 1974
No. 14

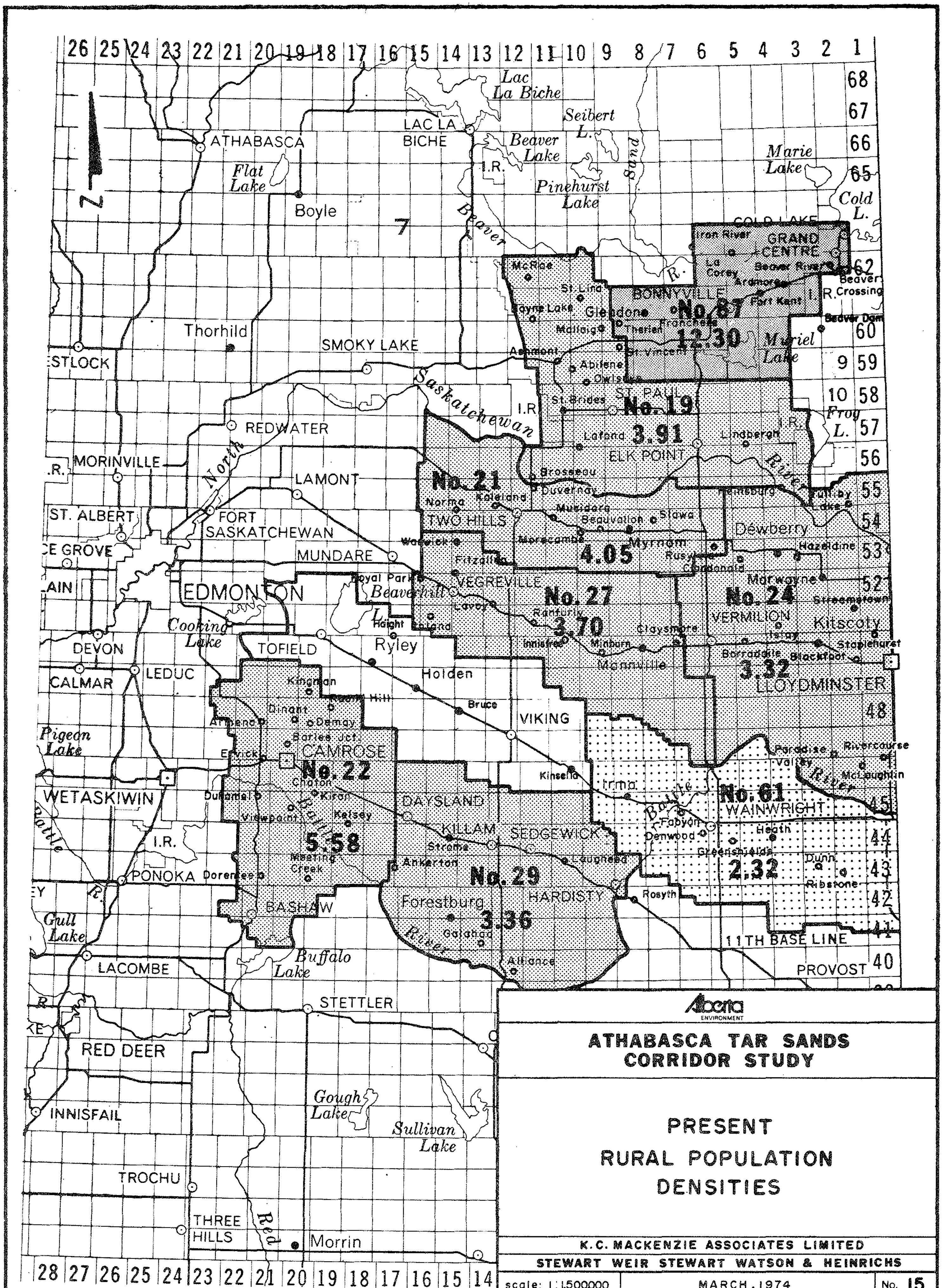
the valley of the North Saskatchewan River which bisects the area from west to east. A secondary geographic feature is the scattering of smaller lakes which characterizes that portion of the area lying north of the North Saskatchewan River and east of Highway 36. Although this pattern of lakes tends to reduce the density of population in the area, it does not significantly affect the agricultural land use pattern.

The basic unit of subdivision and land ownership in the area is the quarter section which is defined by the standard subdivision grid described in Section Three.III.A.2. of Volume 5 - Appendix. The only additional feature of the settlement pattern in the expanded study area is the relatively large number of Indian reservations which occupy, in general terms, that portion of the area which was previously described as featuring a large number of lakes.

The approach adopted within this Chapter to the study of the human settlement pattern includes the separate examination of the rural and urban settlement patterns in Sections II and III, and the Chapter is concluded with Section IV which contains recommendations concerning the human settlement pattern as a possible constraint upon the location of a pipeline and transportation corridor.

II. THE RURAL SETTLEMENT PATTERN

The density of rural population within the expanded study area is illustrated on Figure 15. These population densities


Alberta ENVIRONMENT
ATHABASCA TAR SANDS CORRIDOR STUDY
PRESENT RURAL POPULATION DENSITIES
K.C. MACKENZIE ASSOCIATES LIMITED
STEWART WEIR STEWART WATSON & HEINRICHS
scale: 1:1,500,000
MARCH, 1974
No. 15
No. 87
12.30
No. 19
3.91
No. 21
4.05
No. 27
3.70
No. 24
3.32
No. 22
5.58
No. 29
3.36
No. 61
2.32
7
ATHABASCA
LAC LA BICHE
Boyle
Thorhild
SMOKY LAKE
REDWATER
MORINVILLE
LAMONT
ST. ALBERT
FORT SASKATCHEWAN
MUNDARE
EDMONTON
TOFIELD
Ryley
Holden
VIKING
DEVON
LEDUC
CALMAR
CAMROSE
WETASKIWIN
DAYSLAND
KILLAM
SEDGEWICK
PONOKA
BASHAW
Forestburg
HARDISTY
LACOMBE
STETTLER
RED DEER
INNISFAIL
TROCHU
THREE HILLS
Morrin
GRAND CENTRE
COLD LAKE
BONNYVILLE
ST. PAUL
ELK POINT
TWO HILLS
VEGREVILLE
VERMILION
Kitscoty
LLOYDMINSTER
Mannville
Dewberry
WAINWRIGHT
PROVOST
11TH BASE LINE

are similar to those indicated within the settled agricultural region of the original study area which are illustrated on Drawing 3 of Volume 5 - Appendix.

In order to determine the extent to which the pattern of rural settlement could become a pipeline corridor location constraint future population for the various census subdivisions of the expanded study area were undertaken. Through a process of simple linear extrapolation of the trends which were evident between the census years of 1966 and 1971, population densities were projected for each census subdivision as outlined on Table 6. The accuracy of these population projections is limited to the extent described in Volume 5 - Appendix but the projections do serve to indicate trends in population density.

The trends indicated on Table 6 are similar to the trends which were determined in the settled agricultural region of the original study area. Although it is probable that the rural population densities will level off before they reach the rather low projections for 1990, it may be concluded that rural population density will be significantly lower by that time. This phenomenon, which may be explained by farm consolidation and improvement of farm technology, will tend to reduce the extent to which the rural settlement pattern would constrain the location of a pipeline corridor. Lower population density will result in a lower density of farm buildings which emerge as the principal location constraint for pipelines which traverse agricultural areas.

TABLE 6

PROJECTED RURAL POPULATION DENSITY

IN PERSONS PER SQUARE MILE

Census Subdivision	Rural Population Density Projected to:	
	1980	1990
Wainwright Municipal District #61	1.65	0.91
Flagstaff County #29	2.54	1.62
Two Hills County #21	2.02	*
Camrose County #22	4.79	3.91
Vermillion River County #24	2.04	0.61
Minburn County #27	2.78	1.76
Bonnyville Municipal District #87	12.26	12.22
St. Paul County #19	2.76	1.47

* Projections become negative by 1990

III. THE URBAN SETTLEMENT PATTERN

Urban settlements within the expanded study area are considered in this Chapter in the same manner that settlements were considered in Section III.A.3. of Volume 5 - Appendix. Urban settlements within the area with a population in excess of three hundred are therefore examined from a comprehensive standpoint to determine the extent to which they should be regarded as pipeline corridor location constraints. Although all urban settlements will emerge as pipeline corridor location constraints, growing communities represent a more severe constraint and the following examination of urban settlements is intended to indicate which settlements may be expected to experience growth in the foreseeable future. The result of this examination is recommended urban settlement bypass distances which appear at the conclusion of this Section.

Urban settlments in the expanded study area with a population exceeding three hundred are analyzed statistically on Table 7 . This Urban Settlments Data Matrix is similar in form to that which was utilized to examine urban settlements in the settled agricultural region. The population projections and calculation of potential growth index number were calculated in the manner described on Pages 43 to 45 inclusive of Volume 5 - Appendix.

Urban settlements within the expanded study area are described below in relation to the Data Matrix on Table 7 and the location of these settlements is shown on Figure 15.

TABLE 7

URBAN SETTLEMENTS DATA MATRIX for EXPANDED STUDY AREA

SOURCES: Alberta Bureau of Statistics and Department of Municipal Affairs Department of Social Development

VARIABLE / SETTLEMENT	1971 Population	Potential Growth Index Number	Provincial Planning Branch Projected Population (1981)	Average Annual Growth Rate (1966 - 1971)	Ratio of Births/Deaths 1971	AGE STRUCTURE: 0 - 15 Years	AGE STRUCTURE: Child-bearing Age	AGE STRUCTURE: 45 Years and Up	Retail Sales Trend	% of Labour Force Employed Full-time	NUMBER OF EMPLOYEES IN: Wholesale Storage	Retail Sales	Auto Sales/Service	Personal Services	Health and Welfare	Education	Government	CENTRAL SERVICE TOTAL	Manufacturing	Construction	TOTAL MANUFACTURING/CONSTRUCTION	Service to Business	Finance, Insurance Real Estate	BUSINESS SERVICE TOTAL	TRANSPORTATION, COMMUNICATION, UTILITIES	RESOURCES: Arable Land	Livestock	Mixed Farming	Potential/Productive Forest	Commercial Fishing	Recreation	Coal	Gas	Oil	Minerals	Primary Highway	Railway	Commercial Airfield	Scheduled Airline Stop
Bonnyville	2587	44.8	3323	3.1%	66/24	32%	36%	32%	stable	23.1%	31	73	56	30	81	99	56	426	41	65	106	10	23	33	33	√	√						√			√	√		
Cold Lake	1309	1.5	1381	0.3%	21/13	35%	41%	21%	down	11.8%	4	21	14	24	25	31	13	132	2	–	2	–	9	9	12	√	√			√	√		√			√			
Elk Point	723	1.5	761	-0.1%	9/14	25%	28%	42%	down	25.1%	14	22	9	5	67	32	8	157	2	10	12	1	6	7	7	√	√						√			√	√		
Grand Centre	2088	25.7	3063	4.1%	48/4	34%	46%	16%	up	14.6%	5	68	39	45	1	52	6	216	2	31	33	15	14	29	26	√	√						√			√	√		
Hardisty	594	0.9	585	-0.1%	9/1	30%	34%	32%	up	25.4%	21	14	22	11	23	12	5	108	–	2	2	–	5	5	36	√	√	√								√	√		
Mundare	511	-3.8	414	-1.9%	4/9	21%	25%	54%	down	17.2%	13	11	2	6	17	25	3	77	2	–	2	–	6	6	3	√		√								√	√		
Sedgewick	730	3.5	750	-0.8%	7/6	27%	33%	40%	?	20.0%	9	22	6	12	6	33	21	109	12	5	17	1	8	9	10	√							√			√	√		
St. Paul	4171	51.1	5457	3.5%	85/35	33%	39%	28%	stable	20.1%	69	136	43	61	105	119	148	681	13	45	58	15	57	72	–	√	√						√			√	√		
Tofield	924	4.8	937	-0.6%	12/9	27%	34%	39%	down	18.0%	3	19	10	8	36	30	8	114	–	25	25	–	11	11	16	√	√						√			√	√		
Two Hills	979	5.5	1012	-1.5%	12/9	24%	35%	41%	down	18.0%	12	11	9	9	33	31	22	127	35	1	36	–	11	11	2	√		√					√			√	√		
Vegreville	3691	36.2	4208	0.5%	62/45	26%	34%	40%	up	22.5%	59	114	43	32	155	81	169	653	15	28	43	20	39	59	188	√	√	√					√			√	√		
Vermillion	2915	27.3	3382	1.7%	43/56	28%	37%	34%	stable	20.7%	53	90	43	17	63	146	86	498	20	–	20	12	42	54	33	√	√	√								√	√		
Viking	1178	9.9	1303	0.6%	15/19	23%	33%	45%	down	27.9%	22	42	26	30	59	45	26	250	7	15	22	4	18	22	35	√	√						√			√	√		
Wainwright	3872	39.8	4300	0%	70/31	34%	41%	24%	up	15.1%	34	76	37	31	107	82	48	415	12	55	67	18	37	55	48	√	√						√	√		√	√		
Glendon	354	-6.1	373	0.2%	10/6	28%	38%	42%	down	20.3%	5	8	8	1	14	28	1	65	2	–	2	–	4	4	1	√	√										√		
Holden	448	-3.3	359	-2.2%	6/8	22%	31%	47%	stable	17.2%	13	8	8	6	–	22	4	61	4	–	4	–	8	8	4	√	√									√	√		
Irma	423	-6.4	418	-0.3%	12/8	25%	34%	41%	down	11.1%	7	8	2	–	–	18	2	37	–	–	–	1	7	8	2	√							√			√	√		
Mannville	646	-3.0	632	-1.1%	6/11	24%	29%	45%	stable	12.4%	8	10	4	6	16	20	5	69	3	–	3	1	6	7	1	√	√	√					√			√	√		
Marwayne	351	-1.4	350	0%	1/9	21%	37%	44%	up	16.5%	11	8	2	7	–	16	1	45	–	1	1	–	10	10	2	√		√								√	√		
Myrnam	403	-4.9	340	-2.5%	1/8	15%	26%	53%	stable	15.9%	6	6	7	2	16	20	–	57	–	–	–	–	6	6	1	√		√								√	√		
Ryley	428	-6.0	395	-0.5%	5/5	27%	34%	40%	down	15.4%	3	7	4	2	–	22	4	42	5	–	5	–	5	5	14	√	√									√	√		

a. Bonnyville: This community features a relatively favourable demographic composition by virtue of an even age - sex distribution and, in 1971, a 2 to 1 ratio of births to deaths which indicates a high rate of natural population increase. Industry is highly diversified and an unusually high proportion of the labour force is employed in manufacturing and construction. Bonnyville's 1971 population of 2,587 would appear to provide a solid and healthy nucleus for growth and the community should benefit from the process of rural depopulation and consequent centralization in nearby urban communities. The linear population projection of the Provincial Planning Branch predicts a 1981 population of 3,323, a prediction which is supported by the potential growth index number calculated on Table 7.

b. Cold Lake: This community had a population of 1,309 in 1971 and, in terms of the standard industrial classifications used in the potential growth index number, Cold Lake is a service center with little economic diversification. For its size, the community has a very low potential growth index number and, additionally, it has no rail connection. There are, however, two factors which should provide this community with a degree of economic stability and some hope for future growth. Firstly, the large lake which bears the name of the community provides recreational potential and some commercail fishing which should contribute to the stability of the community's economy. Secondly, the proximity of Shell Canada's project for the development of the nearby oil sands should contribute to the town's continued existence and, if expanded in future, could lead to considerable growth. Until such a major change in the regional economy does occur, however, Cold Lake should remain a relatively stable settlement in terms of population growth.

c. Elk Point: The Provincial Planning Branch projects a slight increase in the population of Elk Point by 1981. The demographic features of the community, however, make such a projection uncertain. Deaths exceeded the births by over 70% in 1971 and a large proportion of the population is over 45 years of age. The trend in retail sales is down and the potential growth index number is low. Although a relatively high percentage of the labour force is employed full-time, there is little indication of economic activity that will contribute to the expansion of the labour force. It is therefore probable that the population of Elk Point will remain stable in the foreseeable future with the possibility of a slight decline.

d. Grand Centre: The linear projection of the Provincial Planning Branch projects an increase of 47% in the population of Grand Centre to 3,063 by 1981. Reference to Table 7 will reveal the justification for this anticipation of growth. Grand Centre has had the second highest growth rate in recent years of the settlements studied. Moreover, births out-numbered deaths 14 to 1 and approximately 45% of the population is of child-bearing age. Based on these demographic characteristics, projections of the population based on natural increase alone could account for one-half of the projected population increase. Additionally, the community possesses a high potential growth index number and its economic base appears to be well diversified. It features high employment in manufacturing and construction and is a relatively well established business center. A significant element in its economic base is its proximity to Canadian Forces Base Medley to which facility the community provides a number of services.

e. Hardisty: Hardisty is atypical of communities in the settled agricultural region by virtue of the fact that it is not primarily an agricultural service center. The basic function of this community is revealed by its particularly high employment in transportation which is explained by the pipeline terminal complex near the community which employs a significant number of the residents of Hardisty. The linear population projection indicates that Hardisty's population should remain very stable at slightly less than 600 in the foreseeable future. It is probable that a major expansion of the community's pipeline terminal service function would cause a significant change in the community's population.

f. Mundare: This community manifests demographic characteristics which reinforce the linear population projection for 1981 which predicts a decline in population of approximately 19%. Deaths outnumbered births in 1971 and 54% of the community's population was over the age of 45. Retail sales have been declining and, since the predominant function of the community is that of a service center, the decline in retail sales is a particularly revealing indicator. Mundare therefore appears to be a typical rural agricultural service center which is experiencing a population decline as a result of the depopulation of its agricultural service area.

g. Sedgewick: Unlike Mundare, Sedgewick appears to have a large enough population to withstand to a significant degree the decline in population which affects smaller agricultural service centers. Its population in 1971 was 730 and this population may be sufficient to provide the community with the economic momentum to maintain population stability. The lineal projection of the Provincial Planning Branch suggests relative population stability and this is supported by the potential growth index number, the community's demographic composition, and the recent annual average growth rate which is only slightly negative.

h. St. Paul: This community features the second highest projected population increase by 1981 of the communities studied. The potential growth index number is the highest of all the settlements studied although, it should be noted, this index tends to be biased upward if a community possesses a 1971 population in excess of 4,000. However, births exceeded deaths in 1971 by almost 150% and the community appears to be demographically very healthy. The only factor which suggests a possible leveling-off of growth is the retail sales trend which is stable. In view of this fact, and the consistent downward trend in rural populations which serve agricultural regions, it is possible that the linear population projection which suggests a 1981 population of 5,500 may be slightly optimistic, although a substantial population growth is probable.

i. Tofield: The demographic composition of this community, combined with recent growth trends, the linear propulation projection for 1981 and the potential growth index number all indicate future population stability for Tofield. Although the trend in retail sales is down this negative factor becomes less important when considered within the context of Tofield's highly diversified economic base which is characterized by relatively high employment in manufacturing and construction. The population of this community should therefore remain stable in the foreseeable future.

j. Two Hills: This community possesses a reasonably diversified economic base with high employment in manufacturing and construction. The population of Two Hills in 1971 was 979 which, when considered in conjunction with a 4 to 3 ratio of births to deaths, should possess the momentum to maintain stability. The linear projection indicates a modest increase in population by 1981 but the proportion of population over 45, and a declining trend in retail sales, suggests that it would be more reasonable to anticipate population stability for Two Hills rather than a modest increase in population. The potential growth index number reinforces the probability of the population of Two Hills remaining relatively stable.

k. Vegreville: This community had a 1971 population of 3,691 and a relatively healthy economic base which manifested upward trends. The linear population projection suggests a 1981 population of 4,200. Vegreville, however, possesses a significant proportion of population over the age of 45 and this would suggest that a slightly more modest increase in population by 1981 should be anticipated.

l. Vermillion: This community has a relatively large population which, in itself, would suggest relative stability in the foreseeable future. It features a high proportion of employment in education which may be attributed to the Vermillion school of agriculture, and it also features a significant amount of employment in business and finance. The linear projection of the Provincial Planning Branch predicts moderate growth to 1981 although the recent growth trend in Vermillion and its relatively high potential growth index number suggests that the predicted 1981 population could possibly be exceeded.

m. Viking: The population of this community is projected by the linear approach to reach 1,303 by 1981, a modest increase over the 1971 population of 1,078. The economic base of Viking is well diversified and employment is high. The recent growth rate of the community has, however, been rather modest. Demographically, deaths exceeded births in 1971 and approximately 45% of the population was over the age of 45. Although the community does not function exclusively as a service center, it is noteworthy that its retail sales trend is downward. The potential growth index number suggests that Viking will remain stable and possibly experience a modest increase in population, a conclusion which is supported by the linear population projection.

n. Wainwright: Although the Provincial Planning Branch's linear projection for 1981 suggests an 11% increase in population, and the recent growth rate suggests only moderate growth, all other factors indicate a relatively high growth potential for Wainwright. The demographic composition of the community indicates a high potential rate of natural increase by virtue of the fact that over 40% of the 1971 population was of child-bearing age. The trend in retail sales is upward and the economic base appears to be strong and well-diversified. The potential growth index number indicates a high growth potential although this may be biased to some extent by the relatively high 1971 population of the community. A significant element in the town's economic base is its proximity to the nearby Canadian Forces Base to which facility the town provides a number of economic services. It is probable, therefore, that the projected population of 4,300 will be easily reached by 1981 and it is possible that this population could be substantially exceeded.

o. Glendon: This community possesses a positive recent growth rate, a 1971 births to deaths ratio of 5 to 4,

and a population increase by 1981 of 5.4% according to the linear projection of the Provincial Planning Branch. Despite these positive indications, Glendon is a relatively small service center with a high proportion of its population over the age of 45. Its retail sales trend is downward and its employment rate is high, which suggests that the unemployed may be leaving the community. It is also significant that Glendon is not located on a primary highway.
Its potential growth index number is, for the size of the community, the lowest of those in the expanded study area and it is probable that the prediction of moderate growth by 1981 may be somewhat optimistic. It would be more realistic to expect the population to remain stable, with the possibility of a modest decline in the foreseeable future.

p. Other Settlements: A number of smaller communities which vary in population from approximately 350 to 650 may be considered as a group. Holden, Irma, Mannville, Marwayne, Myrnam, and Ryley may all be characterized as modestly sized agricultural service centers which feature very little diversification of economic base and consistently high proportions of population over child-bearing age. Although the linear population projections for 1981 and the potential growth index numbers vary among these communities, they may all be characterized as communities which will probably decline in population in the foreseeable future. Marwayne might be regarded as a possible exception by virtue of relatively stable population trends recently, although its 1971 demographic characteristics tend to indicate a delcine similar to other agricultural service centers with slightly smaller populations. It is therefore suggested that these communities will not experience any population growth in the foreseeable future.

The foregoing descriptions of the various settlements within the expanded study area indicate that most urban settlements will remain relatively stable or decline in terms of population. Some settlements, however, are expected to grow and will therefore emerge as more significant pipeline corridor constraints than those for which no growth may be foreseen.

The extent to which urban communities in an agricultural area should be regarded as pipeline corridor constraints is discussed on Pages 55 and 56 of Volume 5 - Appendix. Based upon the criteria outlined on those pages, urban settlement bypass distances are recommended on Table 8 of this Chapter in respect of urban settlements within the expanded study area of the settled agricultural region. These bypass distances are recommended on the basis of avoiding disruption to existing communities that might accrue to corridor construction and operation and, in the cases of communities which have some prospect of growth, the avoidance of a conflict between a community's pattern of growth and the corridor function. These corridor bypass distances, when applied as geographic extensions of the existing communities, result in the pattern of pipeline corridor location constraints outlined on

TABLE 8

URBAN SETTLEMENT BYPASS DISTANCES

Radius ½ Mile	Radius 1 Mile	Radius 1½ Miles
Beauvallon	Ardmore	Bonnyville
Beaver Crossing	Ashmont	Cold Lake
Beaver Dam	Bruce	Elk Point
Vorradaile	Clandonald	Grand Centre
Brosseau	Fort Kent	Hardisty
Claysmore	Heinsberg	Sedgewick
Duvernay	Mallaig	St. Paul
Fabyan	Ranfurly	Tofield
Greenshields	Mundare	Two Hills
Haight	Holden	Vegreville
Hazeldine	Irma	Vermillion
Iron River	Myrnam	Viking
Islay	Glendon	Wainwright
Kinsella	Marwayne	Mannville
La Corey	Ryley	
Lindberg	Lougheed	
Morecambe	Innisfree	
Musidora	Minburn	
Owlseye		
Rosyth		
Royal Park		
St. Lina		
Therien		
Warwick		
Kitscoty		
Dewberry		
Forestburg		

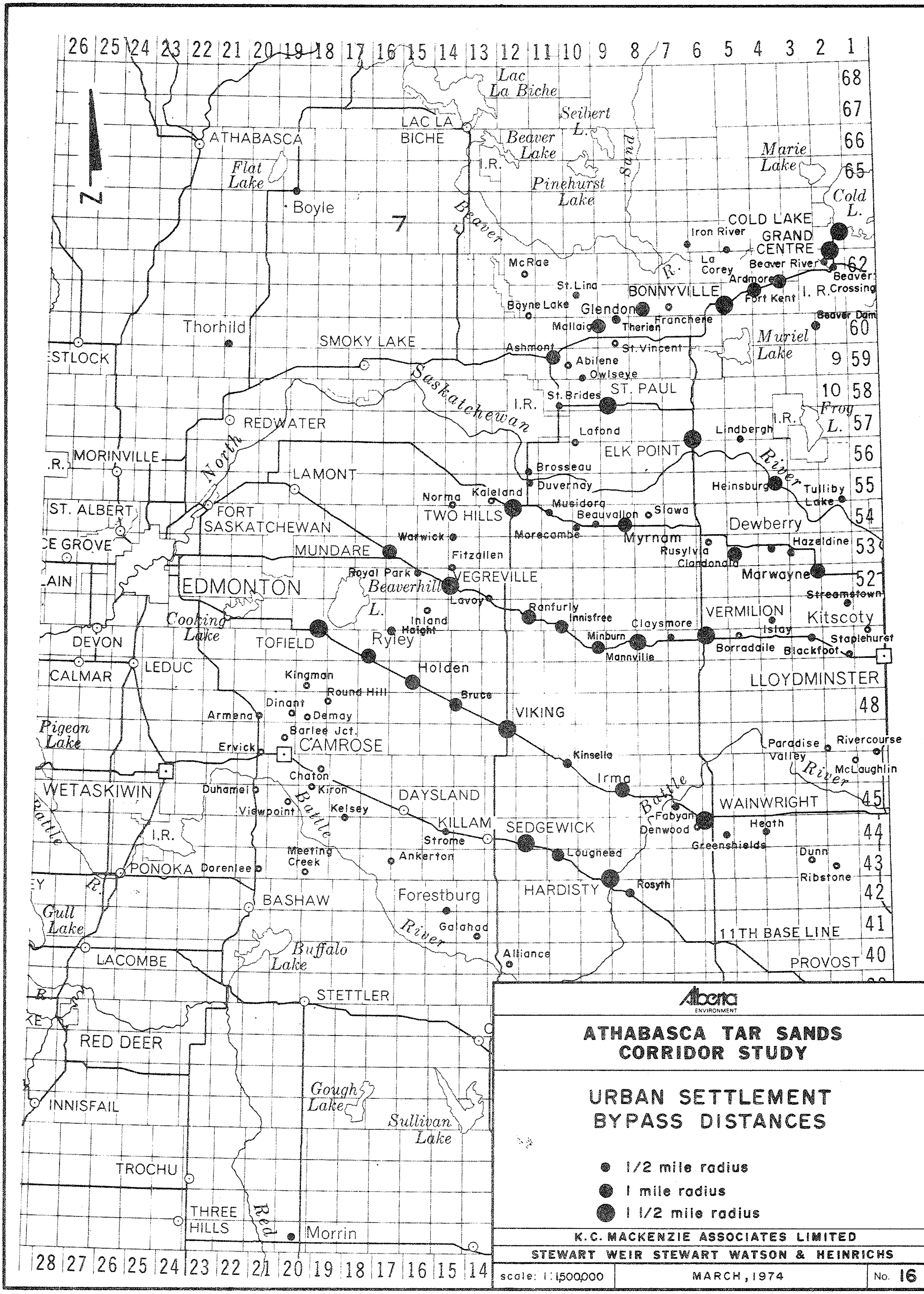
Figures 16 and 17 of this chapter.

IV. RECOMMENDATIONS

1. In this region, the generalized pipeline corridor route or route alternatives should be selected on the basis of avoiding all existing urban settlements and their suggested bypass areas.

2. In rural areas, pipeline corridor locations adjacent to, or straddling, quarter section lines should be considered in order to minimize dislocation and acquisition cost, and to preserve efficient units of cultivation.

3. In instances where the pipeline corridor passes near an existing urban settlement potential multiple uses of the right of way for transportation and green belt purposes should be examined.



Alberta ENVIRONMENT

ATHABASCA TAR SANDS CORRIDOR STUDY

URBAN SETTLEMENT BYPASS DISTANCES

- 1/2 mile radius
- 1 mile radius
- 1 1/2 mile radius

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scale: 1:1,500,000	MARCH, 1974	No. 16

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