INTRODUCTION

HISTORICAL SUMMARY

By the 1850's Canada was becoming interested in colonizing the Western Prairies. In 1857 Great Britain sent Captain John Palliser with a company of scientists to investigate the agricultural potential of the region. Seeing the area during a drought cycle, Palliser reported that a large area was so lacking in wood and water and with such poor soil that it was unsuitable for cropping. This area (Figure 15) became known as the "Palliser Triangle".

When the early Mormon settlers came into Southern Alberta from Utah, where they had grown up on an irrigation economy, one of the first things they did was to divert water from the smaller streams and use this for irrigation purposes. As the success of their operation was observed it became apparent that irrigation could very well be the answer to the water shortage in the Palliser Triangle. This began the era of colonization and irrigation development in Alberta.

The Canadian Pacific Railway Company had completed its Trans Canada railway line, and was looking for ways of increasing its freight hauling to increase its income in order to help pay for the rail lines. The Railway Companies and the Canadian Government considered the problem and it was subsequently agreed that Canada would turn over to the Railway Companies, large blocks of land in the Western Prairies that could be developed with irrigation, on the condition that the Companies would build the irrigation works and then could sell the land to settlers in order to pay for the construction costs. The increased agricultural production would then provide the additional freight needed by the Railway Companies to make better use of their railway facilities. By this arrangement, three large areas of Southern Alberta were developed into irrigation systems. These were:

1. the Lethbridge - Coaldale area which was constructed by the Alberta Railway and Irrigation Company (A.R. & I). This was

later taken over by the C.P.R. and became part of the St. Mary project.

2. the Western Block of the C.P.R. development east of Calgary, in the area of Strathmore, and

3. the Eastern Block of the C.P.R. development in the area of Brooks.

At the same time that these three areas were being developed by the railway companies, enterprising financiers in England were convinced that irrigation development on the prairies would be a good investment. They organized the Canada Land and Irrigation Company (C.L. & I), and through an agreement with Canada, obtained a large block of land in the Vauxhall area and proceeded with the development of an irrigation project.

All four of these ventures suffered great financial problems and never did complete the full potential of their development. This phase of development has been referred to in the Hanson report (1958), (21) as the "Commercial (or Company) phase" of irrigation development in Alberta.

In 1915, the Alberta Government enacted the Irrigation Districts Act, which set the stage for the next basic period of development. This Act provided that a group of farmers could organize into an Irrigation District, and then by floating a bond issue, the said District could raise capital to finance the construction of the irrigation works. Under this legislation, the following Irrigation Districts were established and developed:

The Taber Irrigation District (1919)
The Lethbridge Northern Irrigation District (1919)
The Raymond Irrigation District (1925)
The Magrath Irrigation District (1926)
The United Irrigation District (1921)
The Mountain View Irrigation District (1921)
The Leavitt Irrigation District (1936)

In the mid 1930's the C.P.R. started a program to withdraw from irrigation. In 1935, the Eastern Block of the C.P.R. was transferred to the farmers of the area, and the Eastern Irrigation District was organized with headquarters at Brooks, Alberta. Subsequent to this, in 1944, the Western Block was transferred to the farmers and the Western Irrigation District was organized with headquarters at Strathmore, Alberta.

During the early 1930's the Lethbridge Northern Irrigation District encountered extreme financial difficulties and was on the verge of going bankrupt. The Alberta Government became involved and discharged the Board of Directors and established an Official Trustee to run the District. It also set up a committee to investigate the affairs of the District; this committee became known as the Ewing Commission. As a result of the findings of this commission, the Alberta Government took over the bonds of the District, and eventually these were written off by the Government. At the same time as this problem, the United Irrigation District was also having financial problems. The Alberta Government took over the bonds of that District, established an Official Trustee to run the District, and eventually wrote off the bonded indebtedness.

The above two actions by the Alberta Government were the forerunner for the third phase of irrigation development, namely the "Government phase".

In anticipation of a large number of war veterans returning to Canada following World War II, and to provide some sort of protection of its share of the international waters of the St. Mary River, Belly River and Waterton River, Canada set up a committee to study and make recommendations on further irrigation development of the St. Mary River system. This report, known as the Meek report was published in 1942 and basically recommended that Canada (at her expense) construct the major river diversions and principal storage reservoirs, which was done between 1945 and 1967, and that Alberta construct the distribution systems of the irrigation works. The report also recommended that because of the high construction costs and the wide spread benefits from irrigation, that only a token water right payment of $10.00 per acre be charged to the irrigation farmer.

In order to allow this Government development to proceed, it was necessary for the Government to take over the old C.P.R. works. This was done by an agreement between Alberta and the C.P.R., and a Crown Corporation known as the St. Mary and Milk River's Development was established by statute in 1946 (S.M.R.D. Act 1946). An agreement between Canada and Alberta was signed in 1950 and construction of the irrigation main canals, reservoirs, and distribution system was carried out over the next 10 years.

In 1950, Canada purchased outright the works and assets of the Canada Land and Irrigation Company, and proceeded to rehabilitate the main works of that project and to expand the distribution system into the Hays area. In 1953, an agreement was signed between Canada and Alberta, to provide for the expansion of the Bow River Project into the area around Enchant, Travers and Lomond, and in 1955 the Bow River Development Act was passed by Alberta, setting up a Crown Corporation to operate and maintain the works constructed by Alberta.

During the early years of operation of the two Crown Corporations (S.M.R.D. and B.R.D.) it was observed that seepage from the canals and resulting waterlogging and alkali damage was occurring along many miles of the canal systems. The managements of these Corporations persuaded the Alberta Government that it should carry out remedial measures to correct the seepage problems and provide some drainage facilities and in 1958 the Government established the Seepage and Drainage Committee to study and direct this operation.

About this same period of time, the older Irrigation Districts were observing that the structures on their own systems were reaching the limit of their life expectancy and that extensive reconstruction of their works was going to be required in order to continue their operations. Representation was made to both the Provincial and Federal Governments for financial assistance on this work. Some early assistance was given to the Eastern Irrigation District and Taber Irrigation District without a clear cut policy being established, in that the Provincial and Federal Governments and the Eastern Irrigation District shared in the cost of replacing the Antelope Creek Syphon, and the Provincial Government and the Taber Irrigation District shared the cost of replacing the Barnwell Flume. In 1963, the Honorable H.E. Strom, Alberta's Minister of Agriculture, instigated a series of studies, under the Agricultural Rehabilitation and Development Act (ARDA), of the Irrigations Districts, in order to determine the extent of the need of rehabilitation of the Districts, and to determine the benefits accruing to the various segments of the country, in order to have some foundation for determining and justifying a cost sharing policy on rehabilitation of Irrigation Districts, and also to establish a policy for future expansion of irrigation in Alberta.

The summary results of these studies are outlined in Volume VII of the ARDA Irrigation Studies along with recommendations for cost sharing of the rehabilitation of the irrigation works of the Districts, and recommendations on a new Irrigation Act for administration of the Irrigation Districts, so that they would all be operating under the same legislation and be governed by the same type of administration. Probably the most significant conclusion from these ARDA Studies, is that the overall benefits of irrigation accruing to the various segments of the country are as follows:

(a) Canada - 35%
(b) Alberta - 32%
(c) Local Municipalities (urban and rural) - 22%
(d) Local Farmer - 11%

LEGAL ORGANIZATION

In 1931, the title or ownership of all natural resources within the Province of Alberta was transferred from the Government of Canada to the Government of Alberta. Prior to this date, the granting and administering of surface water rights was a function of the Government of Canada with administrative procedure being defined in its Irrigation Act. Since 1931, the administrative procedure on surface water rights is outlined in the Alberta Water Resources Act (29).

In 1915, the Government of Alberta enacted the Irrigation Districts Act, to provide for the orderly organization of irrigation areas into operating Irrigation Districts and to provide a uniform method of controlling irrigation development in Alberta. The irrigation development prior to 1915 was done mostly by priviate enterprize under the legislation of Canada's Irrigation Act. Under the legislation of the Irrigation Districts Act (1915) many areas of Alberta were developed and organized into Irrigation Districts; in some cases, because of specific unique problems, special acts of legislation were enacted to cover these problems. By the time the Governments of Alberta and Canada embarked on the Agricultural Rehabilitation and Development Act (A.R.D.A.) studies in 1963, the following acts were in existence covering the legislative administration of irrigation in Alberta:

1. Irrigation Districts Act
2. Eastern Irrigation District Act
3. Western Irrigation District Act
4. United Irrigation District Act
5. Lethbridge Northern Irrigation Colonization Act
6. St. Mary and Milk Rivers Development Act
7. Bow River Development Act

Following the completion of the A.R.D.A. studies in 1967, the Alberta Government formulated and enacted "The Irrigation Act 1968" which legislated the two Crown Corporations into Irrigation Districts, established Boards of Directors for the two Districts which were being administeredby Official Trustees, and superseded all of the seven acts referred to above. This "Irrigation Act 1968" established a uniform system of administration of all of the organized irrigation areas in Alberta, except the Bow River Project which is owned and operated by the Government of Canada. It set the framework whereby the Irrigation Districts could enter into cost-sharing agreements for the rehabilitation of their works.

IMPORTANCE OF IRRIGATION TO THE ECOMONY OF ALBERTA

As stated in the previous section, the area in Southern Alberta, referred to as the "Palliser Triangle," is on the borderline of being a desert. The average annual precipitation varies from about 10" in the Medicine Hat area to about 15" in the Lethbridge area. Average water requirements for optimum crop production run from 18" on up to 24" or even as much as 30" for some crops. About half of the total precipitation in the area falls in the form of snow in the winter months and for the most part is lost through runoff and hence is of no value to the crop production. This then leaves quite a water deficit for good crop production of from 10" to 24" and the most feasible way of providing this deficit is through irrigation of the growing crops.

The value of the irrigation to the economy of the area is demonstrated by the table on the following page, which information is taken from Volume IV of the ARDA Studies. (4)

It is noted here that although this increase in gross value of crops in the irrigation areas, gives added stability to the local area, the conclusion of the ARDA Studies was that the total benefits from the existence of the irrigation in this area accrues to the Province and the country as a whole to the extent of approximately 1/3 benefit to Canada, 1/3 benefit to Alberta and 1/3 benefit to the local farmer and municipality.

It is also noted that a statistic often quoted in economic circles is that as a result of irrigation in the southern part of Alberta, 20% of the gross agricultural production of Alberta comes from the four percent of the agricultural area of the Province under irrigation.

Figure 1

Comparison of Values of Crop Production per Cultivated Acres and Value of Total Operated; Irrigated Use Versus Assumed Dryland Use of Irrigated Land 1963 (Volume IV - ARDA Studies - 1966)

Irrigation District	Cultivated			Total Operated		
	$ Irrigated	Assumed Dryland Use	Ratio	$ Irrigated	Assumed Dryland Use	Ratio
MOUNTAIN VIEW	25.12	14.85	1.7	25.12	14.85	1.7
LEAVITT	46.38	16.44	2.8	40.89	15.38	2.7
AETNA	40.06	27.40	1.5	38.80	26.51	1.5
UNITED	38.74	23.10	1.7	38.61	23.10	1.7
MAGRATH	37.51	19.26	1.9	37.51	19.26	1.9
RAYMOND	76.64	12.65	6.1	75.10	12.39	6.1
LETHBRIDGE NORTHERN	72.56	16.33	4.4	71.63	12.71	5.6
TABER	109.53	8.68	12.6	106.48	6.18	17.2
ST. MARY RIVER	62.84	11.98	5.3	61.82	10.38	6.0
ROSS CREEK	53.53	8.41	6.3	53.53	2.50	22.4
BOW RIVER	27.86	5.14	5.4	27.56	5.12	5.4
BOW RIVER (Federal)	46.61	16.86	2.8	46.40	12.77	3.6
WESTERN	38.75	18.00	2.2	36.63	14.28	2.6
EASTERN	41.62	9.36	4.4	41.28	1.54	26.9

GENERAL

INTRODUCTION

This general section has been prepared to assist the readers of the report in interpreting the terms, definitions and graphs of the detailed sections.

This section presents tables and figures which are summaries of information presented throughout the report. Figures and graphs of the reservoirs are placed in the general section as there is no specific sub-section in which they would properly fall.

CLIMATOLOGY

Corn as a Heat Unit Indicator

Corn was selected as a "Heat Unit" indicator since it is a "climate sensitive" crop. Now only does the length of growing season and temperature have profound effects on production, but also wind and its occurrence seems to play an important regulating role. Areas of high wind mileage do not produce crops of corn comparable with areas of lower wind mileage and similar growing season and temperatures. Thus, as an irrigated crop, corn is a good climatic indicator, since where corn produces well, it can be assumed that there will be little or no climatic problems in the growing of other specialty crops under irrigation.

HEAT UNITS

"Heat Units" are arbitrary values based on relationships between corn development and temperature. They are calculated on the basis of temperatures above 50 degrees F. in daytime and 40 degrees F. at night. The daytime temperatures are modified, as 86 degrees F. is considered optimum for corn development. The sum of heat units "between a derived planting date and the autumn date when killing frost can be expected one year in ten" is used to provide a heat unit rating for locations in Southern Alberta.

Locations having similar heat unit ratings are joined by lines on the map. Thus lines and numbers on this map outline the heat units available for growing and maturing corn in Southern Alberta. Grain corn can be grown in those areas having a rating of more than 2300-2400 heat units. Only silage corn may be safely grown in areas having less than 2200-2300 heat units.

Figure 2

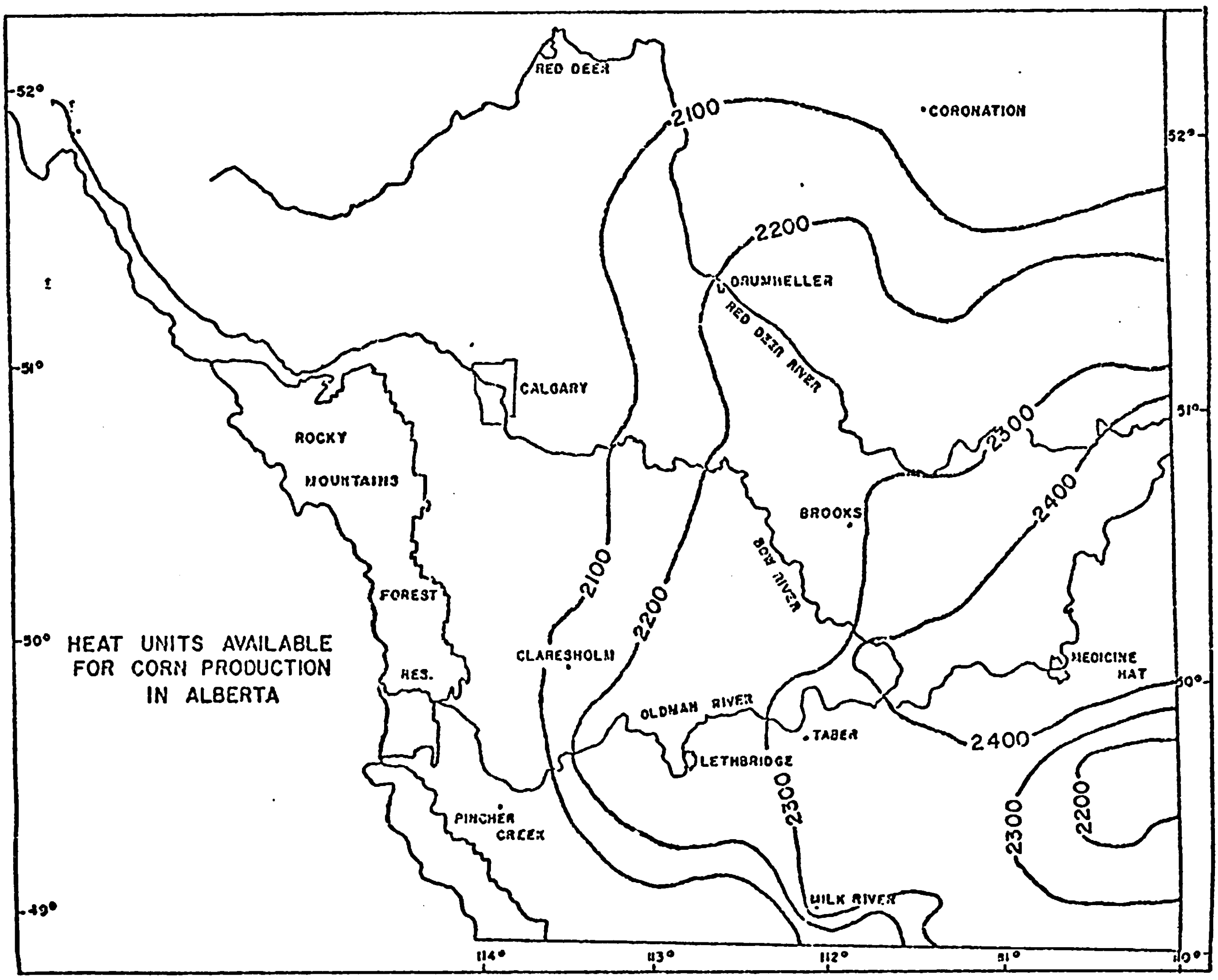


Figure 3

PRECIPITATION TOTALS AND TEMPERATURE MEANS FOR MAY TO SEPTEMBER

District	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Mountain View	5.27	15.33	11.50	15.22	19.24	18.93	13.77	8.63	19.09	13.17	12.24
		56.9	54.4	56.5	52.9	52.2	56.0	57.1	53.2	55.2	57.7
Leavitt	5.71	10.26	7.72	12.68	14.91	16.54	14.24	6.72	15.37	10.46	8.71
		58.6	56.3	58.2	55.1	53.8	57.9	58.8	55.0	56.9	58.7
Aetna	5.71	10.26	7.72	12.68	14.91	16.54	14.24	6.72	15.37	10.46	8.71
		58.6	56.3	58.2	55.1	53.8	57.9	58.8	55.0	56.9	58.7
United	4.85	14.10	10.58	14.00	17.70	17.42	12.67	7.94	17.56	12.11	11.26
		58.6	56.0	58.2	54.5	53.8	57.7	58.8	54.8	56.9	59.4
Magrath	7.10	11.37	7.29	10.49	11.75	16.76	15.77	5.77	12.72	8.72	8.75
	58.4	59.3	57.3	59.0	56.1	54.9	57.7	59.0	55.5	57.8	59.4
Raymond	6.70	10.73	6.88	9.90	11.09	15.81	14.88	5.44	12.00	8.23	8.26
	59.3	60.2	58.2	59.9	57.0	55.7	58.6	59.9	56.3	58.7	60.3
Lethbridge Northern	6.03	9.74	7.16	11.91	9.56	15.57	14.63	6.70	11.79	8.97	7.09
	60.5	61.3	59.4	61.0	58.0	56.7	59.3	60.4	57.1	59.5	61.4

Figure 3 (cont'd.)

PRECIPITATION TOTALS AND TEMPERATURE MEANS FOR MAY TO SEPTEMBER

District	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Taber	5.89	6.29	7.51	11.12	7.92	12.22	12.08	5.64	9.80	5.82	7.66
	60.5	61.3	59.7	61.1	58.5	55.0	59.7	61.0	57.5	60.4	62.0
St. Mary River East	5.69	5.52	7.19	10.69	7.33	11.99	10.93	4.43	9.58	5.26	8.40
	61.3	62.4	60.4	62.0	59.5	56.8	60.2	61.7	58.4	61.2	62.3
St. Mary River West	6.03	9.74	7.16	11.91	9.56	15.57	14.63	6.70	11.79	8.97	7.09
	60.5	61.3	59.4	61.0	58.0	56.7	59.3	60.4	57.1	59.5	61.4
Ross Creek	5.48	4.74	6.86	10.25	6.73	11.76	9.77	3.22	9.36	4.70	9.14
	62.1	63.5	61.2	62.9	60.4	58.6	61.6	62.4	59.3	62.0	62.5
Bow River	4.99	5.65	7.68	9.86	6.61	12.38	10.92	5.14	11.22	6.53	7.81
	59.2	60.4	58.3	59.8	57.5	55.6	58.1	59.0	55.1	58.4	59.5
Bow River (Federal)	4.99	5.65	7.68	9.86	6.61	12.38	10.92	5.14	11.22	6.53	7.81
	60.1	61.3	59.2	60.7	58.4	56.4	59.0	59.9	55.9	59.3	60.4
Western	7.46	7.77	9.06	11.38	10.43	16.91	11.65	5.19	12.62	10.41	9.48
	57.4	58.7	56.6	58.7	55.8	54.3	56.2	57.7	54.5	56.2	
Eastern	5.05	2.74	7.20	11.07	9.43	12.37	11.38	4.52	10.62	4.25	9.80
	59.7	60.6	58.6	60.3	57.7	57.0	59.1	60.0	56.8	59.7	60.2

Figure 3a

SUMMARY - CLIMATIC DATA
FOR
IRRIGATION DISTRICTS

Irrigation District	Elevation Above Sea Level	Mean Growing Season Temperature (May-September)	Mean Growing Season Precipitation (May-September)	Prevailing Winds (May-September) miles/month	Killing Frost-Free Period (days above 28°F)	Heat Units (Corn)	Moisture Requirements For Pasture	Crop Production Capability
Mountain View	4100 - 4400	55.3°F	12.4"	S.W. 7000	132	2000	20.14"	Hay and grain
Leavitt	3700 - 4300	56.5°F	11.0"	S.W. 8000	135	2100	21.0"	Hay and grain
Aetna	3700 - 4300	56.5°F	11.0"	S.W. 8000	135	2100	21.0"	Hay and grain
United	3300 - 4000	57.0°F	11.4"	S.W. 8000	135	2000	20.0"	Hay and grain
Magrath	3200 - 3550	58.5°F	9.3"	S.W. 8000	142	2200+	23.0"	Specialty crops reduced yields
Raymond	3100 - 3150	59.4°F	8.8"	S.W. 8000	145	2200+	23.5"	Specialty crops reduced yields
Lethbridge Northern	2750 - 3200	59.2°F	9.5"	W. 8000	145	2200	23.5"	Hay and grain in west part and including specialty crops in east
Taber	2500 - 2750	59.8°F	9.0"	W. 5000	148	2300+	24.5"	Hay, grain and most specialty crops
St. Mary - East	2200 - 2800	60.8°F	8.6"	S.W. 7300	149	2400	25.0"	Most specialty crops
St. Mary - West	2750 - 3050	59.1°F	9.3"	W. 8000	149	2200+	23.0"	Most specialty crops

SUMMARY - CLIMATIC DATA
FOR
IRRIGATION DISTRICTS

3a (continued)

Irrigation District	Elevation Above Sea Level	Mean Growing Season Temperature (May-September)	Mean Growing Season Precipitation (May-September)	Prevailing Winds (May-September) miles/month	Killing Frost-Free Period (days above 28°F)	Heat Units (Corn)	Moisture Requirements For Pasture	Crop Production Capability
Ross Creek	2450 - 2500	61.6°F	8.1"	S.W. 7000	148	2400	26.0"	Most specialty crops
Bow River	2600 - 2750	58.3°F	8.6"	W-NW 5000	135	2200	23.0"	Hay and grain
Bow River (Federal)	2500 - 2600	59.2°F	8.5"	W. 4600	135	2300	24.0"	Hay, grain and specialty crops
Western	2700 - 3400	56.5°F	10.4"	N-NW 7600	137	2000+	19.5"	Hay, grain and some specialty crops in east area
Eastern	2400 - 2600	59.0°F	8.8"	N.W. 6650	143	2300	23.0"	Hay, grain and some specialty crops in S.E.

NOTE: Hay Crops include sweet clover, alfalfa, Timothy, Brome and Sanfoin.
Grain Crops include wheat, oats, rye and barley.
Specialty Crops include sugar beets, silage corn, flax, rape, sunflower, safflower, mustard, soybeans, potatoes, peas, corn, beans, carrots and small amounts of market garden produce.

DRAINAGE

Drainage, in the broadest sense, is the removal of superfluous water from the soil surface and sub-surface by the force of gravity. Consequently drainage patterns develop to greater or lesser degrees depending on land slope, soil types, local amounts of excess water to be drained and in some cases underlying bedrock. Drainage waters from the organized irrigated areas flow into the South Saskatchewan River system, with three notable exceptions. These are: (1) the Pakowki Lake - Etzikom Coulee internal drainage basin. Drainage and spill water from approximately 15,000 irrigable acres of the Raymond Irrigation District flow into this system; (2) the Forty Mile Coulee internal drainage basin, comprised of about 20,000 irrigable acres within the eastern division of the S.M.R.I.D.; and (3) the Lost Lake Basin which collects all the spill water from the B.R.I.D.

With respect to irrigation agriculture, Maierhofer's definition is appropriate (20): "Drainage is the removal of excess water and saline from agriculture soils". This leads to the consideration of control of surface waste water, and also the need to consider the control of groundwater levels and provide for necessary outlet drainage facilities.

Factors or variables affecting the need for drainage include climate, soils, topography, geology, groundwater, cropping patterns, irrigation practices, and management: these will be dealt with below in general terms. Specifics will be discussed for each irrigation district where applicable.

Climate affects, to a large extent, the amount of water required for crop irrigation. Climatic extremes or weather variations result in either above or below normal precipitation during the growing season. Consequently the amount of water to be applied artificially can vary greatly. The end result is that need for artificial drainage also shows variation extremes both locally and across the total area under consideration. Several important climatic and weather variables affecting need for drainage are: precipitation intensity, precipitation in relation to when a field has been irrigated, and Chinook and general wind evaporative effect on salt movement. Implications with respect to length of growing season are that with a shorter season, less irrigation water will be applied, resulting in fewer drainage problems. The converse statement can also be made. This may be seen in the field, but is generally masked by other variables.

Several soil performance characteristics have a direct bearing on the need for surface and sub-surface drainage. These include intake rate, hydraulic conductivity, moisture characteristic curve and water holding capacity. Each of these characteristics is interrelated with the other so that given certain basic facts about the physical and chemical composition of a soil profile, definite predictions can be made on drainage requirements for irrigated fields. Similarly, where laterals and canals are constructed from a specified soil, need for groundwater and seepage control can be forecast. It is a well established fact that there is no such thing as a uniformly deposited soil, dealing both with the surface form and with sub-surface layering. For this reason, a detailed investigation of pertinent soil characteristics is essential, when solving a drainage problem. For example, when working with soils of the coarse-textured Cavendish association or similar soils, it is expected that water table control will be important as these soils have a relatively high hydraulic conductivity and a low storage capacity.

The need for surface drainage is directly related to topography.

Generally, where local relief is high, drainage patterns are well developed and need for drain construction is minimal. Conversely with low local relief a drainage pattern is either poorly developed or lacks definition. In either case drainage costs are high. Closed basins exist within some districts ranging in size from a few to several thousand acres. These create a unique need for drainage; solution of this type of problem is either by construction of ditch outlets, or by use of pumps.

Geology and groundwater are related inherent characteristics which pose a special problem to the drainage worker. Near surface bedrock exposures generally create serious seepage problems; groundwater recharge from either natural sources or canals and laterals, or both, discharges at the surface of lower lands accessible to the hydraulic gradient of the aquifer.

High water tables result from any of the following or may be caused by a combination of these factors:-

(1) seepage from canals, laterals and reservoirs;

(2) over-irrigation;

(3) soil type;

(4) groundwater discharge from higher land; and

(5) mis-management of water, either in the distribution system or on the farm.

The general cropping pattern of an area or irrigation district can have a marked effect on need for drainage, or in the case of canal seepage, alternatives to drainage, such as canal lining. Factors to be considered include summerfallow density, row crop intensity, and pasture and forage crop distribution. Statistics, to be found elsewhere in this report, show that in individual districts the percentage of land actually irrigated of the classified irrigable acreage varies from 30 to 75. Generally, the lower intensity of irrigation water application indicates higher precipitation, rough or steep topography, well developed drainage patterns, a livestock economy in which pasture and hay predominate, shorter growing season, and a casual approach to irrigation farming. Drainage problems do occur. Usually there is a philosophy of living with the problem, as much of the areas affected supports vegetative growth useful for grazing. Conversely where water use is higher, precipitation is lower, topography is generally smoother, drainage patterns are moderately to poorly developed, the economy is based on row crops, grains, hay and pasture, growing season is longer, and finally a much more serious approach to irrigation farming is evident. Drainage problems are common, and are being tackled and solved.

A discussion of irrigation practices and management logically follows. Ultimately, the people who deliver the water to the farm, and the people who use the water after it reaches the farm, will 'make or break' the irrigation economy. How is this related to the topic - drainage? Low efficiency of water caused by the actions of the two groups mentioned can cause severe seepage, sub-surface and surface drainage problems which can gradually destroy farms and eventually bankrupt districts. This statement is based on the assumptions that irrigation distribution systems remain largely unlined, and that a large percentage of seepage problems are caused by irrigation district works. Needless checking of water at high levels in canals and laterals, and retention of water in individual distributaries when not being used are major causes of seepage and drainage problems. Leaky farm turnouts is another problem source of indeterminate, but significant magnitude.

Farm management factors which bear on the need for drainage are efficiency, methods and frequency of irrigation. Irrigation efficiency implies the actual water used by plants in comparison to that applied and can range from as low as 30% to as high as 75% to 80%. The unused water may be lost through deep percolation or by surface runoff. A drainage system is essential in the latter case. Irrigation methods are intimately linked with efficiency: for example, wild flooding results in a very low efficiency, while center-pivot self-propelled sprinkler systems can approach an efficiency of 75% to 85%. The frequency of irrigation along with stream size used is important in assessing need for drainage. Overall management varies widely across an irrigation district so that usually good and poor managers are not necessarily evenly distributed. Thus, need for drainage as a consequence of poor management is generally evenly distributed. A particular problem observed and documented in many cases occurs when a small stream of water is used over an extended period of time. Very low efficiencies and in many cases salinity problems, result. For example, the legal duty of water for irrigation in Alberta is 18 inches. Actual crop use of irrigation water ranges from about 12 inches for short-season crops to about 24 inches for deep rooted perennials. Application of water in excess of these amounts is common; this causes severe seepage and drainage problems. In one case, 50 inches excess irrigation was applied: the net effect was not only reduced growth in the field but also discharge problems downslope.

In summary, wise use of land, water and other natural resources must be supplemented by an adequate surface drainage system, if the full benefit of these resources is to be maintained to perpetuate an irrigation agriculture economy. Control of seepage is a second prime requisite. Finally, management, or the human resource input, must be attuned to optimizing output, so that drainage needs and expenditures may be minimized.

WATER SOURCES

The total irrigation development in the southern part of Alberta lies within the South Saskatchewan River Basin, and the water for irrigation is obtained from various tributary streams as follows:

River	Irrigation District	Approximate Location of Diversion
Belly River	M.V.I.D.	6 miles S.W. of Mountain View
Belly River	L.I.D.	6 miles S.W. of Mountain View
Belly River	A.I.D.	6 miles S.W. of Mountain View
Belly River	U.I.D.	6 miles W. of Hillspring
Waterton River)	M.I.D.	(4 miles N.W. of Hillspring
Belly River)	R.I.D.	(5 miles S.W. of Glenwood
St. Mary River)	S.M.R.I.D.	(13 miles S.W. of Magrath
)	T.I.D.	(
Old Man River	L.N.I.D.	12 miles S.W. of Ft. Macleod
Bow River	W.I.D.	within City of Calgary, near its eastern edge.
Bow River	B.R.P. }	2 miles S. of Carseland
Bow River	B.R.I.D. }	
Bow River	E.I.D.	5 miles S.W. of Bassano
Ross Creek }	R.C.I.D.	15 miles E. of Medicine Hat
Gros Ventre Creek }		12 miles S.E. of Medicine Hat

RESERVOIR USAGES

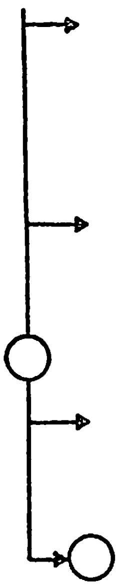
The sample reservoir studies which have been included in the graphs illustrate the typical usage of the reservoir in the irrigation systems of Southern Alberta. The reservoirs commonly follow the expected pattern of recharge in the fall and spring with varying degrees of drawdown in midsummer at times of low river flows and high irrigation demand.

Without the reservoirs, the canal system could not meet peak demands or prevent overflow of canals from excess tailwaters.

Figure 4
SCHEMATIC DIAGRAM OF THE MAJOR FLOWS IN THE WATERTON AND ST. MARY RIVER'S IRRIGATION SYSTEMS

ITEM	MAXIMUM Q DESIGN VALUE CFS	LIVE STORAGE ACRE FEET
Waterton Reservoir		93,000
Canal to Belly River	1,966	
Canal from Belly River Headgate	2,450	
St. Mary Reservoir		286,000
Spillway	53,000	
Irrigation Tunnel	3,200	
Magrath	150	
Spring Coulee	1,800	
Canal to Pothole	3,200	
Jensen Reservoir		3,800
Outlet Canal	3,000	
Milk River Ridge Reservoir		104,000
Cross Coulee Reservoir		2,100
Raymond Reservoir		1,300
Canal	2,903	
Canal	2,585	
Raymond West Turnout	60	
Raymond East Turnout	165	
Headgate to Lethbridge S.E.	1,100	
Canal	1,783	
Turnout	170	
Readymade Turnout	52	
Chin Reservoir		150,000
Chin Reservoir Outlet Canal	1,783	

ITEM	MAXIMUM Q DESIGN VALUE CFS	LIVE STORAGE ACRE FEET
Stafford Reservoir		9,430
Outlet Headgate	1,656	
Outlet Canal	1,656	
T.I.D. Turnout	200	
Canal	1,448	
Turnout to Horsefly Reservoir	1,000	6,800
- Taber Reservoir		4,500
- Fincastle Reservoir		2,700
Turnout to South Grassy Lake	123	
Canal	1,137	
Turnout to Grassy Lake Reservoir	380	12,500
Canal	946	
Canal	847	
Canal	838	
Canal	721	
Turnout to Lateral 10	250	
Canal	533	
Canal	495	
Canal	371	
Turnout to Lateral 26	150	
Canal	313	
Sauder Reservoir		4,660
Outlet Canal	472	
Turnout to Lateral 2	168	
Canal	351	
Canal	295	



ITEM	MAXIMUM Q DESIGN VALUE CFS	LIVE STORAGE ACRE FEET
Turnout to Lateral 12 & 13	242	
Canal	242	
Canal	205	
Turnout to Stornham Creek	200	
Canal	199	
Murray Reservoir		25,000
Outlet Canal	50	
Outlet to Seven Persons	200	
Seven Persons Reservoir		1,060

LAND CLASSIFICATION

INTRODUCTION

The soils classification data and the topography classification data are presented separately.

The percentage of the various categories of topography and soils are derived from soils and topography maps of all lands within an Irrigation District boundary and as such are many times larger than actual acres irrigated within any one Irrigation District. They represent absolute maximum development within any Irrigation District.

The soils categories are derived in a modified form from "The Alberta Standards for Irrigated Land Classification" (1). The modified standards are as follows:

Soil Categories

Category 1. A soil with profile characteristics, salt status, hydraulic conductivity and water holding capacity which results in optimum soils for irrigation use. (Basic ratings from 72 to 100).

Category 2. A soil with one or more moderate restrictions in profile characteristics, salt status, hydraulic conductivity and water holding capacity which results in a fair to good soil for irrigation use. (Basic rating from 46 to 71).

Category 3. A soil with moderate to severe restrictions in profile characteristics, salt status, hydraulic conductivity and water holding capacity which results in a fair soil for irrigation use. (Basic rating from 25 to 45).

Category 4-6. A soil with severe restrictions in profile characteristics, salt status, hydraulic conductivity and water holding capacity which results in a soil not suitable for irrigation use. (Basic rating below 25).

Topography Categories

Category 1-3. Topography is level to undulating, slope less than 2% maximum, earthmoving requirement up to 325 cubic yards per acre, land suitable for any method of irrigation.

Category 4. Topography is undulating to gently rolling, knolls and low areas are prevalent, earthmoving requirement is about 425 cubic yards per acre, if downfield slope is less than 2% the land is suitable for gravity irrigation, if downfield slope is greater than 2% land is suitable for sprinkler irrigation.

Category 5. Land is characterized by rolling topography, slopes are variable, mostly over 4%, earthmoving requirement excessive, except on small isolated fields, land suitable for sprinkler irrigation only.

Category 6. Land in this category is not suitable for irrigation due to any one or a combination of factors such as steep slopes, excessive rocks, ponds, knob and kettle, coulees, etc.

Topographic and soil categories are presented as percentages of the total acreage.

General statements as to soils, topography and irrigation practices are presented for each Irrigation District.

OTHER USES OF WATER

GENERAL

In recent years there has been a large increase in the use of water conveyed in irrigation systems for purposes other than crop irrigation.

This section of this report contains the results of an investigation made into these "other uses of water" and the quantities consumed. Information obtained was from the irrigation records and accounts. In many areas, water quantities could not be obtained for no metering or measuring is done.

Water usages were compiled under the following headings:

A. Community (Domestic)

Listed under communitites are the cities, towns, villages and hamlets that depend partially or entirely on irrigation water for their domestic supply.

B. Industrial

Industries located within the District and who are purchasing irrigation water are listed under "Industrial." Industries such as commercial fishing arc not listed but they are dependent on irrigation reservoirs.

C. Recreation

Listed under "Recreation" are recreational facilities or organizations that purchase irrigation water. There are many recreational activities which are centered around irrigation reservoirs (boating, fishing, etc.) who do not contribute any money for use of this water. Wildlife and the sporting goods industry is heavily dependent on irrigation works.

D. Miscellaneous

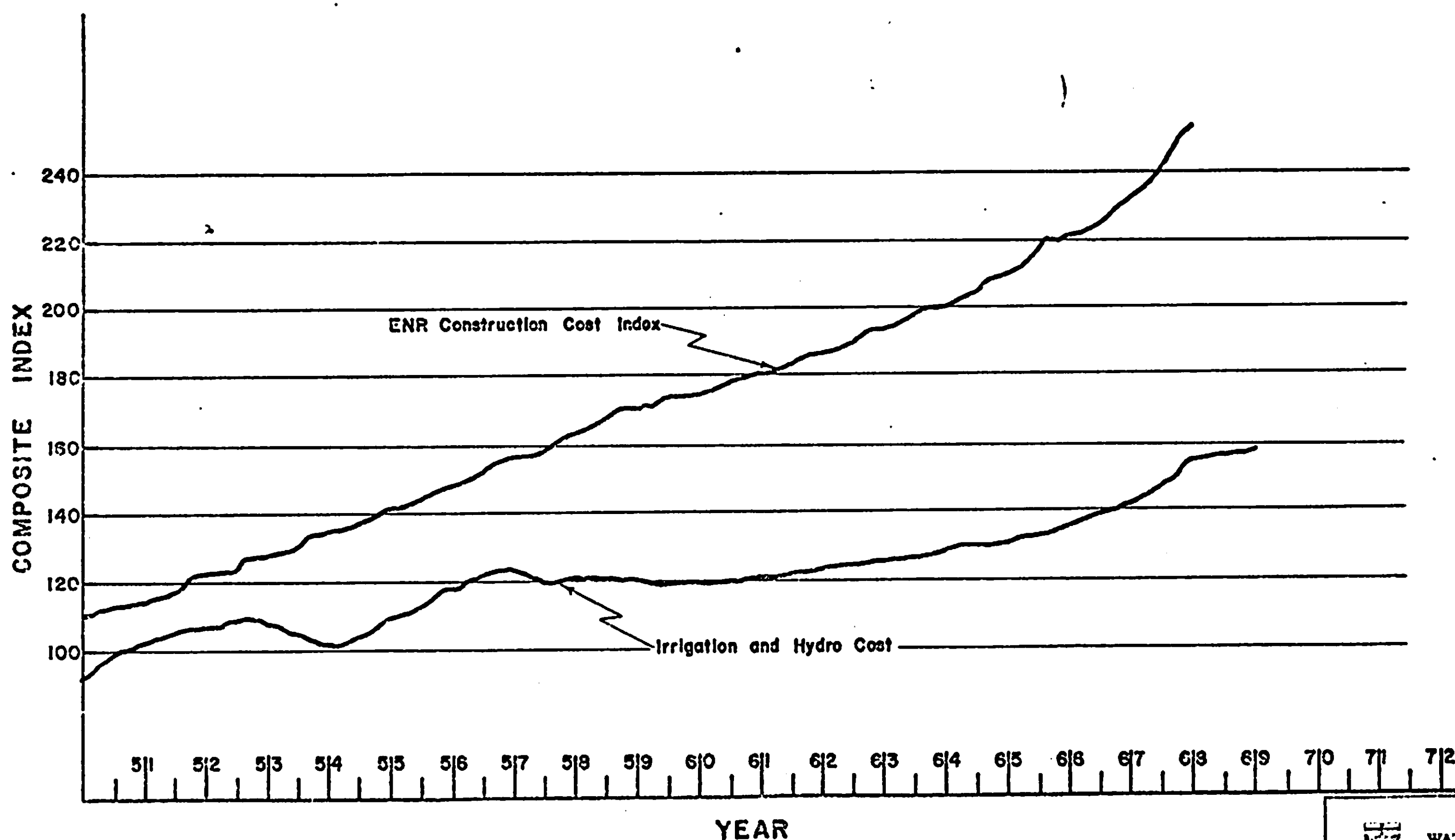
Water uses that could not be placed under the other categories are listed here.

E. Future

Under this heading were placed water uses which are contemplated for the areas in the near future.

AETNA, LEAVITT, MAGRATH, ROSS CREEK IRRIGATION DISTRICTS

These Irrigation Districts are not supplying water for any non-agricultural purpose.



INDEXES, 1949 = 100

WATER RESOURCES DIVISION

CONSTRUCTION COST INDEXES

Scale NO SCALE   Date FEB. 1972

Submitted by
Date
Approved by
Date

DWG

Figure 13 - Summary of Inventory

Irrigation Unit	<50 cfs Miles of Canals: Earth	<50 cfs Miles of Canals: Concrete	<50 cfs Number of Structures: Timber	<50 cfs Number of Structures: Concrete & Steel	>50 cfs Miles of Canals: Earth	>50 cfs Miles of Canals: Concrete	>50 cfs Number of Structures: Timber	>50 cfs Number of Structures: Concrete & Steel	1970 Water Rates	1970 Assessed Acreage	Reservoirs: Number of	Reservoirs: Total Live Storage (acre feet)
Government of Canada					55						4	490,000
Government of Alberta					24½						3	8,000
Mountain View	25¾		167						.60	3,719	0	nil
Leavitt	44		275	30					1.25	4,343	1	75
Aetna	28		163	30					.30 / 1.00	9.196	0	nil
United	137½		1,000	450	35	½	100	100	1.25	33,353	1	2,000
Magrath	52½		265	95	7		30	8	2.50	8,506	0	nil
Raymond	198		299		19		26	82	1.25	20,761	4	600
Lethbridge Northern	420	4	2,812		108		316	357	3.00	89,965	3	41,000
Taber	200	3	2,229		70		71		3.00	57,484	3	13,600
St. Mary River East	726	8.2	4,980		195	1	375		3.30	105,608	7	209,450
West	360	3½	1,231	1,183	90	1	256	175	2.30		1	1,600
Ross Creek	18½		unknown		5			3	1.00	2,069	1	5,000
Bow River	192		1,500		93		475		3.00	23,030	0	
Bow River (Federal)	298		3,159		80		503		1.50	94,000	3	439,000
Western	1,050		unknown		280	½	30		2.00 / 1.65	44,000	1	nil
Eastern	1,000		6,723		268		128		2.70	200,034	8	177,910

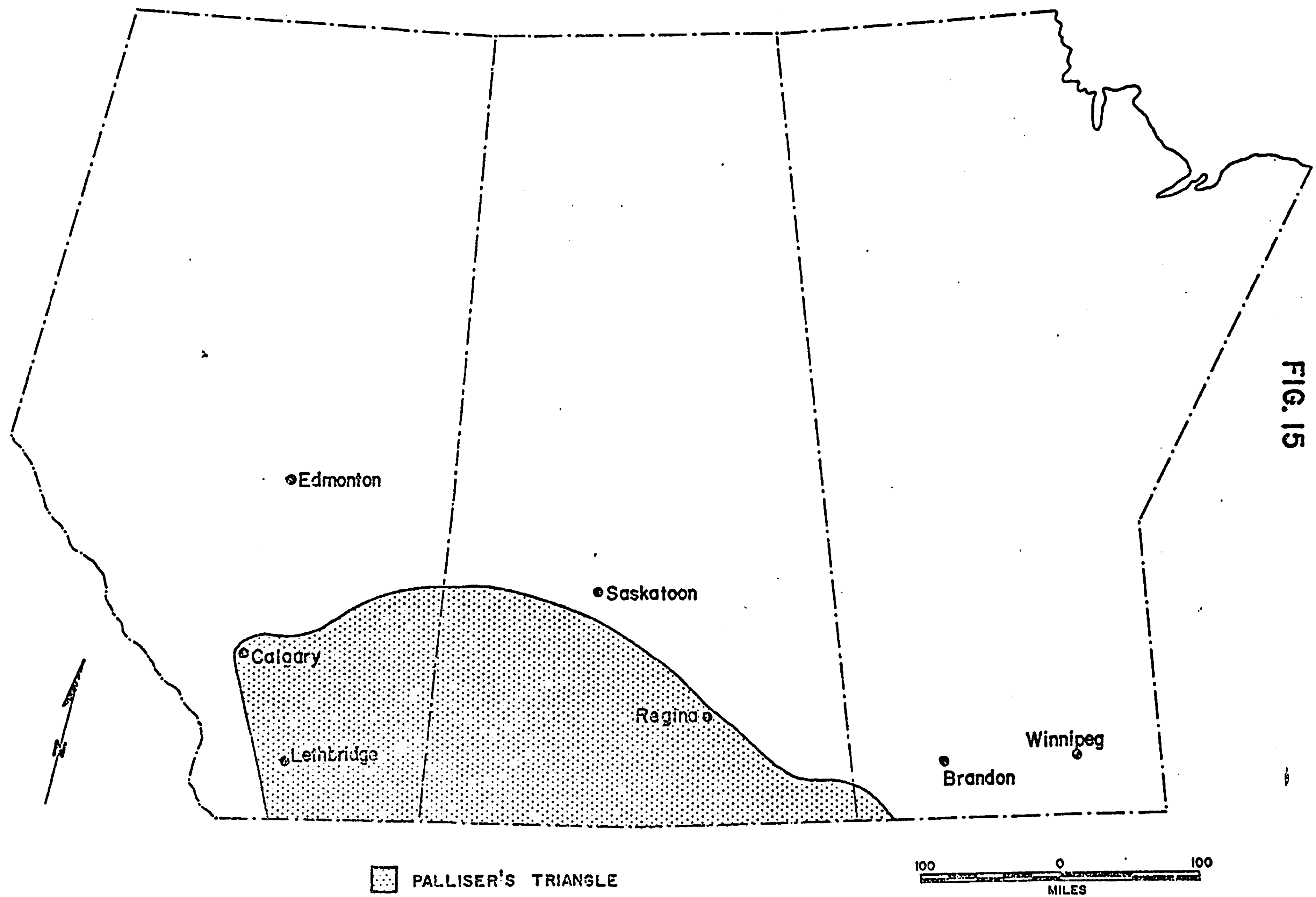

Edmonton
Saskatoon
Calgary
Regina
Lethbridge
Winnipeg
Brandon
N
PALLISER'S TRIANGLE
100 0 100
MILES

FIG. 15