

PRAIRIE PROVINCES WATER BOARD

REPORT NO. 12

WATER SUPPLY AND WATER USE  
IN THE  
ASSINIBOINE & QU'APPELLE BASINS

May 1966

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## FOREWORD

At its September 1962 meeting, the Prairie Provinces Water Board agreed to undertake a joint study of future water requirements in the Qu'Appelle and Assiniboine river systems. The use of supplementary water from the South Saskatchewan Reservoir was to be included in this study. An outline for such a study was prepared by the Secretary, and approved at a Board Meeting on January 16, 1963. On January 17, 1963, work assignments were delegated by the Board.

Progress reports of the study were presented to the Board as follows:

Report No. 7 of the Prairie Provinces Water Board, entitled  
"Compilation and Reconstruction of Monthly Streamflow Records  
for the Qu'Appelle - Assiniboine Study"

----- October 1963

Supplement to Report No. 7 containing,  
a) recorded and reconstructed flows for the Swan River Basin  
b) an index table and map showing lake and reservoir gauges  
in the Assiniboine, Souris and Qu'Appelle river basin

----- February 1964

Report No. 9 of the Prairie Provinces Water Board, entitled,  
"Estimated Water Requirements Qu'Appelle & Assiniboine River  
Basins"

----- June 1964

This report, Prairie Provinces Water Board Report No. 12, is a study of the supply and use of water in the Assiniboine and Qu'Appelle River Basins. It is a preliminary study and detailed investigations are needed before final recommendations can be made.

## ASSINIBOINE - QU'APPELLE STUDY

## SUMMARY

This report describes a study of water supply and water use in the Assiniboine - Qu'Appelle watershed for two levels of development: Year 1980 and Year 2000.

The stream flow records of the period 1921 to 1960 were assumed to be a measure of the water supply for a "representative" forty year period. It was also assumed that a maximum release of 1300 cfs from the South Saskatchewan reservoir was available to supplement the water supply. The use of reservoirs was incorporated into this study. In addition to Theodore, Shellmouth, Avonlea, and Rivers reservoirs, eleven more were proposed.

The demands considered were for the consumptive use requirements for municipal, industrial and irrigation purposes, (evaporation from lakes and reservoirs was considered as a consumptive use demand) and for the non-consumptive use of dilution of polluted waters.

The watershed was sub-divided into three basins:

1. the Upper Assiniboine to Kamsack
2. the Lower Assiniboine to Portage la Prairie
3. the Qu'Appelle basin.

For the Upper Assiniboine Basin the study shows that the available water is inadequate to meet all the proposed requirements. The accumulated shortage for a forty year period for the 1980 level of

development is 403,000 ac. ft. (the accumulated demand is 830,000 ac. ft.). For the 2000 level of development the accumulated shortage is 1,560,000 ac. ft. (the accumulated demand is 3,500,000 ac. ft.). These figures do not include the estimated dilution requirements of 15 cfs by 1980 and 20 cfs by the year 2000, which could be met by diverting a portion of the Swan River into the Assiniboine. A preliminary estimate indicates that a flow of 50 cfs could be added to the Assiniboine river north of Kamsack.

For the Qu'Appelle River Basin -- based on the overall operating assumptions of this study -- there were no shortages in meeting the demands of irrigation, municipal and industrial uses, lake surface evaporation and pollution dilution. The available water in the Qu'Appelle river was supplemented by releases from the South Saskatchewan reservoir, a maximum of 1300 cfs being allowed at minimum operating level. Average monthly releases of 217 cfs for 1980 and 450 cfs for the year 2000 were required to meet the consumptive use demands in the Qu'Appelle basin. A major portion of this was used in the Buffalo Pound Lake area.

A preliminary estimate of the dilution requirements of Moose Jaw and Regina for both levels of development, indicated that an average monthly release in the order of 800 cfs from the South Saskatchewan reservoir was needed during the winter months. (For the 2000 level of development, the increased pollution load is offset by the higher residual flow in the Qu'Appelle River.)

For the Lower Assiniboine Basin considering the consumptive demand only, there was enough water available to meet the demands at the 1980 level of development without the importation of South Saskatchewan water. However, at the 2000 level of development, imported water was required and would eliminate shortages if judicious use was made of Victor Reservoir as a balancing reservoir ..... that is, by keeping the reservoir near a storage of 100,000 ac. ft. using imported water as required. Without Victor Reservoir the accumulated shortage for the forty year period of the study was 1,380,000 acre feet.

For the Lower Assiniboine Basin considering the dilution demands plus the consumptive demands, it was assumed that the water employed to dilute the Qu'Appelle river would be available for re-use in the Lower Assiniboine Basin. At the 1980 level of development no shortage occurred in the basin, provided that supplementary water was imported from the South Saskatchewan Reservoir. At the 2000 level of development and without the use of Victor Reservoir but with releases from the South Saskatchewan Reservoir,.... shortages occurred for 160 months, i.e. 33% of the time. The accumulated shortage for the forty year period of the study was 3,650,000 acre feet.

When Victor Reservoir was included in the Year 2000 Study, the accumulated shortage in the basin was reduced to 1,480,000 acre feet, and the number of months during which shortages occurred were decreased from 160 to 59. However, in order to accomplish this decrease, Victor Reservoir had to be kept as near as possible to its capacity of 210,000 acre feet by importing South Saskatchewan

water. It is to be noted that it was necessary to release the maximum allowable -- 1300 cfs ---from the South Saskatchewan Reservoir for a total of 220 months.

Detailed descriptions of the computational methods employed in this study are given in the appendices of this report. The appendices are compiled under separate cover.



## I. INTRODUCTION

### A. HISTORY

#### 1. Purpose of Report

The prospect of future developments of water-using industries and recreational facilities along the Qu'Appelle and Assiniboine valleys competing for water, necessitates that some guides for water allocation be adopted now. The study described in this report will serve as a basis for any such proposed allocation of the waters of the Qu'Appelle and Assiniboine Rivers.

#### 2. Authorization of Study

At its September 1962 meeting, the Prairie Provinces Water Board agreed to undertake a joint study of future water requirements in the Qu'Appelle and Assiniboine river systems, giving due consideration to the use of imported water from the South Saskatchewan Reservoir. The Board instructed its Secretariat to undertake this study with the participation of Manitoba and Saskatchewan in some phases of the work.

#### 3. Previous Reports

To date, two reports pertaining to the study have been submitted to the Board: Report No. 7, entitled, "Compilation and Re-construction of Monthly Streamflow Records for the Qu'Appelle - Assiniboine Study" .... and Report No. 9, "Estimated Water Requirements Qu'Appelle and Assiniboine River Basins". The first of these reports tabulated the available water at

official gauging stations in the Assiniboine and Qu'Appelle system, while the second report listed the future water requirements of Saskatchewan and Manitoba in the system, as estimated by the provincial authorities, for the years 1980 and 2000.

## B. BASIC ASSUMPTIONS AND PROCEDURES

### 1. Organization of Study

In this study the Assiniboine - Qu'Appelle watershed has been divided into three major areas (See Key Map, Fig. 1):

- a) The Upper Assiniboine Basin to Kamsack, Saskatchewan
- b) The Qu'Appelle River Basin
- c) The Lower Assiniboine Basin to Portage la Prairie, Manitoba.

These major areas were divided into sub-areas of water use. Initially, local runoff was used to satisfy local demand. An attempt was then made to fill any deficits with upstream or imported water. Any excess flow was available for use downstream. Two "levels of demand" were studied: Year 1980 and Year 2000.

### 2. Water Use Demands

- a) The water requirements for irrigation, industrial and municipal uses and for pollution dilution were taken from P.F.W.B. Report No. 9.
- b) Consumptive (stream-depleting) demands -- irrigation, industrial, municipal -- were considered separately from the non-consumptive demands for pollution dilution water.

Due to natural purification in the stream, dilution waters become available for use downstream for further pollution dilution or for consumptive uses. (The mechanics of re-using dilution water is discussed in more detail in the appropriate sections of this report.) Since the consumptive and non-consumptive demands were processed and tabulated independently, future changes can be made in the dilution requirements without negating the consumptive-use study.

### 3. Inflow and Evaporation Data

Streamflow records from 1921 to 1960 as tabulated in P.P.W.B. Report No. 7 were used. Where required, additional data were generated based on correlations with neighbouring streams. It was assumed that the Souris River contributes an amount of water equal to the mean monthly flow at Wawanesa minus 50 cfs.

Net evaporation figures were calculated using the gross evaporation figures given in the P.P.W.B. Report No. 5 Supplement A, "Evaporation from Lakes and Reservoirs on The Canadian Prairies", and local rainfall records.

### 4. Reservoirs Considered in Study

The following reservoirs were considered in this study:

- a) Proposed reservoirs -- Victor Reservoir on the Qu'Appelle River, Wascana Reservoir northwest of Regina, Moose Jaw Creek Reservoir and eight reservoirs in the Upper Assiniboine basin. It is assumed that some of these reservoirs would not be required, or constructed, until the Year 2000.

- b) Existing reservoirs -- Avonlea Reservoir, Theodore Reservoir, Rivers Reservoir and Shellmouth Reservoir (partly constructed).

5. Diversions into Basin

In this study, water is imported into the system from the South Saskatchewan Reservoir at the Qu'Appelle Dam (maximum of 1300 cfs at minimum operating level). The possibility of diverting 50 cfs out of Swan River into the Assiniboine River north of Kamsack is noted in this report.

## II. THE UPPER ASSINIBOINE BASIN

### A. General

The Upper Assiniboine Basin is defined as that drainage area above Kamsack, Saskatchewan. Previous to the construction of Theodore Dam in 1964, there were no major storage reservoirs in this basin. Out of many proposed storage sites investigated, eight were selected for this study as follows:

	<u>Storage Site</u>	<u>Location</u>
Site 3 --	Conjuring Creek	21-34-6-2
Site 9 --	Kop Creek	32-34-4-2
Site 17 --	Stove Creek	3-37-7-2
Site 23 --	Assiniboine River	16-37-7-2
Site 33 --	Whitesand River	21-31-2-2
Site 38 --	Assiniboine River	35-31-1-2
Site 60 --	Yorkton Creek	13-26-4-2
Site 161 -	Cussed Creek	23-27-5-2

These reservoirs offer a combined storage capacity of 155,000 acre feet. The detailed operational assumptions made for each reservoir are appended to this report.

This study considered the demands for irrigation, municipal and industrial needs. Municipal demands were considered at Yorkton, Kamsack, Canora, Preeceville and Sturgis, and industrial demands at Kamsack and Yorkton. A continuous flow of 2.2 cfs was required for the municipal needs of small centres for the Year 2000 Study.

It was assumed that the per capita consumption for municipal purposes will be 100 gallons per day in 1980 and also in 2000, and that 60% of the gross diversion will be return flow.

An estimate of a continuous flow of 15 cfs for the year 1980 and 20 cfs for the year 2000 for dilution requirements was made in P.P.W.B. Report No. 9 for the Upper Assiniboine basin. It was assumed that Yorkton, the largest population centre, would require the majority of the dilution water. However, in this study, shortages were experienced in trying to meet the municipal demands of Yorkton. Therefore, it was decided not to allow for the dilution estimates.

B. Year 1980 Study

It was assumed that irrigation areas Nos. 1 and 5 will be fully developed by 1980. Area 5 (2,000 acres) was supplied from Theodore Reservoir. Area 1 (10,000 acres) was supplied by the proposed reservoirs 9, 3, 23 and 17. (Reservoir No. 9 also supplied municipal water for the town of Sturgis.) The procedure used in supplying the irrigation demand was to draw on the nearest reservoir first making up a deficit by drawing on the next upstream reservoir, and so on. In this study the "order of draft" (starting at the first reservoir), was 9, 3, 23 and 17. Even with these four reservoirs the study showed that shortages still occur.

The only other reservoir in this basin, Reservoir No. 60 (proposed) on Yorkton Creek, was used to supply the industrial

and municipal demand of Yorkton in excess of the 1964 gross municipal demand. Since the capacity (1500 ac. ft.) of the proposed reservoir was inadequate to meet all of the 1980 demands, it was assumed that the equivalent of the 1964 demand would be met from groundwater supplies or some other source.

The net effect, i.e. the change in natural flow resulting from the operation of Theodore Reservoir and reservoirs 60, 9, 3, 23 and 17 was summarized and employed later in the study to estimate the net inflow to the next downstream reservoir, which is the Shellmouth Reservoir. In addition, the natural flow was reduced by municipal diversions at Kamsack, Canora and small centres, and by an industrial demand at Kamsack.

#### C. Year 2000 Study

The operational procedure used for the Year 2000 Study was similar to the Year 1980 Study. The irrigation demands of Area 1 and 5 remain unchanged; it is anticipated that additional Areas 2, 3, 4 and 6 (totalling 35,000 acres) will be fully developed by the year 2000. The municipal and industrial demands were increased in accordance with the expected rate of growth in the twenty years between 1980 and 2000. To cope with the increased demand for water, it was assumed that Reservoirs No. 38 on the Assiniboine River, No. 33 on the Whitesand River and No. 161 on Cussed Creek will have been constructed by the year 2000. Reservoir No. 38 was operated as a water supply for the municipal and industrial demand of

Kamsack and irrigation of Area 4 and Area 2. Reservoir No. 161 on Cussed Creek and Reservoir No. 33 on Whitesand River were used to supply the irrigation demands of Area 6 and Area 3 respectively. Reservoir No. 33 supplied the town of Canora as well. The inflow into Shellmouth Reservoir at the lower end of the basin is the residual flow in the Assiniboine River resulting from the study.

Detailed descriptions of individual reservoir operations and assumptions are given in the Appendix, which is compiled under separate cover.

D. Swan River Diversion

A dam north of Pelly could divert Swan River flows into Spruce (Snake) Creek and thence into the Assiniboine River in Township 32 near the 2nd Meridian. It was estimated that the optimum storage of the proposed reservoir would be 100,000 acre feet which would allow a net annual draft of 35,000 acre feet (a monthly draft of 50 cfs). This water could be used for dilution at Kamsack and for increasing the inflow into Shellmouth Reservoir and perhaps for irrigation near Kamsack.



## III. THE QU'APPELLE RIVER BASIN

A. General

This basin differs from the Upper Assiniboine Basin in that the flow was routed through a series of lakes rather than through man-made reservoirs. To simplify the water accounting procedure, several basic assumptions were made as follows:

1. Initially, the lakes are at full supply level.
2. The monthly net evaporation is based on the areas at full supply level.
3. The minimum allowable lake levels are one foot below F.S.L.
4. A design flow of 1300 cfs can be imported from the South Saskatchewan Reservoir and is used to make up deficits.
5. The contributions of Moose Jaw Creek and Wascana Creek to the Qu'Appelle River are affected by the operations of the Avonlea Reservoir (constructed) and the proposed Moose Jaw Creek and Wascana reservoirs. (Preliminary water budget studies were made on these 3 reservoirs before commencing the main study.)
6. The water requirements for this basin as listed in Section 2 of the Prairie Provinces Water Board Report No. 9 are reasonable estimates, which may be adjusted in the future as new knowledge about municipal, industrial, irrigation and dilution demands becomes

available; the estimated requirements are submitted by the Province without prejudice to its future position. The studies for the Year 1980 and the Year 2000 followed essentially the same procedure, with demands being higher for the Year 2000 Study.

B. Consumptive Use Study

The study started at the upper end of the basin by considering the inflows and demands on Buffalo Pound Lake. The demands were: municipal demand for Moose Jaw and Regina; industrial demands for Moose Jaw, Regina, Belle Plain and Findlater; irrigation demands for the reach, "above Buffalo Pound Lake to Craven"; evaporation from Buffalo Pound Lake. The designated operating levels for the lake were maintained by local inflow, supplemented by imported water from the South Saskatchewan Reservoir.

In the reach from Buffalo Pound Lake to Craven, spill from Buffalo Pound Lake is increased by local inflow, by Moose Jaw Creek (including return flow from Moose Jaw) and by Wascana Creek (including return flow from Regina).

At a point just below Craven the study then dealt with the operation of Last Mountain Lake. The operating rules for Last Mountain Lake are summarized as follows:

1. No diversion may be made during the period from September 30th to April 30th.
2. When diverting into the lake, a minimum flow of 25 cfs must be maintained in the Qu'Appelle

River downstream from the diversion.

The last reach studied was that from Craven to the confluence with the Assiniboine. In this reach are numerous lakes which have a profound effect on the operation of the system due to evaporation from the lake surface. The total area at F.S.L. of Pasqua, Echo, Lebret, Katepwa, Crooked and Round Lake is 20,300 acres. The total area at F.S.L. of the Fishing Lakes is 14,000 acres. In addition to the evaporation demand, there is the municipal demand of local areas; the industrial demand of Melville, Esterhazy and Estevan; and an irrigation demand.

C. Dilution Study

After the consumptive use study was completed, a dilution study was made. The two sole contributors of pollution were the cities of Moose Jaw and Regina. As there was no "convenient" source of dilution water at the two cities, the effluent was assumed to proceed down the Moose Jaw Creek and Wascana Creek Channels and enter the Qu'Appelle River near Craven. The available water in the Qu'Appelle River was balanced against the dilution demands and any deficits were made up by imported water from the South Saskatchewan Reservoir ..... subject to the maximum release of 1300 cfs less prior demands. It was assumed that the resultant flow will naturally purify itself as it proceeds downstream to the extent that it will become suitable for consumptive or dilution purposes in the Lower Assiniboine basin.

## IV. LOWER ASSINIBOINE BASIN

A. General

For the purpose of this study the Lower Assiniboine Basin is defined as that drainage area from Kamsack, Saskatchewan to Portage la Prairie, Manitoba, but excluding the Souris River Basin. However, a contribution of the Souris River was considered and was calculated as follows: the Souris River contributes an amount of water equal to the mean monthly flow at Wawanesa minus 50 cfs.

The water budget study for this area was affected by the operation of 3 reservoirs -- River, Shellmouth and Victor. The Rivers Reservoir (capacity, 24,500 ac. ft.) on the Minnedosa River modified the flow on this tributary. All the residual flow from the Upper Assiniboine passed through the Shellmouth Reservoir (capacity, 430,000 ac. ft.). For the Year 2000 Study only, all the residual flow of the Qu'Appelle River was routed through the proposed Victor Reservoir (capacity, 210,000 ac.ft.).

B. Year 1980 Study1. Consumptive Use

A water budget study was performed for the consumptive use demands for municipal, industrial and irrigation purposes as listed in Section 3 of the P.P.W.B. Report No. 9. Initially, a consumptive use study was made for the Minnedosa River watershed. The flow entering the Assiniboine River from the Minnedosa River was that spilled from the Rivers Reservoir (overflow). An attempt was made to meet the total consumptive

demand for the Lower Assiniboine Basin out of local inflow (including Rivers Reservoir spill); the shortages were recorded. Next, an attempt was made to meet these shortages with the water from Shellmouth Reservoir and the residual flow in the Qu'Appelle (this flow remained after depletion for consumptive uses); the resultant shortages were recorded. Then an attempt was made to fill the remaining shortages from the South Saskatchewan Reservoir.

## 2. Dilution

A study was also made which included the dilution requirements. The consumptive use figures as previously calculated were used. The study commences at the upper end of the basin.

A water budget was prepared, crediting to the account the residual flows from the Qu'Appelle and Upper Assiniboine basins. (The residual flow of the Upper Assiniboine Basin was determined by the consumptive use study only -- no dilution was considered in this basin. The residual flow from the Qu'Appelle Basin was determined from the combined consumptive use and dilution study.) Demands and local inflows were entered and processed on the budget sheets. Water was "re-used", based on the assumption that the dilution water can be used downstream (for further dilution or consumptive use) after a reasonable distance has been allowed for self-purification. For example, it is assumed that the dilution water required at the mouth of the

Minnedosa River will be reusable at the diversion to Carman, Winkler and Morden, but will not be used for dilution purposes at Brandon.

C. Year 2000 Study

Essentially the same procedures are used for the Year 2000 Study as for the Year 1980 Study; the demands for irrigation, municipal and industrial uses, and dilution are higher for the Year 2000 Study. It was assumed that the Victor Reservoir would be constructed and would regulate the flow out of the Qu'Appelle Basin. A detailed description of the operational procedures of this reservoir is placed in the appendices which are compiled under separate cover.

D. Shellmouth Reservoir Operation

The Shellmouth dam is in its initial stages of construction and it can be assumed that the reservoir will be used to regulate the inflows from the Upper Assiniboine Basin and the Shell river by the year 1980. The reservoir will have a two-fold purpose -- flood control and water supply storage. Maximum allowable storage levels were set at the end of each month for flood control purposes. A minimum riparian flow of 25 cfs was maintained if possible. In addition, the shortages occurring in the Lower Assiniboine determined the releases from the reservoir. A detailed description of the Shellmouth reservoir operation and assumptions is given in the appendix under the

heading "Shellmouth Reservoir Study".

E. Victor Reservoir Study

In discussions held with representatives of the Province of Manitoba at the P.P.W.B. meeting February 8, 1966, it was proposed that a reservoir on the Qu'Appelle River near Victor, Manitoba be included in this study in order to regulate the outflows from the Qu'Appelle River into the Assiniboine River. Since there were no shortages occurring in the Lower Assiniboine basin in meeting the water demands at the 1980 level of development without this regulation, it was assumed for the purposes of this study that the proposed Victor Reservoir will not be needed until the year 2000. In this part of the study Victor Reservoir was operated to reduce or eliminate the shortages occurring in the Lower Assiniboine basin after the local inflows in the basin and the outflows from Shellmouth Reservoir had been considered. A detailed description of the operational assumptions and procedures applied to the Victor Reservoir study is placed in the appendices.

## BIBLIOGRAPHY

1. Prairie Provinces Water Board Report No. 5 - Supplement A, "Evaporation From Lakes and Reservoirs on The Canadian Prairies", April 1965.
2. Prairie Provinces Water Board Report No. 7, "Compilation and Reconstruction of Monthly Streamflow Records for the Qu'Appelle-Assiniboine Study", October 1963.
3. Prairie Provinces Water Board Supplement to P.P.W.B. Report No. 7, February 1964.
4. Prairie Provinces Water Board Report No. 9, "Estimated Water Requirements Qu'Appelle and Assiniboine R. Basins", June 1964.
5. Prairie Provinces Water Board Memorandum No. 6, "Proposals for the Study of Water Supply and Water Use in the Qu'Appelle and Assiniboine Basin", November 1962.
6. P.F.R.A. Hydrology Report No. 17, "A Folio of Information for the Qu'Appelle Valley", March 1958.
7. P.F.R.A. Hydrology Report No. 19, "Uses of Water in the Qu'Appelle Watershed", April 1957.
8. P.F.R.A. Hydrology Report No. 33, "Kamsack and Canora Water Supplies", December 1961.
9. P.F.R.A. Manitoba Regional Office Report, "Qu'Appelle River Project Victor Dam", May 1964.
10. P.F.R.A. Manitoba Regional Office Report, "Preliminary Report Rivers Reservoir", January 1957.
11. P.F.R.A. Manitoba Regional Office Report, "Upper Assiniboine Basin Water Development Report No. 1 on Site 23, Site 17, Site 9 and Site 3".
12. P.F.R.A. Hydrology Division and Manitoba Regional Office Report, "Appendix III, Water Supply and Flood Control Aspects of the Upper Assiniboine River Storage Investigations", April 1959.



Bibliography (Cont'd)

13. P.F.R.A. Saskatchewan and Manitoba Regional Office Report,  
"Interim Report Upper Assiniboine Storage Investigations",  
June 1959.
  14. South Saskatchewan River Development Commission,  
"Qu'Appelle Diversion and the Capacity of Outlet Works in the  
Qu'Appelle Valley Dam, South Saskatchewan River Project",  
January 1962.
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TABLE I

AVERAGE ANNUAL WATER REQUIREMENTS  
IN THE ASSINIBOINE & QU'APPELLE WATERSHEDS

By Manitoba in the Lower Assiniboine Basin:

Year 1980, consumptive use	-----	96,900 acre feet
Year 1980, dilution	-----	437,000 acre feet
Year 2000, consumptive use	-----	354,300 acre feet
Year 2000, dilution	-----	1,323,400 acre feet

By Saskatchewan in the Upper Assiniboine Basin:

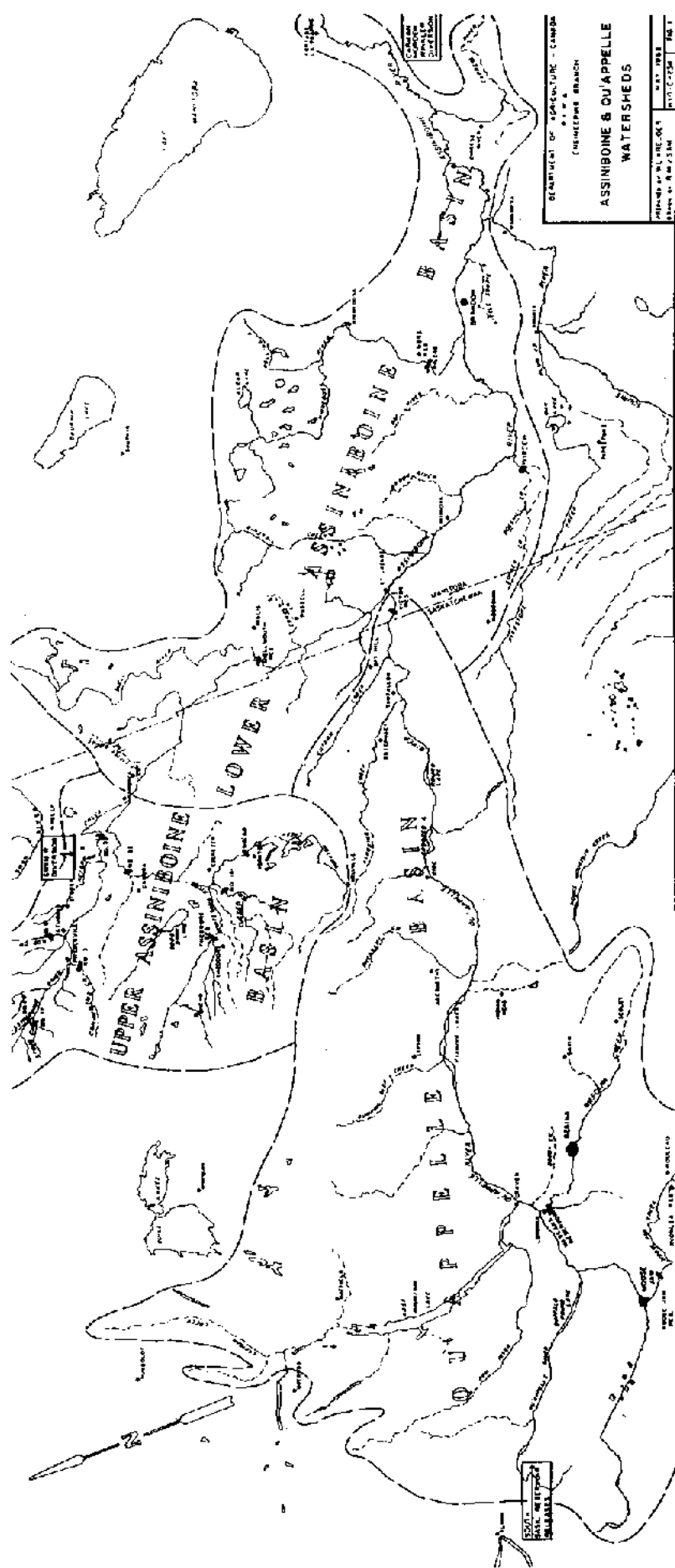
Year 1980, consumptive use	-----	20,600 acre feet
Year 2000, consumptive use	-----	87,300 acre feet

By Saskatchewan in the Qu'Appelle Basin:

Year 1980, consumptive use	-----	99,000 acre feet
Year 1980, dilution	-----	357,000 acre feet
Year 2000, consumptive use	-----	191,300 acre feet
Year 2000, dilution	-----	434,400 acre feet

Evaporation Demand in the Qu'Appelle Basin ---- 111,000 acre feet



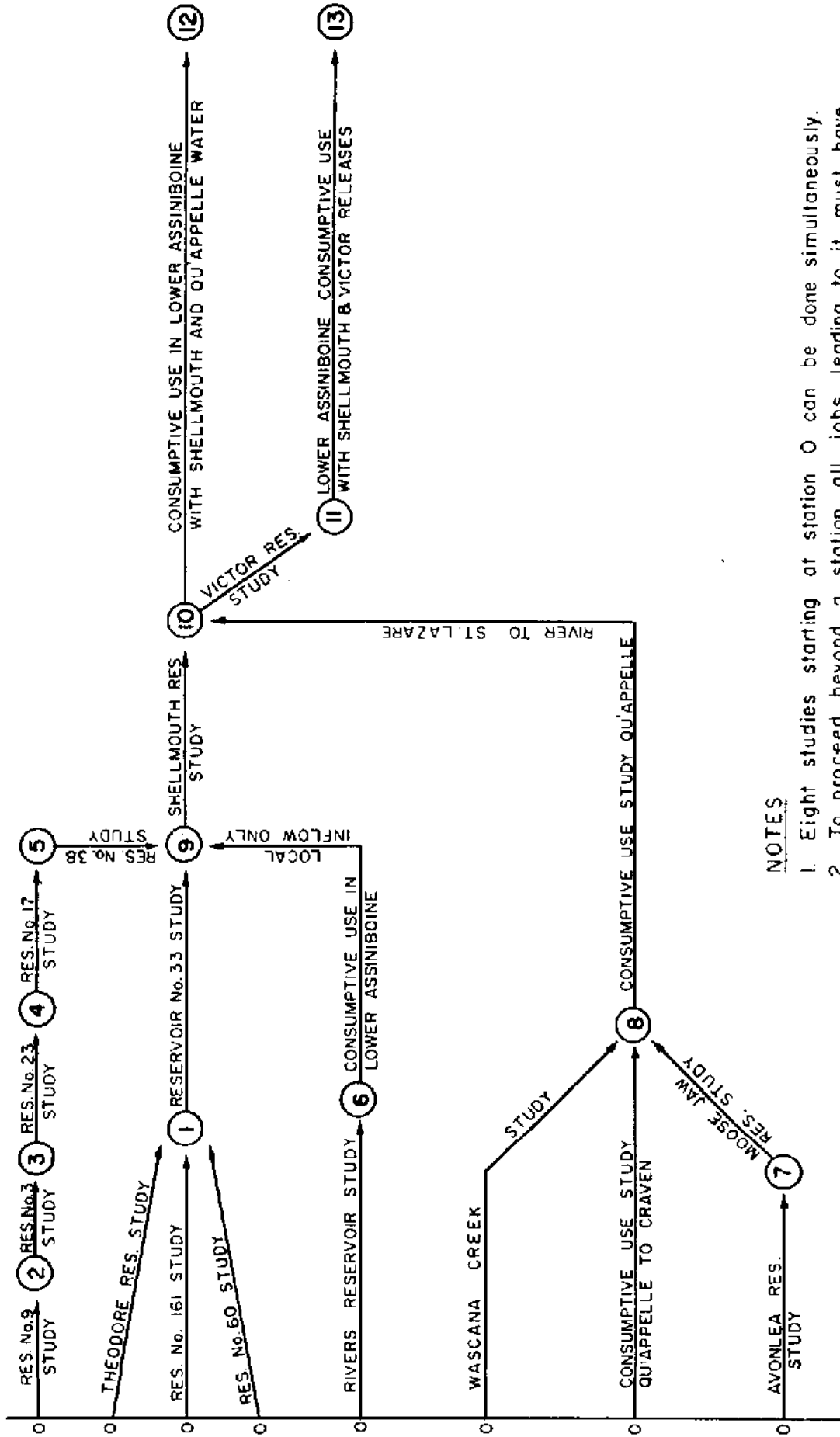


SCALE METERS  
1:50,000

DEPARTMENT OF LANDS AND FORESTS - CANADA  
 P. O. BOX 100  
 OTTAWA, ONTARIO  
 K1P 5S6  
 ENGINEERING BRANCH  
 ASSINIBOINE & QU'APPELLE  
 WATERSHEDS  
 PRINTED AT OTTAWA, ONT. MAY 1988  
 DRAWN BY R. M. J. SIMON  
 PHOTOGRAPHED BY J. G. GIBSON

ASSINIBOINE - QU'APPELLE STUDY

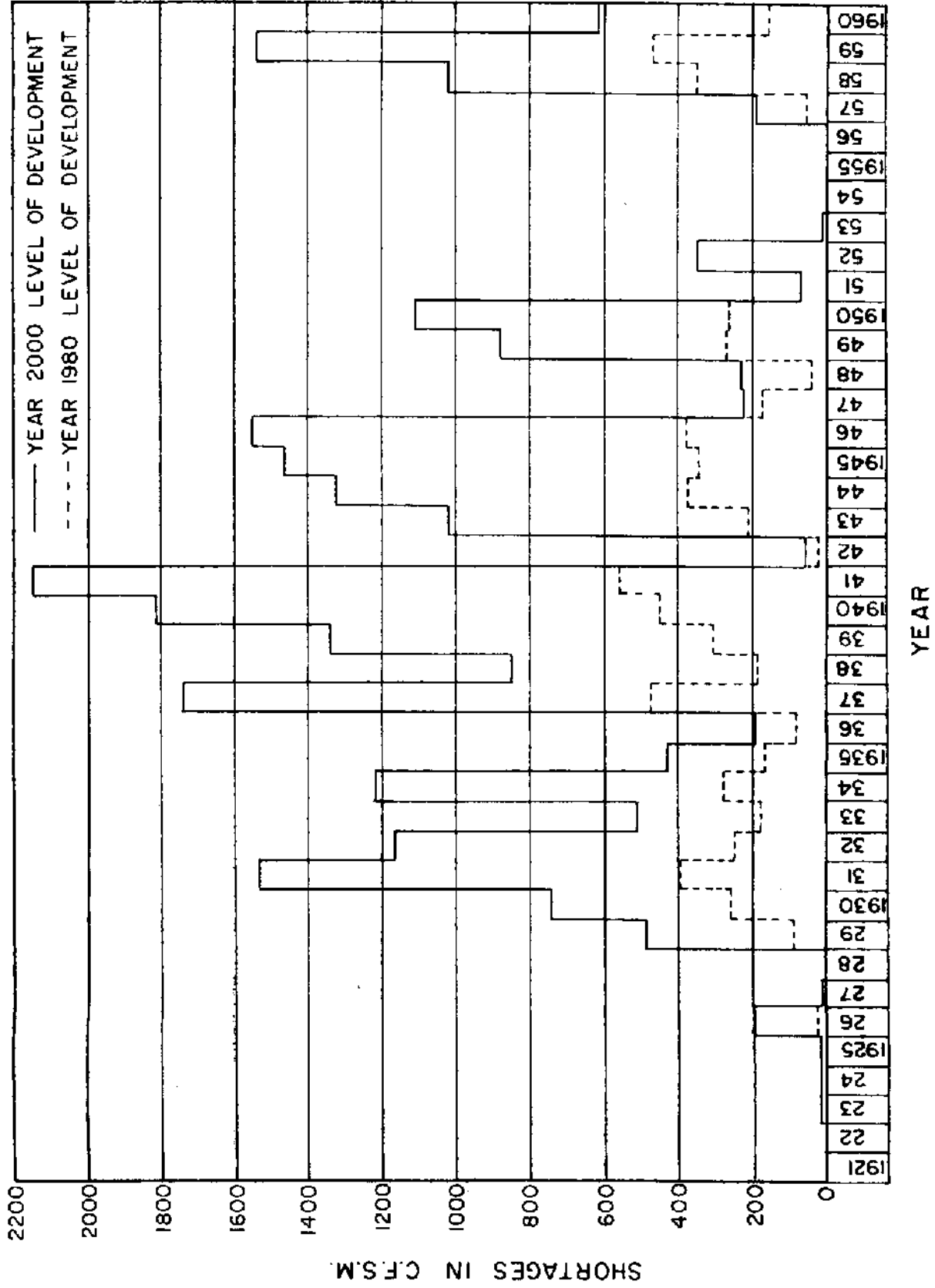
PATH DIAGRAM FOR STUDY SCHEDULE YEAR 2000 CONSUMPTIVE DEMANDS

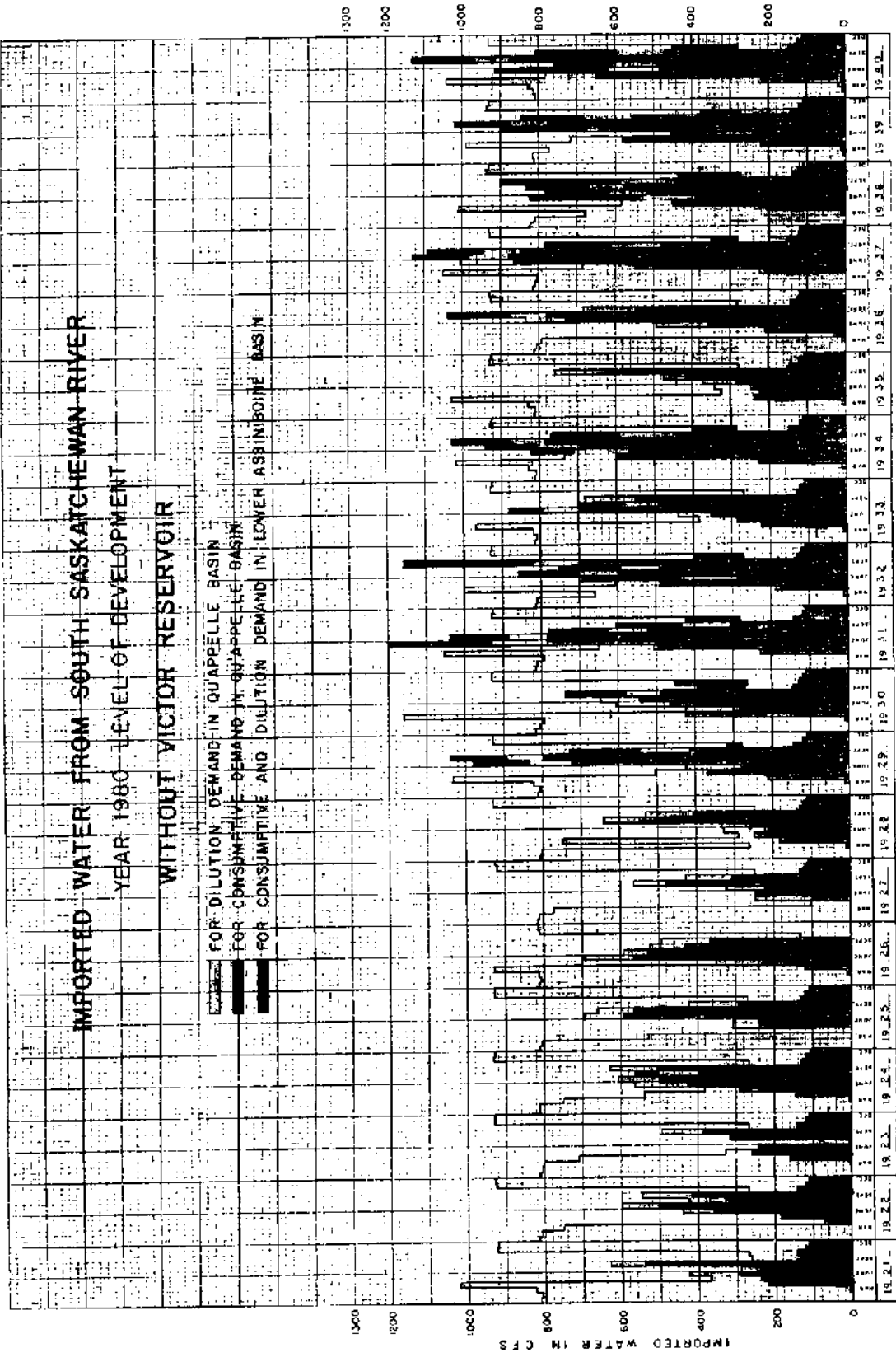


NOTES

1. Eight studies starting at station 0 can be done simultaneously.
2. To proceed beyond a station all jobs leading to it must have been completed.

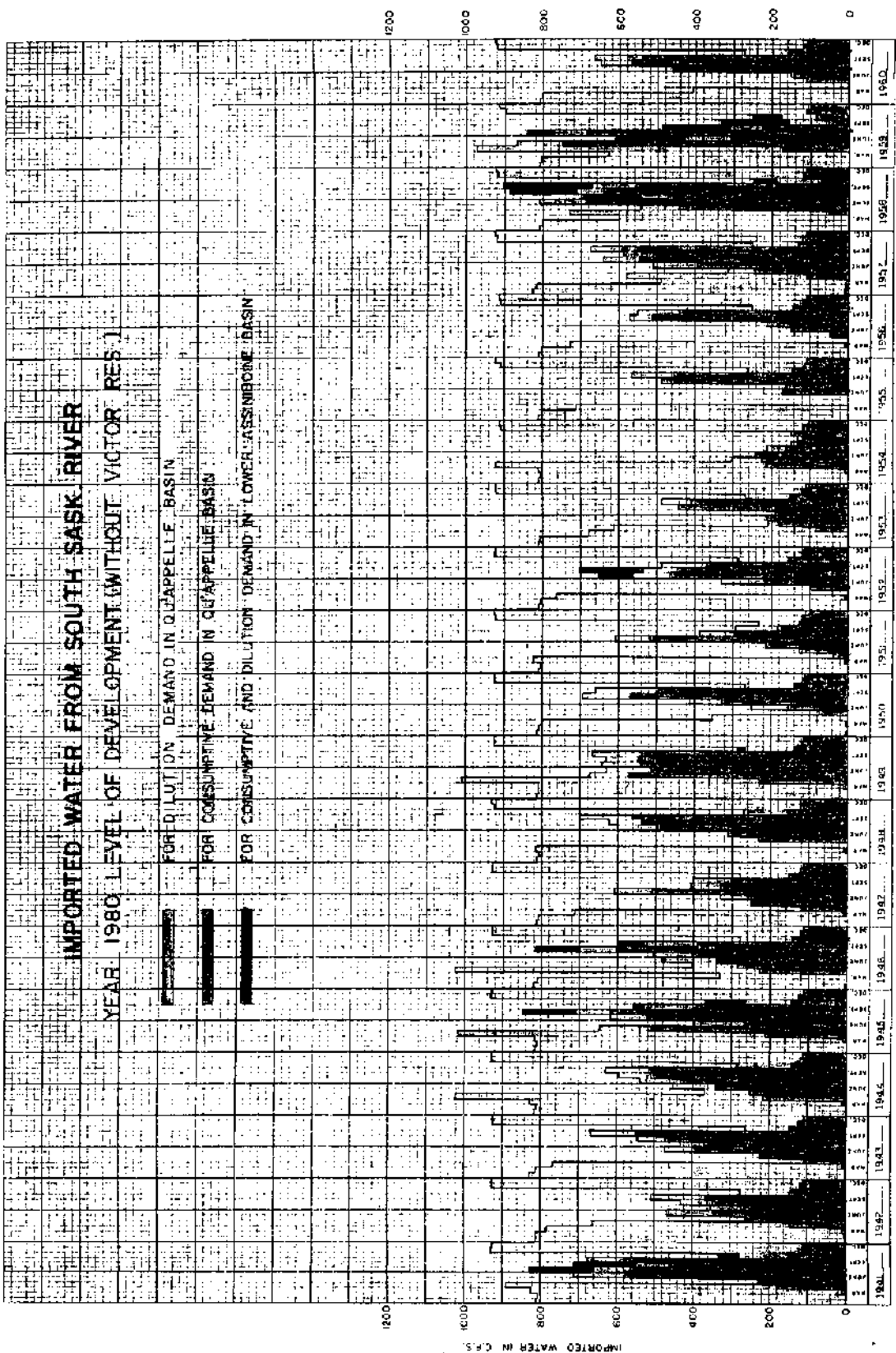
# SHORTAGES IN THE UPPER ASSINIBOINE BASIN





HYD.-8-139  
FIG. 4

PERIOD OF THE STUDY

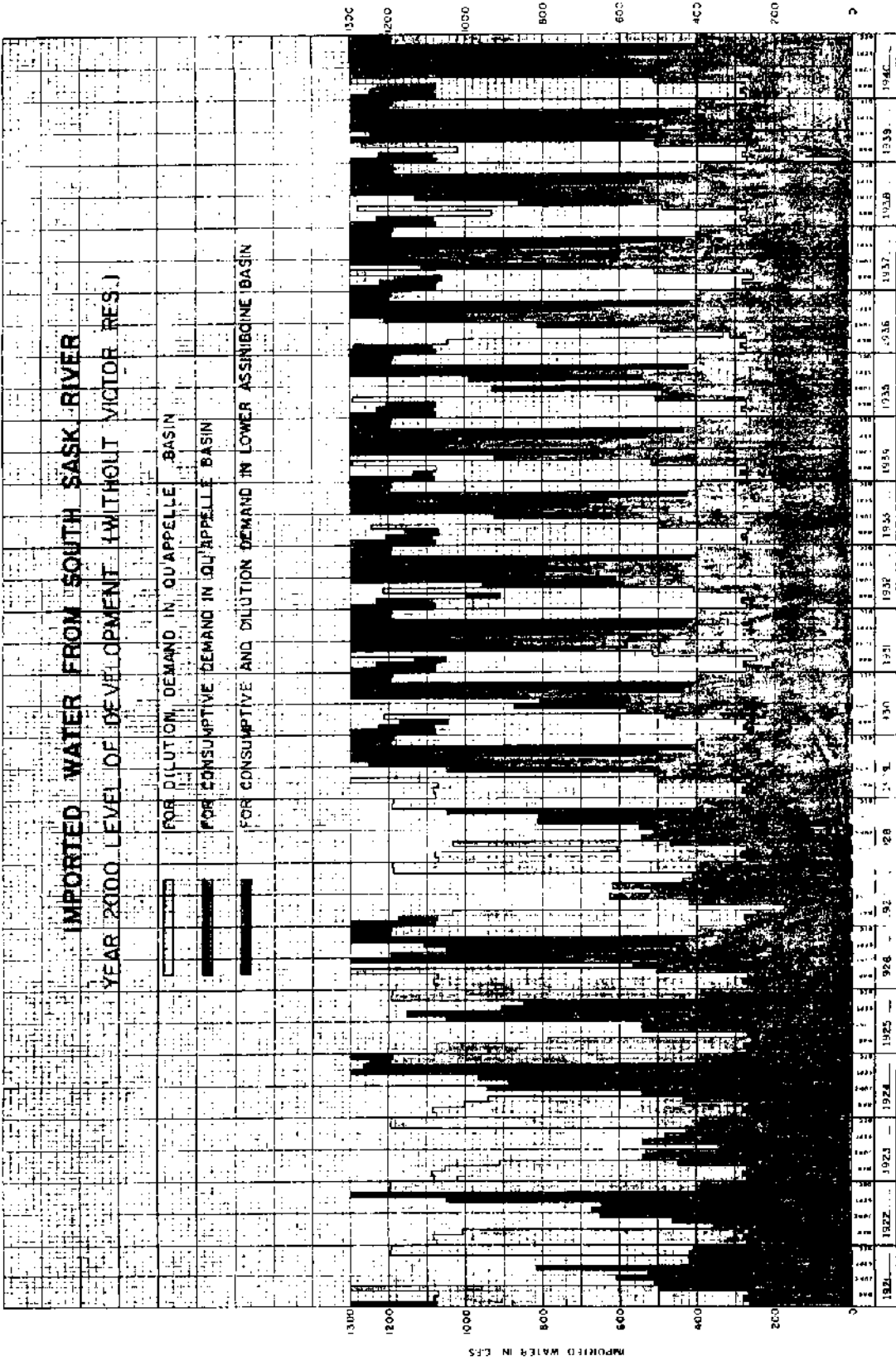


HYD-B-140  
FIG. 5

PERIOD OF STUDY

K-E 20 YEARS 40 MONTHS 47 2853  
SOUTH SASK RIVER  
SASKATCHEWAN PROVINCE

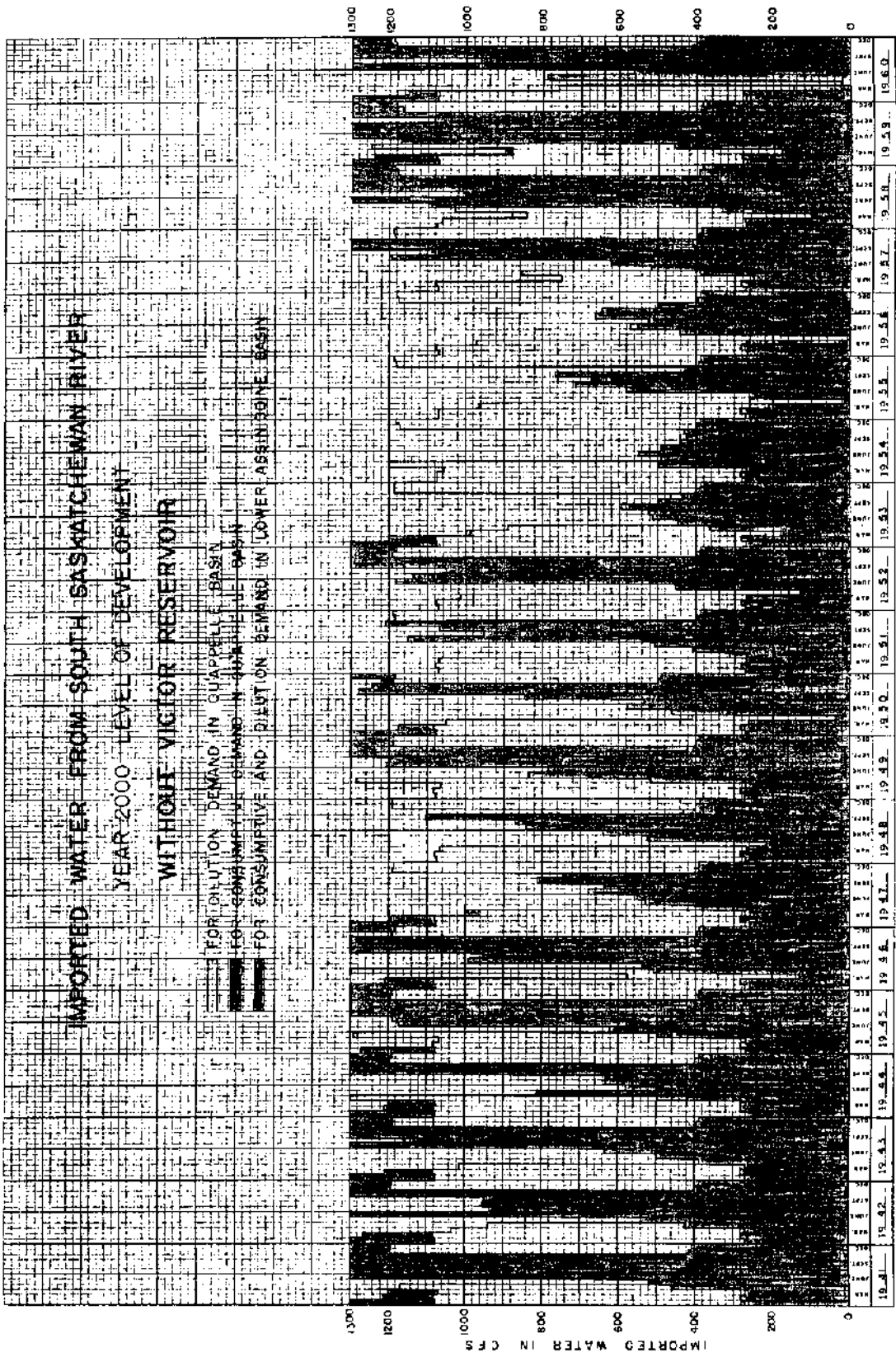




HYD-B-141  
 FIG. 5

PERIOD OF STUDY

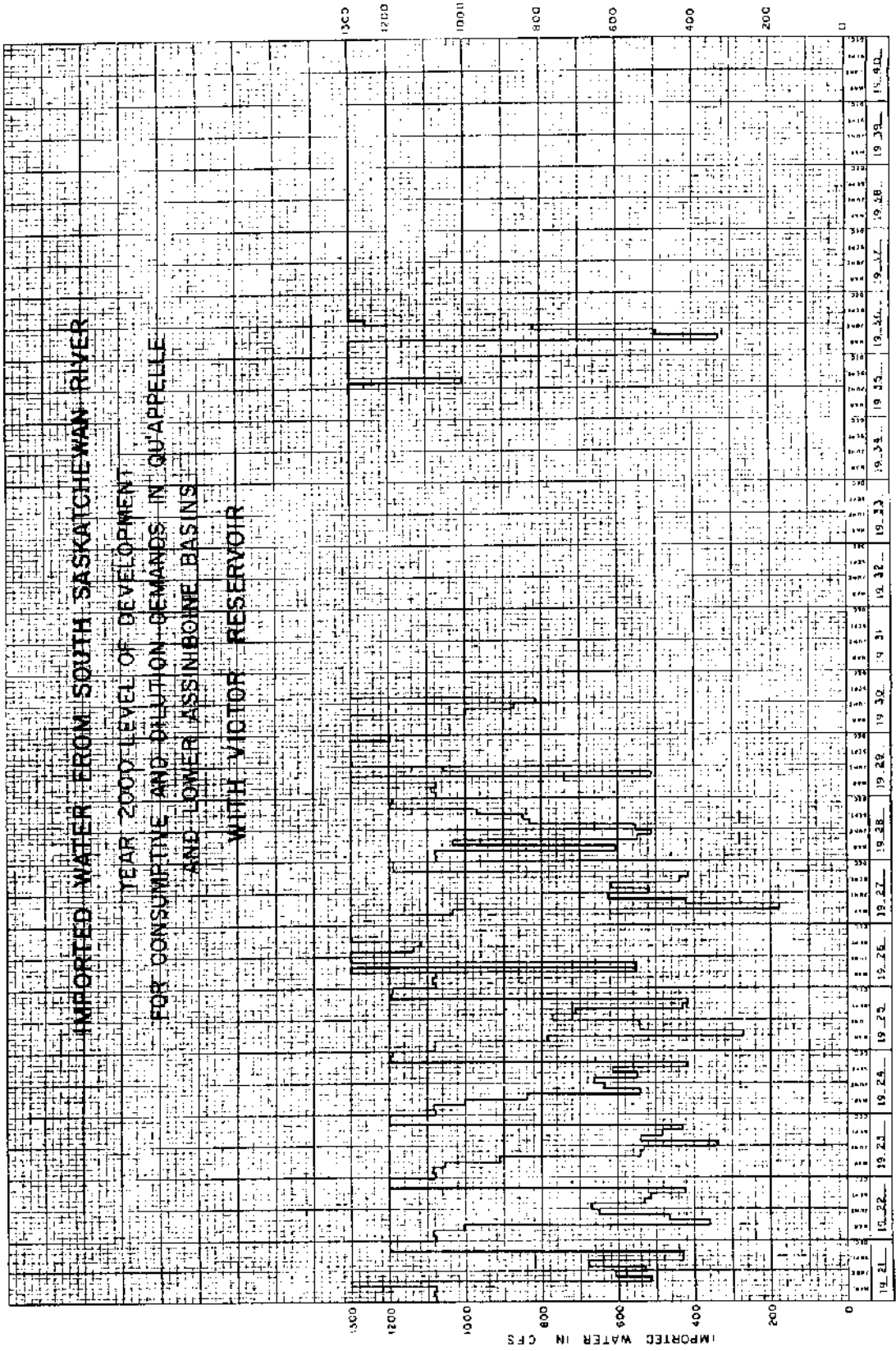
1571 20 YEARS BY ROUTING 47 2893  
 1572 1418 BY ROUTING 47 2893  
 1573 1418 BY ROUTING 47 2893



PERIOD OF THE STUDY

HYD-B-142  
FIG. 7

H-E 20 YEARS BY MONTHS 47 2023  
R-110 DIVISIONS  
MAY 1951 - 1958 C.F.

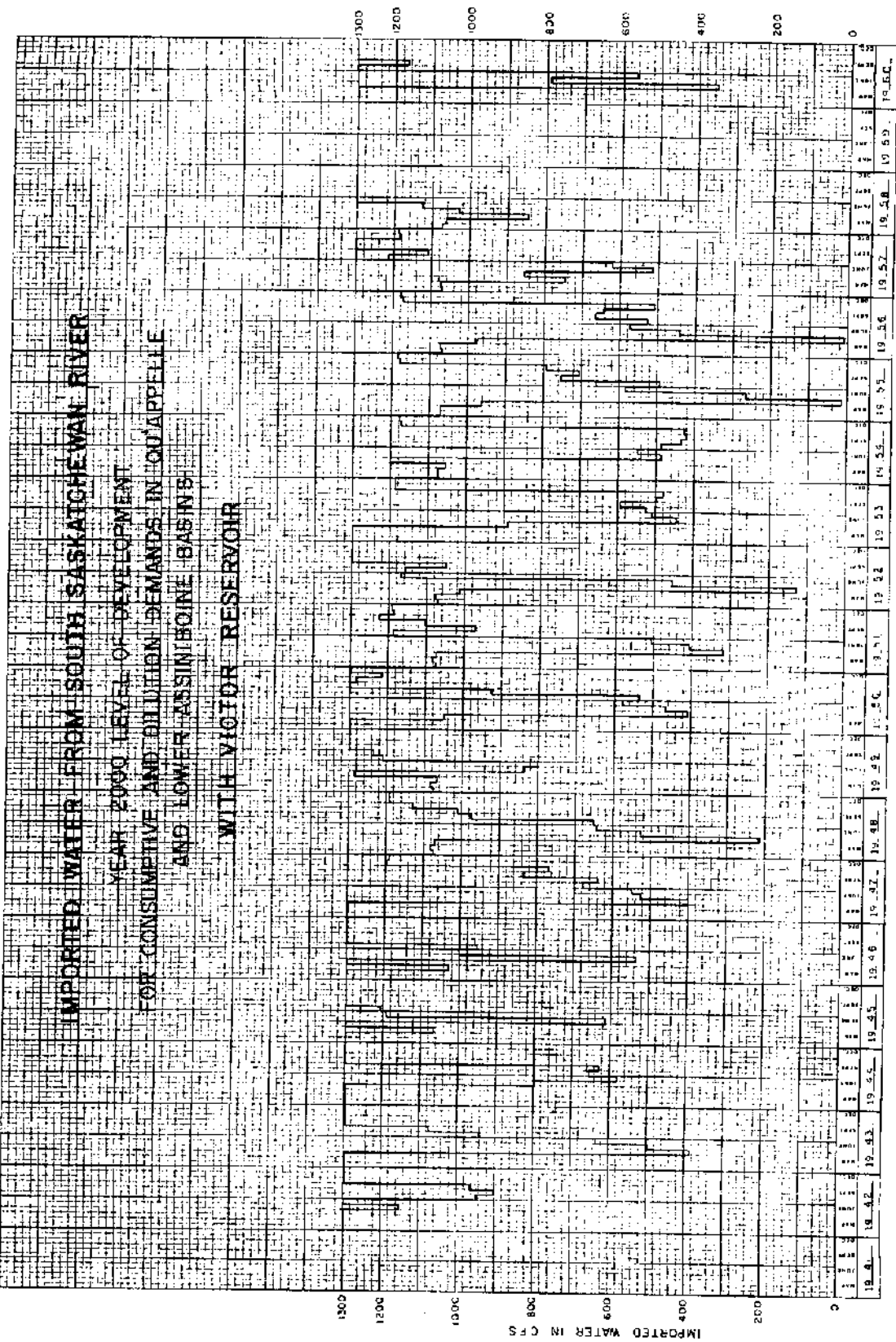


PERIOD OF F.L. STUDY

HYD-8-143  
 FIG. 8

K-M 20 YEARS BY MONTHS 47 3853  
 2 710 BIV. 8-296  
 REPORT A 3858 CO.

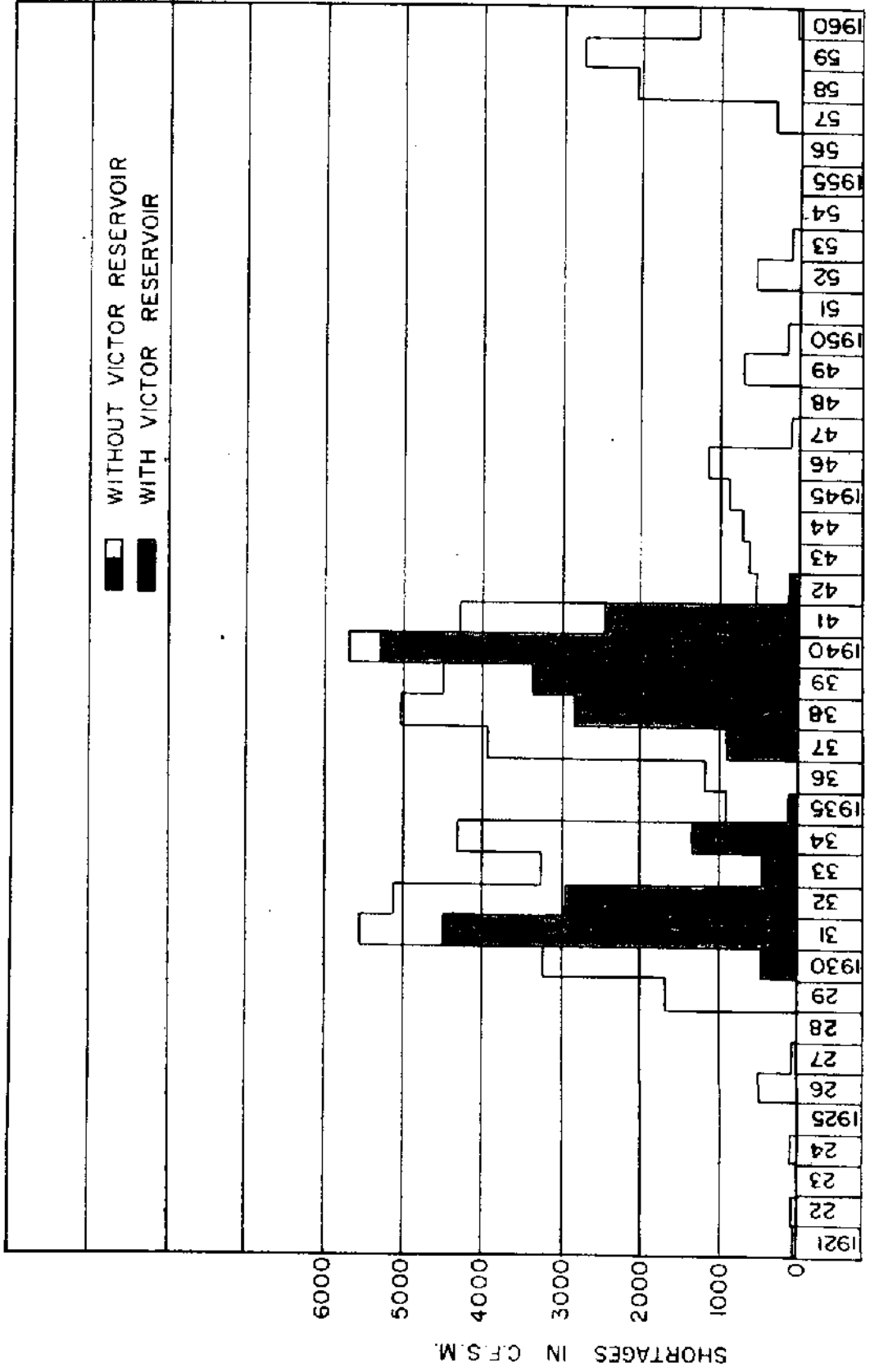
Hydrograph  
 20 YEARS MONTHLY  
 47 2853  
 DISTRICT ENGINEER  
 MINNAPOLIS



PERIOD OF THE STUDY

HYD.-B-144  
 FIG. 9

YEAR 2000 LEVEL OF DEVELOPMENT OF CONSUMPTIVE AND DILUTION DEMANDS  
ANNUAL SHORTAGES IN THE LOWER ASSINIBOINE BASIN  
AFTER MAXIMUM ALLOWABLE MONTHLY IMPORT FROM SOUTH SASK. RESERVOIR



PERIOD OF STUDY