TECHNICAL REPORT TO THE

PPWB COMMITTEE ON HYDROLOGY

NATURAL FLOW

SWAN RIVER

AT SASKATCHEWAN - MANITOBA BOUNDARY

PREPARED BY:

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SYNOPSIS

The average annual natural flow of Swan River at the Saskatchewan-Manitoba boundary is 184 100 dam^3. Average annual consumptive water use in the Saskatchewan portion of the basin now amounts to approximately 117 dam^3, 0.06% of the average annual natural flow.

The present (1983) level of consumptive use in the Saskatchewan portion of the Swan River basin would not have exceeded Saskatchewan's 50% share of the natural flow at the Saskatchewan-Manitoba boundary at any time during the 71-year period 1912-13 to 1982-83. In fact, Saskatchewan would have used an annual maximum of only 0.75% of the natural flow (corresponds to the water balance period 1963-64). The average annual quantity of water which would have been delivered to Manitoba in excess of 50% of natural flow would have amounted to approximately 91 900 dam^3.

The existing hydrometric network does not provide adequate hydrometric data for calculating the natural flow of Swan River at the Saskatchewan-Manitoba boundary. However, an accurate estimate of natural flow at the boundary is not required until water uses in the Saskatchewan portion of the basin become significant. Monitoring of apportionment is not required at the present time because the uses in the Saskatchewan portion of the basin are negligible.

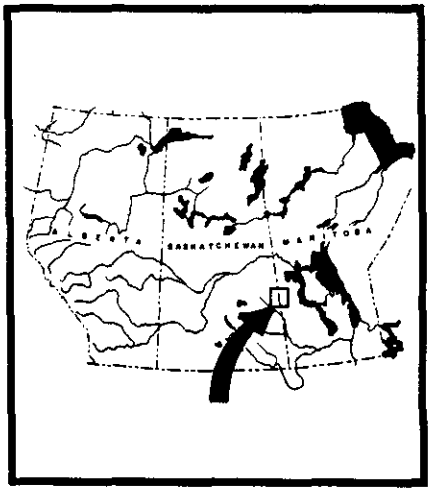


TABLE OF CONTENTS

	Page Number
INTRODUCTION	1
BASIN GEOGRAPHY	3
BASIN WATER USE	5
NATURAL FLOW CALCULATIONS	7
PRESENT USE FLOW CALCULATIONS	13
PROCEDURE FOR FUTURE CALCULATION OF NATURAL FLOW	15
CONCLUSIONS AND RECOMMENDATIONS	23
ACKNOWLEDGEMENTS	25
BIBLIOGRAPHY	27

Page Number

APPENDICES:

Appendix A - Water Use - Swan River Basin at the Saskatchewan-Manitoba Boundary 29

Appendix B - Recorded and Natural Streamflow Arrays 33

TABLES:

1 Water Use Projects within the Effective Drainage Area of the Swan River Basin 6

2 Partial Natural Flow Calculations - 1983 Swan River near Minitonas - 05LE006 18

3 Total Natural Flow Calculations - 1983 Swan River near Minitonas - 05LE006 20

4 Natural Flow Calculations - 1983 Swan River near Norquay - 05LE008 21

5 Determination of Natural Flows - 1983 Swan River at Saskatchewan-Manitoba Boundary 22

APPENDIX A

A-1 Swan River Basin at the Saskatchewan-Manitoba Boundary - Total Historic Water Use 31

A-2 Swan River Basin at the Saskatchewan-Manitoba Boundary - Total Water Use at the Present (1983) Level of Use 32

Page Number

APPENDIX B

B-1 Swan River at Swan River - 05LE001 Recorded Flow 35

B-2 Swan River near Minitonas - 05LE006 Recorded Flow 36

B-3 Swan River near Norquay - 05LE008 Recorded Flow 37

B-4 Swan River near Minitonas - 05LE006 Regression Equations Used to Estimate Natural Monthly Mean Flow 38

B-5 Swan River near Minitonas - 05LE006 Natural Flow 39

B-6 Swan River near Norquay - 05LE008 Natural Flow for Recorded Period 40

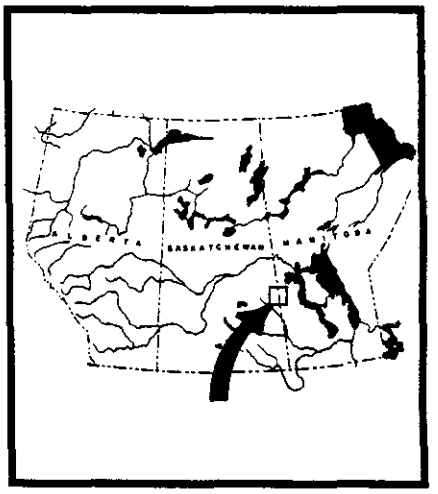
B-7 Swan River at the Saskatchewan-Manitoba Boundary Natural Flow 41

B-8 Swan River at the Saskatchewan-Manitoba Boundary Flows at the Present (1983) Level of Upstream Use . . . 42

B-9 Swan River Basin Balance of Flow Table for Apportionment at the Present (1983) Level of Use . . . 43

FIGURE:

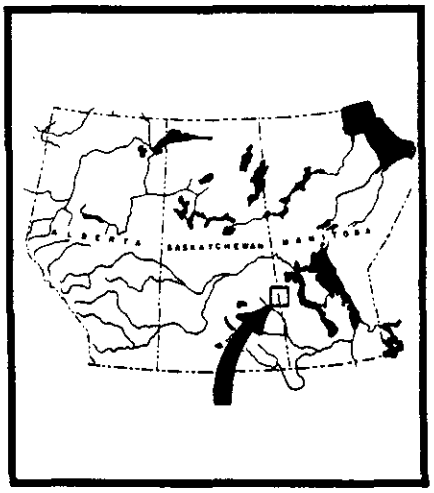
1 Location Map of the Swan River Basin 45



INTRODUCTION

The Swan River natural flow study is one of a series of natural flow studies conducted for the Prairie Provinces Water Board. Following completion of the Prairie Provinces Water Board's study on determination of natural flow of the North Saskatchewan, South Saskatchewan, Saskatchewan, Churchill, and Qu'Appelle River basins in 1977, the Board agreed to have other interprovincial basins studied to determine if monitoring of flow for apportionment purposes might be required. Eighteen interprovincial basins were initially identified and assigned a priority. (Two additional basins, Beaver River and Overflowing River, were subsequently added to the list.) The Board agreed that the basins would be studied in order of priority as funds and time became available.

This report entitled 'Natural Flow, Swan River at Saskatchewan-Manitoba Boundary' describes the basin geography, water use within the basin, and the derivation of historic natural flows at the Saskatchewan-Manitoba boundary. The present (1983) level of use is analyzed in conjunction with natural flows to determine the potential for apportionment deficits now and in the foreseeable future. The procedure to be used for the future calculation of natural flow is also provided, and the adequacy of the existing hydrometric network for the determination of natural flow at the interprovincial boundary is assessed.



BASIN GEOGRAPHY

Swan River originates in eastern Saskatchewan, immediately west of the Porcupine Hills, approximately 75 km north of the Town of Norquay, Saskatchewan (see Figure 1). The river flows in a southerly direction for approximately 80 km and then, near the Town of Norquay, it swings in an easterly direction for 30 km before passing into Manitoba. After reaching Manitoba, the river takes a northeasterly course for approximately 25 km to the Town of Swan River. The river continues flowing in a northeasterly direction and eventually discharges into Swan Lake approximately 55 km from the Town of Swan River.

The topography of the area provides reasonably well drained conditions throughout the basin (i.e. effective to gross drainage area ratio is in the order of 0.85). However, in certain portions of the basin, runoff is retarded by several small lakes. Consequently, the unit runoff in these areas is probably somewhat lower than for the rest of the basin.

The gross and effective drainage areas of the Swan River basin at the Saskatchewan-Manitoba boundary are 3 397 km^2 and 2 831 km^2, respectively. A minor portion of the runoff at the boundary originates in Manitoba from an area having a gross drainage area of 227 km^2 and an effective drainage area of 212 km^2. Also, a minor tributary of the Swan

River originates in Saskatchewan and flows into Manitoba, joining the Swan River between the interprovincial boundary and the gauging station Swan River at Swan River (05LE001). The drainage area (effective drainage area equals gross drainage area) of the Saskatchewan portion of this tributary is 58.8 km^2. A table of gross and effective drainage areas[1,2] for key points in the basin is provided in Figure 1.

Swan River is classified as a perennial stream. Snowmelt in the spring contributes to high flows which eventually give way to a generally diminishing base flow resulting from groundwater contribution which persists throughout the remainder of the year. The median and mean annual natural runoff volumes of Swan River at the Saskatchewan-Manitoba boundary are 161 900 dam^3 and 184 100 dam^3, respectively. These values were determined from the array of natural flows at the interprovincial boundary as presented in Appendix B, Table B-7.

BASIN WATER USE

No major water use projects are located within the effective drainage area in the Saskatchewan portion of the Swan River basin. However, the Bear Head Creek Project (file number 13931), constructed by Ducks Unlimited in 1979, is sufficiently large that the project was simulated separately to determine the evaporative water use of the project. Information on licensed minor water use projects was obtained from the Saskatchewan Water Corporation. Unauthorized water use projects were identified on aerial photographs and then investigated during an October, 1984 field trip. This field assessment involved quantitatively estimating the amount of use (including evaporation losses) for all man-made storages and interviewing local residents to determine the period of time each project had been in operation. All water use projects within the effective drainage area of the Swan River basin at the Saskatchewan-Manitoba boundary are included in Table 1.

Several licensed and unauthorized minor water use projects are located within the effective drainage area in the Manitoba portion of the Swan River basin. Information on licensed water use projects was obtained from the Water Resources Branch of the Manitoba Department of Natural Resources. Unauthorized water use projects were identified on aerial photographs and assessed during the October, 1984 field investigation. In addition, effluent from the Town of Swan River sewage system is

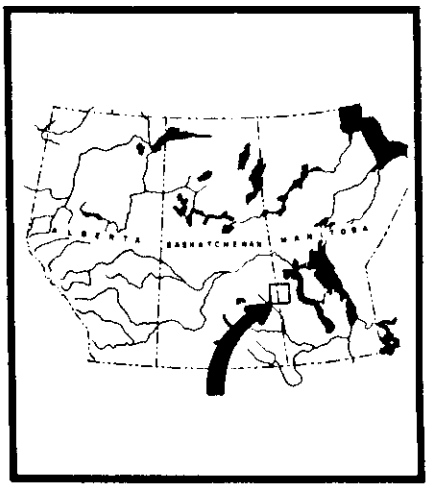
discharged into the Swan River. (The town obtains its water from wells.) Monthly effluent discharges from the Town of Swan River sewage system were estimated from water consumption records and historic system operation. Prior to 1954, no sewage was discharged into the Swan River by the Town of Swan River. Between 1954 and 1975, the sewage treatment plant utilized an activated sludge process and was assumed to have discharged effluent uniformly throughout the year. Since 1975, the Town of Swan River has used aerobic lagoons for sewage treatment. Effluent discharge from these lagoons is assumed to have occurred twice a year in the months of May and October.

An itemized list of all historic water uses within the effective drainage area of the Swan River basin is provided in Table 1.

Table 1
Water Use Projects within the Effective Drainage Area of the Swan River Basin

Project Number	Land Location	Province	Project Status	File Number	First Year of Operation	Purpose	Reservoir Capacity (dam^3)	Estimated Annual Depletion* (dam^3)	Comments
1	SE19-32-29-1	Sask.	Licensed	13931	1979	Wildlife	2506	72.7	
2	SE24-33-30-1	Sask.	Licensed	14660	1982	Irrigation	-	27.0	
3	NE15-33-32-1	Sask.	Unauthorized		1940	Domestic	37.0	7.4	Washed Out in 1974
4	NE33-33-01-2	Sask.	Unauthorized		1947	Domestic	19.7	7.9	
5	SE06-35-01-2	Sask.	Unauthorized		1940	Domestic	6.1	2.5	Washed Out in 1957
6	NW20-35-01-2	Sask.	Licensed	08944	1964	Irrigation	-	6.0	
7	SW04-36-01-2	Sask.	Licensed	07182	1957	Domestic	3.7	2.5	
8	SE15-37-01-2	Sask.	Unauthorized		1937	Domestic	4.9	3.6	
9	SE05-26-28-1	Man.	Licensed	63-12	1963	Irrigation	-	18.5	Abandoned in 1972
10	NE20-34-28-1	Man.	Unauthorized		1940	Domestic	14.8	5.6	
11	NW11-35-28-1	Man.	Licensed	71-19	1971	Domestic	4.0	2.9	
12	NE29-33-29-1	Man.	Unauthorized		1937	Domestic	14.8	3.0	
13	W 24-35-29-1	Man.	Licensed	81-76	1981	Irrigation	-	247.0	
14	E 26-35-29-1	Man.	Licensed	81-77	1981	Irrigation	-	247.0	

* Estimated average annual net depletion to streamflow, including evaporation.



NATURAL FLOW CALCULATIONS

Natural flow, the quantity of water which would have been recorded under natural conditions (i.e. prior to the effect of human interference or intervention), was derived by using the Project Depletion Method[3] to adjust recorded flow. The natural flows were transferred, as appropriate, from the gauging station Swan River at Swan River (05LE001) to the gauging station Swan River near Minitonas (05LE006) and the resultant partial array was extended to cover the 72-year historic period 1912 to 1983. The natural flows were then transferred to the Saskatchewan-Manitoba boundary using a procedure based on drainage area ratios.

The first hydrometric gauging station in the basin, Swan River at Swan River (05LE001), was established in 1912 and operated for 25 years until 1936. It was reactivated in 1950 and operated for 11 years until 1960. In 1960, the station was moved 18 km downstream and since then, it has been operated as the hydrometric gauging station Swan River near Minitonas (05LE006). Another hydrometric gauging station, Swan River near Norquay (05LE008), was established upstream of the Saskatchewan-Manitoba boundary in 1965 and is also still in operation. The arrays of recorded monthly mean flows for these three stations are shown in Appendix B, Tables B-1, B-2 and B-3.

Historic upstream minor water uses within the effective drainage area of the Swan River basin, as shown in Table 1, were determined on an annual basis as a function of estimated water use (including evaporation) and available inflow. The estimated annual water uses varied from year to year because of the variable net evaporation and the limitation of restricting annual water use in any given year to available flow. All of the water use projects presented in Table 1 lie within the effective drainage area of the Swan River basin above the most downstream hydrometric gauging station, Swan River near Minitonas (05LE006) and thus were used in the natural flow calculations.

The variable estimated annual water uses for all projects located above each of the three hydrometric gauging stations were added to the appropriate recorded monthly mean flows of the respective gauging stations. The resulting natural monthly mean flows for the station 05LE001 were transferred downstream to the hydrometric station 05LE006 using the effective drainage area ratio of 1.045 to produce an array of natural monthly mean flows of Swan River near Minitonas (05LE006) for the years 1912 to 1936 and 1950 to 1983. Natural monthly mean flows for periods of missing record in the period 1912 to 1983 were estimated from recorded and natural flows in adjacent drainage basins, and from precipitation records for the nearest long-term climate station (Yorkton).

For the months March to November inclusive, missing natural monthly mean flows of Swan River near Minitonas (05LE006) were estimated using the regression equations presented in Appendix B, Table B-4. Priorities were assigned to the regression equations on the basis of the adjusted (to account for degrees of freedom) coefficient of correlation, the adjusted standard error of estimate, the magnitude of the intercept, and the overall hydrologic validity of each equation. The regression equation assigned priority No. 1 was used to estimate as many missing values as possible, then the regression equations assigned priorities No. 2, 3 and 4 were used to estimate values which had not been estimated from higher priority regression equations. The variables used in these

regression equations were selected on the basis of hydrologic similarity and their potential for providing estimates of flow for periods of missing data.

For the months December to February inclusive, missing natural flows of Swan River near Minitonas (05LE006) were derived from graphical regression analysis with natural flows of Assiniboine River at Brandon (05MH001) for the corresponding period. (The station Assiniboine River at Brandon [05MH001] was the only station in the vicinity that had recorded winter flows which covered the corresponding period of missing data for the base station, Swan River near Minitonas [05LE006].) The summed winter flow for the missing months December to February were determined from the graphical regression analysis. Based on the recorded period 1961-83, the monthly mean flow in each individual month was then calculated as a fixed proportion of the estimated summed winter flow; December as 50%, January as 28%, and February as 22% of the summed winter flow.

Natural flows of Swan River at the Saskatchewan-Manitoba boundary were determined for all months of the period 1974-83, for March to October of 1965-73 and for November and December of 1973 by interpolating between calculated natural flows for the hydrometric gauging stations Swan River near Minitonas (05LE006) and Swan River near Norquay (05LE008) using the equation:

$$Q_1 = Q_2 + \frac{A_1 - A_2}{A_3 - A_2}(Q_3 - Q_2)$$

$$= 0.4156\ Q_2 + 0.5844\ Q_3$$

where:

Q_1 = Natural monthly mean flow (m^3/s) of Swan River at the Saskatchewan-Manitoba boundary,

Q_2 = Natural monthly mean flow (m^3/s) of Swan River near Norquay (05LE008),

Q_3 = Natural monthly mean flow (m^3/s) of Swan River near Minitonas (05LE006),

A_1 = Effective drainage area (km^2) of Swan River at the Saskatchewan-Manitoba boundary,

A_2 = Effective drainage area (km^2) of Swan River near Norquay (05LE008), and

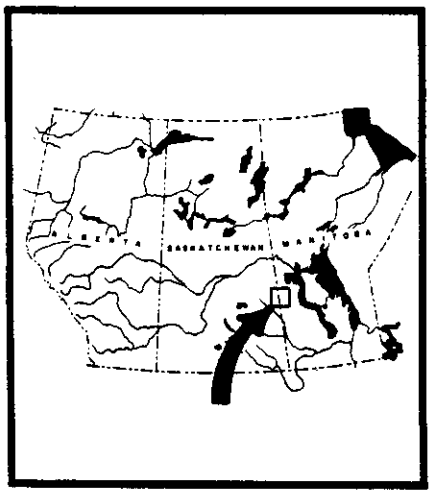
A_3 = Effective drainage area (km^2) of Swan River near Minitonas (05LE006).

For all other months in the period 1912-83, natural flows of Swan River at the Saskatchewan-Manitoba boundary were determined using only the natural flows derived for the hydrometric gauging station Swan River near Minitonas (05LE006). It was felt that using only this station to estimate natural flows at the boundary provided better estimates than could have been obtained by also utilizing the upstream station (i.e. 05LE008) whereby estimates of natural flow at the boundary would have been calculated as before by interpolation between the two stations 05LE008 and 05LE006. (An additional inherent uncertainty would have been introduced by the use of estimated monthly flows for 05LE008.) However, the upstream station was used indirectly. Twelve linear relationships between the ratio of average monthly runoff for the hydrometric station Swan River near Norquay (05LE008) to average monthly runoff for the hydrometric station Swan River near Minitonas (05LE006) were developed based on the overlapping period of record 1965-83. These monthly relationships were substituted into the foregoing equation and the equation was reduced to simply a function of Q_3 having the following monthly coefficients:

January	- 0.922	July	- 0.869
February	- 0.972	August	- 0.870
March	- 0.920	September	- 0.991
April	- 0.749	October	- 0.943
May	- 0.815	November	- 0.929
June	- 0.857	December	- 0.933

The simplified monthly relationships were used to transfer natural flows derived for the hydrometric gauging station Swan River near Minitonas (05LE006) to the Saskatchewan-Manitoba boundary. The resulting

natural monthly mean flows derived for Swan River at the Saskatchewan-Manitoba boundary for the water years 1912-13 to 1982-83 are shown in Appendix B, Table B-7. Caution should be exercised by users who may wish to utilize this data base in conducting other studies. Such data users should recognize the limitations of the estimates which were made. The estimates have been published because it is unlikely that better estimates of streamflow can be generated based on the present level of hydrologic expertise in estimating missing streamflow data. These estimates provide an adequate means of evaluating the effect of present consumptive water use in Saskatchewan on flows of Swan River at the Saskatchewan-Manitoba boundary over the 71-year historic period 1912-13 to 1982-83.



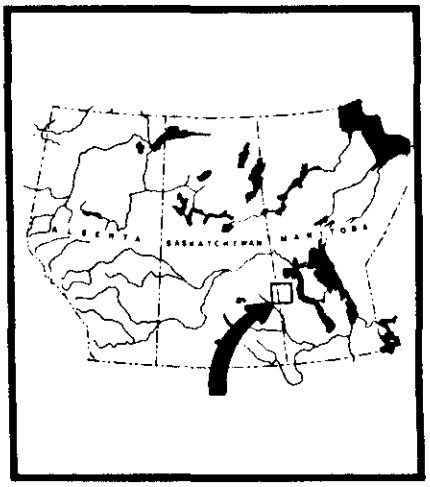
PRESENT USE

FLOW CALCULATIONS

An analysis was made to determine whether present (1983) use flow of Swan River at the Saskatchewan-Manitoba boundary would have been less than 50% of the natural flow, under the terms of the 1969 Master Agreement on Apportionment, in the period 1912-13 to 1982-83. A monthly array of uses was created, assuming that the Bear Head Creek Project (file number 13931) and the current minor uses upstream of the Saskatchewan-Manitoba boundary (note: all uses are in Saskatchewan) were in existence for the entire study period. The existing water uses within the effective drainage area of the Swan River basin upstream of the interprovincial boundary were determined for the study period on an annual basis as a function of estimated water use (including evaporation) and available inflow. The estimated annual water uses varied from year to year because of the variable net evaporation and the limitation of restricting annual water use in any given year to available flow. Current water uses upstream of the Saskatchewan-Manitoba boundary were combined to form an array of monthly uses (Appendix A, Table A-2). This array of monthly uses was subtracted from the natural flows at the interprovincial boundary to produce an estimate of monthly flows (Appendix B, Table B-8) which would have been recorded at the Saskatchewan-Manitoba boundary during the period 1912-13 to 1982-83 had the present (1983) level of use been in effect for the entire period.

An array of one-half the natural flow at the interprovincial boundary was then subtracted from the array of natural flows adjusted for present use (Appendix B, Table B-8). The residual monthly flows (Appendix B, Table B-9) provide a picture of the balance-of-flow situation for Swan River over the 71-year historic period 1912-13 to 1982-83. Table B-9 indicates that Saskatchewan would have always passed at least 50% of the natural flow of Swan River at the interprovincial boundary on a monthly basis during the 71-year period. In fact, Saskatchewan would have used an annual maximum of only 0.75% of the natural flow (corresponds to the water balance period 1963-64) under the present (1983) level of development. Thus, Manitoba would have received an average annual volume of approximately 91 900 dam^3 in excess of its 50% share.

At some time in the future, the procedure for determining whether both provinces have received their share of the natural flow may become more complex depending upon the magnitude and location of water use projects because a portion of the basin drains from Manitoba into Saskatchewan. However, as the portion of the basin which drains from Manitoba into Saskatchewan is relatively small, the need for a complex methodology is unlikely. If required, the implementation of a methodology for monitoring the apportionment of flow will be made by the appropriate jurisdictions using the methodology presented in a report[4] currently being prepared for the PPWB by the Committee on Hydrology. This methodology has been developed specifically as a base for providing a mutual resolution of flow apportionment in such situations (i.e. apportionment of flows in westward flowing tributaries of eastward flowing streams).



PROCEDURE FOR FUTURE CALCULATION OF NATURAL FLOW

If it becomes necessary to formally monitor the apportionment of streamflow in the Swan River basin, natural flow calculations would have to be performed on a regular basis to ensure that Manitoba receives its share of the flow. Natural flows of Swan River would be computed using the Project Depletion Method, based on the generalized equation:

$$Q_{Nat.} = Q_{Rec.} + N.D.$$

where:

$Q_{Nat.}$ is the natural flow at the hydrometric station,

$Q_{Rec.}$ is the recorded flow at the hydrometric station, and

N.D. is the net depletion of streamflow at upstream projects.

The net depletion of streamflow at a project may be computed as the sum of:

1. water withdrawal for human or livestock use, less the portion of this withdrawal which is returned to the stream or reservoir,
2. net evaporation (gross evaporation minus precipitation) from the reservoir, and
3. change in reservoir storage over the specified time interval; an increase in storage is considered a positive (+) net depletion while a decrease in storage is considered a negative (-) net depletion.

The computed natural flows at the interprovincial boundary to be used for monitoring flow apportionment should be determined using the methodology developed in this section. However, the methodology may have to be modified as necessary to account for any further developments in the basin or changes to the hydrometric network. This section describes the procedure for calculation of natural flow of Swan River at the Saskatchewan-Manitoba boundary based on current water use projects and the existing hydrometric network. The procedure has been simplified because of the insignificance of the current water use in relation to runoff. When water use in the Swan River basin becomes significant, a more complex procedure such as the one used to calculate historic natural flows should be considered.

Recorded flows of Swan River near Minitonas (05LE006) and Swan River near Norquay (05LE008) are first adjusted for net depletions to streamflow by upstream projects. The resultant natural flows are then used to estimate the natural flow at the Saskatchewan-Manitoba boundary. A more detailed explanation of the entire process is provided in the following subsections.

1) Net Depletions to Natural Flow

a) Swan River near Minitonas (05LE006)

Flow of Swan River near Minitonas (05LE006) is affected by all water uses within the effective drainage area of the Swan River basin above the station including effluent discharges from the Town of Swan River sewage lagoons, minor water uses in both Saskatchewan and Manitoba and water use by major projects such as the Ducks Unlimited Bear Head Creek Project (file number 13931). The effluent discharges increase the flow, while the other water uses decrease the flow. The effects of these "uses" must be considered in determining the flow that would have occurred under natural conditions.

i) Town of Swan River Sewage Effluent Discharges

The Town of Swan River presently obtains its water supply from groundwater through two wells on the northeast town limits.

Sewage is then treated in lagoons located approximately two kilometres northeast of the town limits and discharged twice annually into the Swan River. These discharges are made after May 15th and prior to November 1st, provided that effluent B.O.D. levels are approved by the Manitoba Environment and the Workplace Safety and Health Department.

Estimation of effluent discharge to Swan River is based on the following assumptions:

1. Nine percent of the annual groundwater volume pumped from town wells is used for backwashing and is added directly to the sanitary sewage system which discharges into the sewage lagoons.

2. The balance of the water is treated in the Town of Swan River water treatment plant and eighty percent of the treated water is assumed to be eventually discharged to the sewage lagoons.

3. The lagoons are assumed to discharge twice a year in the months of May and October. These discharges are assumed to be of equal volume equivalent to one-half the annual effluent volume.

As an example, 397 dam^3 of water was pumped from the Town of Swan River wells in 1983 and of this volume, 36 dam^3 was used for backwashing and then discharged directly to the lagoons. Of the remaining 361 dam^3 of treated water, eighty percent was assumed to pass through the sewage system as wastewater to be treated in the sewage lagoons. From the annual combined backwash and wastewater volume of 324.8 dam^3, equal discharges from the lagoons of 162.4 dam^3 in the months of May and October were assumed to reach the Swan River. Consequently, these volumes were deducted (i.e. by adding a negative value) from the recorded flow in the calculation of natural flow.

ii) Minor Water Uses

All estimated annual net depletions by existing water use projects (i.e. all projects shown in Table 1 excluding project numbers 3, 5 and 9) within the effective drainage area of the Swan River basin above the gauging station Swan River near Minitonas (05LE006) are considered. Domestic projects are assumed to deplete streamflow during

the month of major spring runoff. Pumped irrigation projects (project numbers 2, 6, 13 and 14) are assumed to use water uniformly throughout the summer months June to August. The wildlife project (project number 1) is assumed to deplete streamflow throughout the year, but because of its relatively large size, this project is given special consideration. However, before its effect on natural flow is determined, partial natural flows are calculated using all of the other water uses, including sewage effluent discharge.

Table 2 illustrates the procedure for calculating partial natural monthly mean flows of Swan River near Minitonas (05LE006) for 1983 by adding the minor water uses and effluent discharge depletions to the recorded flow.

Table 2
Partial Natural Flow Calculations - 1983
Swan River near Minitonas - 05LE006

Month	Recorded Flow		Minor Uses Net Depletion to Streamflow	Effluent Discharge Depletion to Streamflow	Partial Natural Flow*	
	(m^3/s)	(dam^3)	(dam^3)	(dam^3)	(dam^3)	(m^3/s)
January	0.838	2 244	0	0	2 244	0.838
February	0.605	1 464	0	0	1 464	0.605
March	0.321	860	0	0	860	0.321
April	34.1	88 387	25.5	0	88 412.5	34.110
May	30.5	81 691	0	-162.4	81 528.6	30.440
June	12.5	32 400	175.7	0	32 575.7	12.568
July	20.9	55 979	175.7	0	56 154.7	20.965
August	5.47	14 651	175.7	0	14 826.7	5.535
September	2.48	6 428	0	0	6 428	2.48
October	2.72	7 285	0	-162.4	7 122.6	2.660
November	2.65	6 869	0	0	6 869	2.65
December	1.25	3 348	0	0	3 348	1.25

* Summation of recorded flow, minor use depletion and effluent discharge depletion.

iii) Bear Head Creek Project (project number 1)

Ducks Unlimited constructed the Bear Head Creek Project at SE19-32-29-W1 in 1979 to control water levels on an existing lake in order to promote the production of migratory waterfowl. Since this project raises the level of an existing lake, the net depletion of

streamflow by this project is calculated as the difference between an estimate of the natural outflow from the lake without controls and the outflow from the project with controls in place.

To calculate the net depletion of this project, reservoir simulations must be performed to calculate both the outflow under natural conditions and the outflow under present conditions. Inflow to the project under both conditions can be estimated by applying the effective drainage area ratio of 0.0276 to the partial natural flows for Swan River near Minitonas (05LE006). Partial natural flows are determined as previously described by accounting for the Town of Swan River effluent discharges and the minor uses above the station excluding the Bear Head Creek Project.

The estimated natural monthly inflows are routed through the reservoir, accounting for monthly reservoir demands. (The only demand on this project is the evaporation losses from the lake surface area. Net evaporation at the project is estimated by transferring precipitation and gross evaporation from Yorkton using transfer factors of 1.118 and 0.830, respectively.) The net depletion by the Bear Head Creek Project is calculated as the difference between the estimated natural outflow from the lake and the estimated spills from the constructed project. This net depletion is then added to the partial natural flow of Swan River near Minitonas (05LE006) in order to obtain the final natural flows for that gauging station. Table 3 illustrates the procedure for calculating natural monthly mean flows of Swan River near Minitonas (05LE006) for 1983 by adding the difference between natural outflows and project spills to the partial natural flows of Swan River near Minitonas (05LE006).

Table 3
Total Natural Flow Calculations - 1983
Swan River near Minitonas - 05LE006

Month	Partial Natural Flow(1) (m^3/s)	Partial Natural Flow(1) (dam^3)	Bear Head Lake Inflow(2) (dam^3)	Natural Outflow(3) (dam^3)	Project Spills(4) (dam^3)	Difference(5) (dam^3)	Total Natural Flow(6) (dam^3)	Total Natural Flow(6) (m^3/s)
January	0.838	2 244	61.9	0	0	0	2 244	0.838
February	0.605	1 464	40.4	0	0	0	1 464	0.605
March	0.321	860	23.7	0	0	0	860	0.321
April	34.110	88 412.5	2 440.2	2 276.6	2 212.5	64.1	88 476.6	34.135
May	30.440	81 528.6	2 250.2	2 250.2	2 250.2	0	81 528.6	30.440
June	12.568	32 575.7	899.1	899.1	899.1	0	32 575.7	12.568
July	20.965	56 154.7	1 549.8	1 549.8	1 549.8	0	56 154.7	20.965
August	5.535	14 826.7	409.2	0.6	0	0.6	14 827.3	5.535
September	2.48	6 428	177.4	0	0	0	6 428	2.480
October	2.660	7 122.6	196.6	0	0	0	7 122.6	2.660
November	2.65	6 869	189.6	72.0	12.8	59.2	6 928.2	2.673
December	1.25	3 348	92.4	92.4	92.4	0	3 348	1.250

(1) From Table 2.
(2) Calculated as partial natural flow(1) multiplied by 0.0276.
(3) Estimated natural outflow from Bear Head Lake derived from reservoir simulations.
(4) Estimated project spills from Bear Head Creek Project derived from reservoir simulations.
(5) Calculated as natural outflow(3) minus project spills(4).
(6) Calculated as partial natural flow(1) plus the difference(5) between natural outflow and project spills.

b) Swan River near Norquay (05LE008)

Natural flow of Swan River near Norquay (05LE008) is affected by minor water use projects (project numbers 6, 7 and 8 shown in Table 1) within the effective drainage area of the Swan River basin above the station in Saskatchewan. Domestic projects are assumed to deplete streamflow during the first month of significant spring runoff. The pumped irrigation project (project number 6) is assumed to use water uniformly throughout the summer months June to August.

Table 4 illustrates the procedure for calculating natural monthly mean flows of Swan River near Norquay (05LE008) for 1983 by adding the minor water uses to the recorded flow.

Table 4
Natural Flow Calculations - 1983
Swan River near Norquay - 05LE008

Month	Recorded Flow		Minor Uses Net Depletion to Streamflow (dam^3)	Natural Flow*	
	(m^3/s)	(dam^3)		(dam^3)	(m^3/s)
January	0.550	1 473	0	1 473	0.550
February	0.466	1 127	0	1 127	0.466
March	0.511	1 369	0	1 369	0.511
April	10.1	26 179	6.1	26 185.1	10.102
May	17.0	45 533	0	45 533	17.0
June	6.16	15 966	2.0	15 968	6.161
July	14.5	38 837	2.0	38 839	14.501
August	2.67	7 151	2.0	7 153	2.671
September	2.18	5 651	0	5 651	2.18
October	2.02	5 410	0	5 410	2.02
November	2.25	5 832	0	5 832	2.25
December	1.41	3 777	0	3 777	1.41

* Summation of recorded flow and minor use depletion.

2) Transfer of Natural Flows to the Interprovincial Boundary

Natural flows of Swan River at the Saskatchewan-Manitoba boundary are determined by interpolating between estimated natural flows at the hydrometric gauging stations Swan River near Minitonas (05LE006) and Swan River near Norquay (05LE008) using the equation:

$$Q_1 = Q_2 + \frac{A_1 - A_2}{A_3 - A_2}(Q_3 - Q_2)$$

$$= 0.4156\ Q_2 + 0.5844\ Q_3$$

where:

Q_1 = Natural monthly mean flow (m^3/s) of Swan River at the Saskatchewan-Manitoba boundary,

Q_2 = Natural monthly mean flow (m^3/s) of Swan River near Norquay (05LE008),

Q_3 = Natural monthly mean flow (m^3/s) of Swan River near Minitonas (05LE006),

A_1 = Effective drainage area (km^2) of Swan River at the Saskatchewan-Manitoba boundary,

A_2 = Effective drainage area (km^2) of Swan River near Norquay (05LE008), and

A_3 = Effective drainage area (km^2) of Swan River near Minitonas (05LE006).

Table 5 illustrates the procedure for transferring Swan River natural flows from the hydrometric gauging stations to the interprovincial boundary for 1983.

Table 5
Determination of Natural Flows - 1983
Swan River at Saskatchewan-Manitoba Boundary

Month	Natural Flow for 05LE008(1) (m^3/s)	Natural Flow for 05LE006(2) (m^3/s)	Natural Flow at Interprovincial Boundary(3) (m^3/s)
January	0.550	0.838	0.718
February	0.466	0.605	0.547
March	0.511	0.321	0.400
April	10.102	34.135	24.147
May	17.0	30.440	24.854
June	6.161	12.568	9.905
July	14.501	20.965	18.279
August	2.671	5.535	4.345
September	2.18	2.480	2.355
October	2.02	2.660	2.394
November	2.25	2.673	2.497
December	1.41	1.250	1.316

(1) From Table 4
(2) From Table 3
(3) 0.4156 (05LE008) + 0.5844 (05LE006)

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. The average annual consumptive water use in the Saskatchewan portion of the Swan River basin now represents 0.06% of the average annual natural flow of Swan River at the Saskatchewan-Manitoba boundary.

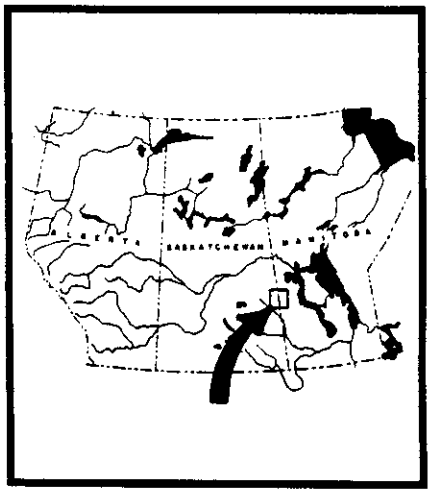
2. Under present (1983) conditions, at least 50% of the natural flow of Swan River at the Saskatchewan-Manitoba boundary would have been passed to Manitoba in all months of the 71-year period 1912-13 to 1982-83. In fact, Saskatchewan would have used an annual maximum of only 0.75% of the natural flow (corresponds to the water balance period 1963-64). The average annual quantity of water which would have been delivered to Manitoba in excess of 50% of natural flow during the 71-year period would have been approximately 91 900 dam^3.

3. The existing hydrometric network is not adequate for calculating the natural flow of Swan River at the Saskatchewan-Manitoba boundary. However, an accurate estimate of natural flow at the boundary is not required until water uses in the Saskatchewan portion of the basin become significant.

RECOMMENDATIONS

1. Based on the present (1983) level of development in the Saskatchewan portion of the Swan River basin, monitoring of apportionment should not be implemented at this time.

2. If monitoring of apportionment becomes necessary, a hydrometric gauging station should be established at the Saskatchewan-Manitoba boundary.



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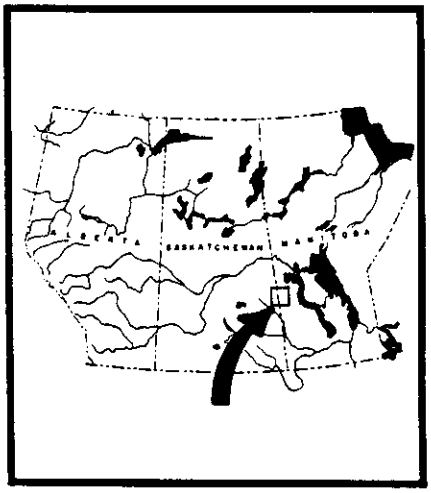

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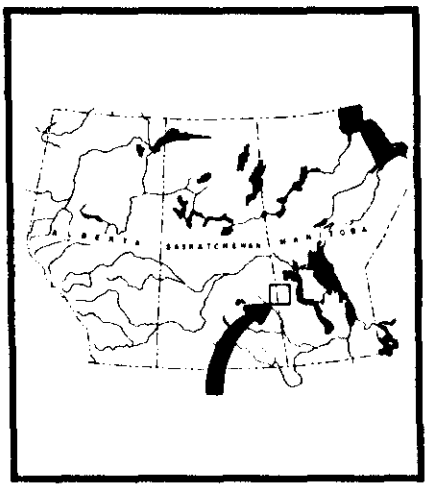


APPENDIX A

WATER USE

SWAN RIVER BASIN

AT THE

SASKATCHEWAN - MANITOBA

BOUNDARY

Page Number

A-1 Swan River Basin at the Saskatchewan-Manitoba Boundary - Total Historic Water Use 31

A-2 Swan River Basin at the Saskatchewan-Manitoba Boundary - Total Water Use at the Present (1983) Level of Use 32

Table A-1

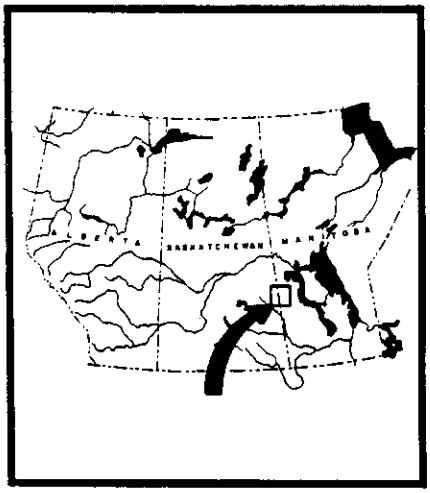
SWAN RIVER BASIN AT THE SASKATCHEWAN-MANITOBA BOUNDARY
TOTAL HISTORIC WATER USE - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU. DAMS
1912	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1913	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1914	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1915	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1916	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1917	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1918	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1919	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1920	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1921	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1922	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1923	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1924	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1925	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1926	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1927	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1928	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1929	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1930	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1931	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1932	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1933	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1934	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1935	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1936	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1937	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1938	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0
1939	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3
1940	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2
1941	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5
1942	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11
1943	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16
1944	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8
1945	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8
1946	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14
1947	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10
1948	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12
1949	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16
1950	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	19
1951	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	17
1952	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15
1953	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	14
1954	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	20
1955	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21
1956	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	15
1957	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	20
1958	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21
1959	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	21
1960	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	23
1961	0.000	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	18
1962	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	30
1963	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	36
1964	0.000	0.000	0.000	0.011	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	25
1965	0.000	0.000	0.000	0.009	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	34
1966	0.000	0.000	0.000	0.008	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	29
1967	0.000	0.000	0.000	0.009	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	26
1968	0.000	0.000	0.000	0.014	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	30
1969	0.000	0.000	0.000	0.009	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	42
1970	0.000	0.000	0.000	0.010	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	30
1971	0.000	0.000	0.000	0.008	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	32
1972	0.000	0.000	0.000	0.009	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	26
1973	0.000	0.000	0.000	0.011	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	29
1974	0.000	0.000	0.000	0.005	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	34
1975	0.000	0.000	0.000	0.005	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	19
1976	0.000	0.000	0.000	0.005	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	19
1977	0.000	0.000	0.000	0.008	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	19
1978	0.000	0.000	0.000	0.006	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	27
1979	0.000	0.000	0.000	0.007	0.000	0.006	0.001	0.001	0.000	0.000	0.000	0.000	21
1980	0.000	0.000	0.000	0.039	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	36
1981	0.000	0.000	0.000	0.051	0.003	0.001	0.002	0.001	0.000	0.011	0.002	0.000	108
1982	0.000	0.000	0.000	0.008	0.000	0.009	0.007	0.004	0.000	0.000	0.001	0.000	183
1983	0.000	0.000	0.000	0.030	0.000	0.004	0.004	0.004	0.000	0.000	0.023	0.000	74
MIN	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	171
MAX	0.000	0.000	0.000	0.051	0.003	0.009	0.007	0.004	0.000	0.011	0.023	0.000	0
MEAN	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	183
													20

Table A-2

SWAN RIVER BASIN AT THE SASKATCHEWAN-MANITOBA BOUNDARY
TOTAL WATER USE AT THE PRESENT (1983) LEVEL OF USE - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU.DAMS
1912	0.000	0.000	0.000	0.002	0.000	0.009	0.004	0.006	0.002	0.005	0.000	0.000	73
1913	0.000	0.000	0.000	0.003	0.001	0.004	0.004	0.007	0.007	0.005	0.000	0.000	81
1914	0.000	0.000	0.000	0.004	0.000	0.010	0.004	0.004	0.000	0.000	0.000	0.000	60
1915	0.000	0.000	0.000	0.031	0.004	0.005	0.006	0.004	0.000	0.000	0.000	0.000	131
1916	0.000	0.000	0.000	0.027	0.000	0.005	0.011	0.004	0.010	0.003	0.000	0.000	160
1917	0.000	0.000	0.000	0.005	0.003	0.004	0.013	0.004	0.000	0.000	0.000	0.000	75
1918	0.000	0.000	0.017	0.006	0.000	0.004	0.007	0.004	0.000	0.011	0.001	0.000	134
1919	0.000	0.000	0.000	0.003	0.000	0.004	0.009	0.009	0.004	0.002	0.000	0.000	85
1920	0.000	0.000	0.000	0.005	0.000	0.006	0.012	0.004	0.000	0.000	0.014	0.000	110
1921	0.000	0.000	0.000	0.005	0.000	0.004	0.009	0.011	0.000	0.003	0.000	0.000	84
1922	0.000	0.000	0.000	0.003	0.000	0.008	0.010	0.007	0.005	0.005	0.000	0.000	100
1923	0.000	0.000	0.000	0.006	0.000	0.004	0.005	0.009	0.001	0.003	0.007	0.000	94
1924	0.000	0.000	0.000	0.003	0.003	0.004	0.007	0.009	0.000	0.009	0.000	0.000	95
1925	0.000	0.000	0.000	0.004	0.002	0.004	0.006	0.010	0.003	0.002	0.000	0.000	84
1926	0.000	0.000	0.000	0.004	0.002	0.006	0.009	0.004	0.000	0.000	0.015	0.000	106
1927	0.000	0.000	0.000	0.004	0.000	0.004	0.004	0.010	0.000	0.002	0.000	0.000	66
1928	0.000	0.000	0.000	0.004	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	45
1929	0.000	0.000	0.000	0.024	0.000	0.005	0.004	0.004	0.000	0.000	0.000	0.000	98
1930	0.000	0.000	0.000	0.028	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	105
1931	0.000	0.000	0.000	0.018	0.002	0.004	0.004	0.004	0.000	0.012	0.000	0.000	117
1932	0.000	0.000	0.000	0.003	0.000	0.004	0.008	0.004	0.000	0.000	0.000	0.000	52
1933	0.000	0.007	0.005	0.003	0.000	0.004	0.008	0.004	0.000	0.012	0.000	0.000	115
1934	0.000	0.000	0.000	0.003	0.000	0.004	0.012	0.004	0.000	0.000	0.000	0.000	62
1935	0.000	0.000	0.000	0.022	0.000	0.004	0.007	0.004	0.000	0.000	0.000	0.000	98
1936	0.005	0.009	0.000	0.005	0.000	0.004	0.009	0.004	0.000	0.000	0.000	0.000	94
1937	0.000	0.000	0.000	0.018	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	81
1938	0.000	0.000	0.000	0.039	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	136
1939	0.000	0.000	0.000	0.019	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	82
1940	0.000	0.000	0.000	0.005	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	45
1941	0.000	0.000	0.000	0.051	0.000	0.009	0.004	0.004	0.000	0.000	0.000	0.000	180
1942	0.000	0.000	0.000	0.041	0.001	0.004	0.004	0.004	0.004	0.000	0.009	0.000	174
1943	0.000	0.000	0.000	0.005	0.000	0.004	0.005	0.004	0.000	0.000	0.011	0.000	75
1944	0.000	0.000	0.000	0.004	0.000	0.004	0.008	0.004	0.000	0.000	0.000	0.000	55
1945	0.000	0.000	0.000	0.031	0.000	0.004	0.007	0.004	0.000	0.000	0.000	0.000	120
1946	0.000	0.000	0.000	0.020	0.000	0.007	0.004	0.004	0.000	0.000	0.013	0.000	124
1947	0.000	0.000	0.000	0.004	0.000	0.004	0.010	0.006	0.000	0.000	0.012	0.000	97
1948	0.000	0.000	0.000	0.004	0.001	0.008	0.004	0.004	0.000	0.000	0.000	0.000	55
1949	0.000	0.000	0.000	0.028	0.000	0.005	0.007	0.004	0.000	0.000	0.000	0.000	114
1950	0.000	0.000	0.000	0.026	0.000	0.005	0.004	0.011	0.000	0.000	0.010	0.000	146
1951	0.000	0.000	0.000	0.005	0.000	0.004	0.011	0.008	0.004	0.002	0.000	0.000	89
1952	0.000	0.000	0.000	0.004	0.000	0.007	0.008	0.004	0.000	0.000	0.000	0.000	62
1953	0.000	0.015	0.007	0.007	0.000	0.004	0.004	0.008	0.004	0.005	0.001	0.000	144
1954	0.000	0.000	0.001	0.003	0.000	0.004	0.006	0.009	0.005	0.004	0.000	0.000	86
1955	0.000	0.000	0.000	0.003	0.000	0.010	0.006	0.004	0.000	0.000	0.000	0.000	60
1956	0.000	0.000	0.000	0.030	0.000	0.004	0.009	0.004	0.000	0.000	0.000	0.000	124
1957	0.000	0.005	0.010	0.012	0.002	0.008	0.004	0.004	0.000	0.000	0.000	0.000	118
1958	0.000	0.000	0.000	0.030	0.004	0.004	0.004	0.004	0.000	0.000	0.000	0.000	122
1959	0.000	0.000	0.000	0.040	0.004	0.004	0.011	0.004	0.000	0.013	0.000	0.000	200
1960	0.000	0.000	0.000	0.006	0.000	0.009	0.004	0.004	0.000	0.000	0.000	0.000	60
1961	0.000	0.000	0.000	0.007	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	52
1962	0.000	0.000	0.000	0.009	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	56
1963	0.000	0.000	0.000	0.006	0.057	0.072	0.064	0.004	0.000	0.000	0.000	0.000	538
1964	0.000	0.000	0.000	0.040	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.009	162
1965	0.022	0.000	0.000	0.007	0.000	0.008	0.007	0.004	0.000	0.005	0.015	0.000	181
1966	0.000	0.000	0.000	0.007	0.003	0.004	0.009	0.012	0.000	0.000	0.000	0.000	95
1967	0.000	0.000	0.008	0.021	0.004	0.013	0.004	0.004	0.000	0.000	0.000	0.000	143
1968	0.000	0.000	0.000	0.009	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	56
1969	0.000	0.000	0.000	0.091	0.003	0.004	0.004	0.004	0.000	0.000	0.000	0.000	277
1970	0.000	0.000	0.000	0.042	0.000	0.004	0.009	0.004	0.000	0.000	0.025	0.000	218
1971	0.000	0.000	0.000	0.007	0.005	0.004	0.004	0.004	0.000	0.000	0.000	0.000	65
1972	0.000	0.000	0.000	0.038	0.002	0.009	0.004	0.004	0.000	0.000	0.000	0.000	148
1973	0.000	0.000	0.000	0.007	0.016	0.027	0.011	0.004	0.000	0.000	0.000	0.000	172
1974	0.000	0.000	0.000	0.025	0.000	0.007	0.004	0.004	0.000	0.000	0.000	0.000	106
1975	0.000	0.000	0.008	0.024	0.000	0.004	0.004	0.004	0.000	0.026	0.003	0.000	195
1976	0.000	0.000	0.000	0.008	0.006	0.004	0.012	0.004	0.000	0.000	0.000	0.000	91
1977	0.000	0.000	0.000	0.008	0.043	0.004	0.004	0.004	0.000	0.032	0.000	0.000	256
1978	0.000	0.000	0.000	0.007	0.003	0.004	0.004	0.004	0.000	0.000	0.000	0.000	58
1979	0.008	0.019	0.002	0.007	0.000	0.009	0.004	0.004	0.000	0.000	0.000	0.000	139
1980	0.000	0.000	0.000	0.040	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	135
1981	0.000	0.000	0.000	0.051	0.003	0.004	0.005	0.004	0.000	0.011	0.002	0.000	209
1982	0.000	0.000	0.000	0.008	0.000	0.009	0.007	0.004	0.000	0.000	0.000	0.000	71
1983	0.000	0.000	0.000	0.030	0.000	0.004	0.004	0.004	0.000	0.000	0.019	0.004	171
MIN	0.000	0.000	0.000	0.002	0.000	0.004	0.004	0.004	0.000	0.000	0.000	0.000	45
MAX	0.022	0.019	0.017	0.091	0.057	0.072	0.064	0.012	0.010	0.032	0.025	0.009	538
MEAN	0.000	0.001	0.001	0.016	0.002	0.007	0.007	0.005	0.001	0.002	0.002	0.000	117



APPENDIX B

RECORDED AND NATURAL STREAMFLOW ARRAYS

		Page Number
B-1	Swan River at Swan River - 05LE001 Recorded Flow	35
B-2	Swan River near Minitonas - 05LE006 Recorded Flow	36
B-3	Swan River near Norquay - 05LE008 Recorded Flow	37
B-4	Swan River near Minitonas - 05LE006 Regression Equations Used to Estimate Natural Monthly Mean Flow	38
B-5	Swan River near Minitonas - 05LE006 Natural Flow	39
B-6	Swan River near Norquay - 05LE008 Natural Flow for Recorded Period	40
B-7	Swan River at the Saskatchewan-Manitoba Boundary Natural Flow	41
B-8	Swan River at the Saskatchewan-Manitoba Boundary Flows at the Present (1983) Level of Upstream Use	42
B-9	Swan River Basin Balance of Flow Table for Apportionment at the Present (1983) Level of Use	43

Table B-1

SWAN RIVER AT SWAN RIVER - 05LE001
RECORDED FLOW - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU.DAMS
1912	-	-	-	-	-	-	-	-	-	-	11.300	2.830	-
1913	1.980	1.420	1.420	63.800	29.600	13.600	51.800	15.300	7.100	4.780	2.830	1.420	514508
1914	1.130	1.130	0.850	34.100	44.500	6.490	1.440	0.634	0.921	1.400	1.130	0.566	248572
1915	0.000	0.000	0.396	11.300	2.300	2.710	5.720	2.110	1.120	1.700	1.140	0.283	75676
1916	0.491	0.356	0.398	14.700	14.700	48.400	16.000	3.680	2.480	3.670	2.130	0.510	282056
1917	0.164	0.094	0.116	15.700	41.100	11.400	18.200	2.450	1.880	1.360	1.630	0.954	251907
1918	0.368	0.122	5.650	12.900	8.190	23.300	28.500	6.860	3.510	3.350	2.000	0.666	251927
1919	0.361	0.291	0.252	20.100	12.000	4.180	4.670	2.910	5.230	6.990	2.210	0.313	156567
1920	-	-	-	53.000	66.000	15.900	4.590	1.530	1.340	2.820	-	-	-
1921	-	-	-	45.200	27.200	21.800	11.300	16.100	13.800	14.900	9.910	2.830	-
1922	1.420	0.850	0.708	74.200	102.000	14.200	5.860	8.200	5.340	4.740	4.870	0.991	589556
1923	0.566	0.425	1.420	61.200	54.500	46.700	29.800	8.300	2.900	3.120	1.310	1.080	556204
1924	0.903	0.691	0.607	14.300	12.800	5.870	2.430	10.100	2.250	2.870	1.460	0.844	145464
1925	0.448	0.137	0.827	82.400	14.700	31.000	19.300	3.990	3.600	2.950	1.730	0.780	423237
1926	0.369	0.190	0.618	48.400	10.800	10.900	2.560	0.491	0.800	3.250	3.590	0.897	216393
1927	0.560	0.303	0.602	47.800	57.300	33.900	17.500	7.070	12.000	9.360	4.890	1.650	508160
1928	0.727	0.324	6.650	9.850	11.800	5.280	12.800	2.810	1.600	1.370	0.708	0.227	143462
1929	0.017	0.006	0.227	7.090	6.190	3.580	3.150	0.668	0.593	0.645	-	-	-
1930	-	-	-	-	8.030	9.350	8.620	1.170	1.350	1.120	-	-	-
1931	-	-	-	-	2.750	1.250	1.340	0.564	1.520	3.000	-	-	-
1932	-	-	-	19.900	5.120	2.760	6.450	1.280	1.190	1.370	-	-	-
1933	-	-	-	23.100	17.500	19.500	11.000	1.680	2.280	2.640	-	-	-
1934	-	-	-	-	39.700	11.200	6.420	1.330	1.070	1.510	-	-	-
1935	-	-	-	-	8.790	23.100	9.660	1.580	1.060	1.710	-	-	-
1936	-	-	-	-	22.000	10.900	4.960	0.745	0.453	-	-	-	-
1937	-	-	-	-	-	-	-	-	-	-	-	-	-
1938	-	-	-	-	-	-	-	-	-	-	-	-	-
1939	-	-	-	-	-	-	-	-	-	-	-	-	-
1940	-	-	-	-	-	-	-	-	-	-	-	-	-
1941	-	-	-	-	-	-	-	-	-	-	-	-	-
1942	-	-	-	-	-	-	-	-	-	-	-	-	-
1943	-	-	-	-	-	-	-	-	-	-	-	-	-
1944	-	-	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	8.140	1.820	1.830	2.760	0.974	-
1951	0.635	0.585	0.636	23.100	43.900	13.600	7.330	5.210	15.800	17.600	9.280	2.180	369100
1952	0.932	0.661	0.744	44.700	19.000	8.520	5.740	3.530	2.590	1.920	1.460	0.640	237164
1953	0.817	0.554	0.599	31.600	21.300	25.100	48.200	18.200	18.600	5.900	5.410	2.140	470763
1954	1.150	1.130	1.060	23.400	51.000	76.400	18.000	3.530	10.200	7.130	4.610	2.160	524867
1955	0.723	0.926	0.968	49.100	51.800	8.750	4.010	0.776	0.480	1.150	1.060	0.696	317212
1956	0.595	0.566	0.685	15.400	65.400	15.200	14.600	3.890	2.770	1.400	1.360	0.919	325769
1957	0.504	0.368	0.345	50.500	37.400	7.610	3.560	1.220	1.490	1.470	1.200	0.626	279346
1958	0.491	0.314	0.760	6.960	2.630	2.010	3.120	0.623	0.217	1.650	0.948	0.431	53023
1959	0.133	0.000	0.456	9.990	6.550	3.760	4.990	0.815	3.600	5.620	3.690	1.240	107579
1960	0.683	0.551	0.515	44.800	20.600	12.800	2.760	1.250	0.358	-	-	-	-
1961	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-	-	-	-	-	-
1967	-	-	-	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-	-
1975	-	-	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-	-
MIN	0.000	0.000	0.116	6.960	2.300	1.250	1.340	0.491	0.217	0.645	0.708	0.227	53023
MAX	1.980	1.420	6.650	82.400	102.000	76.400	51.800	18.200	18.600	17.600	11.300	2.830	589556
MEAN	0.647	0.480	1.100	33.055	27.622	16.206	11.658	4.250	3.809	3.827	3.254	1.109	306457

Table B-2

SWAN RIVER NEAR MINITONAS - 05LE006
RECORDED FLOW - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU. DAMS
1912	-	-	-	-	-	-	-	-	-	-	-	-	-
1913	-	-	-	-	-	-	-	-	-	-	-	-	-
1914	-	-	-	-	-	-	-	-	-	-	-	-	-
1915	-	-	-	-	-	-	-	-	-	-	-	-	-
1916	-	-	-	-	-	-	-	-	-	-	-	-	-
1917	-	-	-	-	-	-	-	-	-	-	-	-	-
1918	-	-	-	-	-	-	-	-	-	-	-	-	-
1919	-	-	-	-	-	-	-	-	-	-	-	-	-
1920	-	-	-	-	-	-	-	-	-	-	-	-	-
1921	-	-	-	-	-	-	-	-	-	-	-	-	-
1922	-	-	-	-	-	-	-	-	-	-	-	-	-
1923	-	-	-	-	-	-	-	-	-	-	-	-	-
1924	-	-	-	-	-	-	-	-	-	-	-	-	-
1925	-	-	-	-	-	-	-	-	-	-	-	-	-
1926	-	-	-	-	-	-	-	-	-	-	-	-	-
1927	-	-	-	-	-	-	-	-	-	-	-	-	-
1928	-	-	-	-	-	-	-	-	-	-	-	-	-
1929	-	-	-	-	-	-	-	-	-	-	-	-	-
1930	-	-	-	-	-	-	-	-	-	-	-	-	-
1931	-	-	-	-	-	-	-	-	-	-	-	-	-
1932	-	-	-	-	-	-	-	-	-	-	-	-	-
1933	-	-	-	-	-	-	-	-	-	-	-	-	-
1934	-	-	-	-	-	-	-	-	-	-	-	-	-
1935	-	-	-	-	-	-	-	-	-	-	-	-	-
1936	-	-	-	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	-	-	-	-	-	-	-
1938	-	-	-	-	-	-	-	-	-	-	-	-	-
1939	-	-	-	-	-	-	-	-	-	-	-	-	-
1940	-	-	-	-	-	-	-	-	-	-	-	-	-
1941	-	-	-	-	-	-	-	-	-	-	-	-	-
1942	-	-	-	-	-	-	-	-	-	-	-	-	-
1943	-	-	-	-	-	-	-	-	-	-	-	-	-
1944	-	-	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	-	-	-
1955	-	-	-	-	-	-	-	-	-	-	-	-	-
1956	-	-	-	-	-	-	-	-	-	-	-	-	-
1957	-	-	-	-	-	-	-	-	-	-	-	-	-
1958	-	-	-	-	-	-	-	-	-	-	-	-	-
1959	-	-	-	-	-	-	-	-	-	-	-	-	-
1960	-	-	-	-	-	-	-	-	-	0.505	0.575	0.366	-
1961	0.252	0.153	0.114	0.863	1.530	0.715	0.087	0.133	0.010	0.065	0.271	0.235	11660
1962	0.068	0.000	0.015	4.510	8.720	1.480	0.402	0.182	1.290	0.901	0.849	0.381	49646
1963	0.089	0.008	0.142	22.600	2.370	2.460	2.510	1.130	0.547	0.541	0.621	0.389	87209
1964	0.331	0.435	0.545	10.200	11.800	1.090	1.200	1.510	4.960	5.040	2.410	1.160	107272
1965	0.804	0.639	0.557	15.600	14.900	35.000	5.650	2.780	3.400	5.090	1.920	1.110	229229
1966	0.840	0.733	0.708	48.300	19.200	15.500	16.500	5.260	4.450	1.450	1.530	1.190	303567
1967	0.983	0.819	0.759	7.900	46.100	8.790	0.961	0.790	0.192	0.754	0.152	0.260	181679
1968	0.184	0.232	2.620	7.400	1.730	3.200	3.510	7.550	5.190	1.890	1.190	0.537	92861
1969	0.471	0.568	0.684	22.000	4.630	2.270	2.820	1.000	0.794	4.920	1.700	0.783	111747
1970	0.413	0.434	0.543	20.200	25.900	10.100	13.400	4.070	1.180	3.650	13.200	2.830	252939
1971	1.180	0.947	0.842	67.200	15.400	5.500	1.630	1.780	0.328	2.640	2.810	1.650	266150
1972	0.992	0.727	0.861	50.800	58.100	5.000	3.520	0.998	0.343	0.742	0.236	0.007	322641
1973	0.002	0.000	1.180	6.940	5.710	14.500	10.400	1.640	0.801	1.290	1.070	0.868	116909
1974	0.672	0.699	0.825	50.800	54.500	18.600	2.210	1.170	2.400	3.490	2.070	1.160	364651
1975	0.839	0.689	0.757	34.600	28.600	15.900	4.100	1.280	4.570	7.110	3.750	1.110	271431
1976	0.770	0.723	0.751	55.300	7.030	33.000	17.800	1.770	0.813	0.907	0.520	0.238	312526
1977	0.355	0.401	0.468	14.100	4.850	2.090	1.770	3.060	6.770	6.410	3.140	1.650	118340
1978	1.100	0.712	0.708	27.200	16.400	2.700	2.440	0.816	1.860	3.950	2.110	1.220	160850
1979	0.870	0.698	0.589	46.600	52.400	25.000	2.920	0.540	0.545	0.773	0.996	0.647	348596
1980	0.418	0.498	0.607	17.900	2.310	0.686	1.810	2.320	2.880	4.510	2.140	1.100	97454
1981	0.557	0.310	0.926	10.100	5.980	2.900	2.440	1.410	0.027	6.710	4.310	1.070	96826
1982	0.134	0.123	0.303	5.210	5.000	2.930	7.980	3.260	1.030	2.460	1.040	0.964	80600
1983	0.838	0.605	0.321	34.100	30.500	12.500	20.900	5.470	2.480	2.720	2.650	1.250	301606
MIN	0.002	0.000	0.015	0.863	1.530	0.686	0.087	0.133	0.010	0.065	0.152	0.007	11660
MAX	1.180	0.947	2.620	67.200	58.100	35.000	20.900	7.550	6.770	7.110	13.200	2.830	364651
MEAN	0.572	0.485	0.688	25.236	18.420	9.648	5.520	2.170	2.037	2.855	2.136	0.924	186365

Table B-3

SWAN RIVER NEAR NORQUAY - 05LE008
RECORDED FLOW - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU. DAMS
1912	-	-	-	-	-	-	-	-	-	-	-	-	-
1913	-	-	-	-	-	-	-	-	-	-	-	-	-
1914	-	-	-	-	-	-	-	-	-	-	-	-	-
1915	-	-	-	-	-	-	-	-	-	-	-	-	-
1916	-	-	-	-	-	-	-	-	-	-	-	-	-
1917	-	-	-	-	-	-	-	-	-	-	-	-	-
1918	-	-	-	-	-	-	-	-	-	-	-	-	-
1919	-	-	-	-	-	-	-	-	-	-	-	-	-
1920	-	-	-	-	-	-	-	-	-	-	-	-	-
1921	-	-	-	-	-	-	-	-	-	-	-	-	-
1922	-	-	-	-	-	-	-	-	-	-	-	-	-
1923	-	-	-	-	-	-	-	-	-	-	-	-	-
1924	-	-	-	-	-	-	-	-	-	-	-	-	-
1925	-	-	-	-	-	-	-	-	-	-	-	-	-
1926	-	-	-	-	-	-	-	-	-	-	-	-	-
1927	-	-	-	-	-	-	-	-	-	-	-	-	-
1928	-	-	-	-	-	-	-	-	-	-	-	-	-
1929	-	-	-	-	-	-	-	-	-	-	-	-	-
1930	-	-	-	-	-	-	-	-	-	-	-	-	-
1931	-	-	-	-	-	-	-	-	-	-	-	-	-
1932	-	-	-	-	-	-	-	-	-	-	-	-	-
1933	-	-	-	-	-	-	-	-	-	-	-	-	-
1934	-	-	-	-	-	-	-	-	-	-	-	-	-
1935	-	-	-	-	-	-	-	-	-	-	-	-	-
1936	-	-	-	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	-	-	-	-	-	-	-
1938	-	-	-	-	-	-	-	-	-	-	-	-	-
1939	-	-	-	-	-	-	-	-	-	-	-	-	-
1940	-	-	-	-	-	-	-	-	-	-	-	-	-
1941	-	-	-	-	-	-	-	-	-	-	-	-	-
1942	-	-	-	-	-	-	-	-	-	-	-	-	-
1943	-	-	-	-	-	-	-	-	-	-	-	-	-
1944	-	-	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	-	-	-
1955	-	-	-	-	-	-	-	-	-	-	-	-	-
1956	-	-	-	-	-	-	-	-	-	-	-	-	-
1957	-	-	-	-	-	-	-	-	-	-	-	-	-
1958	-	-	-	-	-	-	-	-	-	-	-	-	-
1959	-	-	-	-	-	-	-	-	-	-	-	-	-
1960	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-	-	-	-	-	-
1965	-	-	0.605	7.830	12.600	28.500	4.320	1.930	3.010	3.570	-	-	-
1966	-	-	0.439	11.500	12.400	13.000	12.400	4.760	3.030	1.540	-	-	-
1967	-	-	0.530	7.290	24.600	6.170	0.943	0.509	0.518	2.210	-	-	-
1968	-	-	0.811	2.210	1.010	2.410	1.790	6.750	4.430	1.540	-	-	-
1969	-	-	0.535	8.910	2.190	0.896	1.060	0.630	0.934	4.230	-	-	-
1970	-	-	0.381	6.330	17.100	7.780	12.900	2.770	0.940	4.000	-	-	-
1971	-	-	0.673	31.100	8.250	2.020	1.410	0.874	0.474	2.520	-	-	-
1972	-	-	0.585	15.200	44.300	3.230	2.020	0.513	0.502	0.494	-	-	-
1973	-	-	0.853	3.560	4.050	12.500	8.510	1.310	1.050	0.916	0.781	0.824	-
1974	0.571	0.516	0.524	13.800	31.600	10.300	1.080	0.748	2.500	3.240	1.330	0.870	177117
1975	0.645	0.493	0.394	8.710	14.700	10.300	2.230	1.090	4.110	5.790	3.170	1.040	138677
1976	0.498	0.798	0.819	17.100	2.540	20.500	11.000	0.982	0.253	0.561	0.423	0.467	146387
1977	0.421	0.555	0.601	6.370	3.630	1.270	1.420	2.910	6.980	5.060	5.050	1.520	94008
1978	0.768	0.573	0.638	10.000	10.300	2.470	2.090	0.513	1.950	3.580	2.460	1.090	95972
1979	0.634	0.543	0.584	11.000	28.500	19.600	1.860	0.423	0.575	0.832	0.643	0.474	172995
1980	0.426	0.389	0.394	6.890	1.200	0.703	1.110	2.600	2.890	3.810	1.710	0.771	60196
1981	0.445	0.408	1.280	9.290	4.540	1.940	2.350	1.520	0.495	6.960	4.570	0.843	91269
1982	0.556	0.331	0.325	6.010	3.900	2.120	5.860	2.080	1.000	2.220	0.836	0.602	68263
1983	0.550	0.466	0.511	10.100	17.000	6.160	14.500	2.670	2.180	2.020	2.250	1.410	158305
MIN	0.421	0.331	0.325	2.210	1.010	0.703	0.943	0.423	0.253	0.494	0.423	0.467	60196
MAX	0.768	0.798	1.280	31.100	44.300	28.500	14.500	6.750	6.980	6.960	5.050	1.520	177117
MEAN	0.551	0.508	0.604	10.168	12.864	7.993	4.676	1.873	1.991	2.900	2.111	0.901	120319

Table B-4

SWAN RIVER NEAR MINITONAS - 05LE006
REGRESSION EQUATIONS USED TO ESTIMATE NATURAL MONTHLY MEAN FLOW

Month[1]	Years	Regression Equation	Correlation Coefficient	Standard Error of Estimate[3]	Priority Number
March	1920-21, 1930-50	$\log Q_E = -.8950 + .7753 \log MH01$	.477	61.5/1600	1
April	1912, 1930-31, 1934-43, 1948	$\log Q_E = -.8208 + 1.0734 \log MH01 + .1313 \log PGM1$	.729	48.2/93.0	4
	1944-46	$Q_E^2 = 6.537 + 2.0428\ MC01$	.887	32. 7	3
	1947, 1950	$\log Q_E = .2948 + .7656 \log MD04$	.867	38.8/63.3	2
	1949	$Q_E = .364 + 2.0868\ MD05 + 1.0714\ MC01$	.910	29.9	1
May	1912, 1937-43	$\log Q_E = -.5320 + .9296 \log MH01$	.878	40.9/69.2	3
	1944-47	$\log Q_E = .6587 + .7260 \log MC01$	.949	31.6/46.3	2
	1948-50	$\log Q_E = .1632 + .5782 \log MD04 + .4218 \log MD05$	.973	25.6/34.4	1
June	1912, 1937-43	$\log Q_E = -.9627 + .6773 \log MH01 + .4566 \log PGM1$	.743	52.1/109	2
	1944-50	$Q_E^2 = 3.926 + 1.7225\ MC01$	.966	32. 8	1
July	1912, 1937-43	$\log Q_E = -.8968 + .7479 \log MH01 + .3347 \log PGM1$	.730	57.3/134	3
	1944-47	$Q_E = 2.423 + 1.6353\ MC01 + .0345\ MH01$	.942	47.1	2
	1948-50	$Q_E = .581 + 1.2126\ MD05 + .9597\ MC01$	.961	34.0	1
August	1912, 1937-43	$\log Q_E = -.5499 + .7940 \log MH01$	.727	54.0/118	2
	1944-49	$Q_E^2 = 1.797 + 1.2173\ \ MC01$	.886	58. 6	1
September	1912, 1937-43	$\log Q_E = -.7890 + 1.0392 \log MH01$	.649	65.5/190	2
	1944-49	$Q_E^2 = 1.490 + 2.5837\ MC01$	.895	66. 0	1
October	1912, 1936-43	$\log Q_E = -.4700 + .8114 \log MH01$	.652	53.0/113	3
	1944-47	$Q_E^2 = 1.997 + 2.2708\ MC01$	.846	56. 6	2
	1948-49	$Q_E = .940 + 1.6221\ MC01 + .7414\ MD05$	.866	27.9	1
November	1920, 1929-35	$Q_E = .113 + .4357\ B6L1 + .0668\ MH01$	.761	70.6	3
	1936	$\log Q_E = -.2947 + .3617 \log B6L2 + .4279 \log MH01$	.766	49.3/97.1	1
	1937-48	$Q_E = .340 + .1700\ MH01$	.682	86.9	4
	1949	$\log Q_E = -.0475 + 1.2791 \log MD05$	.744	49.4/97.7	2

[1] Missing natural monthly mean flows for the months December to February were estimated using the following procedure:

- summed missing winter flows for the months December to February for the years 1920-21 and 1929-50 were estimated by a graphical regression analysis with the corresponding summed winter flows for MH01.
- estimated summed winter flow was distributed to the individual winter months using the following percentages:

  December = 50% of summed winter flow
  January = 28% of summed winter flow
  February = 22% of summed winter flow

- January to March monthly flows for 1912 were estimated as the average monthly flows for the periods 1913-19, 1922-29, and 1951-83.

[2] The lower end of the regression line was manually adjusted to intersect the origin.

[3] Standard error of estimate expressed as a percentage of mean of the dependent variable for the regressed period. For logarithmic relationships, both the lower/upper bounds are given.

LIST OF SYMBOLS

B6L1 Natural flow of Swan River near Minitonas (05LE006) in October, in m^3/s.

B6L2 Natural flow of Swan River near Minitonas (05LE006) in September, in m^3/s.

MC01 Recorded flow of Assiniboine River at Sturgis (05MC001), in m^3/s.

MD04 Natural flow of Assiniboine River near Kamsack (05MD004), in m^3/s, as presented in Table B-4 of the November, 1980 PPWB Assiniboine River natural flow report(5).

MD05 Recorded flow of Shell River near Inglis (05MD005), in m^3/s.

MH01 Natural flow of Assiniboine River at Brandon (05MH001), in m^3/s, as developed for the November, 1980 PPWB Assiniboine River natural flow report(5).

PGM1 Total monthly precipitation at Yorkton during specified month, in mm.

Table B-5

SWAN RIVER NEAR MINITONAS - 05LE006
NATURAL FLOW - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU. DAMS
1912	0.624	0.491	0.827	28.622	31.072	15.089	12.044	6.116	16.993	14.328	11.808	2.957	387565
1913	2.069	1.484	1.484	86.668	30.930	14.211	54.128	19.988	7.419	4.995	2.957	1.484	537633
1914	1.287	1.181	0.868	35.633	46.500	6.782	1.505	0.662	0.962	1.963	1.181	0.591	259744
1915	0.000	0.000	0.414	11.608	2.403	2.832	5.977	2.205	1.170	1.776	1.191	0.296	79077
1916	0.513	0.372	0.416	15.361	15.361	50.575	16.719	3.845	2.591	3.835	2.226	0.533	294734
1917	0.171	0.098	0.121	16.406	42.947	11.912	19.018	2.560	1.965	1.481	1.703	0.997	263230
1918	0.385	0.127	5.904	13.480	8.558	24.347	29.781	1.168	3.668	3.501	2.090	0.696	263250
1919	0.471	0.304	0.263	21.003	12.539	4.368	4.880	3.041	5.465	7.304	2.309	0.327	163605
1920	0.262	0.035	0.515	55.382	68.967	16.615	4.796	1.599	1.400	2.947	2.168	0.985	410454
1921	0.952	0.433	0.408	47.232	28.423	22.760	11.808	16.824	14.420	15.570	10.355	2.957	451721
1922	1.484	0.868	0.740	77.535	106.585	14.835	6.184	8.569	5.580	4.953	5.089	1.036	616056
1923	0.591	0.444	1.484	63.851	56.950	48.799	31.139	8.673	3.030	3.260	1.369	1.129	581205
1924	0.944	0.782	0.634	14.943	13.375	6.134	2.539	10.554	2.351	2.999	1.526	0.882	152002
1925	0.468	0.143	0.864	86.104	15.361	32.393	20.167	4.169	3.762	3.083	1.808	0.615	442260
1926	0.386	0.199	0.646	50.575	11.285	11.390	2.675	0.513	0.836	3.396	3.751	0.937	226120
1927	0.385	0.311	0.629	49.948	59.875	35.424	18.287	7.385	12.539	9.781	5.110	1.729	531000
1928	0.760	0.339	6.949	10.293	12.330	5.517	13.375	2.936	1.672	1.432	0.740	0.237	149910
1929	0.018	0.006	0.237	7.409	6.468	3.741	3.292	0.698	0.620	0.674	0.772	0.735	64989
1930	0.412	0.323	0.397	14.937	8.391	9.170	9.007	1.223	1.411	1.170	0.740	0.370	127073
1931	0.319	0.251	0.446	3.026	2.674	1.306	1.400	0.589	1.588	3.135	1.722	0.435	45060
1932	0.244	0.191	0.285	20.794	5.350	2.684	6.740	1.338	1.243	1.432	1.097	0.700	110903
1933	0.192	0.308	0.312	24.156	18.287	20.376	11.494	1.756	2.382	2.159	1.693	0.765	222535
1934	0.680	0.365	1.186	22.407	41.484	11.703	6.709	1.390	1.118	1.578	1.083	0.575	237771
1935	0.322	0.253	0.373	10.457	9.185	24.138	10.094	1.651	1.108	1.787	1.323	0.810	161460
1936	0.454	0.356	0.254	45.451	22.989	11.390	5.183	0.776	0.473	1.175	0.690	0.520	235216
1937	0.291	0.229	0.250	5.781	8.935	3.806	1.754	0.529	0.237	0.958	0.855	0.355	50459
1938	0.199	0.156	1.344	17.217	6.398	5.211	2.960	1.124	0.545	0.928	0.862	0.500	98190
1939	0.280	0.220	0.663	7.657	4.404	3.968	2.339	1.087	0.525	0.930	0.999	0.375	61645
1940	0.210	0.165	0.130	2.089	2.730	2.853	1.930	0.690	0.357	0.729	0.815	0.340	34896
1941	0.240	0.220	0.229	12.809	5.221	3.278	1.137	0.518	0.662	0.962	0.934	0.850	69655
1942	0.196	0.156	0.846	39.035	8.388	9.490	4.625	2.859	3.982	2.783	1.472	0.580	194492
1943	0.328	0.255	0.343	35.048	19.601	12.481	6.698	2.382	1.720	1.730	1.303	0.860	216908
1944	0.316	0.248	0.209	4.000	2.964	1.710	4.027	0.190	0.319	0.320	1.470	0.500	43420
1945	0.280	0.220	0.273	10.500	6.555	5.601	4.413	0.974	1.220	1.800	1.479	0.525	90289
1946	0.294	0.231	1.249	14.410	5.190	5.150	4.241	0.544	1.950	2.370	2.632	0.665	103791
1947	0.288	0.301	0.285	20.749	14.060	6.699	12.767	2.138	2.715	3.194	2.261	1.230	175971
1948	0.689	0.581	0.467	25.838	73.025	6.974	15.028	1.670	0.650	2.593	1.690	0.810	345507
1949	0.454	0.356	0.182	12.267	0.485	10.347	4.313	1.460	0.479	1.864	1.229	0.750	90462
1950	0.434	0.341	0.478	14.966	14.102	5.826	7.968	3.506	1.902	1.912	2.804	1.018	159308
1951	0.664	0.611	0.665	24.147	43.873	14.211	7.659	5.444	16.510	18.391	9.697	2.278	385713
1952	0.974	0.691	0.777	46.711	19.854	8.903	5.998	3.689	2.706	2.006	1.526	0.669	247845
1953	0.854	0.579	0.626	33.032	22.251	26.228	50.366	19.018	19.436	8.165	5.653	2.236	491951
1954	1.199	1.178	1.105	24.461	53.290	19.832	18.807	3.686	10.656	7.448	4.815	2.255	548414
1955	0.753	0.965	1.009	51.313	54.126	9.140	4.188	0.808	0.499	1.195	1.105	0.725	331405
1956	0.618	0.569	0.713	16.101	68.337	15.860	15.254	4.062	2.892	1.460	1.418	0.958	340354
1957	0.524	0.381	0.351	52.719	39.078	7.949	3.711	1.272	1.554	1.533	1.251	0.651	291833
1958	0.510	0.325	0.791	7.282	2.745	2.097	3.257	0.648	0.224	1.721	0.987	0.447	55338
1959	0.337	0.000	0.474	10.450	6.842	3.927	5.212	0.849	3.759	5.870	3.853	1.293	112378
1960	0.711	0.573	0.535	46.681	21.523	13.373	2.881	1.303	0.377	0.502	0.572	0.363	234416
1961	0.249	0.150	0.111	0.876	1.527	0.712	0.084	0.130	0.007	0.062	0.268	0.232	11606
1962	0.064	0.000	0.011	4.526	8.716	1.476	0.398	0.178	1.286	0.897	0.845	0.377	49587
1963	0.085	0.003	0.138	22.609	2.366	2.458	2.508	1.128	0.543	0.537	0.617	0.385	87131
1964	0.327	0.430	0.541	10.207	11.796	1.089	1.199	1.509	4.955	5.036	2.405	1.156	107182
1965	0.798	0.633	0.551	15.609	14.894	34.998	5.647	2.777	3.394	5.084	1.914	1.104	229112
1966	0.835	0.727	0.703	48.307	19.195	15.498	16.498	5.258	4.445	1.445	1.525	1.185	303457
1967	0.977	0.813	0.753	7.910	46.094	8.788	0.958	0.787	0.186	0.748	0.146	0.254	181565
1968	0.178	0.226	2.637	7.394	1.724	3.198	3.507	7.547	5.184	1.884	1.184	0.531	92766
1969	0.465	0.561	0.678	22.009	4.624	2.267	2.817	0.997	0.787	4.914	1.693	0.777	111609
1970	0.407	0.427	0.537	20.210	25.894	10.097	13.397	4.067	1.173	3.644	13.193	2.824	252804
1971	1.174	0.940	0.836	67.207	15.394	5.497	1.627	1.777	0.322	2.634	2.804	1.644	266017
1972	0.985	0.719	0.854	50.807	58.093	4.996	3.516	0.994	0.336	0.735	0.229	0.000	322474
1973	0.000	0.000	1.173	6.949	5.703	14.493	10.394	1.634	0.794	1.283	1.063	0.861	116763
1974	0.664	0.690	0.817	50.800	54.492	18.592	2.203	1.163	2.392	3.482	2.062	1.152	364416
1975	0.839	0.689	0.757	34.610	28.544	15.901	4.101	1.281	4.570	7.054	3.750	1.110	271162
1976	0.770	0.723	0.751	55.309	6.977	33.001	17.801	1.771	0.813	0.854	0.520	0.238	312272
1977	0.355	0.401	0.468	14.115	4.794	2.091	1.771	3.061	6.770	6.354	3.140	1.650	118084
1978	1.100	0.712	0.708	27.211	16.338	2.701	2.441	0.817	1.860	3.888	2.110	1.220	160554
1979	0.870	0.698	0.589	46.611	52.322	25.006	2.921	0.541	0.545	0.695	0.996	0.647	348226
1980	0.418	0.498	0.607	17.944	2.239	0.687	1.811	2.321	2.880	4.439	2.140	1.100	97198
1981	0.557	0.310	0.926	10.156	5.923	2.932	2.472	1.441	0.027	6.661	4.312	1.070	96949
1982	0.134	0.123	0.303	5.220	4.928	3.003	8.047	3.325	1.030	2.388	1.040	0.964	80785
1983	0.838	0.605	0.321	34.135	30.440	12.568	20.965	5.535	2.480	2.660	2.673	1.250	301958
MIN	0.000	0.000	0.011	0.876	0.485	0.687	0.084	0.130	0.007	0.062	0.146	0.000	11606
MAX	2.069	1.484	6.949	86.104	106.585	79.832	54.128	19.018	19.436	18.391	13.193	2.957	616056
MEAN	0.536	0.420	0.791	26.808	22.357	12.443	8.715	3.165	3.033	3.285	2.352	0.918	223234

Note: 1. Shaded area denotes natural flow data derived by regression analysis as indicated in Table B-4. Caution should be exercised in using these flows.

2. Cross-hatched area denotes natural flow data derived by transferring natural flows from Swan River at Swan River (05LE001) using an effective drainage area ratio of 1.045.

Table B-6

SWAN RIVER NEAR NORQUAY - 05LE008
NATURAL FLOW FOR RECORDED PERIOD - m^3/s

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	CU.DAMS
1912	-	-	-	-	-	-	-	-	-	-	-	-	-
1913	-	-	-	-	-	-	-	-	-	-	-	-	-
1914	-	-	-	-	-	-	-	-	-	-	-	-	-
1915	-	-	-	-	-	-	-	-	-	-	-	-	-
1916	-	-	-	-	-	-	-	-	-	-	-	-	-
1917	-	-	-	-	-	-	-	-	-	-	-	-	-
1918	-	-	-	-	-	-	-	-	-	-	-	-	-
1919	-	-	-	-	-	-	-	-	-	-	-	-	-
1920	-	-	-	-	-	-	-	-	-	-	-	-	-
1921	-	-	-	-	-	-	-	-	-	-	-	-	-
1922	-	-	-	-	-	-	-	-	-	-	-	-	-
1923	-	-	-	-	-	-	-	-	-	-	-	-	-
1924	-	-	-	-	-	-	-	-	-	-	-	-	-
1925	-	-	-	-	-	-	-	-	-	-	-	-	-
1926	-	-	-	-	-	-	-	-	-	-	-	-	-
1927	-	-	-	-	-	-	-	-	-	-	-	-	-
1928	-	-	-	-	-	-	-	-	-	-	-	-	-
1929	-	-	-	-	-	-	-	-	-	-	-	-	-
1930	-	-	-	-	-	-	-	-	-	-	-	-	-
1931	-	-	-	-	-	-	-	-	-	-	-	-	-
1932	-	-	-	-	-	-	-	-	-	-	-	-	-
1933	-	-	-	-	-	-	-	-	-	-	-	-	-
1934	-	-	-	-	-	-	-	-	-	-	-	-	-
1935	-	-	-	-	-	-	-	-	-	-	-	-	-
1936	-	-	-	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	-	-	-	-	-	-	-
1938	-	-	-	-	-	-	-	-	-	-	-	-	-
1939	-	-	-	-	-	-	-	-	-	-	-	-	-
1940	-	-	-	-	-	-	-	-	-	-	-	-	-
1941	-	-	-	-	-	-	-	-	-	-	-	-	-
1942	-	-	-	-	-	-	-	-	-	-	-	-	-
1943	-	-	-	-	-	-	-	-	-	-	-	-	-
1944	-	-	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	-	-	-
1955	-	-	-	-	-	-	-	-	-	-	-	-	-
1956	-	-	-	-	-	-	-	-	-	-	-	-	-
1957	-	-	-	-	-	-	-	-	-	-	-	-	-
1958	-	-	-	-	-	-	-	-	-	-	-	-	-
1959	-	-	-	-	-	-	-	-	-	-	-	-	-
1960	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-	-	-	-	-	-
1965	-	-	0.605	7.832	12.600	28.501	4.321	1.931	3.010	3.570	-	-	-
1966	-	-	0.439	11.502	12.400	13.001	12.401	4.761	3.030	1.540	-	-	-
1967	-	-	0.530	7.293	24.600	6.171	0.944	0.510	0.518	2.210	-	-	-
1968	-	-	0.811	2.213	1.010	2.411	1.791	6.751	4.430	1.540	-	-	-
1969	-	-	0.535	8.913	2.190	0.897	1.061	0.631	0.934	4.230	-	-	-
1970	-	-	0.381	6.333	17.100	7.781	12.901	2.771	0.940	4.000	-	-	-
1971	-	-	0.673	31.102	8.250	2.021	1.411	0.875	0.474	2.520	-	-	-
1972	-	-	0.585	15.202	44.300	3.231	2.021	0.514	0.502	0.494	-	-	-
1973	-	-	0.853	3.563	4.050	12.501	8.511	1.311	1.050	0.916	0.781	0.824	-
1974	0.571	0.516	0.524	13.802	31.600	10.301	1.081	0.749	2.500	3.240	1.330	0.870	177128
1975	0.645	0.493	0.394	8.712	14.700	10.301	2.231	1.091	4.110	5.790	3.170	1.040	138689
1976	0.498	0.798	0.819	17.102	2.540	20.501	11.001	0.983	0.253	0.561	0.423	0.467	146399
1977	0.421	0.555	0.601	6.373	3.630	1.271	1.421	2.911	6.980	5.060	5.050	1.520	94023
1978	0.768	0.573	0.638	10.002	10.300	2.471	2.091	0.514	1.950	3.580	2.460	1.090	95984
1979	0.634	0.543	0.584	11.002	28.500	19.601	1.861	0.424	0.575	0.832	0.643	0.474	173007
1980	0.426	0.389	0.394	6.892	1.200	0.704	1.111	2.601	2.890	3.810	1.710	0.771	60208
1981	0.445	0.408	1.280	9.293	4.540	1.941	2.351	1.521	0.495	6.960	4.570	0.843	91283
1982	0.556	0.331	0.325	6.012	3.900	2.121	5.861	2.081	1.000	2.220	0.836	0.602	68273
1983	0.550	0.466	0.511	10.102	17.000	6.161	14.501	2.671	2.180	2.020	2.250	1.410	158317
MIN	0.421	0.331	0.325	2.213	1.010	0.704	0.944	0.424	0.253	0.494	0.423	0.467	60208
MAX	0.768	0.798	1.280	31.102	44.300	28.501	14.501	6.751	6.980	6.960	5.050	1.520	177128
MEAN	0.551	0.508	0.604	10.171	12.864	7.994	4.677	1.873	1.991	2.900	2.111	0.901	120331

Table B-7

SWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY
NATURAL FLOW - m^3/s

	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CU.DAMS
1912-13	21.438	30.214	12.961	10.466	5.321	16.840	13.511	10.970	2.759	1.908	1.442	1.365	340287
1913-14	49.934	25.208	12.207	47.037	13.909	7.352	4.710	2.747	1.384	1.089	1.148	0.817	442210
1914-15	26.689	37.898	5.825	1.308	0.576	0.954	1.380	1.097	0.552	0.000	0.000	0.381	202336
1915-16	8.844	1.959	2.433	5.194	1.918	1.160	1.675	1.107	0.276	0.473	0.362	0.383	67823
1916-17	11.505	12.519	43.444	14.529	3.346	2.568	3.616	2.068	0.497	0.158	0.095	0.112	247822
1917-18	12.288	35.002	10.233	16.527	2.227	1.947	1.340	1.582	0.930	0.355	0.124	5.432	233379
1918-19	10.096	6.975	20.914	25.880	6.236	3.635	3.301	1.942	0.649	0.348	0.296	0.242	212411
1919-20	15.732	10.220	3.752	4.241	2.645	5.416	6.888	2.145	0.305	0.242	0.053	0.474	137232
1920-21	41.481	56.208	14.272	4.168	1.391	1.388	2.779	2.011	0.919	0.509	0.421	0.368	332029
1921-22	35.376	23.164	19.568	10.261	14.637	14.290	14.682	9.620	2.759	1.368	0.863	0.681	387411
1922-23	58.074	86.866	12.746	5.321	7.455	5.530	4.671	4.728	0.966	0.545	0.432	1.365	498291
1923-24	47.899	46.414	41.918	27.060	7.546	3.003	3.074	1.272	1.053	0.870	0.702	0.584	477595
1924-25	11.192	10.901	5.269	2.207	9.182	2.330	2.828	1.417	0.823	0.432	0.139	0.795	125481
1925-26	64.492	12.519	27.826	17.526	3.627	3.728	2.907	1.679	0.760	0.356	0.193	0.594	356322
1926-27	37.881	9.198	9.784	2.325	0.446	0.828	3.203	3.485	0.875	0.540	0.308	0.579	181444
1927-28	37.411	48.799	30.429	15.891	6.427	12.427	9.223	4.747	1.609	0.700	0.329	6.393	459670
1928-29	7.709	10.049	4.739	11.623	2.555	1.657	1.350	0.687	0.221	0.016	0.006	0.218	108084
1929-30	5.549	5.272	3.213	2.860	0.607	0.614	0.636	0.717	0.686	0.380	0.314	0.356	55840
1930-31	11.188	6.839	8.393	7.827	1.064	1.398	1.104	0.687	0.532	0.294	0.244	0.410	105146
1931-32	2.266	2.342	1.122	1.217	0.513	1.574	2.956	1.603	0.406	0.225	0.186	0.225	38598
1932-33	15.575	4.360	2.477	5.857	1.164	1.232	1.350	1.019	0.653	0.361	0.299	0.287	90936
1933-34	18.080	14.904	17.503	9.989	1.527	2.361	2.601	1.573	0.732	0.406	0.335	1.054	186840
1934-35	16.783	33.810	10.053	5.830	1.209	1.108	1.488	1.006	0.536	0.297	0.246	0.343	192179
1935-36	7.832	7.486	20.735	8.772	1.436	1.098	1.685	1.229	0.756	0.419	0.346	0.234	136620
1936-37	34.043	18.736	9.784	4.504	0.677	0.469	1.108	0.641	0.485	0.268	0.223	0.230	186676
1937-38	4.330	4.022	2.582	1.524	0.460	0.235	0.903	0.794	0.331	0.183	0.152	1.236	44148
1938-39	12.896	5.214	4.476	2.572	0.978	0.540	0.875	0.801	0.466	0.258	0.214	0.628	78463
1939-40	5.735	3.589	3.403	2.033	0.946	0.520	0.877	0.928	0.350	0.194	0.160	0.120	49558
1940-41	1.565	2.225	2.451	1.677	0.600	0.354	0.687	0.794	0.466	0.258	0.214	0.211	30307
1941-42	9.594	4.255	2.816	0.988	0.447	0.656	0.907	0.870	0.327	0.181	0.150	0.778	57596
1942-43	29.237	6.836	8.152	4.019	2.487	3.907	2.624	1.367	0.541	0.300	0.248	0.316	157046
1943-44	26.251	15.975	10.721	5.821	2.072	1.705	1.631	1.396	0.522	0.290	0.239	0.192	175455
1944-45	2.996	2.416	1.469	3.499	0.339	0.316	0.302	1.366	0.466	0.258	0.214	0.709	37850
1945-46	7.865	5.342	4.811	3.835	0.847	1.209	1.697	1.374	0.490	0.271	0.225	1.149	76606
1946-47	11.093	4.393	4.424	3.685	0.473	1.932	2.235	2.464	0.639	0.354	0.293	0.262	84574
1947-48	15.541	11.459	5.754	11.095	1.853	2.691	3.012	2.100	1.148	0.635	0.526	0.430	148297
1948-49	19.351	59.515	5.991	13.059	1.453	0.644	2.445	1.756	0.756	0.419	0.346	0.167	281162
1949-50	9.203	0.395	9.232	3.748	1.270	0.471	1.758	1.142	0.704	0.400	0.331	0.440	76108
1950-51	11.210	11.493	5.005	6.924	7.400	1.885	1.803	2.679	0.950	0.612	0.594	0.611	135093
1951-52	18.086	37.387	12.207	6.656	4.736	16.362	17.343	9.009	2.125	0.898	0.671	0.715	333076
1952-53	34.991	16.181	7.648	5.212	3.209	2.682	1.892	1.417	0.624	0.787	0.563	0.576	198791
1953-54	24.741	18.140	22.530	43.768	16.546	19.261	5.814	5.252	2.086	1.106	1.145	1.017	425808
1954-55	18.321	43.431	68.575	16.343	3.207	10.560	7.024	4.473	2.104	0.694	0.938	0.928	463949
1955-56	38.433	44.112	7.852	3.639	0.703	0.494	1.131	1.026	0.676	0.571	0.572	0.656	263250
1956-57	12.060	55.695	13.641	13.255	3.534	2.866	1.377	1.318	0.893	0.483	0.370	0.329	280751
1957-58	39.531	31.848	6.828	3.230	1.106	1.540	1.446	1.162	0.607	0.470	0.316	0.728	233554
1958-59	5.454	2.237	1.801	2.830	0.564	0.222	1.623	0.917	0.417	0.126	0.000	0.436	43811
1959-60	7.827	5.576	3.373	4.529	0.739	3.726	5.536	3.580	1.207	0.656	0.557	0.493	99539
1960-61	35.069	17.541	11.487	2.504	1.134	0.368	0.474	0.532	0.339	0.230	0.146	0.102	183148
1961-62	0.656	1.245	0.612	0.073	0.113	0.007	0.058	0.249	0.216	0.059	0.000	0.010	8704
1962-63	3.390	7.104	1.268	0.346	0.155	1.275	0.846	0.785	0.352	0.078	0.003	0.127	41547
1963-64	16.934	1.928	2.112	2.180	0.981	0.538	0.506	0.573	0.359	0.301	0.418	0.497	71382
1964-65	7.645	9.613	0.935	1.042	1.312	4.911	4.748	2.235	1.078	0.736	0.615	0.574	93415
1965-66	12.377	13.941	32.298	5.096	2.426	3.235	4.455	1.778	1.030	0.770	0.707	0.593	206327
1966-67	33.011	16.371	14.460	14.795	5.051	3.857	1.484	1.416	1.105	0.901	0.790	0.661	246747
1967-68	7.653	37.161	7.700	0.952	0.672	0.324	1.356	0.136	0.237	0.164	0.220	1.878	155160
1968-69	5.241	1.427	2.871	2.794	7.216	4.871	1.741	1.100	0.496	0.428	0.545	0.618	77251
1969-70	16.566	3.612	1.697	2.087	0.845	0.848	4.630	1.573	0.725	0.375	0.415	0.472	88756
1970-71	14.443	22.239	9.134	13.191	3.528	1.076	3.792	12.257	2.634	1.082	0.914	0.768	224396
1971-72	52.202	12.425	4.052	1.537	1.402	0.385	2.587	2.605	1.534	0.908	0.699	0.742	211920
1972-73	36.009	52.361	4.262	2.895	0.794	0.405	0.635	0.212	0.000	0.000	0.000	1.040	260593
1973-74	5.542	5.016	13.665	9.611	1.499	0.900	1.130	0.946	0.846	0.625	0.618	0.695	108086
1974-75	35.424	44.978	15.146	1.736	0.991	2.437	3.381	1.757	1.035	0.758	0.608	0.606	286674
1975-76	23.847	22.790	13.573	3.324	1.202	4.379	6.529	3.509	1.081	0.657	0.754	0.779	216718
1976-77	39.430	5.133	27.806	14.975	1.443	0.580	0.732	0.480	0.333	0.382	0.465	0.523	241150
1977-78	10.897	4.310	1.750	1.625	2.998	6.857	5.816	3.934	1.596	0.962	0.654	0.679	110512
1978-79	20.059	13.829	2.605	2.295	0.691	1.897	3.760	2.255	1.166	0.772	0.634	0.587	132913
1979-80	31.812	42.422	22.759	2.480	0.492	0.557	0.752	0.849	0.575	0.421	0.453	0.518	273884
1980-81	13.351	1.807	0.694	1.520	2.437	2.884	4.178	1.961	0.963	0.510	0.351	1.073	83263
1981-82	9.797	5.348	2.520	2.422	1.474	0.222	6.785	4.419	0.976	0.309	0.209	0.312	91675
1982-83	5.549	4.501	2.636	7.139	2.808	1.018	2.318	0.955	0.814	0.718	0.547	0.400	77733
MIN	0.656	0.395	0.612	0.073	0.113	0.007	0.058	0.136	0.000	0.000	0.000	0.010	8704
MAX	64.492	86.866	68.575	47.037	16.546	19.261	17.343	12.257	2.759	1.908	1.442	6.393	498291
MEAN	19.895	18.263	10.752	7.450	2.750	3.007	3.123	2.201	0.852	0.494	0.407	0.723	184076

Note: Caution should be exercised in using this data base for other studies.

Table B-8

SWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY
FLOWS AT THE PRESENT (1983) LEVEL OF UPSTREAM USE - m^3/s

	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CU.DAMS
1912-13	21.435	30.214	12.952	10.462	5.315	16.838	13.507	10.970	2.759	1.908	1.442	1.365	340214
1913-14	49.931	25.208	12.203	47.033	13.903	7.345	4.706	2.747	1.384	1.089	1.148	0.817	442129
1914-15	26.684	37.898	5.815	1.303	0.572	0.954	1.380	1.097	0.552	0.000	0.000	0.381	202276
1915-16	8.813	1.955	2.428	5.188	1.914	1.160	1.675	1.107	0.276	0.473	0.362	0.383	67692
1916-17	11.478	12.519	43.439	14.518	3.341	2.558	3.613	2.067	0.497	0.158	0.095	0.112	247660
1917-18	12.283	34.999	10.229	16.514	2.223	1.947	1.340	1.582	0.930	0.355	0.124	5.415	233258
1918-19	10.090	6.975	20.910	25.873	6.232	3.635	3.290	1.941	0.649	0.348	0.296	0.242	212322
1919-20	15.728	10.220	3.748	4.232	2.636	5.411	6.886	2.145	0.305	0.242	0.053	0.474	137147
1920-21	41.476	56.208	14.266	4.156	1.387	1.388	2.779	1.997	0.919	0.509	0.421	0.368	331920
1921-22	35.372	23.164	19.564	10.252	14.626	14.290	14.680	9.620	2.759	1.368	0.863	0.681	387328
1922-23	58.071	86.866	12.738	5.312	7.447	5.525	4.666	4.728	0.966	0.545	0.432	1.365	498191
1923-24	47.893	46.414	41.914	27.055	7.537	3.002	3.072	1.264	1.053	0.870	0.702	0.584	477501
1924-25	11.189	10.898	5.265	2.200	9.173	2.330	2.819	1.417	0.823	0.432	0.139	0.795	125386
1925-26	64.488	12.517	27.822	17.519	3.617	3.725	2.905	1.679	0.760	0.356	0.193	0.594	356238
1926-27	37.877	9.195	9.778	2.316	0.442	0.828	3.203	3.470	0.875	0.540	0.308	0.579	181339
1927-28	37.407	48.799	30.425	15.887	6.417	12.427	9.221	4.747	1.609	0.700	0.329	6.393	459603
1928-29	7.705	10.049	4.735	11.619	2.550	1.657	1.350	0.687	0.221	0.016	0.006	0.218	108039
1929-30	5.525	5.272	3.208	2.856	0.603	0.614	0.636	0.717	0.686	0.380	0.314	0.356	55742
1930-31	11.160	6.839	8.388	7.823	1.060	1.398	1.104	0.687	0.532	0.294	0.244	0.410	105041
1931-32	2.249	2.340	1.118	1.213	0.509	1.574	2.944	1.603	0.406	0.225	0.186	0.225	38481
1932-33	15.572	4.360	2.473	5.849	1.160	1.232	1.350	1.019	0.653	0.361	0.292	0.282	90854
1933-34	18.076	14.904	17.499	9.980	1.523	2.361	2.590	1.573	0.732	0.406	0.335	1.054	186756
1934-35	16.779	33.810	10.049	5.818	1.205	1.108	1.488	1.006	0.536	0.297	0.246	0.343	192117
1935-36	7.811	7.486	20.731	8.765	1.432	1.098	1.685	1.229	0.756	0.414	0.337	0.234	136488
1936-37	34.038	18.736	9.780	4.495	0.673	0.469	1.108	0.641	0.485	0.268	0.223	0.230	186616
1937-38	4.311	4.022	2.578	1.520	0.456	0.235	0.903	0.794	0.331	0.183	0.152	1.236	44067
1938-39	12.856	5.214	4.472	2.568	0.974	0.540	0.875	0.801	0.466	0.258	0.214	0.628	78327
1939-40	5.716	3.589	3.399	2.028	0.942	0.520	0.877	0.928	0.350	0.194	0.160	0.120	49476
1940-41	1.560	2.225	2.446	1.673	0.596	0.354	0.687	0.794	0.466	0.258	0.214	0.211	30262
1941-42	9.542	4.255	2.806	0.984	0.443	0.656	0.907	0.870	0.327	0.181	0.150	0.778	57417
1942-43	29.197	6.836	8.148	4.015	2.483	3.903	2.624	1.358	0.541	0.300	0.248	0.316	156872
1943-44	26.246	15.975	10.717	5.816	2.068	1.705	1.631	1.385	0.522	0.290	0.239	0.192	175379
1944-45	2.992	2.416	1.465	3.491	0.335	0.316	0.302	1.366	0.466	0.258	0.214	0.709	37796
1945-46	7.834	5.342	4.807	3.828	0.843	1.209	1.697	1.374	0.490	0.271	0.225	1.149	76486
1946-47	11.073	4.393	4.417	3.681	0.469	1.932	2.235	2.451	0.639	0.354	0.293	0.262	84450
1947-48	15.537	11.459	5.750	11.084	1.847	2.691	3.012	2.088	1.148	0.635	0.526	0.430	148200
1948-49	19.347	59.515	5.983	13.055	1.449	0.644	2.445	1.756	0.756	0.419	0.346	0.167	281108
1949-50	9.175	0.395	9.227	3.741	1.266	0.471	1.758	1.142	0.704	0.400	0.331	0.440	75993
1950-51	11.183	11.493	5.000	6.920	7.389	1.885	1.803	2.669	0.950	0.612	0.594	0.611	134946
1951-52	18.081	37.387	12.203	6.645	4.729	16.358	17.341	9.009	2.125	0.898	0.671	0.715	332987
1952-53	34.987	16.181	7.640	5.205	3.205	2.682	1.892	1.417	0.624	0.787	0.548	0.569	198674
1953-54	24.734	18.140	22.526	43.764	16.537	19.257	5.808	5.251	2.086	1.106	1.145	1.016	425718
1954-55	18.318	43.431	68.571	16.337	3.198	10.555	7.019	4.473	2.104	0.694	0.938	0.928	463864
1955-56	38.430	44.112	7.842	3.633	0.699	0.494	1.131	1.026	0.676	0.571	0.572	0.656	263190
1956-57	12.030	55.695	13.637	13.246	3.530	2.866	1.377	1.318	0.893	0.483	0.365	0.319	280589
1957-58	39.519	31.847	6.820	3.226	1.102	1.540	1.446	1.162	0.607	0.470	0.316	0.728	233474
1958-59	5.424	2.233	1.797	2.826	0.560	0.222	1.623	0.917	0.417	0.126	0.000	0.436	43689
1959-60	7.786	5.573	3.369	4.519	0.735	3.726	5.522	3.580	1.207	0.656	0.557	0.493	99340
1960-61	35.063	17.541	11.478	2.500	1.130	0.368	0.474	0.532	0.339	0.230	0.146	0.102	183088
1961-62	0.649	1.245	0.607	0.069	0.109	0.007	0.058	0.249	0.216	0.059	0.000	0.010	8652
1962-63	3.381	7.104	1.264	0.342	0.151	1.275	0.846	0.785	0.352	0.078	0.003	0.127	41491
1963-64	16.928	1.871	2.040	2.116	0.977	0.538	0.506	0.573	0.359	0.301	0.418	0.497	70844
1964-65	7.604	9.613	0.931	1.037	1.308	4.911	4.748	2.235	1.069	0.714	0.615	0.574	93194
1965-66	12.370	13.941	32.290	5.089	2.421	3.235	4.450	1.763	1.030	0.770	0.707	0.593	206205
1966-67	33.004	16.367	14.456	14.787	5.039	3.857	1.484	1.416	1.105	0.901	0.790	0.652	246631
1967-68	7.632	37.157	7.687	0.948	0.668	0.324	1.356	0.136	0.237	0.164	0.220	1.878	155039
1968-69	5.232	1.427	2.866	2.790	7.212	4.871	1.741	1.100	0.496	0.428	0.545	0.618	77195
1969-70	16.475	3.610	1.693	2.083	0.840	0.848	4.630	1.573	0.725	0.375	0.415	0.472	88479
1970-71	14.401	22.239	9.130	13.182	3.524	1.076	3.792	12.232	2.634	1.082	0.914	0.768	224178
1971-72	52.195	12.420	4.048	1.533	1.398	0.385	2.587	2.605	1.534	0.908	0.699	0.742	211856
1972-73	35.972	52.359	4.253	2.890	0.790	0.405	0.635	0.212	0.000	0.000	0.000	1.040	260445
1973-74	5.535	5.000	13.639	9.600	1.495	0.900	1.130	0.946	0.846	0.625	0.618	0.695	107914
1974-75	35.398	44.978	15.140	1.732	0.986	2.437	3.381	1.757	1.035	0.758	0.608	0.598	286547
1975-76	23.823	22.790	13.569	3.319	1.198	4.379	6.502	3.506	1.081	0.657	0.754	0.779	216544
1976-77	39.423	5.126	27.801	14.963	1.439	0.580	0.732	0.480	0.333	0.382	0.465	0.523	241059
1977-78	10.889	4.267	1.746	1.621	2.994	6.857	5.784	3.934	1.596	0.962	0.654	0.679	110256
1978-79	20.052	13.826	2.601	2.291	0.687	1.897	3.760	2.255	1.166	0.764	0.614	0.585	132780
1979-80	31.805	42.422	22.750	2.476	0.488	0.557	0.752	0.849	0.575	0.421	0.453	0.518	273820
1980-81	13.312	1.807	0.690	1.516	2.433	2.884	4.178	1.961	0.963	0.510	0.351	1.073	83128
1981-82	9.747	5.346	2.516	2.417	1.470	0.222	6.775	4.417	0.976	0.309	0.209	0.312	91466
1982-83	5.542	4.500	2.628	7.132	2.804	1.018	2.318	0.955	0.814	0.718	0.547	0.400	77661
MIN	0.649	0.395	0.607	0.069	0.109	0.007	0.058	0.136	0.000	0.000	0.000	0.010	8652
MAX	64.488	86.866	68.571	47.033	16.537	19.257	17.341	12.232	2.759	1.908	1.442	6.393	498191
MEAN	19.879	18.261	10.745	7.443	2.745	3.006	3.120	2.199	0.852	0.494	0.407	0.722	183959

Note: Caution should be exercised in using this data base for other studies.

Table B-9

SWAN RIVER BASIN BALANCE OF FLOW TABLE FOR APPORTIONMENT AT THE PRESENT (1983) LEVEL OF USE - m^3/s

	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	CU.DAMS
1912-13	10.716	15.107	6.472	5.229	2.655	8.418	6.751	5.485	1.380	0.954	0.721	0.683	170070
1913-14	24.964	12.603	6.100	23.515	6.948	3.669	2.350	1.373	0.692	0.544	0.574	0.409	221024
1914-15	13.340	18.949	2.902	0.650	0.284	0.477	0.690	0.548	0.276	0.000	0.000	0.190	101108
1915-16	4.391	0.975	1.211	2.591	0.955	0.580	0.838	0.553	0.138	0.237	0.181	0.191	33781
1916-17	5.725	6.259	21.717	7.253	1.669	1.274	1.805	1.034	0.249	0.079	0.048	0.056	123750
1917-18	6.139	17.498	5.112	8.251	1.110	0.973	0.670	0.791	0.465	0.177	0.062	2.699	116569
1918-19	5.042	3.487	10.453	12.933	3.114	1.817	1.639	0.970	0.325	0.174	0.148	0.121	106117
1919-20	7.863	5.110	1.872	2.111	1.314	2.703	3.442	1.073	0.153	0.121	0.027	0.237	68531
1920-21	20.736	28.104	7.130	2.072	0.691	0.694	1.389	0.991	0.460	0.254	0.210	0.184	165905
1921-22	17.684	11.582	9.780	5.121	7.307	7.145	7.338	4.810	1.380	0.684	0.432	0.340	193622
1922-23	29.034	43.433	6.365	2.651	3.720	2.760	2.330	2.364	0.483	0.273	0.216	0.683	249046
1923-24	23.943	23.207	20.955	13.525	3.764	1.500	1.535	0.628	0.526	0.435	0.351	0.292	238704
1924-25	5.593	5.447	2.630	1.096	4.582	1.165	1.405	0.709	0.411	0.216	0.070	0.398	62645
1925-26	32.242	6.257	13.909	8.756	1.803	1.861	1.451	0.840	0.380	0.178	0.096	0.297	178077
1926-27	18.936	4.597	4.886	1.154	0.219	0.414	1.601	1.727	0.437	0.270	0.154	0.289	90616
1927-28	18.701	24.399	15.210	7.941	3.203	6.213	4.610	2.373	0.804	0.350	0.165	3.196	229769
1928-29	3.850	5.025	2.365	5.807	1.273	0.828	0.675	0.344	0.111	0.008	0.003	0.109	53997
1929-30	2.750	2.636	1.602	1.426	0.300	0.307	0.318	0.359	0.343	0.190	0.157	0.178	27822
1930-31	5.566	3.419	4.192	3.910	0.528	0.699	0.552	0.344	0.266	0.147	0.122	0.205	52468
1931-32	1.115	1.169	0.557	0.604	0.252	0.787	1.466	0.801	0.203	0.112	0.093	0.113	19182
1932-33	7.784	2.180	1.234	2.920	0.578	0.616	0.675	0.510	0.327	0.181	0.143	0.138	45386
1933-34	9.037	7.452	8.747	4.986	0.760	1.181	1.289	0.786	0.366	0.203	0.168	0.527	93336
1934-35	8.388	16.905	5.022	2.903	0.600	0.554	0.744	0.503	0.268	0.148	0.123	0.172	96028
1935-36	3.894	3.743	10.363	4.379	0.714	0.549	0.843	0.615	0.378	0.205	0.164	0.117	68178
1936-37	17.017	9.368	4.888	2.243	0.335	0.235	0.554	0.321	0.243	0.134	0.111	0.115	93278
1937-38	2.146	2.011	1.287	0.758	0.226	0.117	0.452	0.397	0.166	0.092	0.076	0.618	21993
1938-39	6.409	2.607	2.234	1.282	0.485	0.270	0.438	0.400	0.233	0.129	0.107	0.314	39096
1939-40	2.849	1.795	1.697	1.012	0.469	0.260	0.438	0.464	0.175	0.097	0.080	0.060	24697
1940-41	0.778	1.112	1.221	0.834	0.296	0.177	0.344	0.397	0.233	0.129	0.107	0.105	15108
1941-42	4.745	2.128	1.399	0.490	0.219	0.328	0.454	0.435	0.163	0.090	0.075	0.389	28618
1942-43	14.578	3.418	4.072	2.005	1.240	1.949	1.312	0.675	0.271	0.150	0.124	0.158	78349
1943-44	13.121	7.987	5.356	2.906	1.032	0.852	0.816	0.687	0.261	0.145	0.120	0.096	87652
1944-45	1.494	1.208	0.730	1.741	0.166	0.158	0.151	0.683	0.233	0.129	0.107	0.355	18870
1945-46	3.902	2.671	2.401	1.911	0.420	0.605	0.849	0.687	0.245	0.136	0.112	0.575	38183
1946-47	5.527	2.196	2.205	1.839	0.233	0.966	1.117	1.219	0.320	0.177	0.146	0.131	42163
1947-48	7.766	5.729	2.873	5.537	0.921	1.345	1.506	1.038	0.574	0.318	0.263	0.215	74051
1948-49	9.672	29.757	2.987	6.526	0.722	0.322	1.223	0.878	0.378	0.209	0.173	0.084	140526
1949-50	4.573	0.198	4.611	1.867	0.631	0.235	0.879	0.571	0.352	0.200	0.166	0.220	37940
1950-51	5.578	5.746	2.498	3.458	3.689	0.942	0.902	1.329	0.475	0.306	0.297	0.306	67400
1951-52	9.038	18.693	6.100	3.317	2.360	8.177	8.669	4.504	1.063	0.449	0.335	0.358	166449
1952-53	17.491	8.090	3.816	2.598	1.600	1.341	0.946	0.709	0.312	0.394	0.266	0.281	99279
1953-54	12.364	9.070	11.261	21.880	8.264	9.627	2.901	2.625	1.043	0.553	0.573	0.508	212815
1954-55	9.157	21.716	34.283	8.165	1.595	5.275	3.507	2.236	1.052	0.347	0.469	0.464	231891
1955-56	19.214	22.056	3.916	1.813	0.347	0.247	0.565	0.513	0.338	0.285	0.286	0.328	131565
1956-57	6.000	27.847	6.816	6.618	1.763	1.433	0.688	0.659	0.447	0.241	0.180	0.155	140213
1957-58	19.753	15.923	3.406	1.611	0.549	0.770	0.723	0.581	0.304	0.235	0.158	0.364	116697
1958-59	2.697	1.114	0.896	1.411	0.278	0.111	0.811	0.459	0.209	0.063	0.000	0.218	21784
1959-60	3.873	2.785	1.682	2.254	0.365	1.863	2.755	1.790	0.603	0.328	0.278	0.246	49570
1960-61	17.529	8.771	5.734	1.248	0.563	0.184	0.237	0.266	0.170	0.115	0.073	0.051	91514
1961-62	0.321	0.622	0.302	0.032	0.052	0.003	0.029	0.124	0.108	0.030	0.000	0.005	4300
1962-63	1.686	3.552	0.630	0.169	0.073	0.637	0.423	0.393	0.176	0.039	0.002	0.063	20718
1963-64	8.461	0.907	0.984	1.026	0.487	0.269	0.253	0.286	0.180	0.151	0.209	0.249	35153
1964-65	3.782	4.807	0.463	0.517	0.652	2.455	2.374	1.117	0.530	0.346	0.307	0.287	46486
1965-66	6.181	6.970	16.141	2.541	1.209	1.617	2.223	0.874	0.515	0.385	0.353	0.297	103041
1966-67	16.498	8.182	7.226	7.389	2.513	1.928	0.742	0.708	0.553	0.451	0.395	0.322	123257
1967-68	3.806	18.577	3.837	0.472	0.332	0.162	0.678	0.068	0.119	0.082	0.110	0.939	77459
1968-69	2.612	0.714	1.431	1.393	3.604	2.435	0.871	0.550	0.248	0.214	0.273	0.309	38570
1969-70	8.192	1.803	0.844	1.039	0.418	0.424	2.315	0.787	0.362	0.187	0.208	0.236	44101
1970-71	7.180	11.119	4.563	6.587	1.760	0.538	1.896	6.104	1.317	0.541	0.457	0.384	111980
1971-72	26.094	6.208	2.022	0.764	0.697	0.193	1.293	1.302	0.767	0.454	0.350	0.371	105895
1972-73	17.967	26.179	2.122	1.443	0.393	0.202	0.317	0.106	0.000	0.000	0.000	0.520	130149
1973-74	2.764	2.492	6.806	4.794	0.746	0.450	0.565	0.473	0.423	0.313	0.309	0.348	53871
1974-75	17.686	22.489	7.566	0.864	0.491	1.218	1.691	0.879	0.517	0.379	0.304	0.295	143210
1975-76	11.899	11.395	6.782	1.658	0.597	2.189	3.238	1.751	0.540	0.328	0.377	0.390	108185
1976-77	19.708	2.560	13.899	7.475	0.718	0.290	0.366	0.240	0.167	0.191	0.233	0.262	120484
1977-78	5.441	2.112	0.871	0.809	1.495	3.429	2.876	1.967	0.798	0.481	0.327	0.339	55000
1978-79	10.023	6.912	1.298	1.144	0.341	0.949	1.880	1.128	0.583	0.378	0.298	0.291	66323
1979-80	15.899	21.211	11.370	1.236	0.242	0.279	0.376	0.425	0.288	0.211	0.226	0.259	136878
1980-81	6.636	0.904	0.343	0.756	1.214	1.442	2.089	0.981	0.482	0.255	0.175	0.537	41496
1981-82	4.848	2.671	1.256	1.206	0.733	0.111	3.382	2.208	0.488	0.155	0.105	0.156	45629
1982-83	2.767	2.250	1.309	3.563	1.400	0.509	1.159	0.478	0.407	0.359	0.274	0.200	38795
MIN	0.321	0.198	0.302	0.032	0.052	0.003	0.029	0.068	0.000	0.000	0.000	0.005	4300
MAX	32.242	43.433	34.283	23.515	8.264	9.627	8.669	6.104	1.380	0.954	0.721	3.196	249046
MEAN	9.932	9.129	5.369	3.718	1.370	1.503	1.559	1.099	0.426	0.247	0.203	0.360	91921

Note: See report section entitled "Present Use Flow Calculations" for information on the derivation of this table. Positive values indicate the quantity of water passed on to Manitoba in excess of 50% of natural flow.