

**Apportionment Period
for Eastward Flowing Streams
Crossing the Saskatchewan-Manitoba
Boundary**

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Prairie Provinces Water Board
Committee on Hydrology

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**APPORTIONMENT PERIOD
FOR EASTWARD FLOWING STREAMS CROSSING
THE SASKATCHEWAN-MANITOBA BOUNDARY**

BACKGROUND

The Master Agreement on Apportionment states in Section 3 of Schedule A that the apportionment period between Alberta and Saskatchewan shall be the calendar year. Similarly, Section 3 of Schedule B specifies that the apportionment period between Saskatchewan and Manitoba is the period from April 1st of each year to March 31 of the year following (hereafter referred as Water Year).

Questions were raised on several occasions as to why different apportionment time periods were specified in Schedules A and B of the agreement. This matter was discussed at the Prairie Provinces Water Board (Old Board Meeting No. 41 held on July 14, 1969), Minute 41-05 recorded that

"...Mr. Clark asked why it was necessary in the provincial agreements, to base apportionment between Alberta and Saskatchewan on the calendar year, and between Saskatchewan and Manitoba on the water year. In his opinion, the elected time base in apportioning streamflows is important, and he could foresee difficulties in administering the agreement. Mr. Weber noted that Manitoba needs were established on the basis of hydro flow requirements and this is the reason why the water year was adopted in the Saskatchewan-Manitoba agreement. Mr. Crook noted that the Board is considering an agreement between Alberta, Saskatchewan and Manitoba on the principles of apportionment. The agreement states what the provinces want. It is realized that technical problems do exist as was stated before, however, technical problems are not immune to solution. Mr. Bailey added that technical and other administrative problems could be resolved through mutual consent and cooperation".

After the signing of the Master Agreement on Apportionment on October 30, 1969, apportionment monitoring for eastward flowing interprovincial streams have been administered based on the apportionment period specified in the Agreement.

In April 1980, the Committee on Hydrology completed a report entitled "Report on Administration of the Apportionment Agreement, April 1980" (PPWB Report #58). Chapter 4 of that report provides an overview on apportionment, balance and audit periods for each of the five major interprovincial streams (i.e. North Saskatchewan, South Saskatchewan, Saskatchewan, Churchill and Qu'Appelle Rivers). The COH recommended that the apportionment period continue to be reported for the calendar year, as defined in Schedule A, and for the twelve-month period of April 1st to March 31st of the following year as defined in Schedule B of the 1969 agreement (Re: Recommendation Chapter and the report's covering letter).

In recent years, concerns were raised regarding the continuing use of water year for apportioning the waters of eastward flowing streams crossing the Saskatchewan-Manitoba boundary, particularly on the suitability of a water year and its effects on apportionment monitoring and reporting.

DISADVANTAGE OF APPORTIONING THE WATER BASED ON WATER YEAR

From a hydrologic point of view, the frequency, magnitude, and spring runoff period for a stream varies from year to year.

The time period in which flow apportionment is accounted for is relatively important particularly for those small interprovincial streams. Most of the spring runoff in the prairie provinces occurred during the period of March to June. An apportionment period based on the calendar year would cover all the spring runoff while an apportionment period based on the water year may encounter one of the following cases:

1. Spring runoff may be spread over the two consecutive apportionment periods.
2. Having two spring runoffs in one apportionment period, and
3. Having little or no spring runoff in one apportionment period.

The data format for streamflow records published by Environment Canada is based on the calendar year rather than the water year. Although some computer programs are used to change the data format from calendar year to water year, it would be easier to use the data in its original format.

CONSIDERATIONS FOR SWITCHING THE APPORTIONMENT PERIOD FROM WATER YEAR TO CALENDAR YEAR

Before considering the possibility of changing the apportionment period from water year to calendar year, several items pertinent to the apportionment period must be addressed. They are discussed in the following sections:

Consideration 1: Flow Required by Manitoba Hydro

When Schedule B of the Master Agreement was negotiated in 1969, between Manitoba and Saskatchewan, hydropower flow requirements for major interprovincial streams (e.g. Saskatchewan River) were considered. A review of the historical flow records of the Saskatchewan River suggests that the same flow pattern would likely be continued despite the apportionment period used (e.g. calendar or water year) (see Figures 1 to 6). However, it would be up to Manitoba and Saskatchewan to decide whether such a change in the flow apportionment is suitable for their operation.

Consideration 2: PPWB Annual Report

If the calendar year is used for apportionment monitoring of streams crossing the Saskatchewan-Manitoba boundary, apportionment calculation for selected interprovincial streams could be completed earlier. However, this does not mean the PPWB Annual Report can be published three months earlier (e.g. in June of each year instead of in September) because most of the "final" hydrometric records (e.g. South Saskatchewan River) and the financial statement are not likely to be available by June of each year.

Consideration 3: The Effect on Annual Apportionment Volume

Switching the apportionment period from water year to calendar year will definitely affect the 'annual' volume of apportionment flow. An evaluation of the recorded and natural flow (or apportionment flow) for the Saskatchewan River, Churchill River and Qu'Appelle River show that the effect is insignificant for most of the cases (See Figures 1 to 6). However, it is interesting to note that, based on the water year, the Qu'Appelle River annual natural flow for 1989-90 was 19 053 dam³. If the apportionment is based on the calendar year, annual natural flow for 1989 was only 91 dam³ (see Tables 6 and 8).

CONCLUSIONS

The calendar year has proved to be a more effective, practical and consistent approach for apportionment monitoring of all eastward flowing interprovincial streams. Adoption of this approach would simplify the process of data evaluation, natural flow computation, apportionment administration and publication of apportionment balance results.

RECOMMENDATIONS

The Committee on Hydrology recommends that Section 3 of Schedule B of the Master Agreement on Apportionment be revised to change the apportionment period from the water year to the calendar year.

FIGURE 1
SASKATCHEWAN RIVER – RECORDED FLOW COMPARISON
Annual Recorded Flow (1000's Cubic Decametres)

BASED ON CALENDAR YEAR

BASED ON WATER YEAR

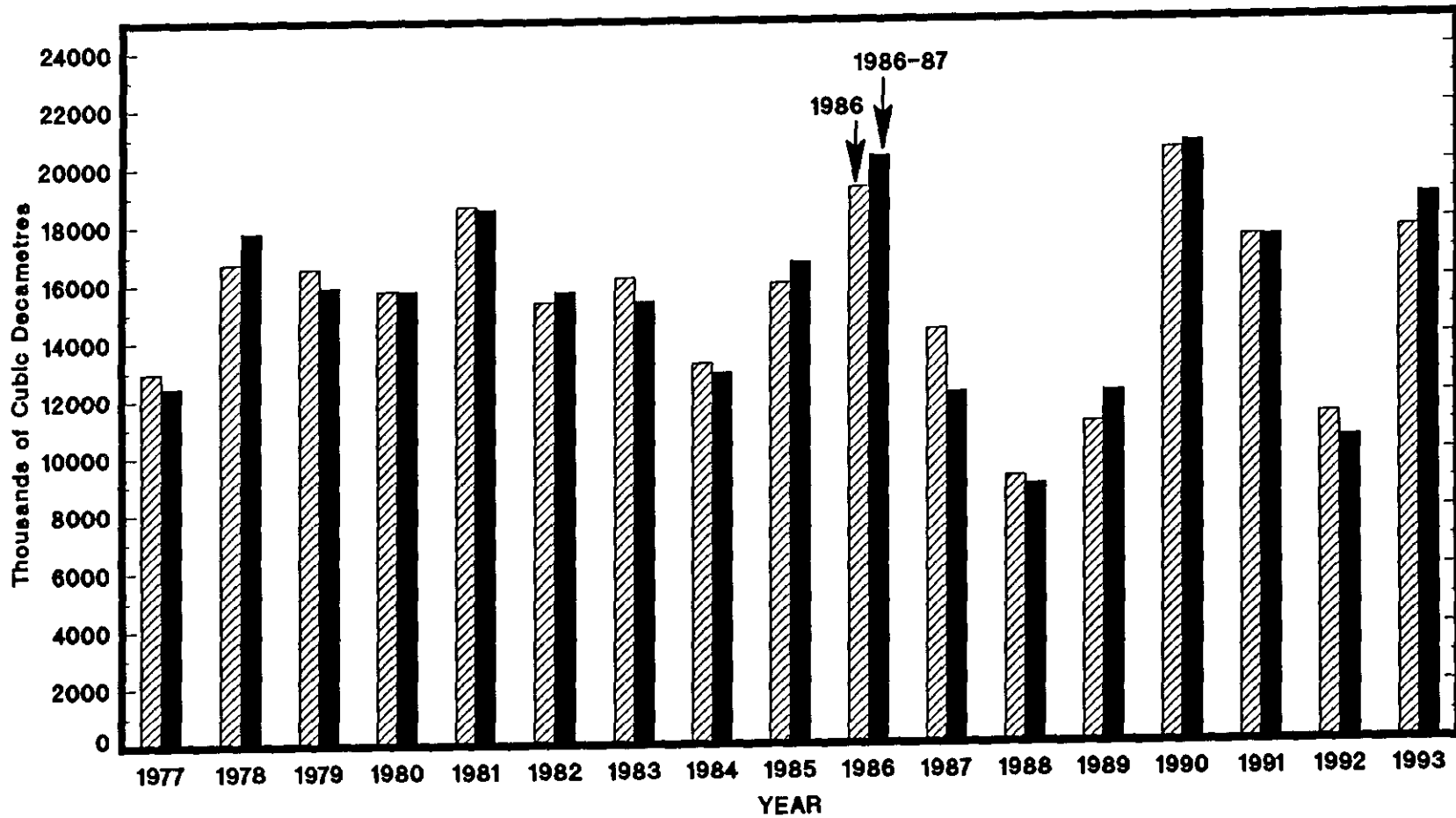
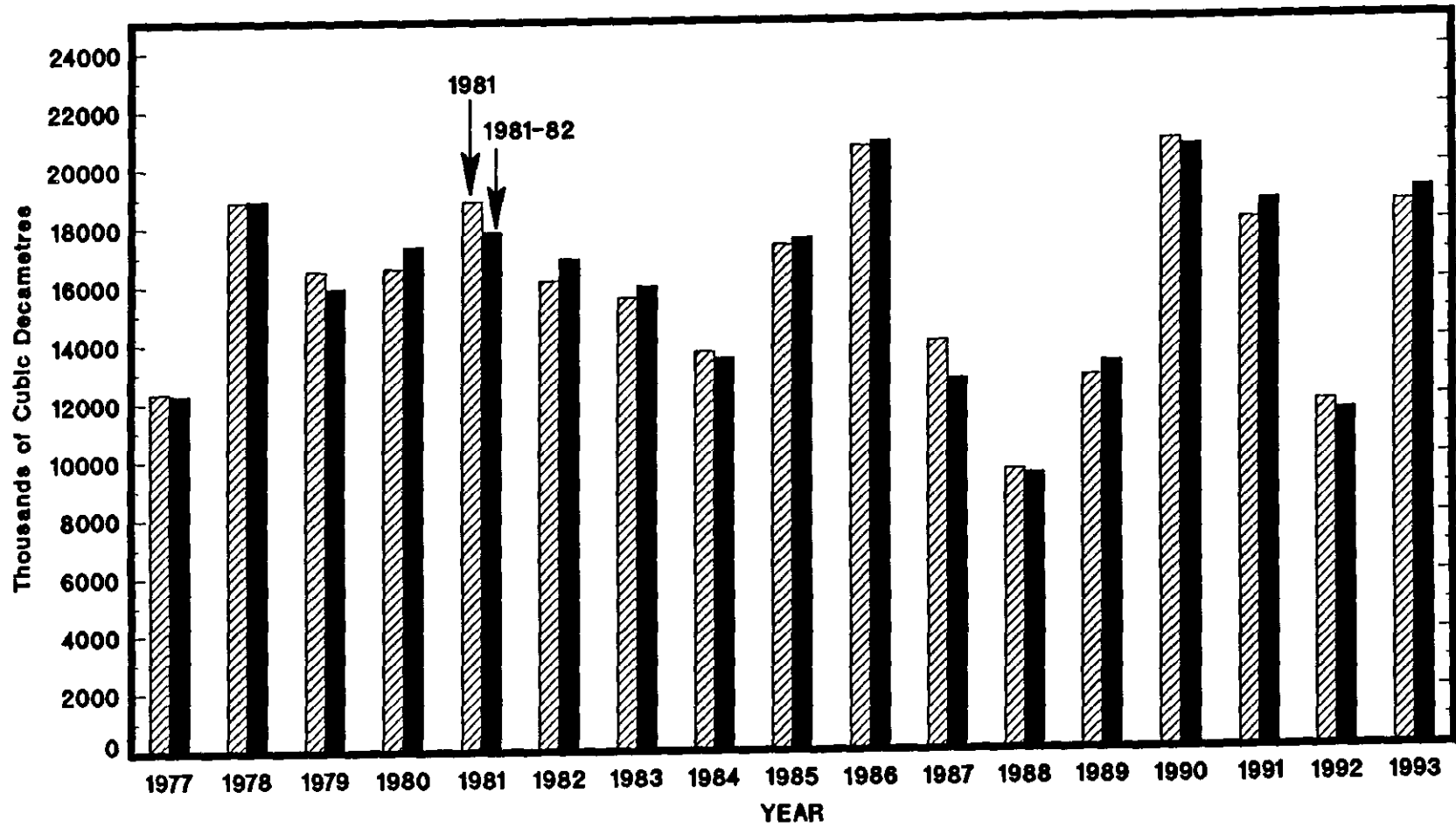


FIGURE 2
SASKATCHEWAN RIVER - APPORTIONMENT FLOW COMPARISON
Annual Apportionment Flow (1000's Cubic Decametres)

BASED ON CALENDAR YEAR

BASED ON WATER YEAR



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TABLE 1

SASKATCHEWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM³

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	1200.	1200.	970.	1350.	1230.	1500.	1100.	970.	1130.	943.	617.	723.	12933.
1978	1040.	905.	945.	1290.	2340.	1810.	1980.	1410.	1450.	1720.	954.	865.	16709.
1979	1200.	1240.	1510.	1380.	3640.	2310.	1230.	1010.	874.	822.	710.	608.	16534.
1980	753.	1230.	1320.	1810.	1490.	1870.	2070.	1170.	1020.	1340.	1040.	627.	15740.
1981	1110.	1080.	1110.	1950.	1460.	2300.	2010.	2870.	1740.	1300.	1070.	637.	18637.
1982	1040.	1060.	1100.	1540.	2120.	1490.	1900.	1530.	982.	1020.	806.	726.	15314.
1983	1150.	1210.	1220.	1520.	2460.	1590.	1980.	1220.	988.	1090.	1000.	729.	16157.
1984	892.	947.	929.	1970.	1490.	1470.	1250.	887.	907.	986.	739.	702.	13169.
1985	742.	748.	964.	2170.	3010.	2070.	1490.	1080.	1080.	1010.	775.	812.	15951.
1986	1070.	864.	1230.	1950.	1930.	1990.	2100.	2630.	1370.	1720.	1240.	1131.	19225.
1987	1210.	1390.	1630.	2090.	1650.	1100.	912.	1040.	996.	919.	749.	617.	14303.
1988	672.	824.	581.	1190.	1300.	713.	806.	702.	741.	707.	448.	485.	9169.
1989	442.	704.	651.	879.	1420.	1030.	1020.	1220.	1410.	1000.	601.	694.	11071.
1990	782.	861.	1220.	2020.	2130.	2970.	4160.	2290.	1290.	1140.	905.	718.	20486.
1991	803.	1080.	1220.	1910.	1760.	1780.	2470.	1960.	1520.	1260.	843.	856.	17462.
1992	953.	1020.	1140.	1420.	1160.	968.	1050.	785.	613.	797.	890.	510.	11306.
1993	729.	827.	715.	1450.	1180.	1050.	2270.	3240.	2240.	1880.	1200.	929.	17710.
MEAN	929.	1011.	1086.	1641.	1869.	1648.	1753.	1530.	1197.	1156.	858.	728.	14549.
MAX.	1210.	1390.	1630.	2170.	3640.	2970.	4160.	3240.	2240.	1880.	1240.	1131.	20486.
MIN.	442.	704.	581.	879.	1160.	713.	806.	702.	613.	707.	448.	485.	9169.
MED.	953.	1020.	1110.	1540.	1650.	1590.	1900.	1220.	1080.	1020.	843.	718.	15951.

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TABLE 2

SASKATCHEWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY APPORTIONMENT FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM³

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	477.	733.	845.	1580.	1440.	1780.	1300.	1160.	1190.	1100.	388.	358.	12351.
1978	500.	621.	878.	1830.	2870.	2990.	2830.	1770.	1610.	1700.	697.	574.	18870.
1979	548.	437.	1080.	1980.	4080.	3080.	1710.	1080.	958.	797.	502.	257.	16509.
1980	244.	484.	750.	2400.	2120.	2910.	2830.	1410.	1160.	1240.	897.	151.	16596.
1981	605.	757.	857.	2100.	1410.	3320.	2970.	3310.	1630.	1050.	759.	107.	18875.
1982	395.	387.	412.	1850.	2770.	2260.	3260.	2010.	971.	1000.	399.	451.	16165.
1983	637.	527.	766.	1810.	2750.	2070.	2420.	1470.	993.	1010.	751.	340.	15544.
1984	659.	830.	840.	2250.	1550.	1830.	1520.	1020.	979.	993.	645.	557.	13673.
1985	628.	662.	825.	2910.	3140.	2440.	1660.	1240.	1280.	1260.	687.	587.	17319.
1986	605.	464.	1280.	2360.	2460.	3040.	2710.	2770.	1400.	1780.	1020.	811.	20700.
1987	764.	763.	979.	2390.	1930.	1300.	1310.	1430.	1200.	1010.	595.	335.	14006.
1988	237.	343.	625.	1500.	1440.	1080.	1050.	918.	868.	804.	413.	291.	9569.
1989	177.	354.	542.	1410.	1920.	1580.	1410.	1420.	1700.	1250.	611.	404.	12778.
1990	456.	487.	600.	2530.	2440.	4250.	4670.	2410.	1360.	905.	385.	369.	20862.
1991	111.	514.	728.	2270.	2240.	2900.	3620.	2340.	1480.	889.	504.	510.	18106.
1992	525.	618.	852.	1670.	1280.	1390.	1700.	1260.	861.	835.	743.	118.	11852.
1993	312.	553.	803.	2100.	1500.	1870.	2660.	3330.	2340.	1800.	666.	717.	18651.
MEAN	464.	561.	804.	2055.	2196.	2358.	2331.	1785.	1293.	1143.	627.	408.	15135.
MAX.	764.	830.	1280.	2910.	4080.	4250.	4670.	3330.	2340.	1800.	1020.	811.	20862.
MIN.	111.	343.	412.	1410.	1280.	1080.	1050.	918.	861.	797.	385.	107.	9569.
MED.	500.	527.	825.	2100.	2120.	2260.	2420.	1430.	1200.	1010.	645.	369.	16509.

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TABLE 3

SASKATCHEWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAMS

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	1350.	1230.	1500.	1100.	970.	1130.	943.	617.	723.	1040.	905.	945.	12453.
1978-79	1290.	2340.	1810.	1980.	1410.	1450.	1720.	954.	865.	1200.	1240.	1510.	17769.
1979-80	1380.	3640.	2310.	1230.	1010.	874.	822.	710.	608.	753.	1230.	1320.	15887.
1980-81	1810.	1490.	1870.	2070.	1170.	1020.	1340.	1040.	627.	1110.	1080.	1110.	15737.
1981-82	1950.	1460.	2300.	2010.	2870.	1740.	1300.	1070.	637.	1040.	1060.	1100.	18537.
1982-83	1540.	2120.	1490.	1900.	1530.	982.	1020.	806.	726.	1150.	1210.	1220.	15694.
1983-84	1520.	2460.	1590.	1980.	1220.	988.	1090.	1000.	729.	892.	947.	929.	15345.
1984-85	1970.	1490.	1470.	1250.	887.	907.	986.	739.	702.	742.	748.	964.	12855.
1985-86	2170.	3010.	2070.	1490.	1080.	1080.	1010.	775.	812.	1070.	864.	1230.	16661.
1986-87	1950.	1930.	1990.	2100.	2630.	1370.	1720.	1240.	1131.	1210.	1390.	1630.	20291.
1987-88	2090.	1650.	1100.	912.	1040.	996.	919.	749.	617.	672.	824.	581.	12150.
1988-89	1190.	1300.	713.	806.	702.	741.	707.	448.	485.	442.	704.	651.	8889.
1989-90	879.	1420.	1030.	1020.	1220.	1410.	1000.	601.	694.	782.	861.	1220.	12137.
1990-91	2020.	2130.	2970.	4160.	2290.	1290.	1140.	905.	718.	803.	1080.	1220.	20726.
1991-92	1910.	1760.	1780.	2470.	1960.	1520.	1260.	843.	856.	953.	1020.	1140.	17472.
1992-93	1420.	1160.	968.	1050.	785.	613.	797.	890.	510.	729.	827.	715.	10464.
1993-94	1450.	1180.	1050.	2270.	3240.	2240.	1880.	1200.	929.	892.	1150.	1360.	18841.
MEAN	1641.	1869.	1648.	1753.	1530.	1197.	1156.	858.	728.	911.	1008.	1109.	15406.
MAX.	2170.	3640.	2970.	4160.	3240.	2240.	1880.	1240.	1131.	1210.	1390.	1630.	20726.
MIN.	879.	1160.	713.	806.	702.	613.	707.	448.	485.	442.	704.	581.	8889.
MED.	1540.	1650.	1590.	1900.	1220.	1080.	1020.	843.	718.	892.	1020.	1140.	15737.

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TABLE 4

SASKATCHEWAN RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY APPORTIONMENT FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAMS

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	1580.	1440.	1780.	1300.	1160.	1190.	1100.	388.	358.	500.	621.	878.	12295.
1978-79	1830.	2870.	2990.	2830.	1770.	1610.	1700.	697.	574.	548.	437.	1080.	18936.
1979-80	1980.	4080.	3080.	1710.	1080.	958.	797.	502.	257.	244.	484.	750.	15922.
1980-81	2400.	2120.	2910.	2830.	1410.	1160.	1240.	897.	151.	605.	757.	857.	17337.
1981-82	2100.	1410.	3320.	2970.	3310.	1630.	1050.	759.	107.	395.	387.	412.	17850.
1982-83	1850.	2770.	2260.	3260.	2010.	971.	1000.	399.	451.	637.	527.	766.	16901.
1983-84	1810.	2750.	2070.	2420.	1470.	993.	1010.	751.	340.	659.	830.	840.	15943.
1984-85	2250.	1550.	1830.	1520.	1020.	979.	993.	645.	557.	628.	662.	825.	13459.
1985-86	2910.	3140.	2440.	1660.	1240.	1280.	1260.	687.	587.	605.	464.	1280.	17553.
1986-87	2360.	2460.	3040.	2710.	2770.	1400.	1780.	1020.	811.	764.	763.	979.	20857.
1987-88	2390.	1930.	1300.	1310.	1430.	1200.	1010.	595.	335.	237.	343.	625.	12705.
1988-89	1500.	1440.	1080.	1050.	918.	868.	804.	413.	291.	177.	354.	542.	9437.
1989-90	1410.	1920.	1580.	1410.	1420.	1700.	1250.	611.	404.	456.	487.	600.	13248.
1990-91	2530.	2440.	4250.	4670.	2410.	1360.	905.	385.	369.	111.	514.	728.	20672.
1991-92	2270.	2240.	2900.	3620.	2340.	1480.	889.	504.	510.	525.	618.	852.	18748.
1992-93	1670.	1280.	1390.	1700.	1260.	861.	835.	743.	118.	312.	553.	803.	11525.
1993-94	2100.	1500.	1870.	2660.	3330.	2340.	1800.	666.	717.	304.	591.	1230.	19108.
MEAN	2055.	2196.	2358.	2331.	1785.	1293.	1143.	627.	408.	453.	552.	826.	16029.
MAX.	2910.	4080.	4250.	4670.	3330.	2340.	1800.	1020.	811.	764.	830.	1280.	20857.
MIN.	1410.	1280.	1080.	1050.	918.	861.	797.	385.	107.	111.	343.	412.	9437.
MED.	2100.	2120.	2260.	2420.	1430.	1200.	1010.	645.	369.	500.	527.	825.	16901.

FIGURE 3
QU'APPELLE RIVER - RECORDED FLOW COMPARISON
Annual Recorded Flow (1000's Cubic Decametres)

BASED ON CALENDAR YEAR **BASED ON WATER YEAR**
 

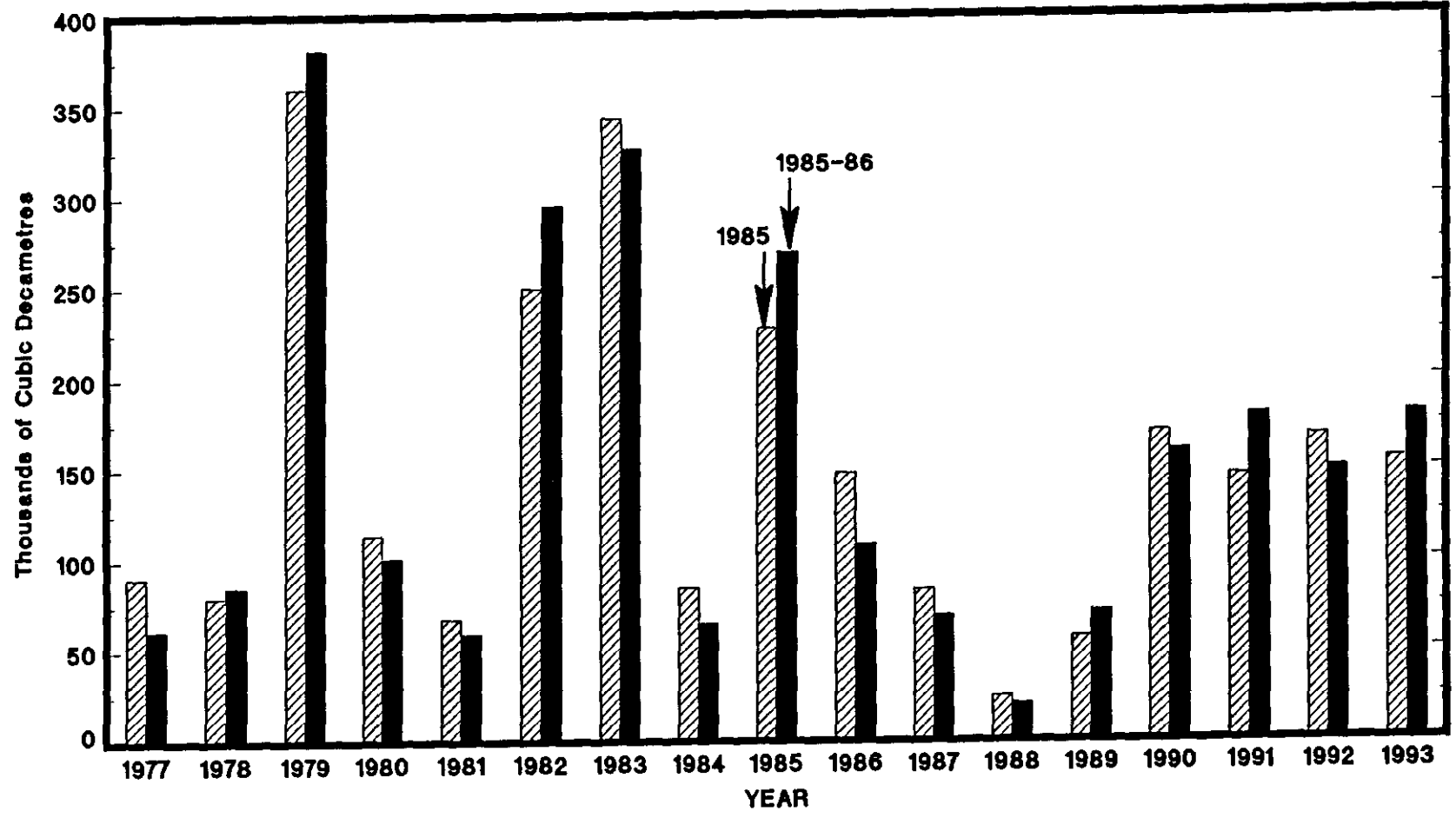


FIGURE 4
QU'APPELLE RIVER - NATURAL FLOW COMPARISON
Annual Natural Flow (1000's Cubic Decametres)

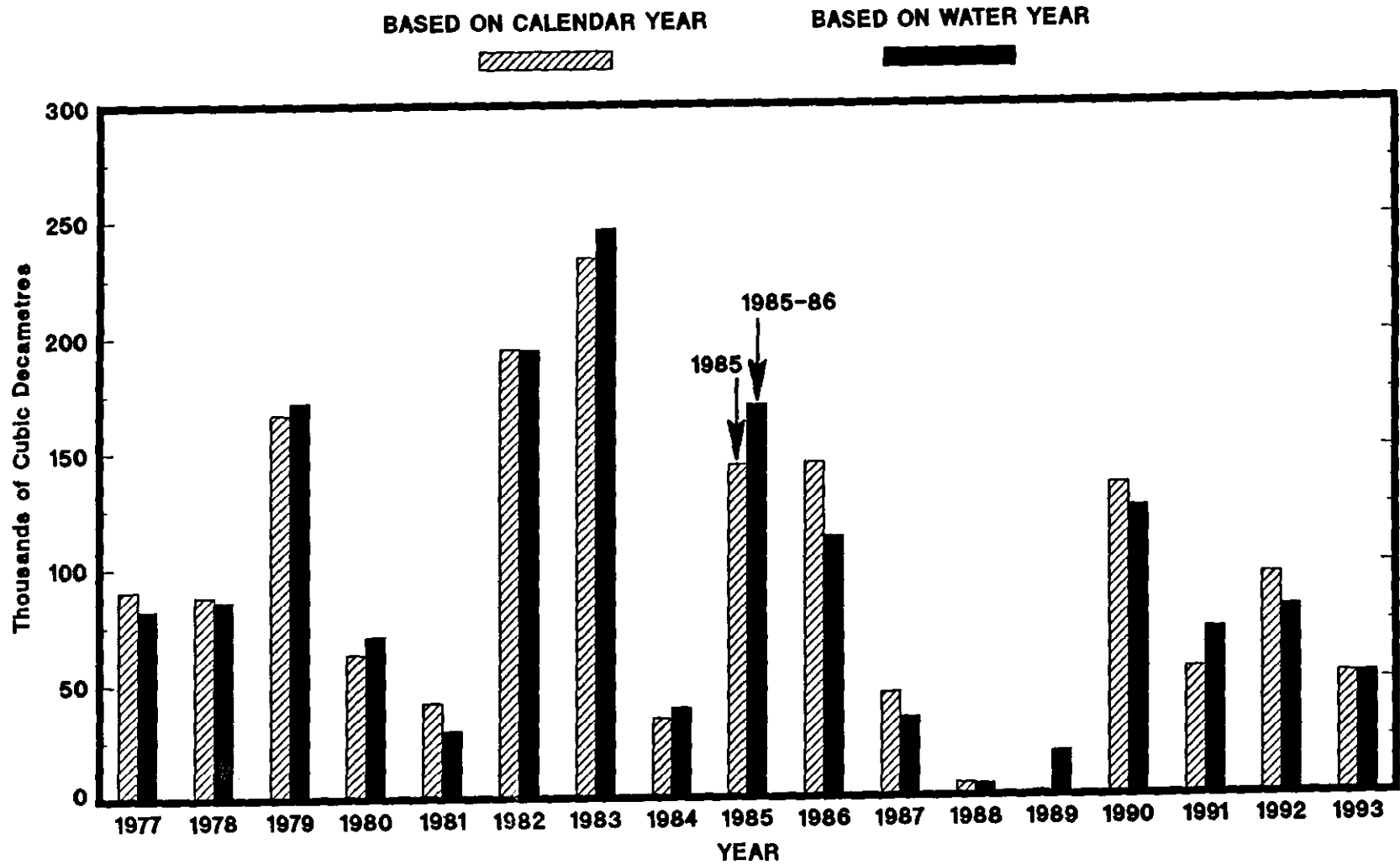


TABLE 5

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QU'APPELLE RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : DAM3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	14700.	9940.	9280.	6290.	7760.	7890.	5700.	2100.	968.	7140.	12600.	6300.	90668.
1978	2470.	881.	1590.	19400.	14300.	10500.	6930.	2730.	709.	5270.	10800.	4430.	80010.
1979	3230.	3210.	4030.	56700.	147000.	69700.	19500.	8930.	6210.	9350.	15100.	17600.	360560.
1980	14700.	9270.	7400.	30700.	11000.	2280.	1340.	859.	522.	9500.	17800.	8420.	113791.
1981	4700.	6690.	7730.	3160.	2560.	2570.	511.	2520.	4180.	9970.	14400.	8570.	67561.
1982	4140.	2570.	4370.	36500.	75100.	42600.	10100.	9060.	5280.	22400.	21200.	16600.	249920.
1983	19600.	17100.	19800.	60500.	83000.	29100.	21900.	27000.	12700.	22100.	18100.	12700.	343600.
1984	10500.	11600.	17800.	5690.	5210.	3850.	2660.	259.	9.	3650.	15600.	7720.	84548.
1985	3830.	1860.	14600.	96900.	18100.	10200.	10300.	5630.	11600.	16000.	22900.	15400.	227320.
1986	11800.	10500.	40200.	17500.	20200.	5730.	5700.	4110.	548.	9220.	14200.	7850.	147558.
1987	6190.	6550.	10400.	22100.	4840.	4350.	3870.	1230.	4520.	6540.	7120.	5940.	83650.
1988	2900.	2770.	2580.	5170.	4830.	2390.	2150.	213.	0.	8.	787.	357.	24155.
1989	345.	636.	3190.	5940.	1600.	952.	795.	318.	850.	14700.	17200.	10300.	56826.
1990	6740.	4640.	7270.	78500.	13000.	9340.	10600.	6180.	2070.	11100.	14000.	6560.	170000.
1991	2060.	1480.	5020.	7620.	6510.	9710.	30100.	24600.	11000.	16100.	18000.	13700.	145900.
1992	11600.	9100.	21400.	36600.	11600.	7900.	4660.	5020.	5740.	17600.	22200.	13900.	167320.
1993	10200.	7470.	6790.	6170.	2490.	6280.	15400.	13300.	15000.	25900.	25100.	20400.	154500.
MEAN	7630.	6251.	10791.	29144.	25241.	13255.	8954.	6709.	4818.	12150.	15712.	10397.	142660.
MAX.	19600.	17100.	40200.	96900.	147000.	69700.	30100.	27000.	15000.	25900.	25100.	20400.	360560.
MIN.	345.	636.	1590.	3160.	1600.	952.	511.	213.	0.	8.	787.	357.	24155.
MED.	6190.	6550.	7400.	19400.	11000.	7890.	5700.	4110.	4180.	9970.	15600.	8570.	145900.

TABLE 6

QRMNT

QU'APPELLE RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY NATURAL FLOW
(DATA FROM ANNUAL REPORT)
UNIT : DAM3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	2096.	308.	7750.	19740.	19000.	15000.	13900.	7770.	4120.	654.	37.	0.	90375.
1978	0.	0.	1970.	30100.	23700.	15400.	9000.	5500.	2160.	164.	2.	0.	87996.
1979	0.	0.	66.	95100.	14700.	30900.	1180.	9130.	13400.	2200.	100.	0.	166776.
1980	0.	0.	5240.	32300.	21300.	3450.	448.	196.	24.	0.	0.	0.	62958.
1981	0.	4690.	8420.	3590.	4110.	6330.	7070.	7450.	113.	0.	0.	0.	41773.
1982	0.	0.	1070.	58900.	74700.	16500.	9150.	20500.	12900.	986.	32.	0.	194738.
1983	0.	0.	651.	71100.	69400.	12400.	25500.	40700.	13100.	744.	22.	0.	233617.
1984	0.	0.	13100.	10800.	8070.	2280.	433.	0.	0.	0.	0.	0.	34683.
1985	0.	0.	17600.	99600.	19500.	5680.	1740.	98.	0.	0.	0.	0.	144218.
1986	0.	0.	43700.	29300.	27300.	19900.	18500.	5800.	400.	20.	0.	0.	144920.
1987	0.	0.	11500.	27360.	3940.	2340.	409.	0.	0.	0.	0.	0.	45549.
1988	0.	0.	617.	1001.	2987.	1103.	0.	0.	0.	0.	0.	0.	5708.
1989	0.	0.	0.	0.	0.	0.	91.	0.	0.	0.	0.	0.	91.
1990	0.	0.	18962.	69380.	38572.	4070.	3552.	449.	75.	0.	0.	0.	135060.
1991	0.	0.	8917.	12174.	4776.	1412.	3682.	7350.	9064.	4940.	2181.	882.	55378.
1992	62.	0.	25973.	47277.	13376.	6787.	1576.	327.	75.	0.	0.	0.	95453.
1993	0.	0.	12140.	6080.	1520.	599.	3480.	4820.	10300.	8060.	4290.	1290.	52579.
MEAN	127.	294.	10452.	36106.	20409.	8479.	5865.	6476.	3867.	1045.	392.	128.	88437.
MAX.	2096.	4690.	43700.	99600.	74700.	30900.	25500.	40700.	13400.	8060.	4290.	1290.	233617.
MIN.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	91.
MED.	0.	0.	8420.	29300.	14700.	5680.	3480.	4820.	113.	0.	0.	0.	87996.

QRMRF

TABLE 7

QU'APPELLE RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : DAM3

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	6290.	7760.	7890.	5700.	2100.	968.	7140.	12600.	6300.	2470.	881.	1590.	61689.
1978-79	19400.	14300.	10500.	6930.	2730.	709.	5270.	10800.	4430.	3230.	3210.	4030.	85539.
1979-80	56700.	147000.	69700.	19500.	8930.	6210.	9350.	15100.	17600.	14700.	9270.	7400.	381460.
1980-81	30700.	11000.	2280.	1340.	859.	522.	9500.	17800.	8420.	4700.	6690.	7730.	101541.
1981-82	3160.	2560.	2570.	511.	2520.	4180.	9970.	14400.	8570.	4140.	2570.	4370.	59521.
1982-83	36500.	75100.	42600.	10100.	9060.	5280.	22400.	21200.	16600.	19600.	17100.	19800.	295340.
1983-84	60500.	83000.	29100.	21900.	27000.	12700.	22100.	18100.	12700.	10500.	11600.	17800.	327000.
1984-85	5690.	5210.	3850.	2660.	259.	9.	3650.	15600.	7720.	3830.	1860.	14600.	64938.
1985-86	96900.	18100.	10200.	10300.	5630.	11600.	16000.	22900.	15400.	11800.	10500.	40200.	269530.
1986-87	17500.	20200.	5730.	5700.	4110.	548.	9220.	14200.	7850.	6190.	6550.	10400.	108198.
1987-88	22100.	4840.	4350.	3870.	1230.	4520.	6540.	7120.	5940.	2900.	2770.	2580.	68760.
1988-89	5170.	4830.	2390.	2150.	213.	0.	8.	787.	357.	345.	636.	3190.	20076.
1989-90	5940.	1600.	952.	795.	318.	850.	14700.	17200.	10300.	6740.	4640.	7270.	71305.
1990-91	78500.	13000.	9340.	10600.	6180.	2070.	11100.	14000.	6560.	2060.	1480.	5020.	159910.
1991-92	7620.	6510.	9710.	30100.	24600.	11000.	16100.	18000.	13700.	11600.	9100.	21400.	179440.
1992-93	36600.	11600.	7900.	4660.	5020.	5740.	17600.	22200.	13900.	10200.	7470.	6790.	149680.
1993-94	6170.	2490.	6280.	15400.	13300.	15000.	25900.	25100.	20400.	14200.	10500.	25200.	179940.
MEAN	29144.	25241.	13255.	8954.	6709.	4818.	12150.	15712.	10397.	7600.	6284.	11728.	151992.
MAX.	96900.	147000.	69700.	30100.	27000.	15000.	25900.	25100.	20400.	19600.	17100.	40200.	381460.
MIN.	3160.	1600.	952.	511.	213.	0.	8.	787.	357.	345.	636.	1590.	20076.
MED.	19400.	11000.	7890.	5700.	4110.	4180.	9970.	15600.	8570.	6190.	6550.	7400.	108198.

TABLE 8

QRMNFT

QU'APPELLE RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY NATURAL FLOW
(DATA FROM ANNUAL REPORT)
UNIT : DAM3

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	19740.	19000.	15000.	13900.	7770.	4120.	654.	37.	0.	0.	0.	1970.	82191.
1978-79	30100.	23700.	15400.	9000.	5500.	2160.	164.	2.	0.	0.	0.	66.	86092.
1979-80	95100.	14700.	30900.	1180.	9130.	13400.	2200.	100.	0.	0.	0.	5240.	171950.
1980-81	32300.	21300.	3450.	448.	196.	24.	0.	0.	0.	0.	4690.	8420.	70828.
1981-82	3590.	4110.	6330.	7070.	7450.	113.	0.	0.	0.	0.	0.	1070.	29733.
1982-83	58900.	74700.	16500.	9150.	20500.	12900.	986.	32.	0.	0.	0.	651.	194319.
1983-84	71100.	69400.	12400.	25500.	40700.	13100.	744.	22.	0.	0.	0.	13100.	246066.
1984-85	10800.	8070.	2280.	433.	0.	0.	0.	0.	0.	0.	0.	17600.	39183.
1985-86	99600.	19500.	5680.	1740.	98.	0.	0.	0.	0.	0.	0.	43700.	170318.
1986-87	29300.	27300.	19900.	18500.	5800.	400.	20.	0.	0.	0.	0.	11500.	112720.
1987-88	27360.	3940.	2340.	409.	0.	0.	0.	0.	0.	0.	0.	617.	34666.
1988-89	1001.	2987.	1103.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5091.
1989-90	0.	0.	0.	91.	0.	0.	0.	0.	0.	0.	0.	18962.	19053.
1990-91	69380.	38572.	4070.	3552.	449.	75.	0.	0.	0.	0.	0.	8917.	125015.
1991-92	12174.	4776.	1412.	3682.	7350.	9064.	4940.	2181.	882.	62.	0.	25973.	72496.
1992-93	47277.	13376.	6787.	1576.	327.	75.	0.	0.	0.	0.	0.	12140.	81558.
1993-94	6080.	1520.	599.	3480.	4820.	10300.	8060.	4290.	1290.	56.	0.	12060.	52555.
MEAN	36106.	20409.	8479.	5865.	6476.	3867.	1045.	392.	128.	7.	276.	10705.	93755.
MAX.	99600.	74700.	30900.	25500.	40700.	13400.	8060.	4290.	1290.	62.	4690.	43700.	246066.
MIN.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5091.
MED.	29300.	14700.	5680.	3480.	4820.	113.	0.	0.	0.	0.	0.	8917.	81558.

FIGURE 5
CHURCHILL RIVER - RECORDED FLOW COMPARISON
Annual Recorded Flow (1000's Cubic Decametres)

BASED ON CALENDAR YEAR **BASED ON WATER YEAR**
 

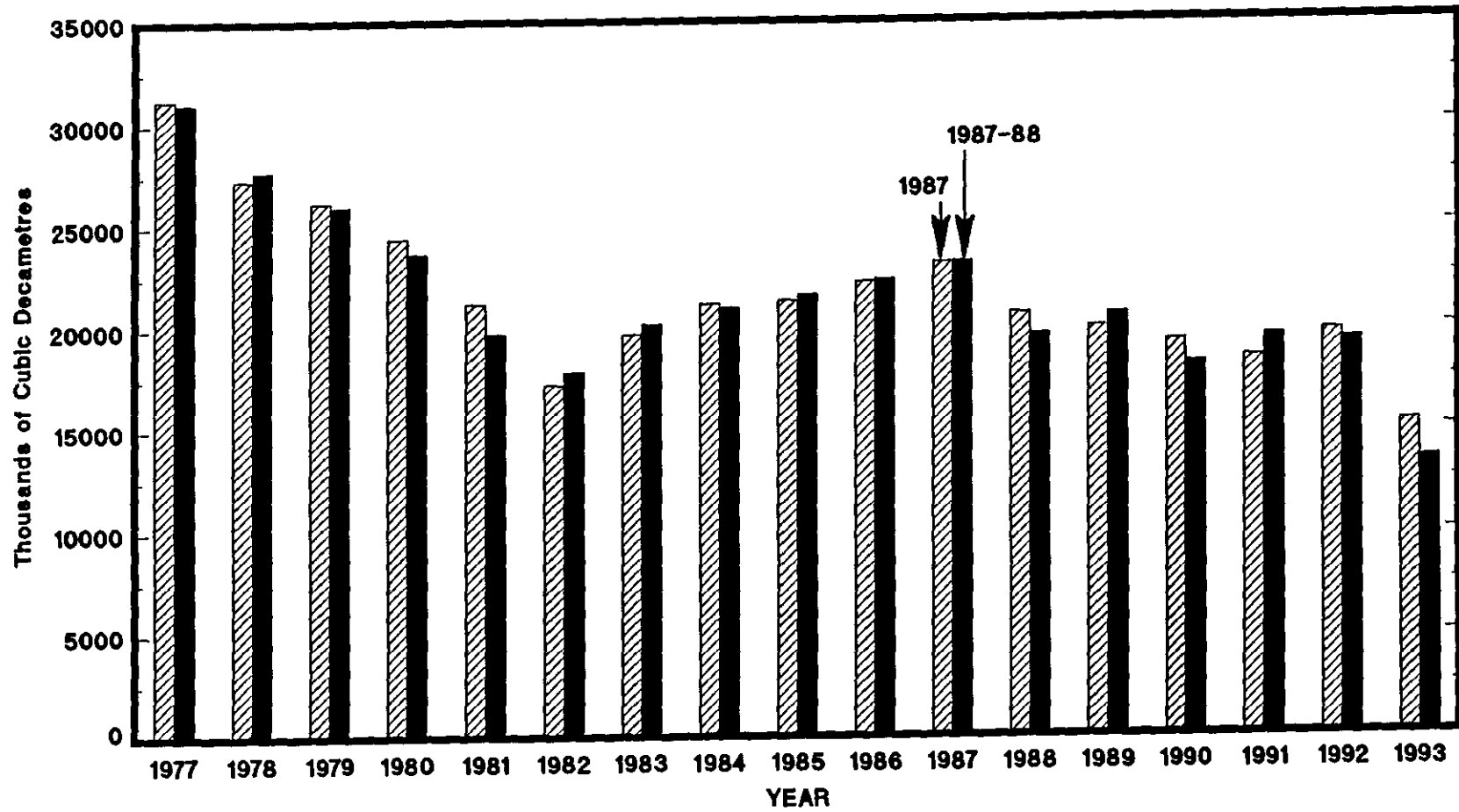


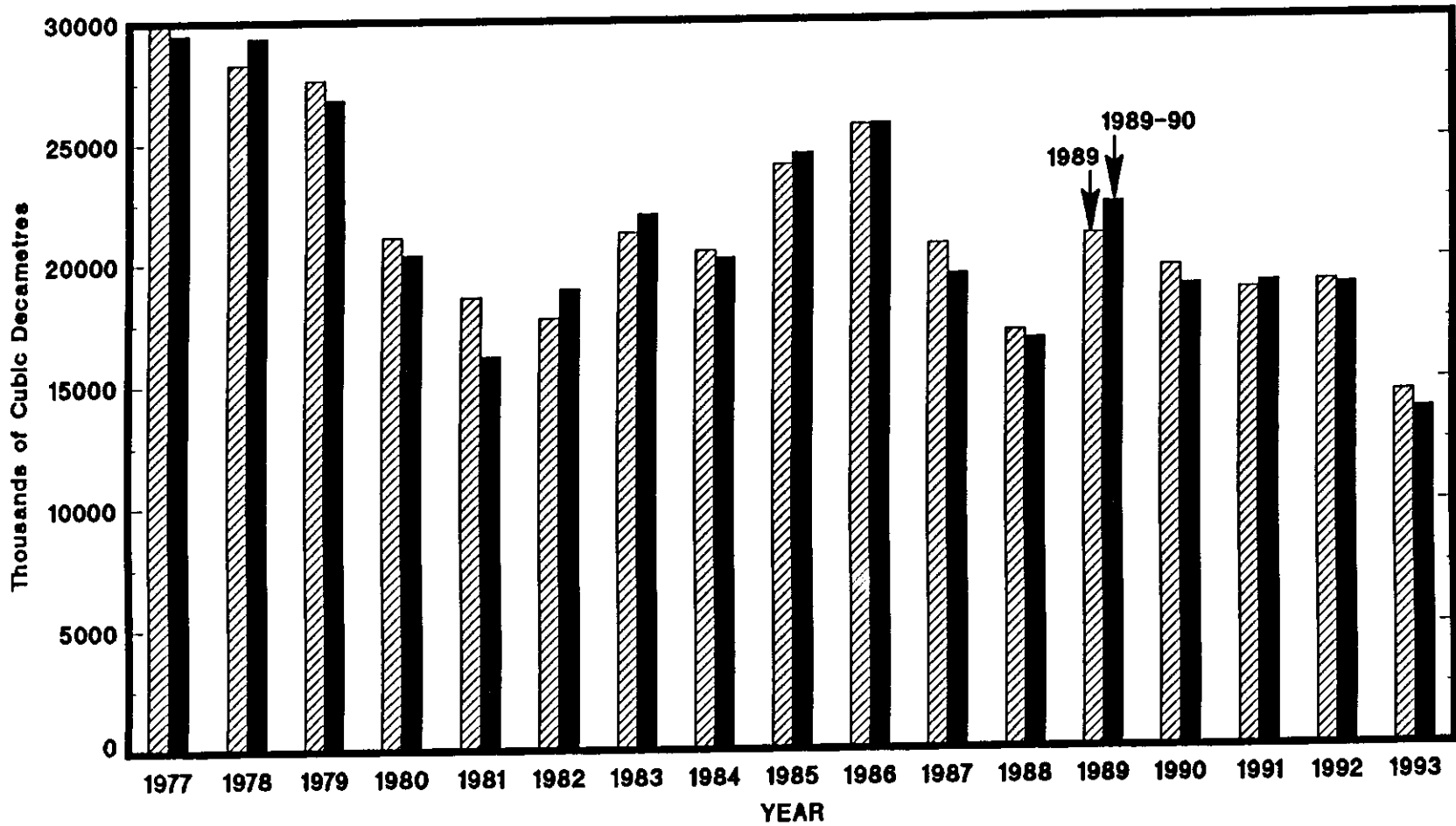
FIGURE 6
CHURCHILL RIVER - APPORTIONMENT FLOW COMPARISON
Annual Apportionment Flow (1000's Cubic Decametres)

BASED ON CALENDAR YEAR

BASED ON WATER YEAR



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TABLE 9

CHURCHILL RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	2330.	2170.	2260.	2240.	2220.	3240.	3810.	3600.	2910.	2210.	2060.	2180.	31230.
1978	2340.	2070.	2160.	1970.	2060.	2330.	2160.	2070.	2070.	3050.	2490.	2520.	27290.
1979	2390.	2240.	2380.	2160.	2320.	2330.	2010.	1750.	1770.	2270.	2260.	2320.	26200.
1980	2320.	2220.	2290.	2190.	1800.	1790.	1840.	1960.	1860.	1990.	1970.	2210.	24440.
1981	2190.	1890.	2000.	1800.	1870.	1680.	1560.	1560.	1630.	1730.	1690.	1650.	21250.
1982	1670.	1420.	1490.	1240.	1370.	1610.	1250.	1290.	1290.	1200.	1560.	1880.	17270.
1983	1860.	1620.	1720.	1600.	1320.	1410.	1450.	1220.	1930.	1870.	1820.	1890.	19710.
1984	1930.	1850.	1910.	1920.	1680.	1870.	1860.	1530.	1400.	1620.	1720.	1890.	21180.
1985	1990.	1740.	1780.	1570.	2030.	1900.	2090.	1730.	1560.	1470.	1640.	1840.	21340.
1986	1990.	1810.	1960.	1770.	2000.	1690.	1720.	1920.	1550.	1890.	1870.	2070.	22240.
1987	1980.	1870.	2020.	2050.	2010.	1880.	1960.	1860.	1800.	1850.	1880.	2010.	23170.
1988	2070.	1880.	1960.	1600.	1830.	1640.	1350.	1810.	1820.	1620.	1520.	1560.	20660.
1989	1600.	1570.	1710.	1440.	1730.	1460.	1800.	1760.	1590.	1760.	1670.	1880.	19970.
1990	1940.	1630.	1970.	1720.	1780.	1510.	1620.	1540.	1380.	1280.	1290.	1640.	19300.
1991	1750.	1390.	1310.	1290.	1530.	1530.	1420.	1450.	1520.	1710.	1720.	1860.	18480.
1992	1850.	1770.	1860.	1570.	1740.	1580.	1500.	1490.	1400.	1600.	1660.	1710.	19730.
1993	1780.	1550.	1730.	1410.	1260.	1110.	1130.	996.	983.	1030.	1080.	1170.	15229.
MEAN	1999.	1805.	1912.	1738.	1797.	1798.	1796.	1737.	1674.	1774.	1759.	1899.	20483.
MAX.	2390.	2240.	2380.	2240.	2320.	3240.	3810.	3600.	2910.	3050.	2490.	2520.	31230.
MIN.	1600.	1390.	1310.	1240.	1260.	1110.	1130.	996.	983.	1030.	1080.	1170.	15229.
MED.	1980.	1810.	1960.	1720.	1800.	1680.	1720.	1730.	1590.	1730.	1720.	1880.	21180.

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TABLE 10

CHURCHILL RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY APPORTIONMENT FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM3

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1977	2160.	1880.	1870.	2040.	2450.	2800.	3260.	3100.	3180.	2680.	2320.	2160.	29900.
1978	2020.	1720.	1780.	1600.	1970.	2750.	2850.	2820.	2390.	3020.	2690.	2680.	28290.
1979	2410.	2090.	2100.	1830.	2010.	2540.	2730.	2560.	2230.	2460.	2390.	2250.	27600.
1980	2160.	1830.	1810.	1860.	1710.	1470.	1620.	1750.	1660.	1670.	1700.	1850.	21090.
1981	1860.	1580.	1620.	1510.	1870.	1910.	1880.	1710.	1440.	1310.	1080.	842.	18612.
1982	876.	795.	942.	912.	1470.	2270.	2150.	2120.	1990.	1570.	1280.	1360.	17735.
1983	1370.	1190.	1240.	1300.	1520.	2030.	2330.	2020.	2290.	2250.	1930.	1760.	21230.
1984	1650.	1470.	1450.	1810.	1710.	1990.	2140.	2010.	1750.	1550.	1440.	1510.	20480.
1985	1530.	1270.	1470.	1360.	2550.	2700.	3220.	2610.	2160.	1850.	1640.	1670.	24030.
1986	1670.	1470.	1580.	1610.	2210.	2530.	2700.	3220.	2350.	2380.	1970.	1980.	25670.
1987	1670.	1490.	1610.	1800.	2390.	2190.	2230.	1890.	1620.	1410.	1180.	1230.	20710.
1988	1170.	1120.	1230.	1170.	1460.	1490.	1650.	1720.	1730.	1580.	1390.	1400.	17110.
1989	1260.	932.	1000.	1230.	2040.	2290.	2480.	2520.	2050.	2040.	1550.	1660.	21052.
1990	1660.	1330.	1530.	1620.	2080.	2100.	2020.	1820.	1590.	1470.	1220.	1280.	19720.
1991	1380.	1180.	1200.	1200.	1520.	1910.	2050.	1970.	1720.	1670.	1480.	1480.	18760.
1992	1400.	1280.	1360.	1400.	1810.	2030.	1950.	1850.	1610.	1570.	1380.	1410.	19050.
1993	1450.	1160.	1310.	1170.	1160.	1110.	1300.	1260.	1120.	1160.	1040.	1240.	14480.
MEAN	1629.	1399.	1477.	1495.	1878.	2124.	2268.	2174.	1934.	1861.	1628.	1633.	20307.
MAX.	2410.	2090.	2100.	2040.	2550.	2800.	3260.	3220.	3180.	3020.	2690.	2680.	29900.
MIN.	876.	795.	942.	912.	1160.	1110.	1300.	1260.	1120.	1160.	1040.	842.	14480.
MED.	1650.	1330.	1470.	1510.	1870.	2100.	2150.	2010.	1750.	1670.	1480.	1510.	20710.

CRMFT

TABLE 11

CHURCHILL RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY RECORDED FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM3

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	2240.	2220.	3240.	3810.	3600.	2910.	2210.	2060.	2180.	2340.	2070.	2160.	31040.
1978-79	1970.	2060.	2330.	2160.	2070.	2070.	3050.	2490.	2520.	2390.	2240.	2380.	27730.
1979-80	2160.	2320.	2330.	2010.	1750.	1770.	2270.	2260.	2320.	2320.	2220.	2290.	26020.
1980-81	2190.	1800.	1790.	1840.	1960.	1860.	1990.	1970.	2210.	2190.	1890.	2000.	23690.
1981-82	1800.	1870.	1680.	1560.	1560.	1630.	1730.	1690.	1650.	1670.	1420.	1490.	19750.
1982-83	1240.	1370.	1610.	1250.	1290.	1290.	1200.	1560.	1880.	1860.	1620.	1720.	17890.
1983-84	1600.	1320.	1410.	1450.	1220.	1930.	1870.	1820.	1890.	1930.	1850.	1910.	20200.
1984-85	1920.	1680.	1870.	1860.	1530.	1400.	1620.	1720.	1890.	1990.	1740.	1780.	21000.
1985-86	1570.	2030.	1900.	2090.	1730.	1560.	1470.	1640.	1840.	1990.	1810.	1960.	21590.
1986-87	1770.	2000.	1690.	1720.	1920.	1550.	1890.	1870.	2070.	1980.	1870.	2020.	22350.
1987-88	2050.	2010.	1880.	1960.	1860.	1800.	1850.	1880.	2010.	2070.	1880.	1960.	23210.
1988-89	1600.	1830.	1640.	1350.	1810.	1820.	1620.	1520.	1560.	1600.	1570.	1710.	19630.
1989-90	1440.	1730.	1460.	1800.	1760.	1590.	1760.	1670.	1880.	1940.	1630.	1970.	20630.
1990-91	1720.	1780.	1510.	1620.	1540.	1380.	1280.	1290.	1640.	1750.	1390.	1310.	18210.
1991-92	1290.	1530.	1530.	1420.	1450.	1520.	1710.	1720.	1860.	1850.	1770.	1860.	19510.
1992-93	1570.	1740.	1580.	1500.	1490.	1400.	1600.	1660.	1710.	1780.	1550.	1730.	19310.
1993-94	1410.	1260.	1110.	1130.	996.	983.	1030.	1080.	1170.	1060.	1050.	1160.	13439.
MEAN	1738.	1797.	1798.	1796.	1737.	1674.	1774.	1759.	1899.	1924.	1739.	1848.	21482.
MAX.	2240.	2320.	3240.	3810.	3600.	2910.	3050.	2490.	2520.	2390.	2240.	2380.	31040.
MIN.	1240.	1260.	1110.	1130.	996.	983.	1030.	1080.	1170.	1060.	1050.	1160.	13439.
MED.	1720.	1800.	1680.	1720.	1730.	1590.	1730.	1720.	1880.	1940.	1770.	1910.	20630.

TABLE 12

CRMFT

CHURCHILL RIVER AT THE SASKATCHEWAN-MANITOBA BOUNDARY MONTHLY APPORTIONMENT FLOW
(DATA FROM ANNUAL REPORT)
UNIT : 1000 DAM3

YEAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
1977-78	2040.	2450.	2800.	3260.	3100.	3180.	2680.	2320.	2160.	2020.	1720.	1780.	29510.
1978-79	1600.	1970.	2750.	2850.	2820.	2390.	3020.	2690.	2680.	2410.	2090.	2100.	29370.
1979-80	1830.	2010.	2540.	2730.	2560.	2230.	2460.	2390.	2250.	2160.	1830.	1810.	26800.
1980-81	1860.	1710.	1470.	1620.	1750.	1660.	1670.	1700.	1850.	1860.	1580.	1620.	20350.
1981-82	1510.	1870.	1910.	1880.	1710.	1440.	1310.	1080.	842.	876.	795.	942.	16165.
1982-83	912.	1470.	2270.	2150.	2120.	1990.	1570.	1280.	1360.	1370.	1190.	1240.	18922.
1983-84	1300.	1520.	2030.	2330.	2020.	2290.	2250.	1930.	1760.	1650.	1470.	1450.	22000.
1984-85	1810.	1710.	1990.	2140.	2010.	1750.	1550.	1440.	1510.	1530.	1270.	1470.	20180.
1985-86	1360.	2550.	2700.	3220.	2610.	2160.	1850.	1640.	1670.	1670.	1470.	1580.	24480.
1986-87	1610.	2210.	2530.	2700.	3220.	2350.	2380.	1970.	1980.	1670.	1490.	1610.	25720.
1987-88	1800.	2390.	2190.	2230.	1890.	1620.	1410.	1180.	1230.	1170.	1120.	1230.	19460.
1988-89	1170.	1460.	1490.	1650.	1720.	1730.	1580.	1390.	1400.	1260.	932.	1000.	16782.
1989-90	1230.	2040.	2290.	2480.	2520.	2050.	2040.	1550.	1660.	1660.	1330.	1530.	22380.
1990-91	1620.	2080.	2100.	2020.	1820.	1590.	1470.	1220.	1280.	1380.	1180.	1200.	18960.
1991-92	1200.	1520.	1910.	2050.	1970.	1720.	1670.	1480.	1480.	1400.	1280.	1360.	19040.
1992-93	1400.	1810.	2030.	1950.	1850.	1610.	1570.	1380.	1410.	1450.	1160.	1310.	18930.
1993-94	1170.	1160.	1110.	1300.	1260.	1120.	1160.	1040.	1240.	1110.	997.	1130.	13797.
MEAN	1495.	1878.	2124.	2268.	2174.	1934.	1861.	1628.	1633.	1567.	1347.	1433.	21344.
MAX.	2040.	2550.	2800.	3260.	3220.	3180.	3020.	2690.	2680.	2410.	2090.	2100.	29510.
MIN.	912.	1160.	1110.	1300.	1260.	1120.	1160.	1040.	842.	876.	795.	942.	13797.
MED.	1510.	1870.	2100.	2150.	2010.	1750.	1670.	1480.	1510.	1530.	1280.	1450.	20180.