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PRAIRIE PROVINCES WATER BOARD

Memorandum No. 4

PRELIMINARY REPORT ON REGULATION POSSIBILITIES IN THE ASSINIBOINE BASIN ABOVE BRANDON

Prepared by:-
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C O N T E N T S

TABLES

FIGURES

PRELIMINARY REPORT ON REGULATION POSSIBILITIES IN THE ASSINIBOINE BASIN ABOVE BRANDON

SUMMARY & CONCLUSIONS

At the Prairie Provinces Water Board Meeting of 14th June 1961, under minute 22-08, the Province of Manitoba submitted a memorandum outlining its future requirements concerning water to be obtained from the South Saskatchewan Reservoir via the Qu'Appelle Valley. It is the purpose of this report to show the extent to which these requirements could be met in terms of streamflow at Brandon, if the proposed Shellmouth Reservoir, the existing Rivers Reservoir and a possible reservoir near Victor, on the Qu'Appelle River in Manitoba, were operated for water supply purposes.

Two studies were made, the first assumed natural inflows to the Shellmouth and Rivers Reservoirs, and inflows to the Victor Reservoir appropriate to the year 2000 as determined by the South Saskatchewan River Development Commission; the second assumed natural inflows to all three reservoirs. Under the conditions of the first study, deficiencies in streamflow at Brandon by the year 2000 would occur on the average, in one month out of 20; under the conditions of the second study, the corresponding figure would be one in 12. The periods of deficiency are shown in Figs. 1 & 2.

The two studies indicate that a large proportion of the future water supply requirements of Manitoba along the lower Assiniboine River could be supplied from sources within the watershed if flood control were not the primary consideration.

BASIC ASSUMPTIONS

(a) Requirements of Assiniboine River at Brandon

The water supply requirements of the lower Assiniboine River can conveniently be considered in terms of streamflow at Brandon. According to the Manitoba memorandum referred to earlier, satisfactory dilution of sewage effluent at Brandon will ensure an adequate supply of water downstream; for this purpose, it was estimated that a flow of 216 c.f.s. would be needed by the year 2000. Industrial, municipal and domestic uses would raise this figure to 285 c.f.s. and it was estimated that a further 500 c.f.s. would be required during the months of May to September inclusive for irrigation purposes.

(b) Reservoir Inflows

(i) Rivers Reservoir

Recorded and reconstructed streamflow data for the gauging station ($5MF_{18}$) on the Minnedosa River, two miles north of Rivers, were used as "natural" inflows for both studies. The reconstructed data were obtained during the course of the first stage of the P.F.R.A. "Unit Run-off" Study. These natural inflows were used in both studies because it was considered that development up tream would not be of such kind and magnitude as to greatly modify the streamflow.

(ii) Shellmouth Reservoir

Recorded and reconstructed streamflow data for the gauging station ($5ME_1$) on the Assiniboine River at Millwood were

used as "natural" inflows for both studies, the reconstructed data being obtained as before from the "Unit Run-off" Study. The gauging station is about 20 miles below the damsite but the increment of drainage area is small and so the error involved is not appreciable. Upstream development in Saskatchewan could reduce the inflow, but the possible extent of such development has not been studied.

(iii) Victor Reservoir

Study No. 1:-

The inflows used in the first study were taken from Table 9 (revised by S.S.R.D.C. in April 1962) of the report, prepared by the South Saskatchewan River Development Commission in January 1962, entitled "Qu'Appelle Diversion and the Capacity of Outlet Works in the Qu'Appelle Valley Dam." The table gives the estimated residual flows in the Qu'Appelle River, under conditions considered appropriate to the year 2000 and is reproduced in Table 1.

Study No. 2:-

The inflows used in the second study, see Table 2, were prepared from "natural" flow data, obtained in the course of the "Unit Run-off" Study, for the Qu'Appelle River at the confluence with the Assiniboine River.

(c) Reservoir Capacities

(1) Rivers Reservoir

The Rivers Reservoir has a capacity of 25,000 acre-feet. The capacity and flooded area curves used in these studies

were taken from Fig. 7 of the P.F.R.A. Report of February 1958 entitled "Preliminary Report, Rivers Reservoir." The storage available for water supply purposes was assumed to be 24,500 acre-feet.

(ii) Shellmouth Reservoir

According to Fig. 10 of the P.F.R.A. Report of July 1960 entitled "Assiniboine River Project, Shellmouth Reservoir", the reservoir will have a capacity of 438,000 acre-feet at an F.S.L. of 1410 feet. The nominal conservation pool elevation is 1404 feet corresponding to storage of 350,000 acre-feet. For the purpose of these studies it was assumed that 430,000 acre-feet of storage would be available for water supply.

(iii) Victor Reservoir

A tentative site on the Qu'Appelle River in the vicinity of the village of Victor in Manitoba was selected by the Hydrology Division and capacity and flooded area curves were prepared. Due to the lack of suitable topographical information, these curves are very approximate but it was estimated that 112,000 acre-feet of storage would be impounded by a dam 50 feet high with an F.S.L. of 1330 f et.

RESERVOIR OPERATION

In both studies, the estimated requirements of the Assiniboine River at Brandon in the year 2000 were imposed on the streamflow conditions of the period 1921-1950 which includes several years of severe drought. The

general principle of operation was to make good any deficiency of recorded i.e. "natural" flow at Brandon by releasing water from one or more of the three reservoirs under consideration. In making these releases, no direct allowance was made for conveyance losses. These losses are allowed for indirectly to a large extent in that the recorded flows at Brandon arise after the deduction of losses from the inflows to the reservoirs.

The studies were made on a monthly basis and deficiencies were balanced by releasing water from the reservoirs in the order - Shellmouth, Rivers then Victor. By releasing water first from Shellmouth Reservoir some allowance was made for the flood control possibilities of this reservoir, although this was only a secondary consideration in these studies.

With regard to the operation of Rivers Reservoir, releases were limited to a maximum rate of 100 c.f.s. in order to reduce the risk of damage downstream on occasions when the flow would normally be low. In addition, 40 acre-feet were released each month in order to allow for the future requirements of the Town of Rivers and a further 200 acre-feet per month, June to October inclusive, for riparian use downstream on the Minnedosa River. These additional releases are specified in the recommendations of the "Rivers Reservoir Operation Study," of February 1960, by the Water Control and Conservation Branch of the Manitoba Department of Agriculture and Conservation.

As indicated earlier, the Victor Reservoir was held in reserve for those occasions when the Shellmouth Reservoir was exhausted and the Rivers Reservoir was either releasing at its maximum rate of 100 c.f.s. or was depleted to the extent that water would have to be held in reserve for the Town of Rivers.

RESULTS

The period 1921-1950 selected for these studies exhibits the worst conditions of consecutive years of low streamflow. Subsequently, apart from 1961, comparatively high annual run-offs have occurred in the Assiniboine Basin and the low flows of 1961 are not very much less than those of previous dry years.

The influence of the three reservoirs on streamflow at Brandon is illustrated by Figures 1 and 2. For convenience of presentation, the years 1931-1950 have been shown; Figure 1 is appropriate to Study No. 1 in which natural inflows to the Shellmouth and Rivers Reservoirs were assumed and estimated inflows corresponding to the demands of the year 2000 to the Victor Reservoir; Figure 2 relates to Study No. 2 in which natural inflows were assumed to all three reservoirs.

Referring to Fig. 1, deficiencies in streamflow at Brandon occur on the average, for the period 1921-1950, in one month out of 20. Deficiencies in Fig. 2 occur in one month out of 12. The higher inflows to Victor Reservoir in Study No. 1, consequent upon the importation of water from the South Saskatchewan River, result in fewer deficiencies than in Study No. 2. It may be noted that, except for the years 1947 and 1948, there is some reduction in flood peaks in both cases.

The fluctuations of storage in the Shellmouth Reservoir under the conditions of the two studies are shown in Fig. 3. There are prolonged intervals during which storage is less than that corresponding to conservation level and it is frequently low prior to spring run-off.

Tables 3, 4 and 5 have been prepared for the Shellmouth, Rivers and Victor Reservoirs, respectively, in order to show the local effects on streamflows of the reservoirs and to indicate the proportioning of requirements at Brandon. Under the conditions of the two studies, the Shellmouth Reservoir carries the greatest part of the Brandon "load." If this "load" were more equitably distributed, it is possible that the deficiencies at Brandon would be reduced.

CONCLUSIONS

It may be concluded from the results of the studies described in this report that the future water supply requirements of Manitoba along the lower Assiniboine River can be satisfied without the importation of water from the South Saskatchewan River. This conclusion is dependent upon the following conditions:-

(a) that the various demands, which have been assumed, are accurate;

(b) that water use in the Saskatchewan portion of the Assiniboine River does not increase significantly;

(c) that the Shellmouth Reservoir can be used for water supply purposes; and

(d) that brief periods of deficiency at Brandon can be alleviated by water released from Qu'Appelle reservoirs in Saskatchewan through interprovincial negotiation.

While advancing the foregoing conclusion, it is recognized that flood control has always been considered to be the primary function of the Shellmouth reservoir. This study was not intended to change that function but rather to illustrate the value of the reservoir for an alternative use.

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FURTHER COMMENTS

1. It was considered pertinent at this stage to draw attention to the possibility of importing water from the Swan River as an alternative to the South Saskatchewan River. The Swan River at the town of Swan River has a median annual run-off equal to about one-half of that of the Assiniboine River at Millwood. It may be feasible to divert water from the Swan River, in the vicinity of Pelly, via an old river channel to a point on the Assiniboine River about 18 miles north of Kamsack.

   This possibility has been given only cursory consideration but it might be advisable to examine it before rejection.

2. In the course of the foregoing studies, no account has been taken of the effects arising from additional regulation on the Souris River.

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TABLE 1

INFLOWS TO VICTOR RESERVOIR
ASSUMING YEAR 2000 DEMANDS IN QU'APPELLE BASIN

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1921	5	1	22	303	57	33	535	17	317	326	298	95
1922	40	38	234	2972	2006	689	255	235	393	246	61	48
1923	18	7	39	3495	1237	529	2408	487	430	341	172	18
1924	15	41	314	1249	449	141	38	32	326	213	18	11
1925	3	3	899	3655	471	278	75	14	330	261	18	7
1926	22	48	42	247	252	45	10	3	311	259	16	11
1927	4	4	26	4077	1167	621	389	275	409	394	322	233
1928	145	43	1407	1165	360	484	273	45	317	191	21	10
1929	10	10	283	317	47	43	0	6	300	217	12	1
1930	5	5	245	994	67	44	8	4	305	227	0	0
1931	20	37	190	298	48	38	0	1	300	181	0	0
1932	34	0	264	0	98	40	0	0	300	187	34	32
1933	13	13	18	259	446	570	185	0	313	191	12	12
1934	6	13	88	457	14	1	4	0	300	149	0	0
1935	7	7	41	0	394	277	187	49	317	152	7	15
1936	9	5	8	1438	424	224	10	3	305	153	8	3
1937	2	0	2	0	49	166	2	0	300	251	39	0
1938	1	0	151	72	60	30	0	13	300	150	0	1
1939	1	0	370	0	0	3	2	0	300	128	0	0
1940	3	0	7	0	146	74	3	0	300	190	66	66
1941	2	2	150	275	23	21	6	1	305	136	4	2
1942	0	2	162	1430	254	283	77	119	319	153	6	4
1943	2	1	71	1879	416	276	18	81	343	159	14	7
1944	4	0	0	178	23	190	17	8	307	139	3	2
1945	1	1	252	98	58	39	46	5	306	184	3	2
1946	1	4	651	104	13	5	229	3	306	248	8	5
1947	3	32	40	2706	399	815	104	5	305	209	4	2
1948	1	7	37	3029	1484	382	231	3	301	128	4	2
1949	2	1	71	289	17	108	9	7	306	158	6	4
1950	2	2	16	1211	363	270	243	5	304	161	5	3

TABLE 2

NATURAL INFLOWS TO VICTOR RESERVOIR

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1921	12	6	41	560	326	167	133	74	70	100	98	43
1922	18	10	46	1303	2048	1278	754	422	327	259	213	170
1923	68	24	58	1332	1607	819	1380	1229	570	322	137	78
1924	30	12	31	707	767	566	285	157	83	118	64	33
1925	14	10	484	2252	1251	614	265	151	130	93	84	34
1926	31	26	19	248	254	205	84	16	37	53	49	33
1927	12	10	8	1252	1674	1159	630	397	430	433	295	117
1928	45	18	204	1335	877	810	708	221	115	97	80	45
1929	25	15	40	333	173	171	42	12	5	13	16	12
1930	11	10	6	780	340	182	105	27	12	13	4	2
1931	2	2	3	236	107	51	9	10	4	2	1	1
1932	35	3	36	0	149	46	7	0	1	35	40	36
1933	25	21	30	441	130	223	134	6	22	16	17	31
1934	29	36	247	471	95	8	26	0	2	12	7	6
1935	14	12	24	24	144	0	717	91	30	18	15	30
1936	32	13	3	1395	510	292	125	13	23	26	30	9
1937	8	4	5	0	53	164	14	0	0	59	31	1
1938	5	4	231	144	108	50	25	20	4	4	4	5
1939	8	4	229	41	22	10	11	0	0	0	3	4
1940	7	2	11	0	111	64	13	1	2	1	51	48
1941	13	9	13	117	55	80	28	2	23	24	27	14
1942	8	7	276	265	226	47	17	208	124	28	19	13
1943	11	9	48	1241	859	462	207	91	65	32	22	15
1944	10	6	4	170	74	244	50	20	44	32	23	12
1945	9	6	142	111	101	55	71	13	14	22	12	8
1946	6	11	279	346	66	30	233	11	25	27	11	8
1947	6	4	5	1030	1049	738	417	33	62	38	14	9
1948	6	4	51	785	1452	643	250	24	7	9	10	7
1949	6	4	6	247	34	130	21	15	13	27	30	18
1950	12	7	23	425	172	119	115	80	16	29	22	21

TABLE 3

SHELLMOUTH RESERVOIR OPERATION

YEAR	INFLOW ac. ft.	RELEASE & SPILL	
		STUDY NO. 1 ac. ft.	STUDY NO. 2 ac. ft.
1922	1,459,860	1,450,080	1,450,080
1923	903,480	895,860	895,860
1924	260,340	239,520	239,700
1925	484,620	486,960	504,180
1926	291,840	280,440	264,060
1927	888,900	875,280	854,220
1928	543,720	527,520	541,560
1929	204,600	290,340	297,780
1930	169,560	228,900	248,580
1931	122,640	294,360	332,340
1932	134,880	189,360	133,620
1933	222,000	135,060	174,000
1934	186,000	219,720	217,320
1935	252,000	124,260	153,420
1936	354,000	166,380	185,100
1937	90,000	257,700	286,320
1938	162,000	237,180	172,560
1939	120,000	140,400	119,700
1940	54,000	54,000	54,000
1941	108,000	106,500	106,500
1942	288,000	104,580	131,880
1943	252,840	103,020	130,260
1944	69,600	139,920	155,640
1945	160,500	148,080	175,500
1946	177,840	129,360	142,980
1947	418,560	237,540	125,520
1948	585,240	578,280	597,900
1949	117,840	150,000	165,600
1950	203,580	136,920	101,100

TABLE 4

RIVERS RESERVOIR OPERATION

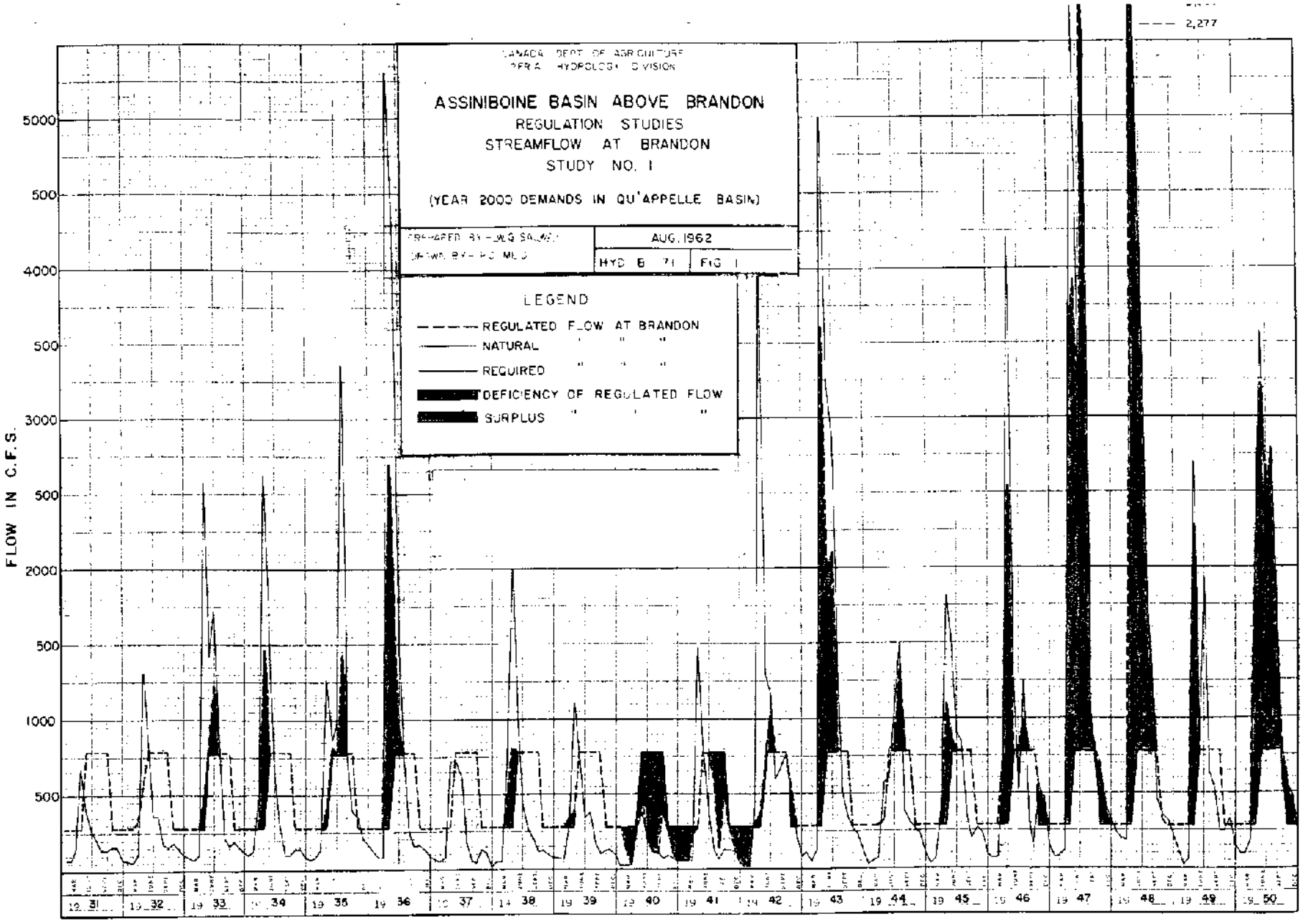
YEAR	INFLOW ac. ft.	RELEASE & SPILL	
		STUDY NO. 1 ac. ft.	STUDY NO. 2 ac. ft.
1922	133,500	129,900	130,140
1923	347,820	343,740	345,060
1924	187,140	185,160	184,620
1925	254,040	258,360	249,660
1926	128,400	113,280	125,580
1927	452,520	450,240	448,920
1928	212,040	217,320	210,180
1929	65,520	53,700	62,040
1930	54,660	53,220	53,280
1931	62,700	57,420	57,780
1932	71,520	85,680	83,400
1933	111,780	92,220	86,100
1934	90,000	85,080	98,760
1935	120,720	118,800	105,240
1936	105,840	101,700	101,700
1937	47,580	43,680	43,680
1938	71,760	67,560	86,700
1939	65,820	77,820	57,960
1940	22,200	27,960	27,660
1941	58,200	54,000	53,820
1942	97,980	73,260	73,320
1943	97,920	94,260	94,260
1944	89,100	86,340	86,340
1945	102,660	99,300	99,300
1946	121,800	118,260	118,260
1947	242,040	238,740	238,740
1948	162,120	158,580	158,580
1949	84,900	81,300	81,300
1950	241,440	239,100	239,100

NOTE:- Annual release of 1620 ac. ft. for Town of Rivers and riparian interests not included in release and spill.

TABLE 5

VICTOR RESERVOIR OPERATION

YEAR	STUDY NO. 1		STUDY NO. 2	
	INFLOW (From Table 1) ac. ft.	RELEASE & SPILL ac. ft.	INFLOW (From Table 2) ac. ft.	RELEASE & SPILL ac. ft.
1922	433,080	428,280	410,820	407,940
1923	550,860	548,520	457,380	455,580
1924	170,820	167,040	171,120	167,340
1925	360,840	355,560	322,860	317,220
1926	75,960	72,600	63,120	58,860
1927	475,260	473,400	385,020	382,620
1928	267,660	266,520	273,300	272,820
1929	74,760	69,960	51,360	46,920
1930	114,240	111,000	89,460	84,600
1931	66,780	59,400	25,620	21,240
1932	59,340	74,580	23,280	119,820
1933	121,920	96,540	65,760	13,500
1934	61,920	53,280	56,340	14,700
1935	87,180	84,060	67,080	43,920
1936	155,400	148,740	148,260	141,480
1937	48,660	39,480	20,340	11,160
1938	46,680	41,160	36,240	88,560
1939	48,240	137,220	19,920	72,960
1940	51,300	68,400	18,660	18,660
1941	55,620	39,240	24,300	23,520
1942	168,600	56,460	74,160	11,460
1943	195,900	192,360	183,720	130,980
1944	52,260	50,580	41,280	39,480
1945	59,640	56,040	33,780	30,120
1946	94,680	92,220	63,120	59,880
1947	277,380	274,380	204,240	198,180
1948	336,600	332,040	194,880	191,940
1949	58,620	51,780	33,000	24,660
1950	155,160	152,400	62,400	59,640


2,277
CANADA DEPT. OF AGRICULTURE
PFRA HYDROLOGY DIVISION
ASSINIBOINE BASIN ABOVE BRANDON
REGULATION STUDIES
STREAMFLOW AT BRANDON
STUDY NO. 1
(YEAR 2000 DEMANDS IN QU'APPELLE BASIN)
AUG. 1962
HYD B 71
FIG 1
LEGEND
REGULATED FLOW AT BRANDON
NATURAL " "
REQUIRED " "
DEFICIENCY OF REGULATED FLOW
SURPLUS " "
FLOW IN C.F.S.
5000
500
4000
500
3000
500
2000
500
1000
500
19 31
19 32
19 33
19 34
19 35
19 36
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19 44
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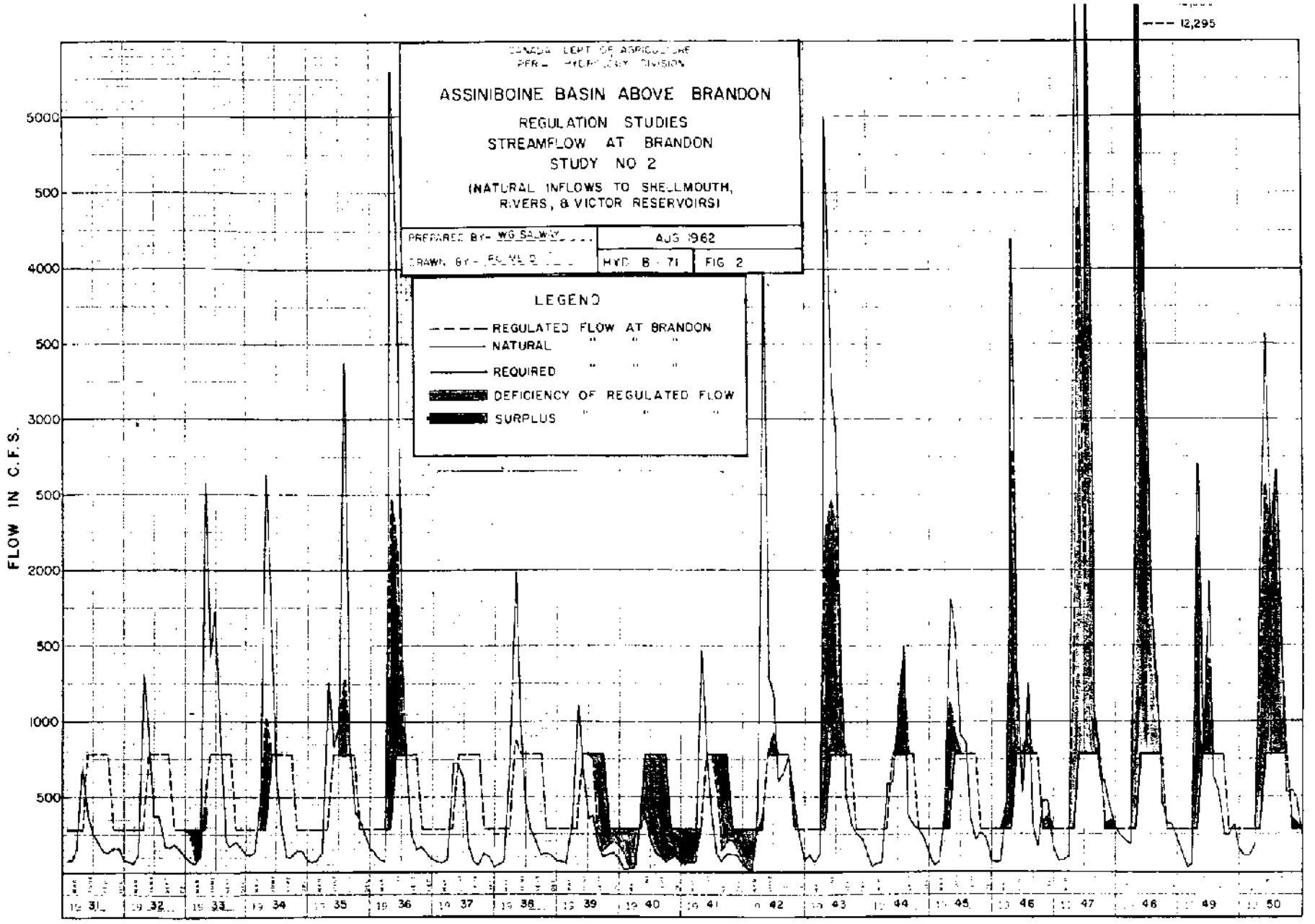
19 47
19 48
19 49
19 50


12,295
CANADA DEPT OF AGRICULTURE
PFRA - HYDROLOGY DIVISION
ASSINIBOINE BASIN ABOVE BRANDON
REGULATION STUDIES
STREAMFLOW AT BRANDON
STUDY NO 2
(NATURAL INFLOWS TO SHELLMOUTH, RIVERS, & VICTOR RESERVOIRS)
PREPARED BY- WG SALWAY
AUG 1962
DRAWN BY-
HYD. B - 71
FIG 2
LEGEND
REGULATED FLOW AT BRANDON
NATURAL " " "
REQUIRED " " "
DEFICIENCY OF REGULATED FLOW
SURPLUS
FLOW IN C.F.S.
5000
500
4000
500
3000
500
2000
500
1000
500
19 31
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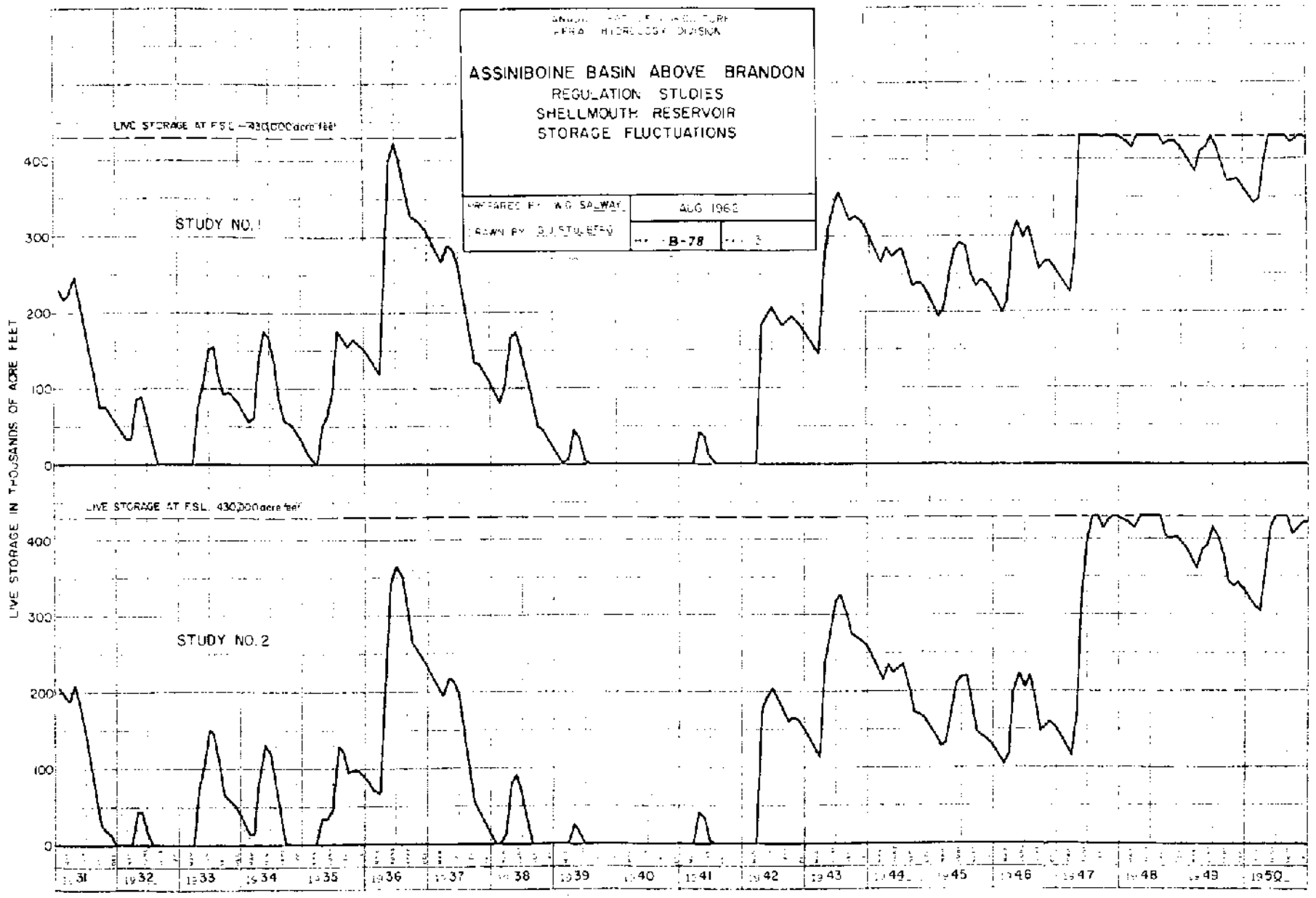
ASSINIBOINE BASIN ABOVE BRANDON
REGULATION STUDIES
SHELLMOUTH RESERVOIR
STORAGE FLUCTUATIONS
AUG 1962
B-78
STUDY NO. 1
STUDY NO. 2
LIVE STORAGE IN THOUSANDS OF ACRE FEET
0
100
200
300
400
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950