CHAPTER 8

Powers Creek

8.1 GENERAL DESCRIPTION

Reference is made to the Key Map shown on Figure 8.1 and Schematic shown on Figure 8.2.

Powers Creek is a small watershed of 56 square miles whose water resource is operated almost exclusively by the Westbank Irrigation District. To this end seven small to medium sized upland lakes have been harnessed to regulate water flow.

In 1970, the area served a population of 3490 persons and an irrigated area of 1637 acres. As will be noted from Figure 8.1 roughly half the developed area served lies outside the natural watershed of Powers Creek.

The headwaters of Powers Creek are located about 16 miles north-west of the Community of Westbank at an elevation of around 5500 feet. The largest mountain in this region is Whiterocks Mountain, elevation 6114 feet. Drainage from the watershed ridge soon reaches and passes through two small lakes known as West Lake (CP1) and Dobbin Lake (CP2). The outflow from Dobbin Lake is soon joined by flow from Islaht Lake (CP3) to form Powers Creek. Next an unnamed creek carries flow from Paynter Lake (CP4) to join Powers Creek. Webber Lake (CP6) and Jackpine Lake (CP5) join to form South Powers Creek which in turn flows into Powers Creek. Jackpine is the second largest take on the system. Lambly Lake, (CP7) by nature part of the Lambly Creek watershed, has been diverted southward in North Powers Creek to become the last and largest lake to join the Powers Creek system.

As shown by the area-elevation curves on Figure 14.2, the median elevation of Powers Creek is 4250 feet. An upland plateau is well pronounced in that 55% of the total area lies within the 4000 to 5000 foot range. It *is* equally apparent that very little land, less than 10% lies within 1000 vertical feet of Okanagan Lake.

The creek profile plotted on Figure 14.3, shows Powers Creek to be quite uniformly steep with a gradient varying little from the average of 213 feet per mile.

There are several hydrometrtc stations on the Powers Creek System and one snow course station on Whiterocks Mountain. These are located on the Key Map, Figure 8.1. The most significant station is 8NM161 near the mouth of Powers Creek. Based on four years of record, hydrographs of mean monthly flows passing this station have been plotted on Figure 14.4.

8.2 HISTORICAL BACKGROUND

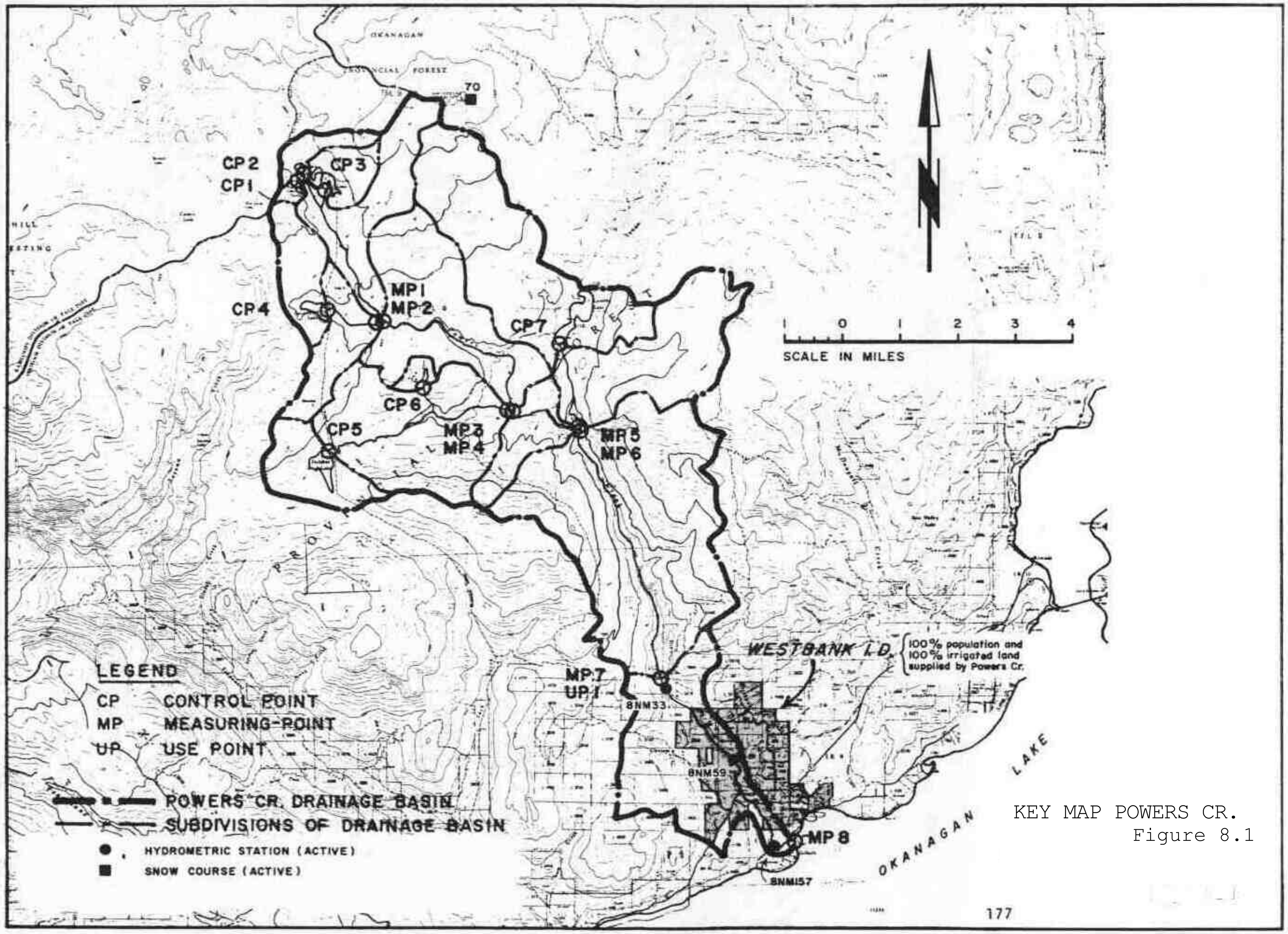
The early settlers held a number of individual small licences which permitted them to divert water from Powers Creek. However, this system of individual action did not lend itself to co-ordination and control of the water resource. Because of this and the fact that the farmers wanted to increase the amount of arable land under irrigation, they applied to the Province to become an improvement district. Their wish was granted on June 4, 1922 by the formation of "Westbank Irrigation District".

The Westbank Water Users Community was a loosely organized group which, in 1968, irrigated approximately 275 acres on the south side of Powers Creek. Their first water licence dates back to January, 1907, when a license to store 600 acre-feet on Jackpine Lake was granted. A shortage of water, insufficient storage and the need for financial aid to improve their condition led the District Water Users Community to seek incorporation within the Westbank Irrigation District. This was achieved on June 9, 1969.

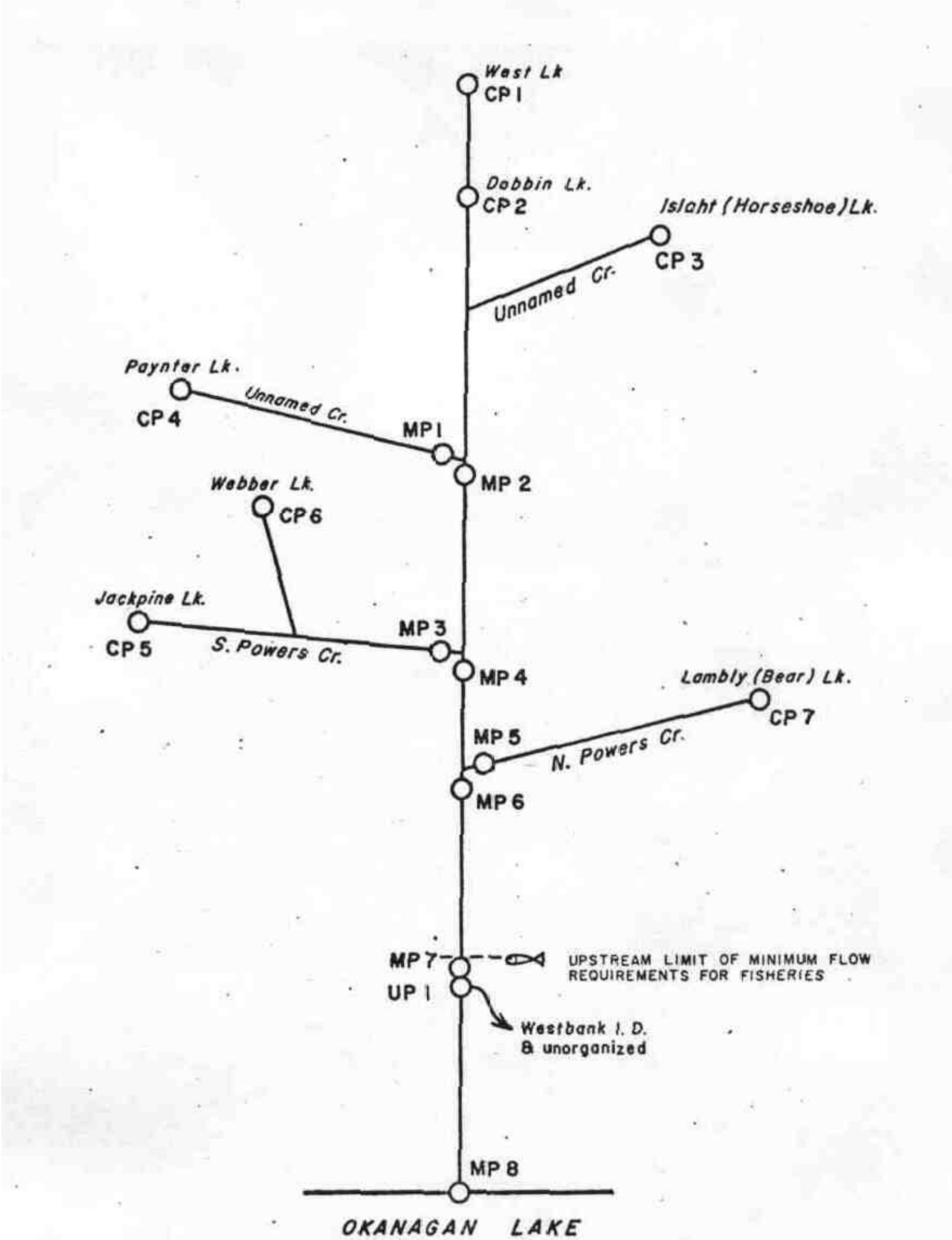
The Westbank Waterworks District was incorporated as an improvement district on January 21, 1957. Its function was to supply domestic water and to maintain and operate sewage disposal facilities serving the settlement of Westbank. In the winter months, the District acquired its water from springs located above the town, but during the summer months, supply was supplemented by water from the Westbank Irrigation District. Like the Mater Users Community, the Waterworks District merged with Westbank Irrigation District on June 9, 1969.

During 1958 and 1963, the Westbank Irrigation District carried out partial rehabilitation of the distribution system by financing renewals from the Renewal Reserve Fund. However, in 1964, faced with immediate and costly replacement of the remaining portions of the distribution system, including major improvement to the storage works, the District applied for assistance, under the Agricultural and Rural Development Act. (ARDA).

The first stage of rehabilitation was completed in 1966 under ARDA. This work consisted of replacing the main diversion flume and intake on Powers Creek. Further work has been done between 1968 and 1973. This included a new water supply system and the development of additional storage.



KEY MAP POWERS CR.
Figure 8.1



POWERS CR. SCHEMATIC Figure 8.2

A brief history of some of the dams In the watershed is as follows:

a) Jackpine Lake Dam (CP5)

The original dam, constructed about 1917, consisted of a small earth-fined crib bulkhead, with a seven-foot cut out of the lake, and provided 450 acre-feet of storage.

This dam was later replaced by an earthfilled structure with a considerable increase in storage. Subsequently, improvements were carried out to increase the freeboard by both raising the dam and lowering the spillway. The present storage is estimated to be 960 acre-feet.

In 1954, an inclined gate was installed and a portion of the culvert replaced, following the use of blasting to open the existing gate.

b) Islaht Lake Dam (CP3)

The original East and West dams were believed to be constructed about 1919. In 1936, both dams were rebuilt, and the structure consisted of a puddled clay core with a peeled log cribwork, contained by earth-fill on the outside.

In 1940, the culvert through the West dam was lowered 18 Inches and the dam raised two feet.

In 1948, a 14 foot section of the West dam washed out and was replaced.

About 1950, the East dam washed out. When the dam was replaced, the crest was raised 1.5 feet. Since that time the dam has again been raised to Its present height.

c) Dobbin Lake Dam (CP2)

The present dam was constructed by the District about 1940, replacing a smaller dam constructed earlier. The structure consists of a puddled clay core contained between two hand-placed rock walls. Since 1940 it has been gradually raised up to its present height.

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d) West Lake Dam (CP1)

The original dam, constructed of a log-crib filled with material from the lake bottom, was believed to be constructed in the early 1930's. In the early 1950's, the District removed the cribwork and replaced it with an earth-fill structure.

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e) Paynter Lake Dam

The original dam was an earth-fill structure, built in the early 1930's.

f) Lambly Lake Dam

In 1929 the Westbank Irrigation District, applied for a licence to store 400 acre-feet of water in Lambly Lake by damming the outlet of the lake and diverting this water to Powers Creek, on which their intake was located, through a diversion ditch. Users on Lambly Creek objected to this diversion of Lambly Creek runoff to Powers Creek and C.L. 10332 (priority October 10th, 1929) was issued to the District on February 5th 1930 for the storage and diversion of only 100 acre-feet, the licence to be renewed each year. Thus, a low dam and spillway at Lambly Lake nutlet and a headgate structure at the south end of the lake were built in 1930. In July, 1931, an application was made to build a dam at each end of Lambly Lake to store and divert 600 acre-feet for use by Westbank Irrigation District. Preliminary plans were submitted in September, 1932, but it was pointed out that some provision would have to be made for allowing late season flow to be spilled into Lambly Creek for downstream users. Revised plans were submitted in April, 1933, along with a request that the application be amended to 250 acre-feet storage and 700 acre-feet diversion. The reduction in storage was necessary due to lack of funds. C.L.'s T1819/20 (priority August 14th, 1931) were issued in October, 1933 for 218 acre-feet storage and 700 acre-feet diversion. (The licence was issued for 218 acre-feet to satisfy the rights of an individual user on Powers Creek to 32 acre-feet storage). Lack of funds did not allow construction of the works until 1939-40.

Westbank Irrigation District in December, 1974 applied for a licence to build a new dam at the Powers Creek end of Lambly Lake to increase their storage capacity. The new dam would be built 3/4 mile south of the old headgate structure built in 1940 and the north dam would be raised to obtain 1,305 acre-feet storage. CL 17582/3 were issued in January, 1947 to store and divert 1,305 acre-feet per year (priority December 5th, 1945).

After some difficulty in finding an acceptable design for the new dam at the Powers Creek end of Lambly Lake due to poor site foundations, Westbank Irrigation District completed this dam at the end of 1952 giving them a storage capacity of 612 acre-feet in Lambly

Westbank Irrigation District rebuilt the north and south dams on Lambly Lake Reservoir in 1969-70 with ARDA assistance. Both dams were raised to increase the storage capacity to 1,800 acre-feet. They were raised further in 1970 to obtain 2,200 acre-feet storage to accommodate the diversion of Paddle

Creek to the reservoir in March, 1970.

8.3 LAND USE AND WATER REQUIREMENTS

With the exception of a few private users (notably the Greata

Ranch) the water resource of Powers Creek is devoted entirely to the needs of West-bank Irrigation District. As will be noted from the Key Map on Figure 8.1, much of the Westbank Irrigation District lies outside the natural watershed of Powers Creek. The area covered is municipal and residential as well as agricultural and this requires that Westbank Irrigation District supply Municipal water in addition to providing irrigation water to farms.

Water users in terms of population and areas irrigated are as follows: Table 8.1

TABLE 8.1

WATER USERS IN THE POWERS CREEK WATERSHED (1970)

Area Served	Area Irrigated (acres)	Population (approx) (persons)	Diversion		Total (ac.ft.)
			Irrigation (ac. ft.)	Domestic (ac.ft.)	
Westbank I.D.	1370	1566	4144	326	4470
Other	267	72	808	15	823
TOTAL	1637	1638	4952	341	5293

Consumptive use diversions as listed above are assumed to result in no return flow within the Powers Creek sub-basin. However, Consumptive use diversions are expected to provide a return flow to Okanagan Lake. The amount of return flow varies with the type of use and is estimated as follows:

a) For "Irrigation" return flow = 50% of diversion.
b) For "Domestic and Waterworks", return flow = 65% of diversion.
c) For "Industry", return flow = 90% of diversion.

From the above, water utilization in terms of the amounts of consumed water and return flow within the Okanagan Basin may be tabulated as follows:

Table 8.2

TABLE 8.2.

WATER UTILIZATION IN POWERS CREEK (1970)

Requirements	Diversion for Consumptive Use (acre-feet)	Consumed Water (acre-feet)	Return flow to Okanagan Lake (acre-feet)
Irrigation	4952	2476	2476
Domestic and Water-works	341	119	222
Industry	0	0	0
TOTALS	5293	2595	2698

A detailed breakdown of diversion requirements for the various organized and unorganized areas at the 1970 stage of development is as shown on Table 8.3.

In order to acquire rights over the use of water, most users, acting either individually or collectively in an irrigation district, have maintained water licences for storage and diversion granted by the Crown, in right of the Province. Licences provide their holder with rights over the stated amount of water, and in cases of a shortage, the older licence takes precedence over the newer.

Current water licences in 1970 for both storage and consumptive use are as listed on Table 8.4.

TABLE 8.4

WATER LICENCES ON POWERS CREEK (1970)

Area Served	Total Licenced Storage (ac.ft.)	Agriculture (ac.ft.)	Licenced Diversion			Computed Diversion Requirement (ac.ft.)
			Domestic (ac.ft.)	Industry (ac.ft.)	Total (ac.ft.)	
Westbank I.D.	5493	3668	672	0	4340	4470
Other	0	861	0	0	861	823
TOTAL	5493	4529	672	0	5201	5293

8.4 ESTIMATED NATURAL WATER SUPPLY

Estimated natural water yields for the area are shown on computer printout sheets, reproduced on Figure 8.3 (Dry Year), Figure 8.4 (Average Year) and Figure 8.5 (Wet Year).

TABLE 8.3

DIVERSION REQUIREMENTS ON POWERS CREEK (1970)

GIVEN IN ACRE-FEET

Month	Type	Westbank Irrigation District	Other	Total
J	Agric.	0	0	0
	Dom.	16	1	17
	Ind.	0	0	0
F	Agric.	0	0	0
	Dom.	13	1	14
	Ind.	0	0	0
M	Agric.	0	0	0
	Dom.	16	1	17
	Ind.	0	0	0
A	Agric.	0	0	0
	Dom.	19	1	20
	Ind.	0	0	0
M	Agric.	622	121	743
	Dom.	33	1	34
	Ind.	0	0	0
J	Agric.	1036	202	1238
	Dom.	42	2	44
	Ind.	0	0	0
J	Agric.	1036	202	1238
	Dom.	53	2	55
	Ind.	0	0	0
A	Agric.	1036	202	1238
	Dom.	53	2	55
	Ind.	0	0	0
S	Agric.	414	81	495
	Dom.	26	1	27
	Ind.	0	0	0
O	Agric.	0	0	0
	Dom.	23	1	24
	Ind.	0	0	0
N	Agric.	0	0	0
	Dom.	16	1	17
	Ind.	0	0	0
D	Agric.	0	0	0
	Dom.	16	1	17
	Ind.	0	0	0
	TOTAL	4470	823	5293

Date Of Print-out
Dec. 7, 1972

FLOWS IN AC. FT.

LOCATION	AREA IN K. AC.	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
CPOA 1	0.1	1.	1.	1.	1.	29.	17.	2.	1.	1.	1.	1.	1.	56.
CPOA 2	0.6	3.	4.	5.	6.	164.	102.	11.	6.	5.	5.	4.	4.	322.
CPOA 3	0.7	4.	5.	6.	10.	183.	111.	12.	7.	6.	6.	5.	5.	359.
CPOA 4	1.1	6.	8.	9.	16.	205.	111.	18.	8.	8.	8.	8.	8.	411.
NPOA 1	2.3	12.	16.	20.	33.	399.	211.	37.	16.	16.	16.	16.	16.	805.
NPOA 2	5.6	25.	33.	39.	69.	924.	516.	78.	36.	33.	33.	32.	32.	1852.
CPOA 5	1.2	6.	6.	9.	17.	149.	73.	17.	6.	6.	6.	6.	6.	306.
CPOA 6	0.2	1.	1.	1.	3.	21.	10.	3.	1.	1.	1.	1.	1.	49.
NPOA 3	5.2	22.	25.	34.	72.	623.	312.	70.	26.	25.	25.	25.	25.	1282.
NPOA 4	14.4	62.	75.	97.	190.	1970.	1040.	195.	79.	75.	75.	74.	74.	4005.
CPOA 7	4.7	21.	26.	32.	63.	743.	413.	67.	29.	26.	26.	25.	25.	1497.
NPOA 5	7.7	35.	43.	54.	104.	1164.	628.	109.	46.	43.	43.	42.	42.	2355.
NPOA 6	23.2	101.	122.	157.	307.	3231.	1716.	317.	130.	122.	122.	120.	120.	6564.
NPOA 7	31.3	126.	153.	197.	391.	3944.	2071.	397.	159.	151.	151.	149.	149.	8038.
NPOA 8	35.3	126.	154.	197.	392.	3948.	2072.	398.	159.	151.	151.	150.	150.	8048.

Revised May 1973

POWERS CR. DRY YEAR (NATURAL FLOW) Figure 8.3

Date Of Print-out:
Dec 7, 1972

FLOWS IN AC. FT.

LOCATION	AREA IN K. AC.	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
CPOA 1	0.1	1.	1.	1.	2.	43.	26.	3.	2.	1.	1.	1.	1.	85.
CPOA 2	0.6	5.	7.	7.	13.	248.	153.	16.	9.	7.	7.	7.	7.	486.
CPOA 3	0.7	6.	8.	9.	15.	277.	168.	19.	10.	9.	9.	8.	8.	548.
CPOA 4	1.1	9.	12.	15.	26.	329.	178.	29.	13.	12.	12.	12.	12.	662.
NPOA 1	2.3	20.	25.	32.	55.	649.	343.	60.	26.	25.	25.	25.	25.	1312.
NPOA 2	5.6	41.	54.	65.	117.	1482.	820.	130.	58.	54.	54.	53.	53.	2980.
CPOA 5	1.2	10.	11.	15.	30.	256.	125.	29.	11.	11.	11.	11.	11.	529.
CPOA 6	0.2	2.	2.	2.	5.	37.	18.	5.	2.	2.	2.	2.	2.	78.
NPOA 3	5.2	40.	44.	60.	128.	1080.	536.	123.	45.	43.	43.	43.	43.	2227.
NPOA 4	14.4	107.	128.	166.	333.	3299.	1723.	337.	133.	126.	126.	125.	125.	6730.
CPOA 7	4.7	36.	44.	54.	111.	1218.	666.	114.	48.	44.	44.	42.	42.	2462.
NPOA 5	7.7	59.	73.	93.	182.	1927.	1027.	187.	77.	73.	73.	71.	71.	3913.
NPOA 6	23.2	174.	209.	270.	541.	5408.	2837.	547.	218.	207.	207.	204.	204.	11026.
NPOA 7	31.3	220.	266.	342.	701.	6683.	3466.	698.	271.	259.	259.	257.	257.	13680.
NPOA 8	35.3	223.	270.	346.	718.	6740.	3490.	712.	274.	262.	262.	260.	260.	13818.

Revised May 1973

POWERS CR. AVERAGE YEAR (NATURAL FLOW) Figure 8.4

Date Of Print-out:
Dec. 7, 1972

FLOWS IN AC. FT.

LOCATION	AREA IN K.AC.	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
CPDA 1	0.1	1.	2.	2.	3.	69.	42.	5.	3.	2.	2.	2.	2.	136.
CPDA 2	0.6	8.	11.	12.	21.	400.	245.	27.	15.	12.	12.	11.	11.	785.
CPDA 3	0.7	10.	13.	15.	25.	451.	272.	32.	17.	14.	14.	13.	13.	889.
CPDA 4	1.1	17.	22.	27.	45.	568.	306.	51.	23.	22.	22.	22.	22.	1144.
NPDA 1	2.3	35.	45.	57.	97.	1136.	598.	106.	46.	45.	45.	45.	45.	2299.
NPDA 2	5.6	74.	97.	117.	219.	2586.	1415.	237.	103.	96.	95.	94.	94.	5227.
CPDA 5	1.2	18.	20.	28.	56.	474.	231.	54.	20.	20.	20.	20.	20.	979.
CPDA 6	0.2	3.	3.	4.	10.	71.	33.	9.	3.	3.	3.	3.	3.	148.
NPDA 3	5.2	74.	81.	113.	242.	1991.	982.	230.	82.	80.	80.	80.	80.	4114.
NPDA 4	14.4	198.	235.	306.	627.	5937.	3068.	625.	241.	230.	230.	228.	228.	12155.
CPDA 7	4.7	64.	78.	98.	203.	2127.	1149.	206.	85.	77.	77.	76.	76.	4317.
NPDA 5	7.7	107.	132.	168.	334.	3406.	1797.	340.	137.	130.	130.	128.	128.	6937.
NPDA 6	23.2	319.	383.	495.	1013.	9692.	5030.	1010.	393.	375.	375.	371.	371.	19828.
NPDA 7	31.3	411.	496.	638.	1350.	12155.	6233.	1320.	497.	478.	478.	474.	474.	25003.
NPDA 8	35.3	431.	570.	661.	1447.	12476.	6370.	1401.	512.	493.	493.	490.	490.	25783.

Revised May 1973

POWERS CR. WET YEAR (NATURAL FLOW) Figure 8.5

In summary, the annual precipitation and natural runoff of the Powers Creek Basin under the three types of year is as follows: Table 8.5

TABLE 8.5

ESTIMATED NATURAL WATER YIELDS FOR POWERS CREEK SUB-BASIN

Type of Year	Annual Runoff		Estimated Average Precipitation (Inches)	Remarks
	Kilo Acre-Feet	Inches Over Basin		
Dry	8.0	2.7	-	Area - 55.2 Square Miles
Average	13.8	4.7	-	
Wet	25.8	8.8	-	

Note: Abstracted from Computer Print-Out Data

An important diversion included in the above is Lambly Lake. This lake, in a saddle between watersheds at the head of Lambly Creek, would naturally tend to share its catchment between watersheds.

8.5 STORAGE

Reference is made to Figure 8.2.

In a climate of spring floods and summer droughts it is necessary to store a high proportion of total available water so that it may be used when needed. To this end, the Powers Creek water users, principally Westbank Irrigation District, have developed a system of seven reservoirs with a total live storage of 3754 acre-feet. The most important storage, by far is Lambly Lake which provides almost half of the total storage. The other lakes vary in importance in direct proportion to their capacity.

a) West Lake

This is a small dam of only 62 acre-feet of storage. It was built of earth fill and log cribbing in 1950. The control works consist of a 12-inch pipe whose Invert is set at elevation 4866.2 feet. The spillway elevation is 4874.4 feet. Like all the lakes in the system, West Lake dam is owned and operated by Westbank Irrigation District.

b) Dobbin Lake

This dam was built in 1950 of earth and rock fill. Although the lake has a storage of only 104 acre-feet, it may be operated in unison with West Lake whose flow runs through it. Control is by means of a 12-inch steel pipe set at invert elevation 4847.8 feet. The spillway elevation is 4854.0 feet.

c) Islaht Lake

Islaht has a capacity of 343 acre-feet live storage. It was built in 1950 of earth fill with log cribbing. Outflow is controlled by means of a wooden structure which permits water release to a minimum elevation of 4865.2 feet. The spillway elevation is set at 4871.7 feet.

d) Paynter Lake

Also built in 1950 and of earth fill, this dam store 384 acre-feet of water. The 24-inch outlet pipe Is set at elevation 4433.3 feet, and the spillway is at elevation 4439.8 feet.

e) Jackpine Lake

This is the second largest lake and the most modern dam on the system. Built in 1970 and rebuilt in 1972, Jackpine has a capacity of 960 acre-feet. The dam is of earth fill. The 24-inch outlet pipe is set at elevation 4300 feet approximately, and the spillway is situated 12 feet above this point.

f) Webber Lake

This is a small storage of only 100 acre-feet. It was built of earth fill in 1940 and is controlled by a 16-inch outlet culvert.

g) Lambly Lake

This is the largest and most important storage in the watershed with a total live storage of 1810 acre-feet in early 1970. With a history of dam building and improving going back to 1930, the most recent construction in 1970 has raised the dam to increase storage to its present 2200 acre-feet. The dams are of earth fill and control is by means of a 24-inch culvert set at an invert elevation of 3773.3 feet. The spillway of the 1970 dam is at 3801.5 feet elevation. As with all the other dams in the watershed, Lambly Lake is operated by Westbank Irrigation District.

Hydrologic information on the seven reservoirs described above is given in Table 8.6.

TABLE 8.6

1970 STORAGES IN THE POWERS CREEK SYSTEM

Reservoir	Drainage Area (acres)	Live Storage (acre-feet)	Surface Area (acres)	Annual Natural Runoff (acre-feet)		
				Dry Year	Average Year	Wet Year
West Lake	100	62	10	56	85	136
Dobbin	600	104	20	322	486	785
Islaht (*Horseshoe*)	1300	343	32	681	1031	1674
Paynter	1100	384	57	411	662	1144
Jackpine	1200	960	107	306	529	979
Webber	200	100	18	44	78	148
Lambly (Bear)	4700	1801	217	1497	2462	4317
TOTAL	9200	3754	461	3317	5333	9183

It would appear on the basis of availability of water in a dry year that increased live storages On Dobbin and Islaht should be examined. However, physical conditions at site may make it uneconomical to increase these storage capacities. In contrast, Jackpine would appear to be cyclic storage operation which could be filled totally only in a heavy runoff year. Finally, Lambly with 1801 acre-feet appears to be of adequate size unless further diversions into it are contemplated.

Storages are currently operated in a manner which seems best to the owners for the purpose of irrigation or other consumptive use. Unlike some other tributaries, the Powers Creek watershed appears to have complete sufficiency of storage for consumptive use purposes and it appears likely that the smaller storages, particularly, could be operated for non-consumptive (Fisheries) use.

Methods of operation are by no means rigid, but generally follow the pattern outlined in Table 8.7

EXPLANATION: For any given month -

1. Percentages shown refer to active storage occupied by water at end of month. e.g. 30% storage occupied by water at end of March.
2. When rule curve is exceeded, all excess water is released.

Photo 33 JACKPINE LAKE - Looking North (Sept. 12, 1973)
Powers Creek System

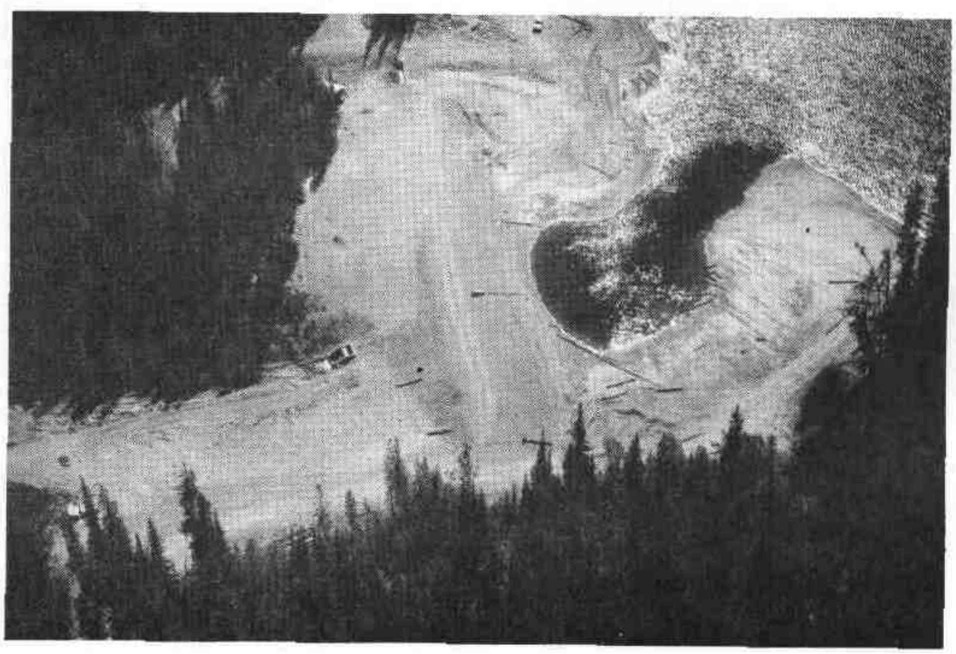


Photo 34 JACKPINE LAKE DAM Showing details of control works
Looking Southwest (Sept. 12, 1973) Powers Creek System

Photo 35 LAMBLY LAKE showing North Dam
Looking Northeast (Sept. 12, 1973)
Powers Creek System

Photo 36 LOGGING OPERATION IN THE WHITEMAN CREEK AREA
Looking Northeast (Sept. 12, 1973)

3. When rule curve value is not achieved, only stated water requirements are released.

4. Information based on local records of water users.

TABLE 8.7

RULE CURVE VALUES FOR POWERS CREEK RESERVOIRS

Reservoir Name	Reservoir Capacity	Rule Curve Values Expressed as a Percentage of Reservoir Capacity											
		J	F	M	A	M	J	J	A	S	O	N	D
West	62	0	0	0	0	100	100	67	33	0	0	0	0
Dobbin	104	0	0	0	0	100	100	67	33	0	0	0	0
Islaht	343	0	0	0	0	100	100	67	33	0	0	0	0
Paynter	384	0	0	0	0	100	100	67	33	0	0	0	0
Jackpine	960	50	50	50	50	100	100	83	67	50	50	50	50
Webber	100	0	0	0	0	100	100	67	33	0	0	0	0
Lambly	1801	30	30	30	65	100	100	77	53	30	30	30	30
TOTAL	3754												

The above rule curves have been used in computer programming for the production of print-outs showing regulated flows.

At the 1970 stage of development, little or no consideration is given to the operation of storage for Fisheries or other non-consumptive use.

8.5.1 Residual Flows

When natural flow is affected by storage changes, diversions to or from the area and withdrawals for irrigation, domestic or industrial purposes, the resulting creek flow is called the "residual flow". These residual flows, for various selected points and three types of weather year at 1970 development, are shown on computer print-outs. They are re-produced as Figure 8.6 (Dry Year), Figure 8.7 (Average Year), and Figure 8.8 (Wet Year).

Reference to these figures will show that residual flows immediately upstream and immediately downstream from selected points are given. The difference is the amount diverted at the point for consumptive use. It will be noted that there are no "demand deficiencies" at the 1970 stage of development, even in a "dry" year.

Date of Print-out:
Oct. 26, 1972

STORAGES GIVEN ARE FOR THE END OF THE MONTH
UNITS FOR DEMANDS, STORAGES, FLOWS, AND DEFICIENCIES ARE ACRE FEET

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
CONTROL POINT	1													
STORAGE		0.	0.	0.	0.	29.	46.	42.	20.	0.	0.	0.	0.	
CONTROL POINT	2													
STORAGE		0.	0.	0.	0.	104.	104.	70.	34.	0.	0.	0.	0.	
CONTROL POINT	3													
STORAGE		0.	0.	0.	0.	215.	343.	230.	113.	0.	0.	0.	0.	
CONTROL POINT	4													
STORAGE		0.	0.	0.	0.	205.	316.	257.	127.	0.	0.	0.	0.	
CONTROL POINT	5													
STORAGE		480.	480.	480.	480.	629.	702.	719.	643.	480.	480.	480.	482.	
CONTROL POINT	6													
STORAGE		0.	0.	0.	0.	21.	31.	34.	33.	0.	0.	0.	0.	
CONTROL POINT	7													
STORAGE		540.	540.	540.	803.	1346.	1759.	1054.	299.	325.	351.	376.	401.	
MEASURING POINT	1													
FLOW		12.	16.	19.	33.	194.	100.	96.	147.	143.	16.	16.	15.	807.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	2													
FLOW		26.	34.	40.	60.	373.	259.	290.	340.	329.	34.	33.	33.	1850.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	3													
FLOW		23.	25.	34.	72.	453.	230.	50.	103.	221.	25.	25.	25.	1285.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	4													
FLOW		64.	70.	97.	189.	1249.	701.	387.	459.	567.	76.	75.	75.	4015.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	5													
FLOW		35.	43.	54.	41.	470.	215.	814.	801.	17.	17.	17.	17.	2491.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	6													
FLOW		103.	123.	157.	243.	1766.	963.	1213.	1264.	588.	97.	96.	90.	6709.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	8													
FLOW		111.	140.	180.	307.	1706.	39.	1.	0.	95.	102.	108.	108.	2897.
DEFICIENCY (FISH)		129.	100.	60.	0.	0.	201.	239.	240.	205.	198.	132.	132.	1636.
USE POINT	1													
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEMAND, TOTAL		17.	14.	17.	20.	777.	1282.	1293.	1293.	522.	24.	17.	17.	5293.
FLOW, UPSTREAM		128.	154.	197.	326.	2479.	1319.	1293.	1293.	617.	126.	125.	123.	8182.
FLOW, DOWNSTREAM		111.	140.	180.	306.	1702.	37.	0.	0.	95.	102.	108.	105.	2889.
~~DEMAND, DEFICIENCY~~		~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~	~~0.~~
DEFICIENCY (FISH)		129.	100.	60.	0.	0.	203.	240.	240.	205.	198.	132.	132.	1639.
GRAND TOTALS FOR ALL THE USE POINTS:														
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
~~DEMAND, TOTAL~~		~~17.~~	~~14.~~	~~17.~~	~~20.~~	~~777.~~	~~1282.~~	~~1293.~~	~~1293.~~	~~522.~~	~~24.~~	~~17.~~	~~17.~~	~~5293.~~
DEMAND, DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

POWERS CR. DRY YEAR (1970)

Figure 8.6

Date of Print-out:
Oct. 26, 1972

STORAGES GIVEN ARE FOR THE END OF THE MONTH
UNITS FOR DEMANDS, STORAGES, FLOWS, AND DEFICIENCIES ARE ACRE FEET

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
CONTROL POINT	1													
STORAGE		0.	0.	0.	0.	43.	62.	42.	20.	0.	0.	0.	0.	
CONTROL POINT	2													
STORAGE		0.	0.	0.	0.	104.	104.	70.	34.	0.	0.	0.	0.	
CONTROL POINT	3													
STORAGE		0.	0.	0.	0.	343.	343.	230.	113.	0.	0.	0.	0.	
CONTROL POINT	4													
STORAGE		0.	0.	0.	0.	329.	384.	257.	127.	0.	0.	0.	0.	
CONTROL POINT	5													
STORAGE		480.	480.	480.	480.	736.	861.	797.	643.	480.	480.	480.	480.	
CONTROL POINT	6													
STORAGE		0.	0.	0.	0.	37.	55.	60.	33.	0.	0.	0.	0.	
CONTROL POINT	7													
STORAGE		540.	540.	540.	651.	1801.	1801.	1387.	849.	540.	540.	540.	540.	
MEASURING POINT	1													
FLOW		19.	25.	32.	55.	320.	288.	187.	157.	152.	25.	25.	25.	1309.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	2													
FLOW		40.	53.	65.	117.	663.	745.	425.	362.	349.	54.	52.	52.	2975.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	3													
FLOW		40.	44.	60.	128.	786.	394.	182.	226.	240.	44.	44.	44.	2237.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	4													
FLOW		107.	128.	166.	333.	2187.	1506.	691.	617.	619.	128.	126.	125.	6734.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	5													
FLOW		60.	74.	92.	71.	777.	1027.	601.	615.	382.	73.	71.	71.	3914.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	6													
FLOW		174.	210.	269.	430.	3146.	2620.	1315.	1240.	1009.	209.	205.	205.	11032.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	7													
FLOW		206.	257.	328.	588.	3700.	1991.	187.	3.	543.	241.	244.	244.	8532.
DEFICIENCY (FISH)		34.	0.	0.	0.	0.	0.	53.	237.	0.	59.	0.	0.	383.
USE POINT	1													
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEMAND, TOTAL		17.	14.	17.	20.	777.	1282.	1293.	1293.	522.	24.	17.	17.	5293.
FLOW, UPSTREAM		220.	267.	341.	591.	4420.	3249.	1466.	1293.	1062.	262.	258.	259.	13687.
FLOW, DOWNSTREAM		203.	253.	324.	571.	3643.	1967.	173.	0.	540.	238.	241.	241.	8394.
DEMAND, DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEFICIENCY (FISH)		37.	0.	0.	0.	0.	0.	67.	240.	0.	62.	0.	0.	406
GRAND TOTALS FOR ALL THE USE POINTS:														
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEMAND, TOTAL		17.	14.	17.	20.	777.	1282.	1293.	1293.	522.	24.	17.	17.	5293.
DEMAND, DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

POWERS CR. AVERAGE YEAR (1970)

Figure 8.7

Date of Print-out:
Oct. 26, 1972

STORAGES GIVEN ARE FOR THE END OF THE MONTH
UNITS FOR DEMANDS, STORAGES, FLOWS, AND DEFICIENCIES ARE ACRE FEET

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
CONTROL POINT	1													
STORAGE		0.	0.	0.	0.	62.	62.	42.	20.	0.	0.	0.	0.	
CONTROL POINT	2													
STORAGE		0.	0.	0.	0.	104.	104.	70.	34.	0.	0.	0.	0.	
CONTROL POINT	3													
STORAGE		0.	0.	0.	0.	343.	343.	230.	113.	0.	0.	0.	0.	
CONTROL POINT	4													
STORAGE		0.	0.	0.	0.	384.	384.	257.	127.	0.	0.	0.	0.	
CONTROL POINT	5													
STORAGE		480.	480.	480.	480.	954.	960.	797.	643.	480.	480.	480.	480.	
CONTROL POINT	6													
STORAGE		0.	0.	0.	0.	71.	100.	67.	33.	0.	0.	0.	0.	
CONTROL POINT	7													
STORAGE		540.	540.	540.	743.	1801.	1801.	1387.	955.	540.	540.	540.	540.	
MEASURING POINT	1													
FLOW		35.	45.	57.	97.	752.	598.	233.	177.	172.	45.	45.	45.	[illegible]
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	2													
FLOW		74.	97.	117.	218.	1693.	1414.	532.	407.	391.	96.	94.	94.	5226.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	3													
FLOW		74.	82.	112.	242.	1445.	947.	470.	271.	270.	80.	80.	80.	4119.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	4													
FLOW		198.	236.	306.	626.	4498.	3033.	1115.	733.	727.	231.	229.	229.	12156.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	5													
FLOW		107.	132.	167.	132.	2340.	1757.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	6													
FLOW		319.	384.	498.	810.	7195.	4995.	1914.	1317.	1280.	375.	372.	372.	19828.
DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
MEASURING POINT	8													
FLOW		413.	507.	642.	1224.	9202.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DEFICIENCY (FISH)		0.	0.	0.	0.	0.	0.	0.	53.	0.	0.	0.	0.	53.
USE POINT	1													
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEMAND, TOTAL		17.	14.	17.	20.	777.	1282.	1293.	1293.	522.	24.	17.	17.	5293.
FLOW, UPSTREAM		[illegible]	498.	630.	1147.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	475.	475.	[illegible]
FLOW, DOWNSTREAM		394.	484.	619.	1127.	8881.	4916.	931.	127.	861.	454.	458.	458.	19711.
DEMAND, DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEFICIENCY (FISH)		0.	0.	0.	0.	0.	0.	0.	113.	0.	0.	0.	0.	113.
GRAND TOTALS FOR ALL THE USE POINTS:														
DEMAND, IRRIGATION		0.	0.	0.	0.	743.	1238.	1238.	1238.	495.	0.	0.	0.	4952.
DEMAND, DOMESTIC		17.	14.	17.	20.	34.	44.	55.	55.	27.	24.	17.	17.	341.
DEMAND, INDUSTRIAL		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DEMAND, TOTAL		17.	14.	17.	20.	777.	1282.	1293.	1293.	522.	24.	17.	17.	5293.
DEMAND, DEFICIENCY		0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

END OF TABLE

POWERS CR.   WET YEAR (1970)

Figure 8.8

Reference to Figure 8.9 and 8.6 will show that, based on Department of Fisheries estimates of need, there would be a considerable shortage of water for non-consumptive use. Even in the winter of a "dry" year, when no diversions for irrigation are being made, it appears that Fisheries water shortages range up to 55% of their stated requirement.

In an "average" year, severe non-consumptive water deficiencies appear only in August. This is due, primarily, to water withdrawals from the Creek for irrigation purposes.

It will be noted on Figure 8.9 that, under modified operation, a consumptive use deficiency of 15% appears in September. This indicates a lack of sophistication in the method of modified operation more than a genuine water shortage.

In conclusion, the contribution which Powers Creek makes to the gross inflow to Okanagan Lake may be evaluated for various types of year as shown on Table 8.8.

TABLE 8.8

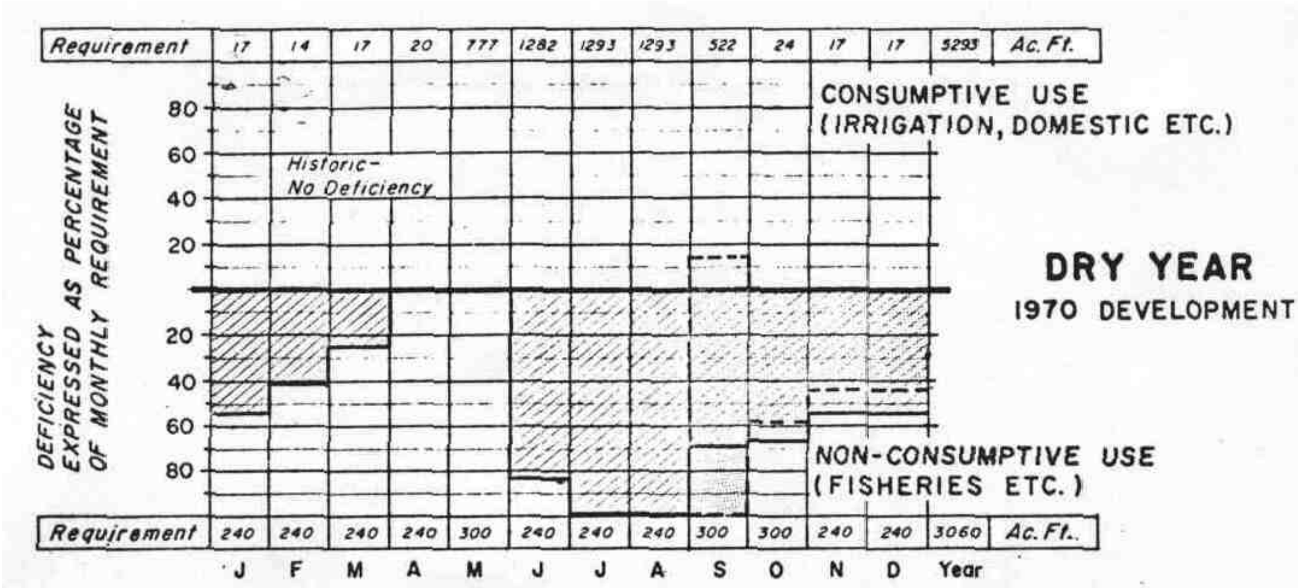
COMPARISON BETWEEN ESTIMATED INFLOWS

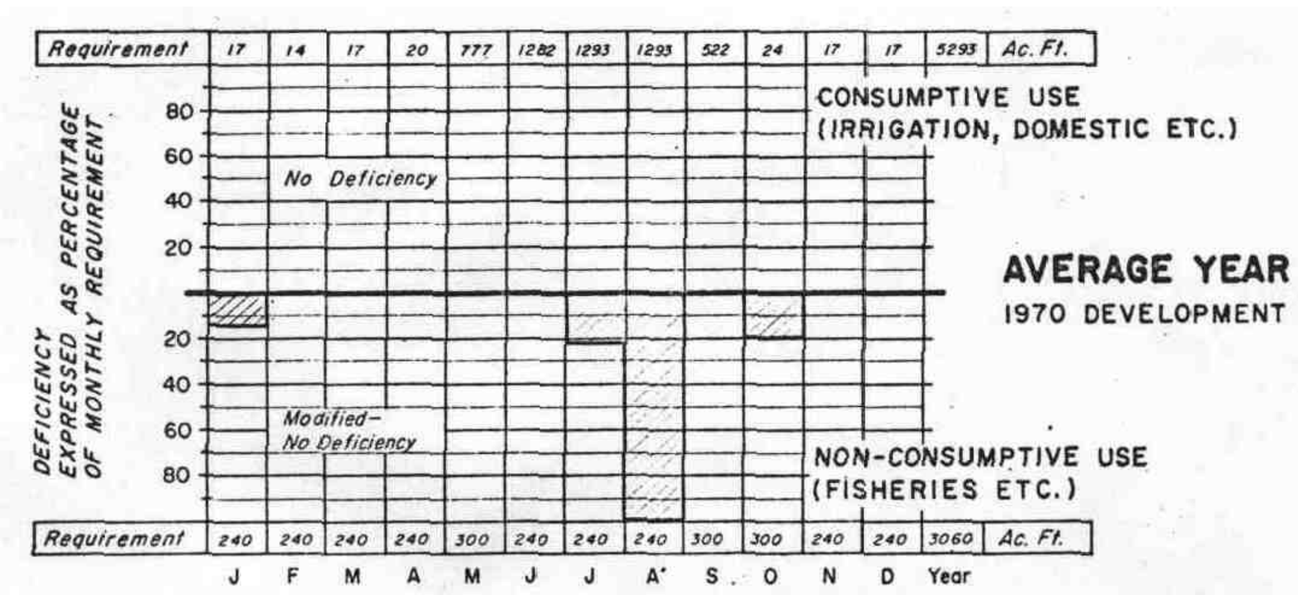
to

POWERS CREEK AND OKANAGAN LAKE

Type of Year	Inflow to Okanagan Lake from Powers Creek* (acre-feet)	Gross Inflow to Okanagan Lake from All Sources* (acre-feet)	Percentage Contribution by Powers Creek to Okanagan Lake Inflow
Dry	2,900	279,200	1.0
Average	8,500	516,000	1.6
Wet	20,500	796,700	2.6

* Regulated flows at 1970 development.





LEGEND: Historic (Simulated) Operation
Modified (Simulated) Operation

NOTES:
1. Consumptive Use deficiencies are totals for whole basin.
2. Non-Consumptive deficiencies are those extant at creek mouth.
3. In a Wet Year, a fisheries deficiency of 53 (Hist) / 0 (Mod) ac. ft. exists at mouth in August.

POWERS CR. (1970) DEFICIENCY DIAGRAM Figure 8.9