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Manuscript Report 1527

November 1979

WATER REQUIREMENTS FOR THE FISHERIES RESOURCE
OF THE
SOOKE RIVER, B.C.

by

ROY E. HAMILTON
C.C. GRAHAM

Habitat Protection Division
Resource Services Branch
Fisheries and Marine Service
Department of Fisheries and Oceans
Vancouver, B.C. V6E 2P1

Hamilton, R. and C. Graham. 1979. Water Requirements for the Fisheries Resource of the Sooke River, B.C. Fish. Mar. Serv. M.S. Report 1527.

ABSTRACT

In March, 1977, the Greater Victoria Water District made application to divert water from the Leech River and Deception Gulch, two tributaries of the Sooke River, B.C. The Fisheries and Marine Service of the Department of Fisheries and Oceans, expressed concern to the Water Rights Branch of the Provincial Ministry of the Environment over the possible effects of such a diversion on the salmon stocks in the river. Subsequently, a study was initiated to determine the fisheries resource maintenance flow requirements for the Sooke River.

This report presents the results of the study and includes a review of the fisheries resource, the hydrology and the resource maintenance flow requirements. The calculated resource maintenance flow was compared to past stream discharge records to determine whether the requirements for fisheries and the Water District were compatible.

The Comptroller of Water Rights held a public hearing on March 1, 1979 to review the license application. A formal presentation was made by Federal Fisheries at that hearing. On June 21, 1979, a license was issued to the Water District. The clauses of this license are reviewed.

Key Words: hydrology, fisheries resource maintenance flows, salmon

RÉSUMÉ

En mars 1977, le District de gestion des eaux de la région métropolitaine de Victoria a demandé l'autorisation de détourner des eaux de la rivière Leech et de Deception Gulch, deux affluents de la rivière Sooke (C.-B.). Le Service des pêches et de la mer du ministère des Pêches et des Océans a exprimé son inquiétude à la direction des droits d'utilisation de l'eau (Water Rights Branch) du ministère provincial de l'Environnement quant aux effets possibles d'un tel détournement sur les populations de saumons de ce cours d'eau. On a donc lancé une étude pour déterminer les débits nécessaires au maintien des ressources halieutiques dans la rivière Sooke.

Le rapport présente les résultats de l'étude et comporte un examen des ressources halieutiques, de l'hydrologie et des débits nécessaires au maintien des ressources halieutiques. On a calculé le débit nécessaire et on l'a comparé aux écoulements enregistrés afin de déterminer si les besoins des ressources halieutiques et ceux du District de gestion des eaux sont compatibles.

Le contrôleur des droits d'utilisation de l'eau a tenu, le 1 mars 1979, une audience publique concernant la demande de permis; à cette occasion, Pêches et Océans a présenté la position officielle. Le 21 juin 1979, le District de gestion des eaux se voyait accorder un permis, dont les clauses sont examinées dans le rapport.

Mots clés: hydrologie, débits de maintien des ressources halieutiques, saumon.

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ACKNOWLEDGEMENTS

We would like to thank: Messrs. F.C. Boyd, W.J. Schouwenburg and R.A. Robertson for their critical review of this report; Messrs. W.J. Field, K. Johansen, and B.R. Eliassen for their field and office support; and Mrs. T. Collins for typing of the manuscript.

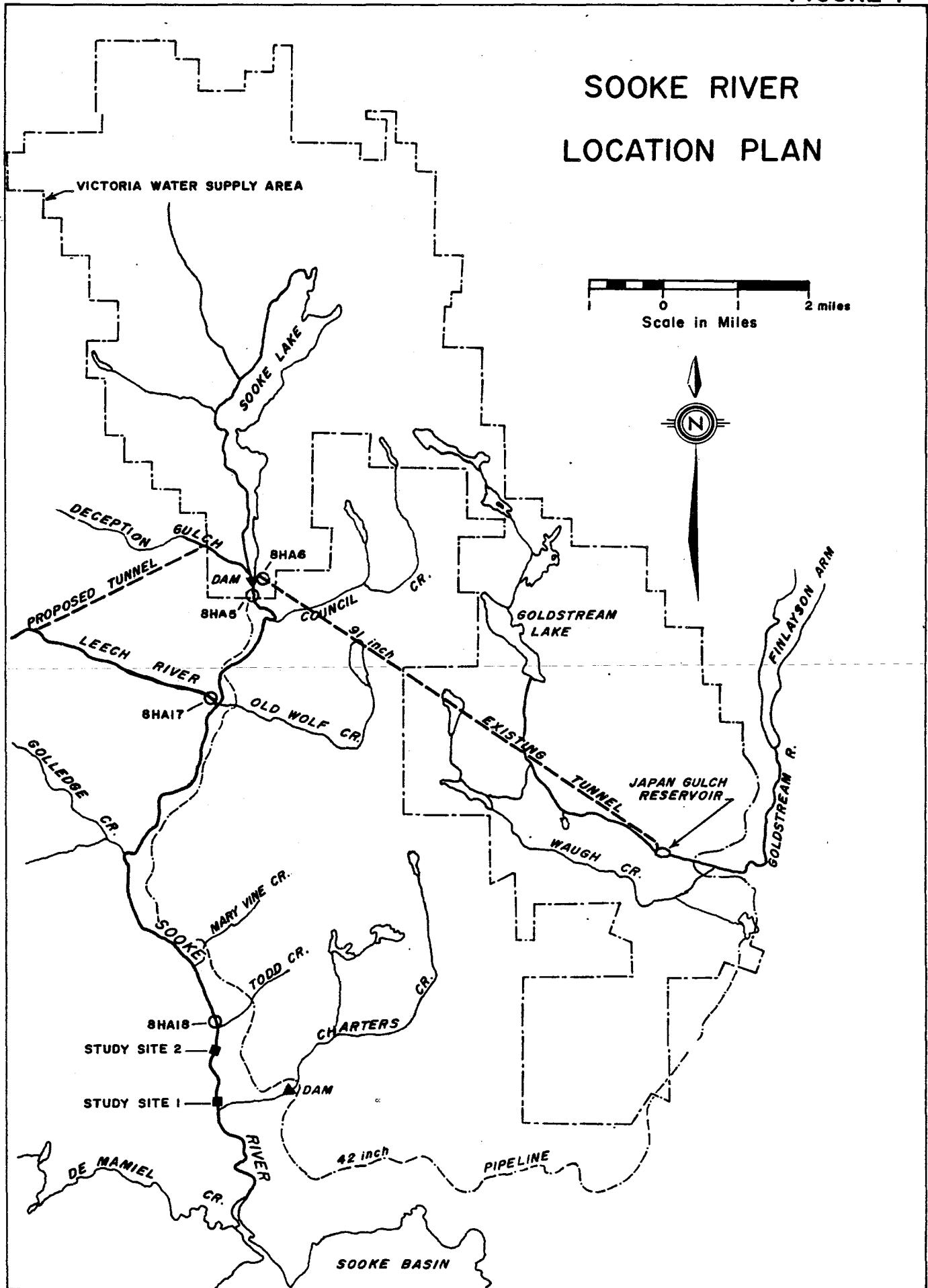
1. Introduction

The Greater Victoria Water District, which includes Victoria, Saanich, Sooke and interlying areas, has obtained its domestic and industrial water supply for several decades from the Sooke-Goldstream watersheds lying to the northwest of the City of Victoria (Figure 1). During 1969 - 1970, to increase the capacity of their supply system, the G.V.W.D. constructed a 91 inch diameter tunnel between the Sooke Lake Reservoir and Japan Gulch Reservoir and raised the Sooke Lake dam to provide 42,000 acre feet of storage. It was then estimated that the system would meet the demands of the Victoria District with no further expansion until 1991¹. In 1973 a diversion dam was constructed on Charters Creek, a tributary of the Sooke River, by the G.V.W.D. to supply water to the Sooke-Saseenos area. The Charters Creek flow is supplemented by flow from the old 42 inch diameter concrete pipeline from Sooke Lake (Figure 1) during low flow periods, which occur almost every summer and occasionally during winter.

The drought conditions which occurred during the fall and winter of 1976, led the Greater Victoria Water District to consider another expansion of their water supply system. Therefore, on February 21, 1977 they applied for a water licence for waterworks and storage of 80,000 acre feet per annum from the Leech River and the total flow from Deception Gulch. On March 7, 1977 these licence applications were reduced, so that the proposed diversions are now 25,000 acre feet from Leech River, and 1,500 acre feet from Deception Gulch. In addition, the Water District proposed to allow a minimum of 10 cfs to continue flowing in the Leech River, or the natural flow if less than 10 cfs, for protection of the fishery resource. In Deception Gulch they proposed to allow 1 cfs or the natural flow if less than 1 cfs.

On April 12, 1977 representatives of the Greater Victoria Water District, the Ministry of Environment, Water Rights Branch and Department of Fisheries and Environment, Fisheries Management Service, met to discuss the details of these proposed diversions. At that time the Assistant Comptroller agreed to hold the water licence applications in abeyance subject to the submission of a report prepared by the Fisheries Management Service that would review the fisheries resource of the Sooke River system and address the flow proposals suggested by the G.V.W.D.

¹ *Report Proposed New Storage Dam at Sooke Lake by Ker, Priestman & Graeme Engineering Ltd., April, 1968.*



2. Fisheries Resource

The Sooke River system (excluding DeMamie Creek) supports populations of chum (Oncorhynchus keta), coho (O. kisutch), and chinook (O. tshawytscha) salmon as well as steelhead trout (Salmo gairdnerii.) This system is a major contributor to the commercial, recreational and Indian food fisheries of Statistical Areas 19 and 20 located along the southeast coast of Vancouver Island. Public interest in the fisheries resource of the Sooke River system is very high, with local groups actively involved in salmon enhancement projects on DeMamie and Mary Vine Creeks.

Quantitative data on spawning escapement for the salmon species utilizing the Sooke River system are available since 1934. Maximum escapement to the spawning grounds over this period of time were: chum, 75,000; coho, 3,500; and chinook, 3,500. Five year average escapement data over the time period 1953 - 1977 is given in Table 1.

The major spawning area in the Sooke River is between the power line, approximately two miles upstream from the river mouth, and the canyon falls, six miles upstream. Spawning distribution by species within this river reach is shown in Figure 2. The canyon falls are an impassable barrier to anadromous salmonids. The watershed above this point offers some potential for coho enhancement, and at the present time, the Amalgamated Conservation Society operates a small coho incubation box facility on Mary Vine Creek. Charters Creek, which enters the Sooke River approximately one mile upstream from its mouth, is also utilized for spawning by coho, chum and some chinook salmon.

The freshwater life cycles of Sooke River salmonids are not well documented. However, based on available scale data, limited juvenile sampling, escapement records, and observations of field officers, the following estimate of the timing of the various freshwater phases has been developed:

1. Chum salmon first appear in the system in mid-September with peak spawning occurring in late October or early November. Incubation continues until March or April when the fry emerge from the gravel and migrate downstream into salt water. Migration is complete by the end of June.

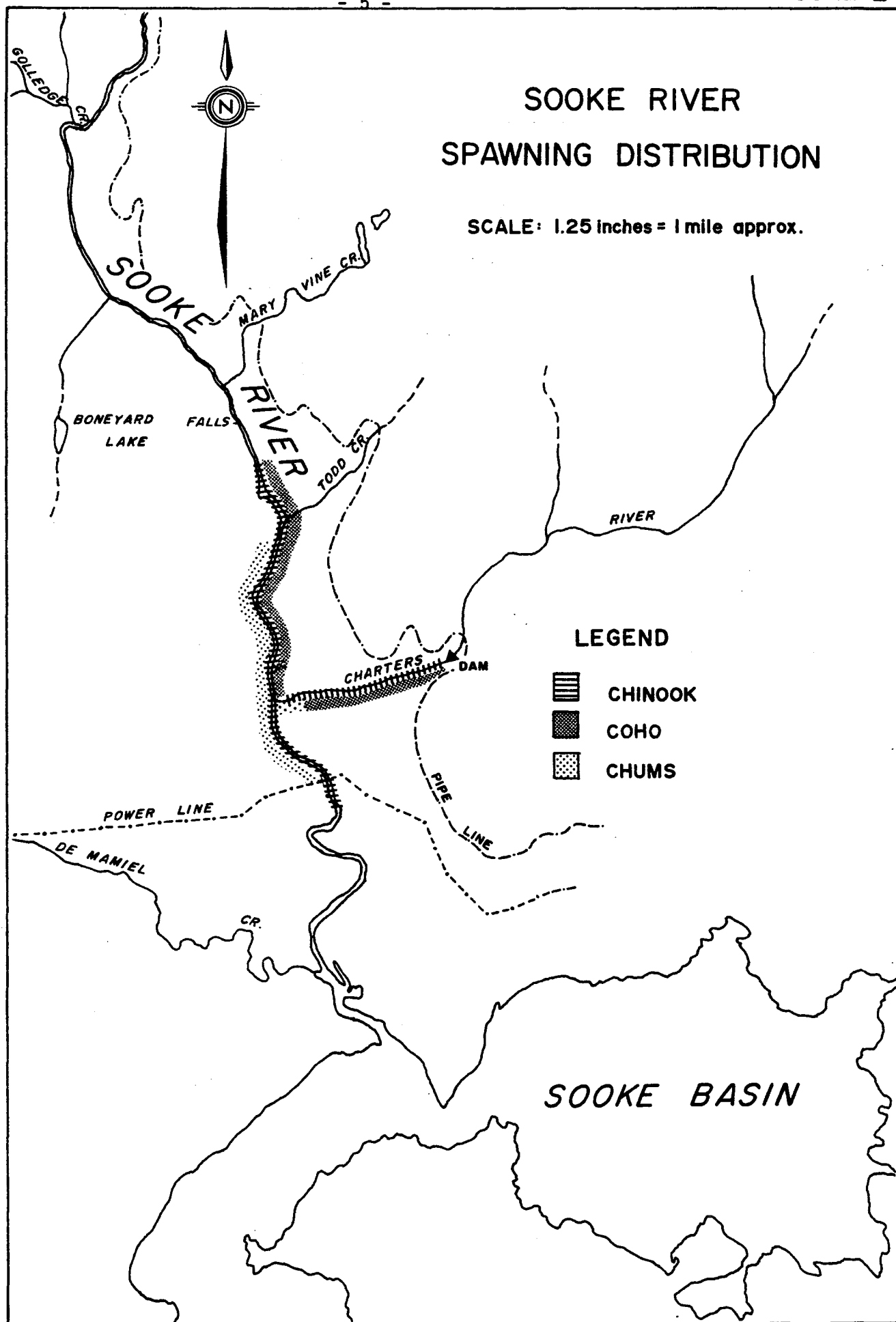
2. Chinook salmon first appear in the system in mid-September and peak spawning occurs between mid-October and mid-November. Incubation continues until approximately April. Following emergence from the gravel, fry reside in the stream for about 90 days before migrating downstream into salt water.

TABLE 1: FIVE YEAR AVERAGE ESCAPEMENTS FOR SOOKE RIVER

PERIOD	CHINOOK	COHO	CHUM
1977 - 1973	832	160	20,600
1972 - 1968	1,100	40	45,000
1967 - 1963	1,030	45	24,000
1962 - 1958	260	120	14,400
1957 - 1953	20	115	36,000

*ESCAPEMENT is the number of adult fish returning to spawn each year.

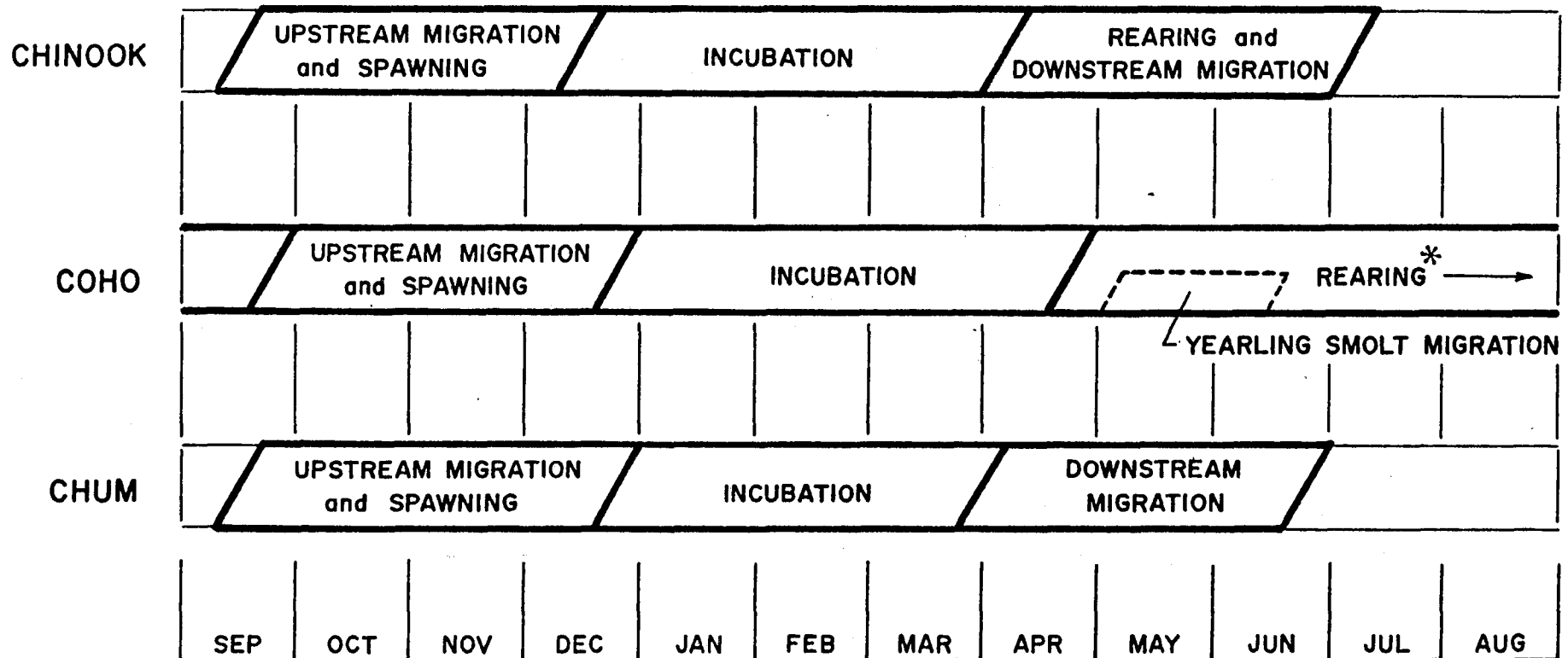
FIGURE 2



3. Coho salmon arrive in the system in late September with peak spawning occurring in mid-October to mid-November. Incubation continues until about April. The majority of coho fry remain in fresh water into their second year of life, and then migrate downstream into salt water as smolts in May and June.

The freshwater life cycle of each of these salmon species are summarized in Figure 3.

FRESHWATER LIFE CYCLES FOR SOOKE RIVER SALMON

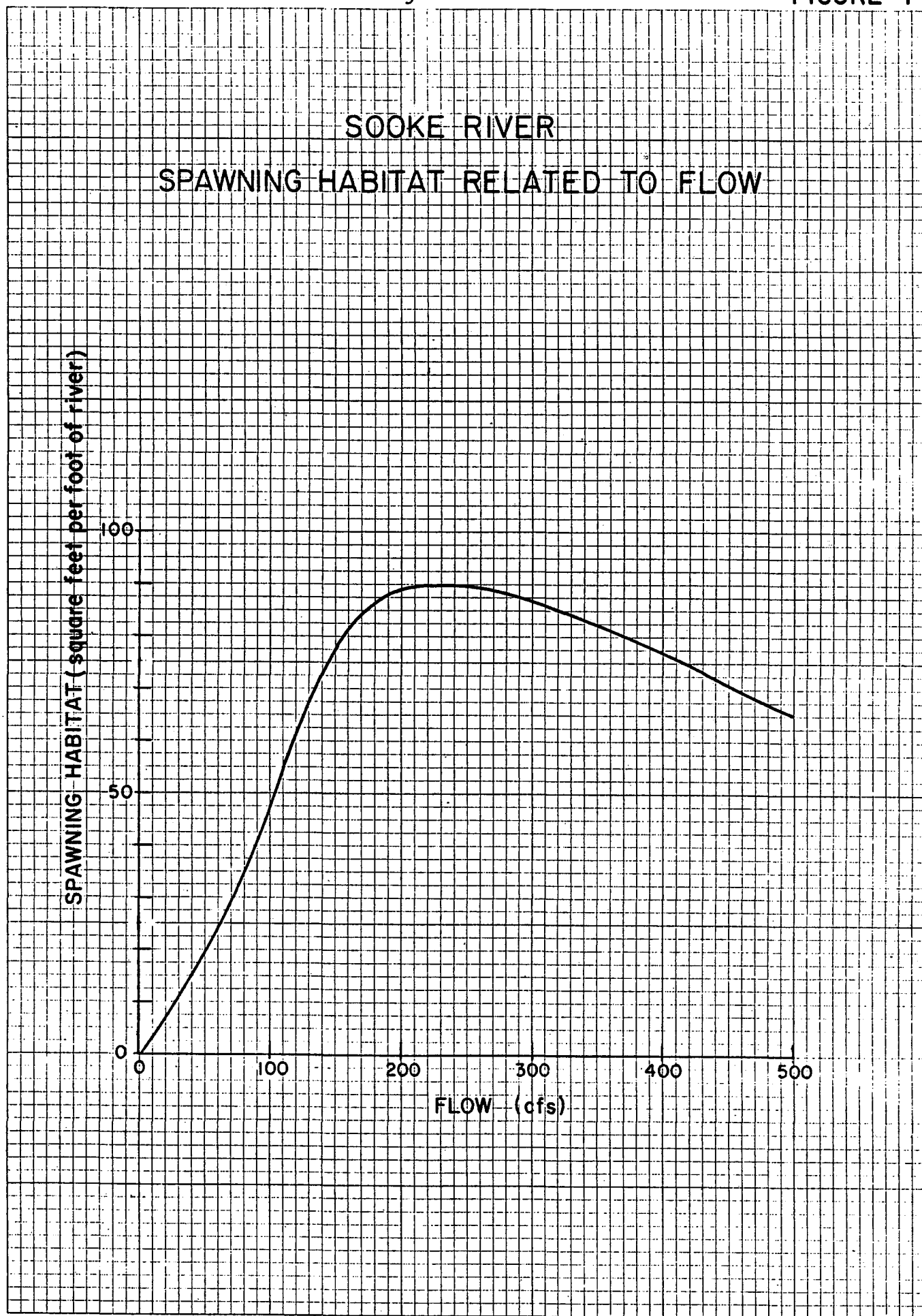


* YEAR ROUND RESIDENCE

3. Fisheries Resource Maintenance Flows

In April, 1977 two study sites were established in known spawning areas on the Sooke River between Charters and Todd Creeks (Figure 1). Four transects were permanently established at each study site, and detailed measurements of velocities and depths were made at each transect several times during the year. The behaviour of spawning chum salmon was observed during the last series of measurements in October. Using the data so obtained and the average velocity/depth ranges preferred by the three species of salmon present in the system, a graph was prepared relating spawning habitat to river flow (Figure 4). The graph, obtained by averaging the results from both study sites, shows that the optimum spawning flow is about 230 cfs, although there is very little difference in amount of spawning habitat over the flow range 200 to 300 cfs. In any case, the hydrographs for the few years of records (Figures 14 to 19) show that during the spawning and incubation periods the flow seldom went below 200 cfs.

Upstream migration into the Sooke River begins in September and continues until the end of October. During this migration period it is desirable to maintain natural flows in the river, including peak flows, to provide attraction for the upstream migrants. During the spawning and incubation periods, through to April 1, a minimum flow of 200 cfs is desirable. After April 1 natural flows, again including peaks, should be maintained to promote both downstream migration and gravel turnover and cleansing.



4. Hydrology

The Sooke River watershed above Charters Creek (Figure 5) has an area of 108.4 square miles. The Leech River is the main tributary with a watershed area of 39.3 square miles. Table 2 and Figure 5 give watershed areas for all the significant tributaries.

Calculations using precipitation data given in Figures 6 and 7 indicate that about 50% of the annual Sooke River runoff comes from the Leech River. This agrees closely with the runoff data available (Table 3) which shows that, on the average, the Leech River represents approximately 52% of the annual runoff. There is, however, considerable monthly variation. Table 3 shows that the Leech River has contributed from 21% to 122% of the total runoff. Random flow measurements by the Fisheries and Marine Service in 1977 in the Sooke River and tributaries (Table 4) indicate that the Leech River represents from 64% to 100% of the total. Both sets of information show that there is no definite monthly pattern explaining the range of contributory flows, but some of the variation will be due to the operation of the Sooke Lake reservoir. For the purposes of this report it is assumed that the Leech River represents, on the average, 75% of the runoff of the Sooke River watershed above Charters Creek during the months November to March inclusive.

Therefore, to provide the recommended Fisheries Resource Maintenance Flows of 200 cfs for spawning and incubation in the Sooke River above Charters Creek, it follows that, during the period November 1 to April 1, G.V.W.D. should only divert water when the flow in the Leech River is in excess of 150 cfs. This requirement has been superimposed on the Leech River hydrographs, Figures 8 to 13. The shaded areas above the 150 cfs line show the amount of water available for storage. The upper boundary of the shaded areas represents the maximum diversion capacity of a 400 cfs tunnel. The volumes represented by the shaded areas add up to the following:

Nov. 1, 1963 to April 1, 1964	- 62,000 ac. ft.
" " 1964 " " " 1965	- 30,000 " "
" " 1965 " " " 1966	- 38,000 " "

By analyzing the records of the Koksilah River, which has 18 years of records, and the San Juan River, which has 15 years of records, it was determined that the 1964 - 65 period (November 1 to April 1) represents the lowest runoff likely to occur about once in 8 years.

TABLE 2: SOOKE RIVER WATERSHED AREAS

Watershed	Watershed Area in Sq. Miles
Leech River	- 39.3
Sooke Lake	- 26.8
Deception Gulch	- 1.9
Council Creek	- 4.6
Old Wolf Creek	- 5.4
Golledge Creek	- 10.7
Sooke Mainstream (Charters Creek to Sooke Dam)	- 19.7
Total Sooke watershed above Charters Creek	- 108.4
Charters Creek	8.1

TABLE 3: AVERAGE MONTHLY FLOWS FOR LEECH AND SOOKE RIVERS
(in cfs) FOR THE PERIOD OF RECORD (1963-65)

Gages: 8HA18 SOOKE
8HA17 LEECH

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
A	Leech R.	459	382	259	211	120	26.1	13.1	7.7	11.7	185	393	386	193
B	Sooke R.	888	1240	259	336	228	125	19.1	11.8	9.6	415	412	524	372
$\frac{A}{B}$	x 100%	52%	31%	100%	63%	53%	21%	69%	65%	122%	45%	75%	74%	52%

TABLE 4: FLOW MEASUREMENTS OF SOOKE RIVER AND TRIBUTARIES

	Watershed Area in Sq. Mi.	Date of flow measurement (cfs)			
		April 20 1977	May 5-6 1977	Sept. 28- 29, 1977	Oct. 26 1977
A Leech River	39.3	105.7	41.8	20.0	450.0
B Sooke River above Leech R.		25.6	5.1	0.4	0.5
C Council Cr.	4.6	0.8	-	-	-
D Old Wolf Cr.	5.4	5.5	1.2	dry	2.0
E Golledge Cr.	10.7	22.4	4.4	4.2	118.0
F Todd Cr.		0.8	0.4	dry	2.0
G Sooke R. above Charters Cr.	108.4	150.0	65.6	20.0	555.0
H Charters Cr.	8.1	2.5	-	0.7	5.0
<hr/>					
$\frac{A}{G} \times 100\%$		70%	64%	100%	81%

As it is unlikely that the diversion works could operate with 100% efficiency, the volumes available would be somewhat less. However, the amount that could be diverted each season between November 1 and April 1 would represent a large part of the 42,000 acre foot capacity of the Sooke Lake reservoir. The diversion works would have to be designed in such a way (possibly utilizing an arrangement of weirs) that the tunnel does not operate until the flow in the river exceeds 150 cfs.

Deception Gulch has a watershed area of 1.9 square miles. As this represents less than 2% of the Sooke River watershed it could be diverted into the Sooke Lake reservoir without appreciably affecting the salmon fishery. However, the Provincial Fish and Wildlife Branch should be consulted respecting the effect of this diversion on resident sport fish.

5. Conclusions and Recommendations

The suggestion that a minimum flow of 10 cfs be provided in the Leech River for fisheries is not acceptable for the high flow period November 1 to April 1. Figures 8 to 13 and Table 3 shows that the natural monthly flow may be approximately 10 cfs during the dry, late summer months, but from November 1 to April 1 the natural flow has seldom dropped below 150 cfs.

As a result of our study of the fisheries resource of the Sooke River system, and of the hydrological characteristics of the watershed, we recommend the following:

1. No diversion of the Leech River except during the period November 1 to April 1.
2. No diversion of the Leech River when the natural flows are less than 150 cfs.
3. The diversion works be designed to pass a minimum flow of 150 cfs down the Leech River during every period of diversion.
4. The gage established by Fisheries Management Service on the Sooke River above Charters Cr  ek be read daily, and a record of the readings be made available to Fisheries Management Service upon request. (The stage discharge curve for the gage is included as Figure 18.)

As the amount of water available for diversion from the Leech River between November 1 and April 1, after provision of a fisheries flow of 150 cfs, is greater than the 25,000 acre feet specified in the licence application, except possibly in extremely dry years, Fisheries Management Service does not object to granting a licence providing it incorporates the foregoing recommendations.

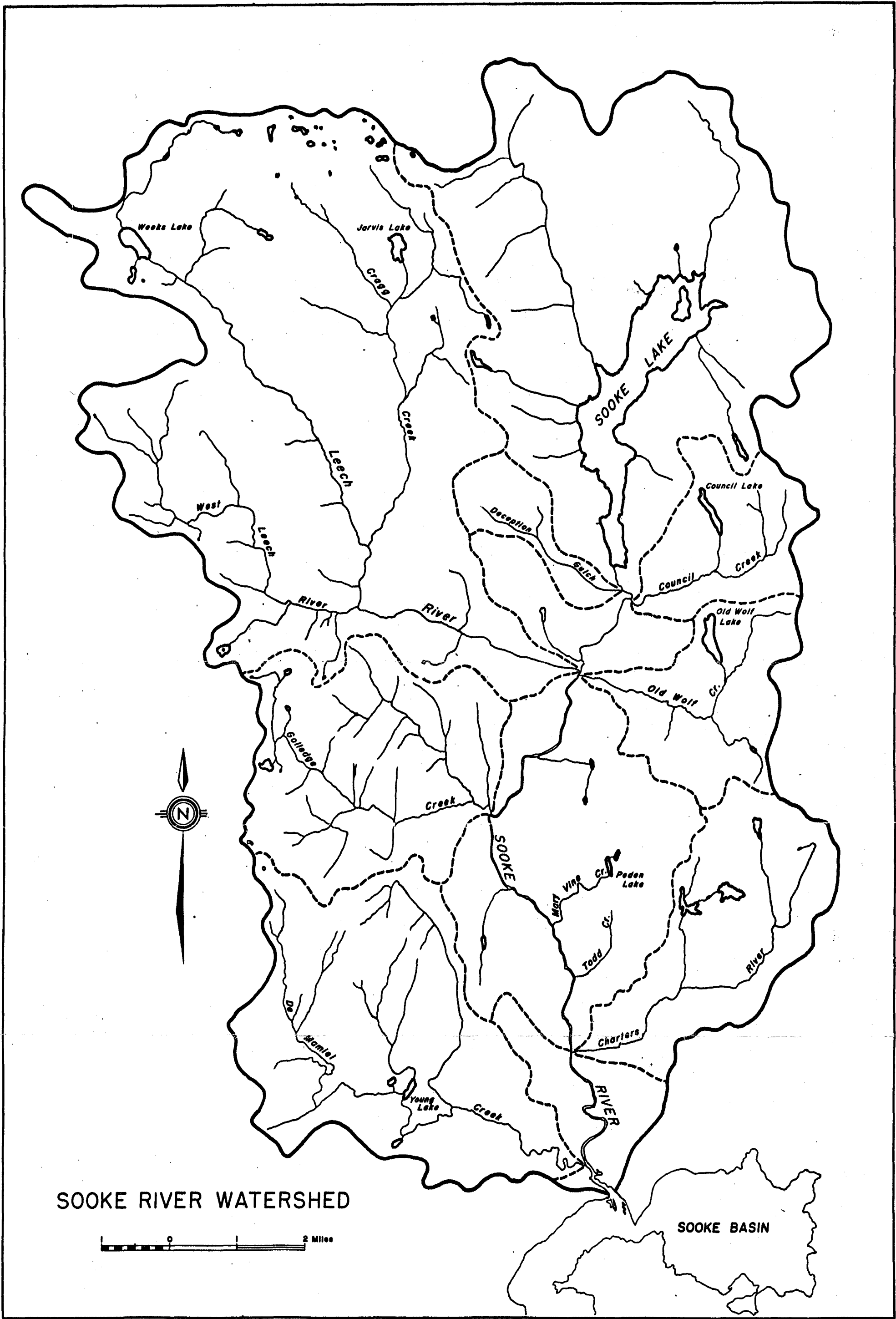
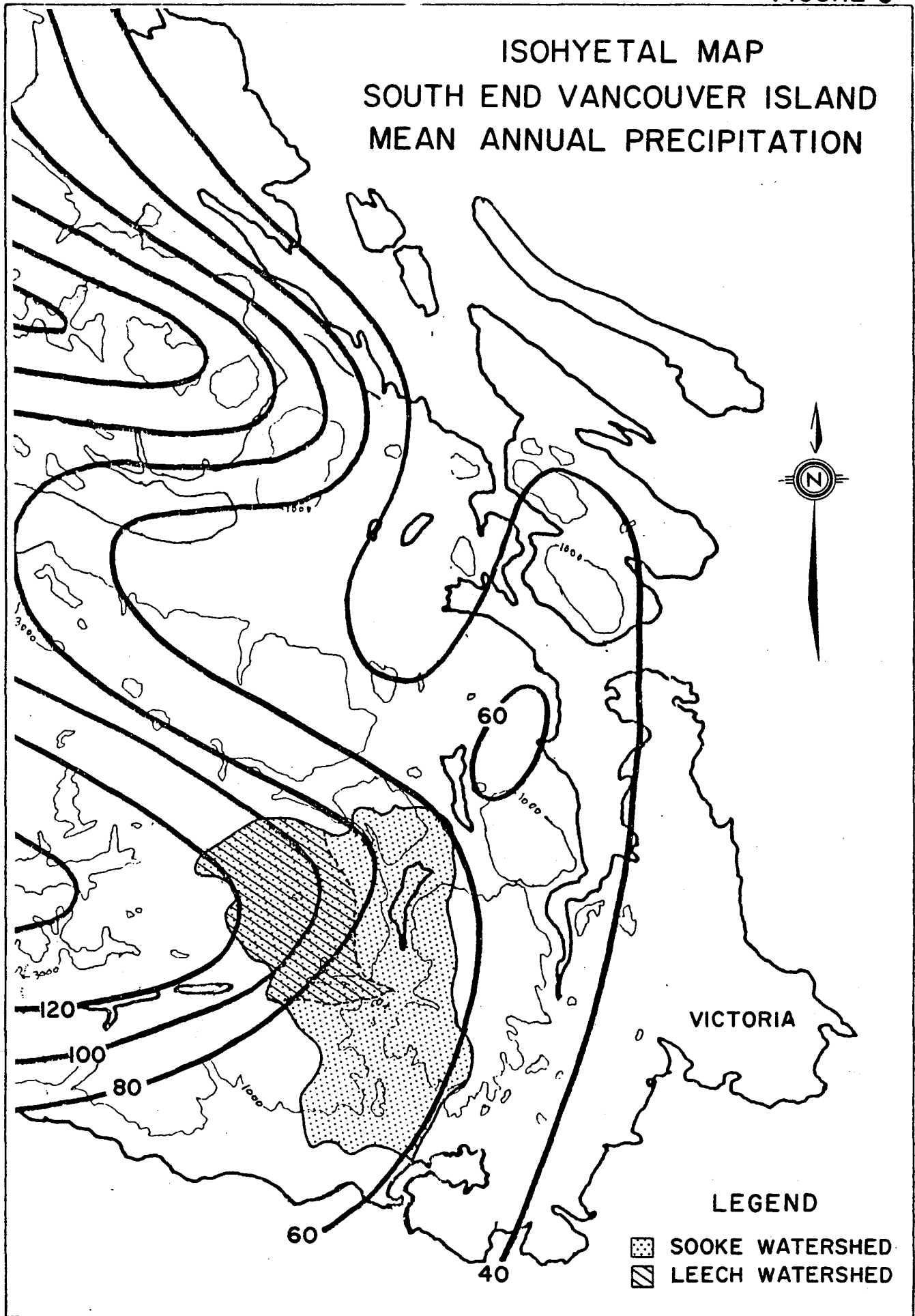
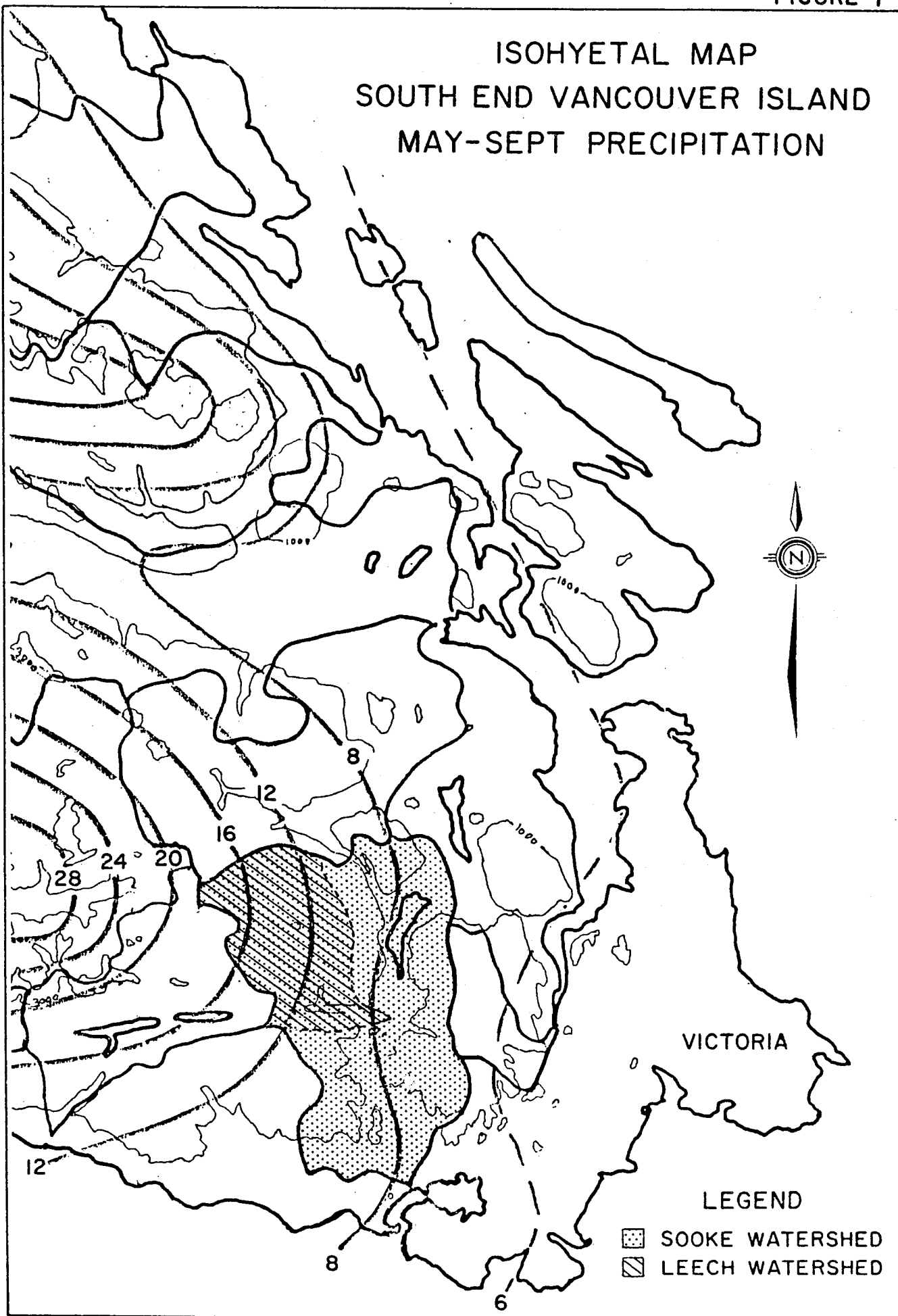


FIGURE 5

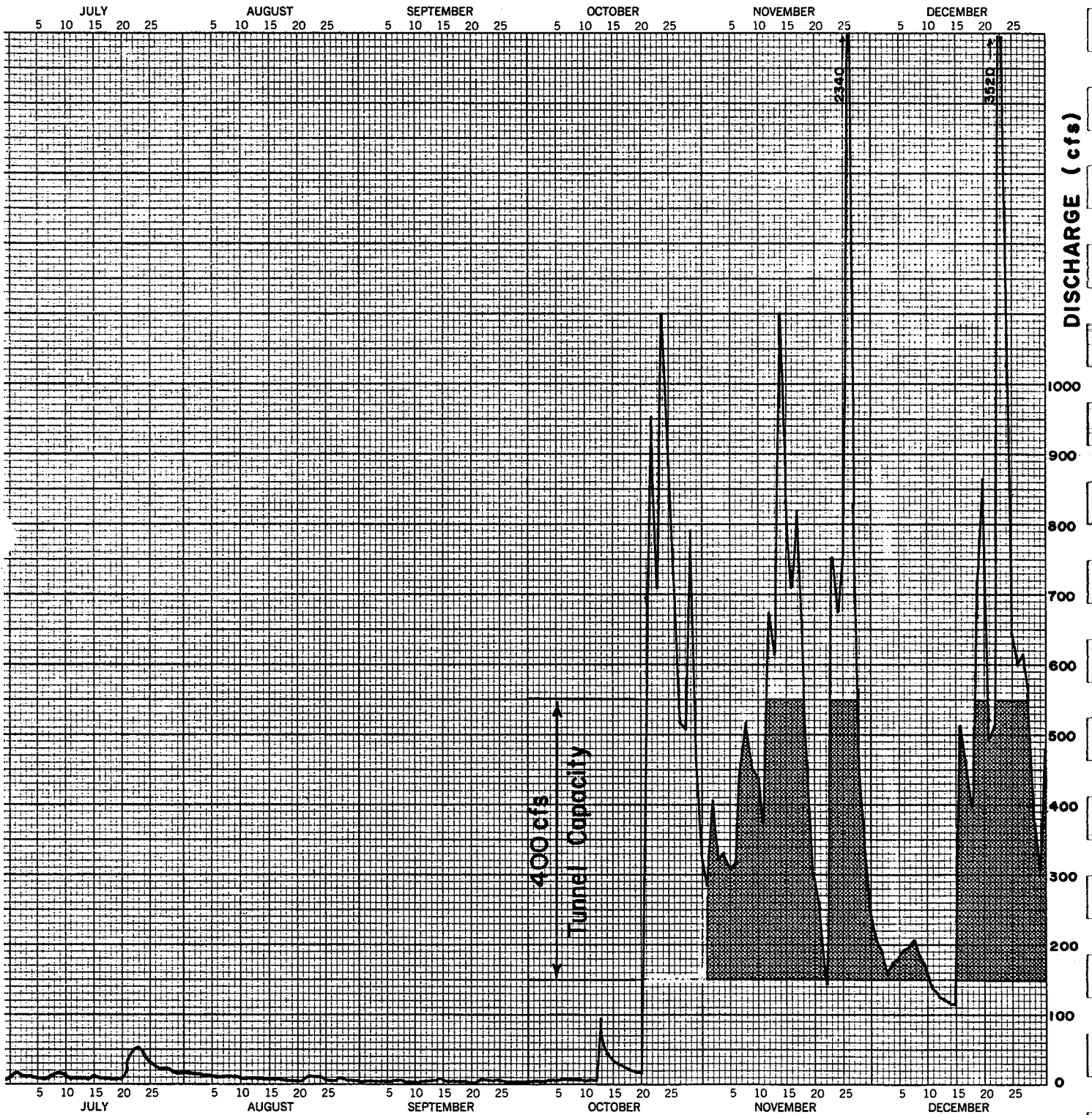


ISOHYETAL MAP
SOUTH END VANCOUVER ISLAND
MAY-SEPT PRECIPITATION



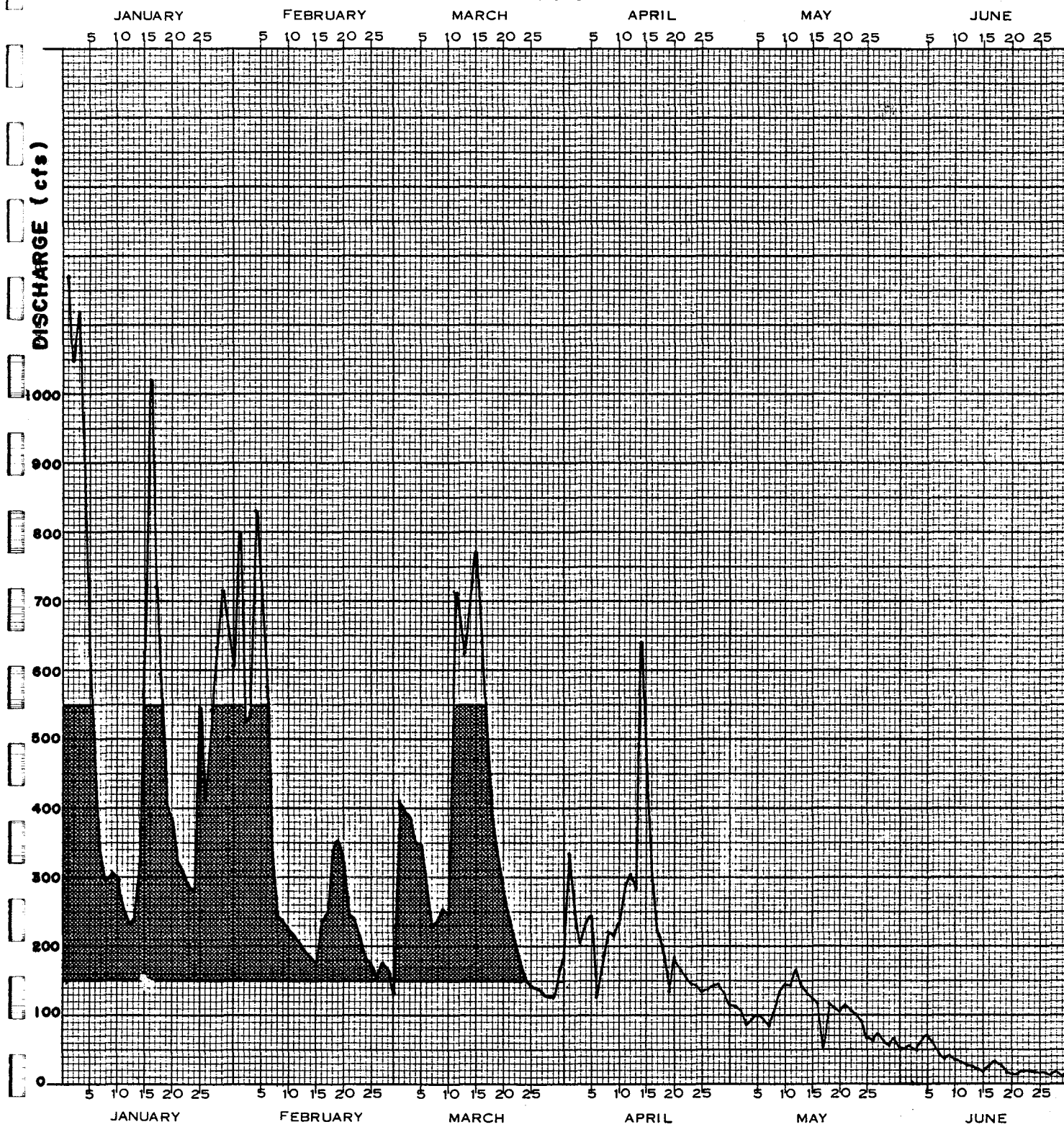
- 19 -
LEECH RIVER
HYDROGRAPH
STA 8HA17
1963

FIGURE 8



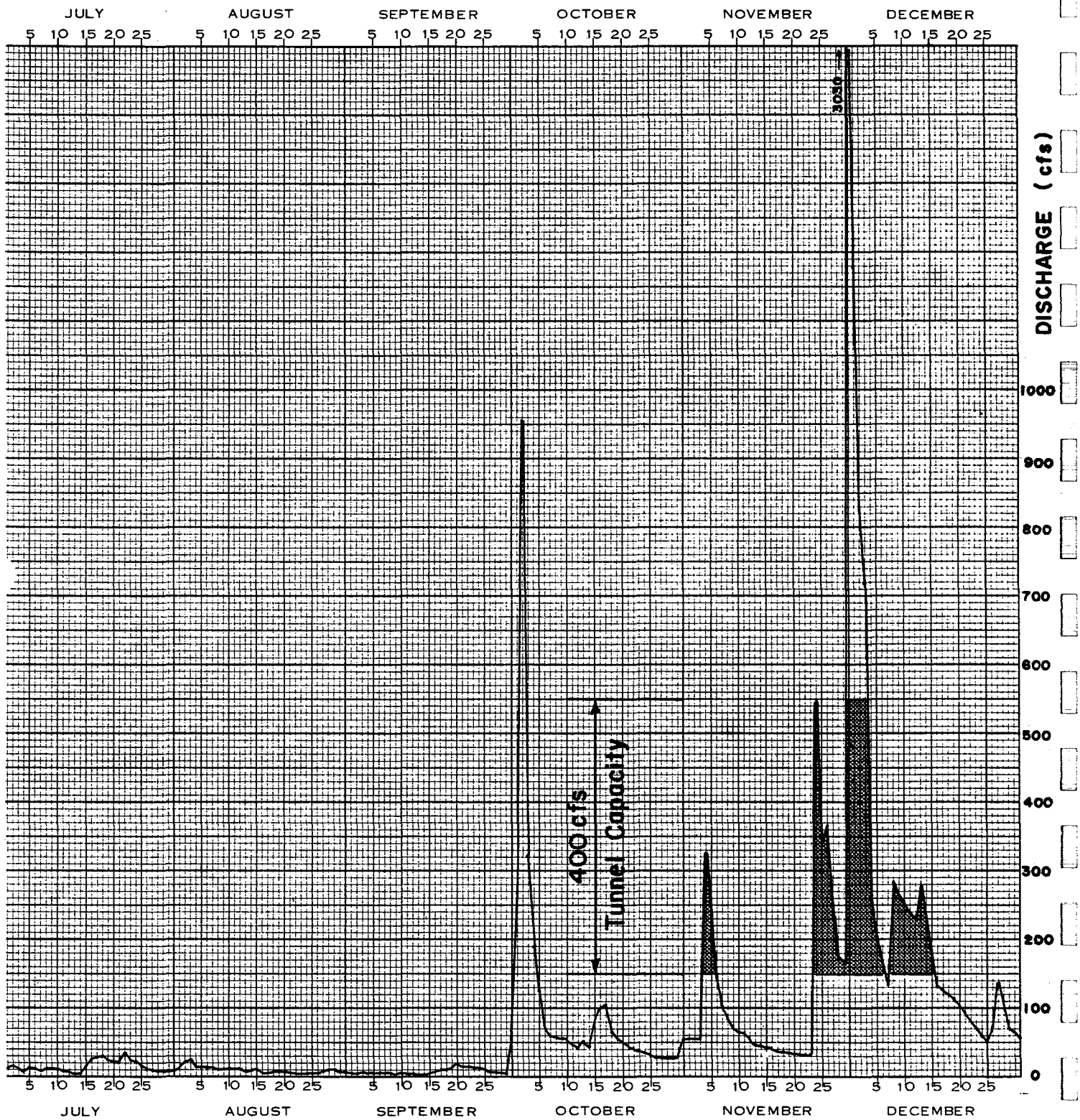
- 20 -
LEECH RIVER
HYDROGRAPH
STA 8HA17
1964

FIGURE 9

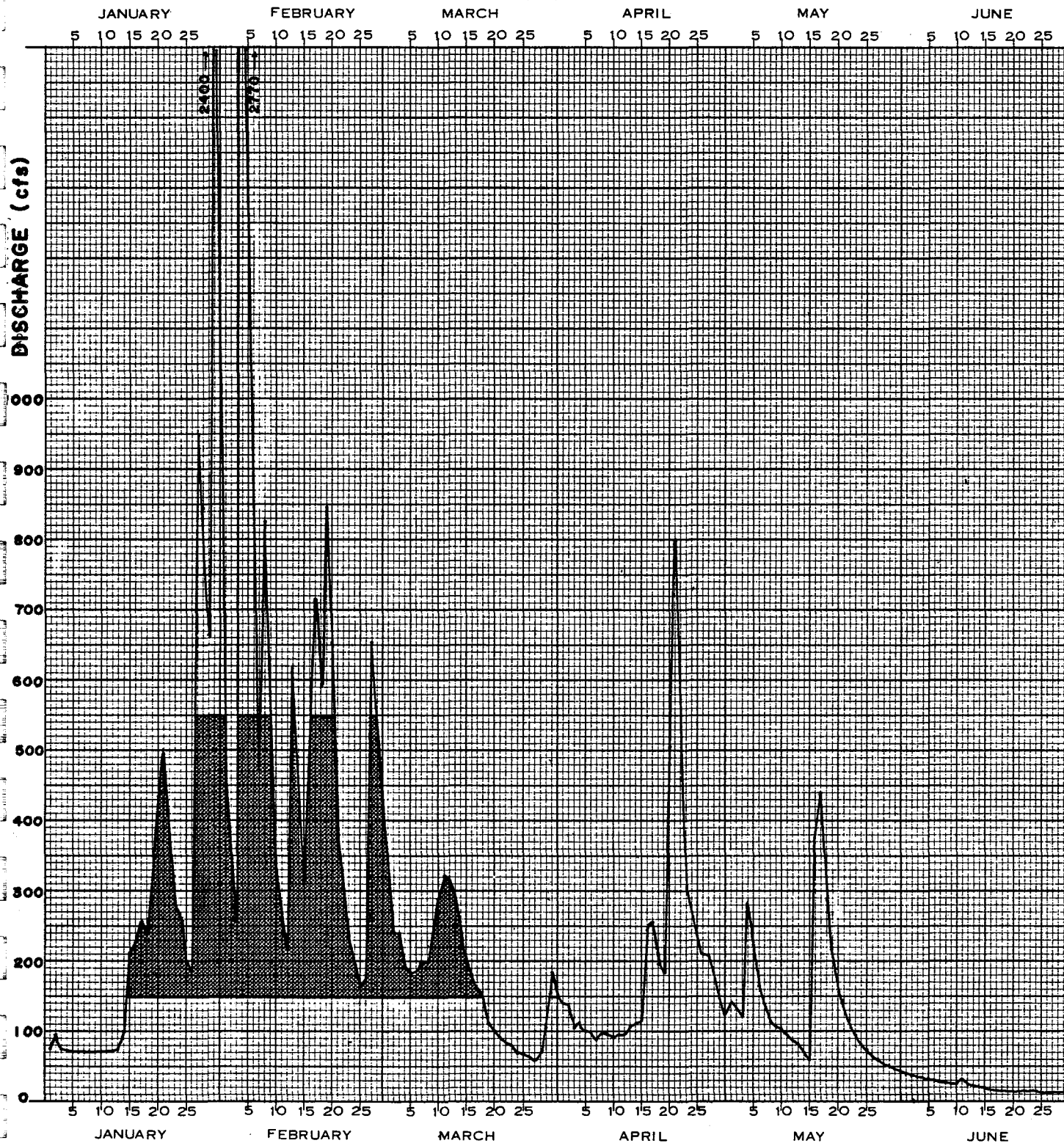


- 21 -
LEECH RIVER
HYDROGRAPH
STA 8HA17
1964

FIGURE 10

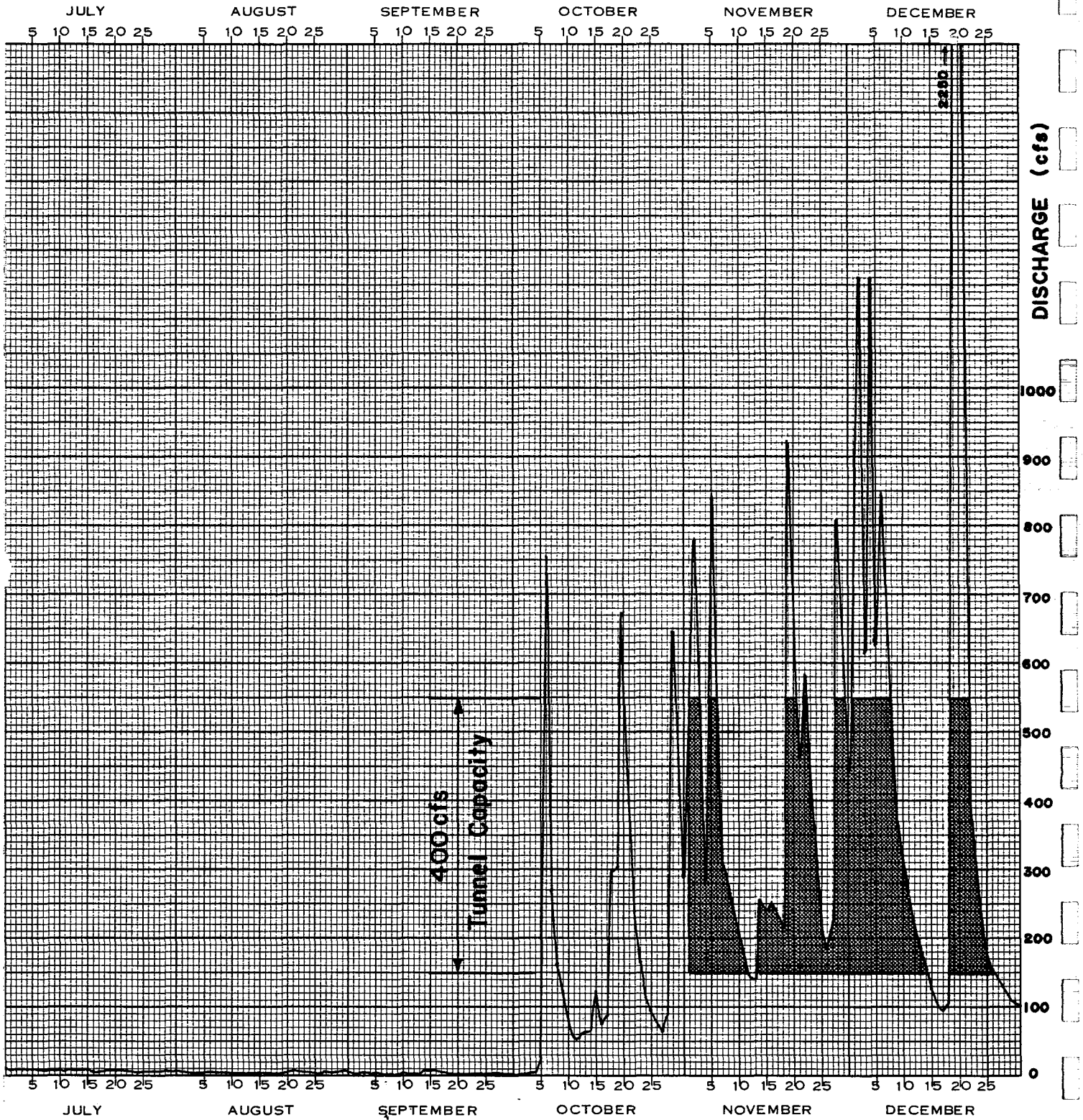


LEECH RIVER HYDROGRAPH STA 8HAI7 1965



LEECH RIVER
HYDROGRAPH
STA 8HA17
1965

FIGURE 12



LEECH RIVER
HYDROGRAPH
STA 8HA17

1966

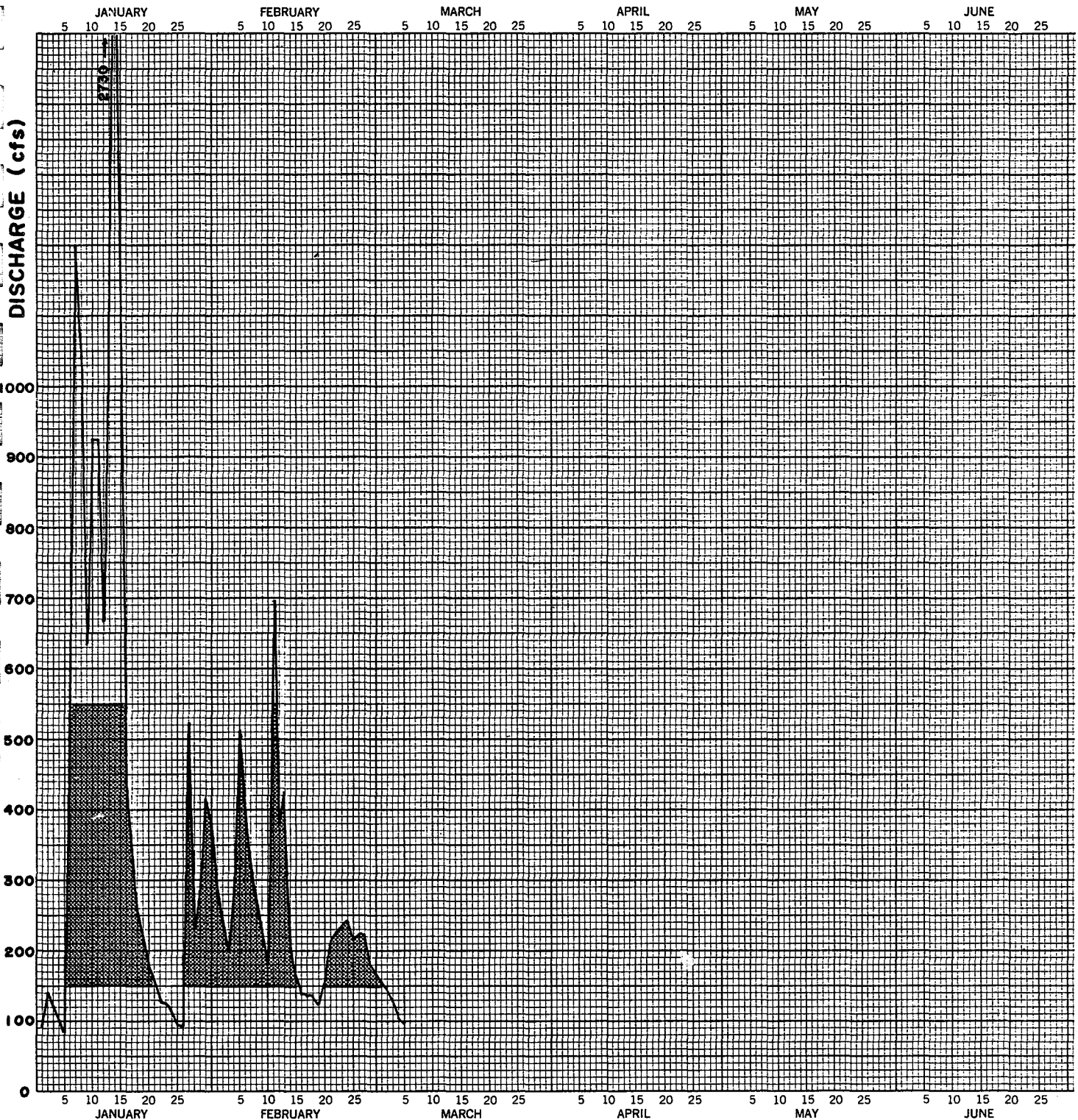
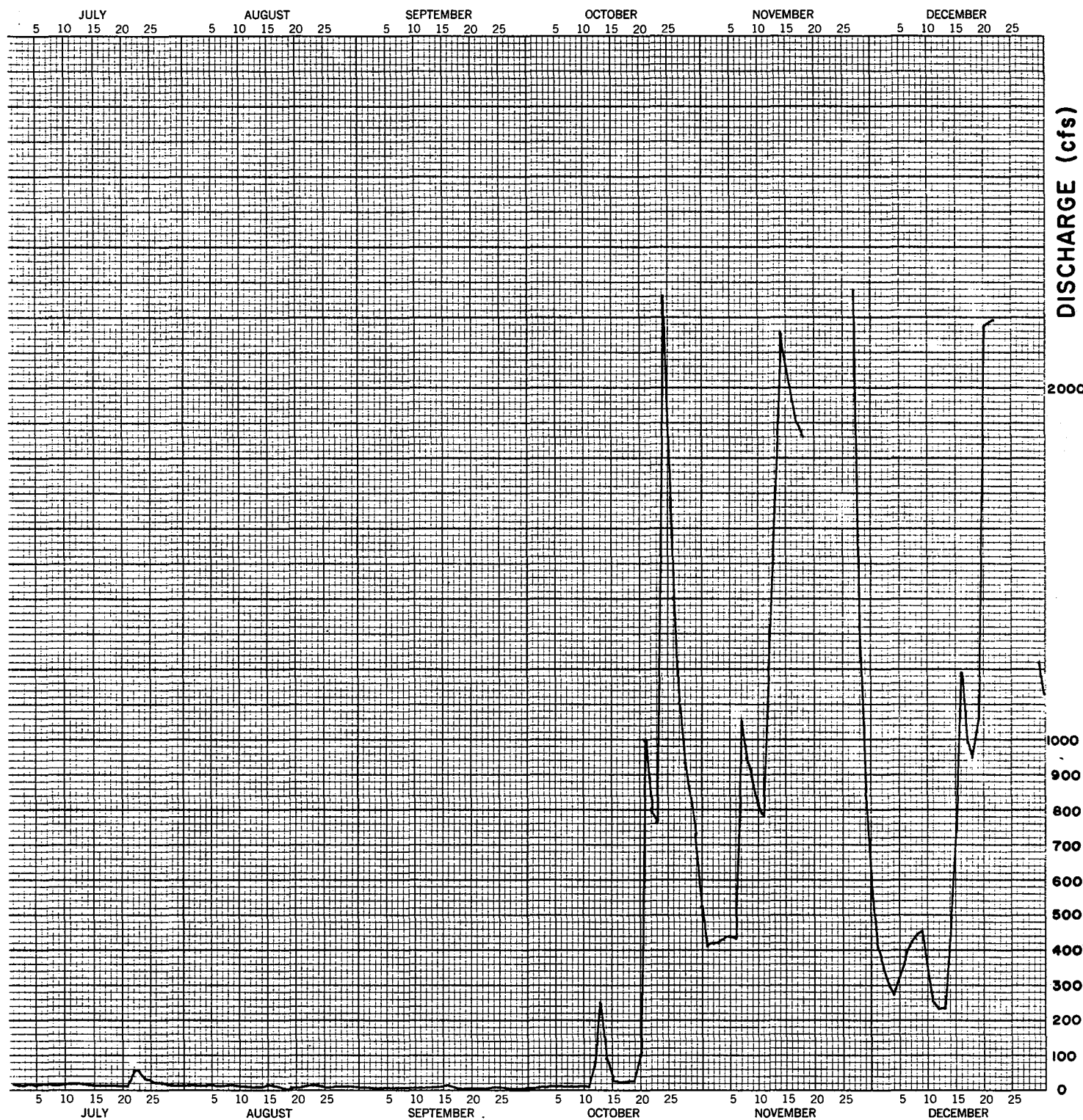
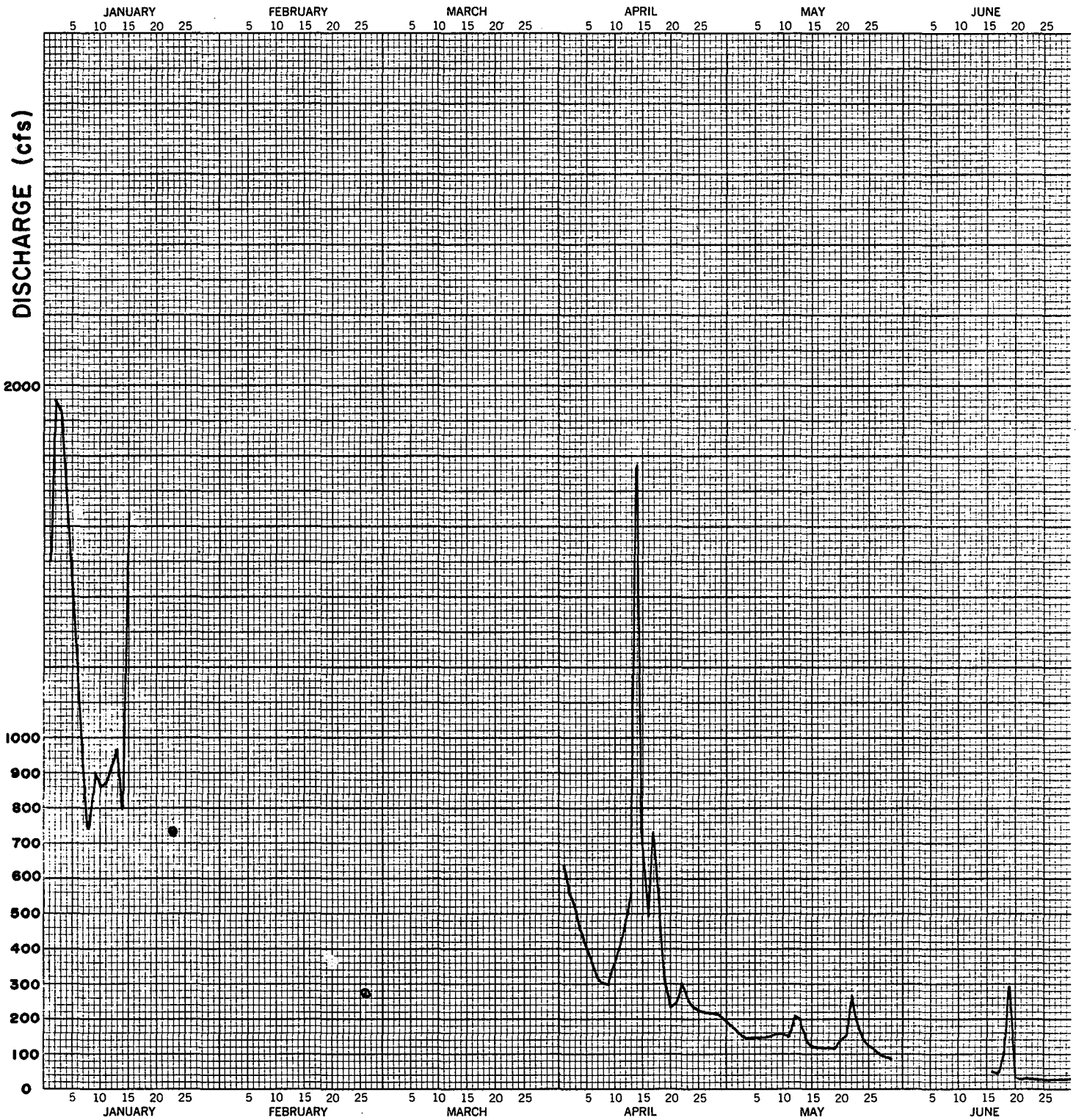


FIGURE 14

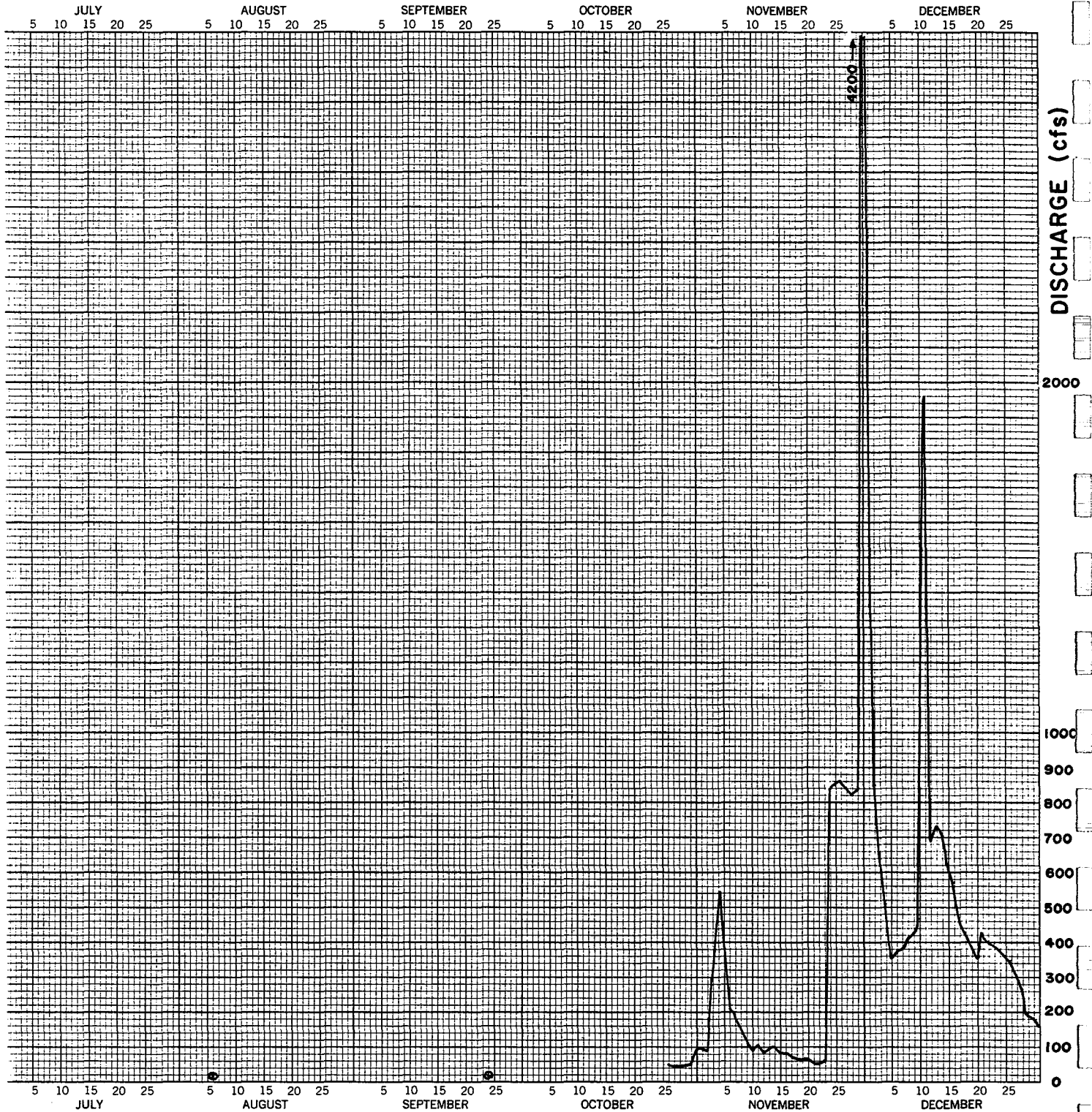
- 25 -
SOOKE RIVER
ABOVE TODD CREEK
HYDROGRAPH STA 8HA18
1963



SOOKE RIVER
ABOVE TODD CREEK
HYDROGRAPH STA 8HA18
1964

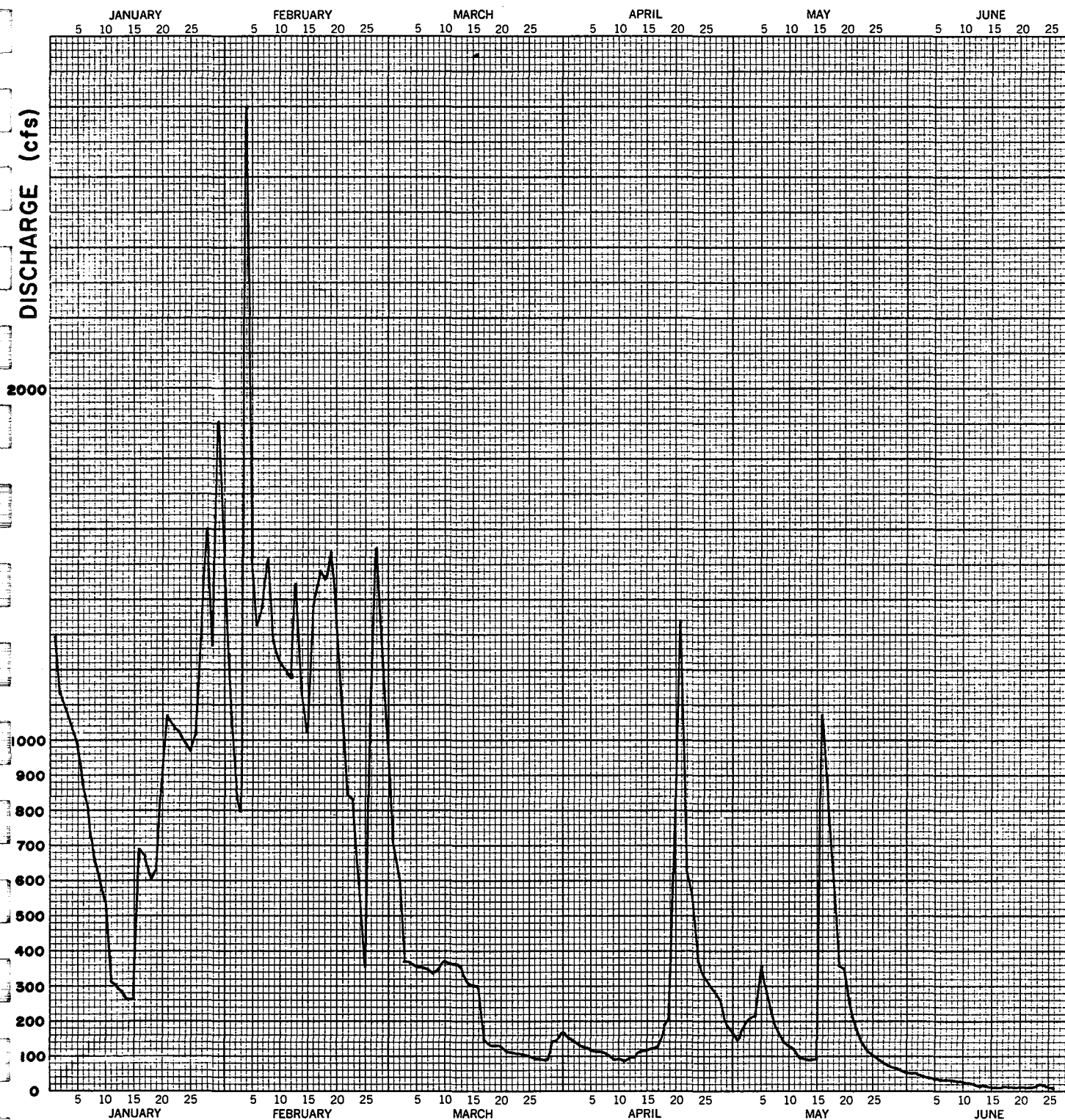


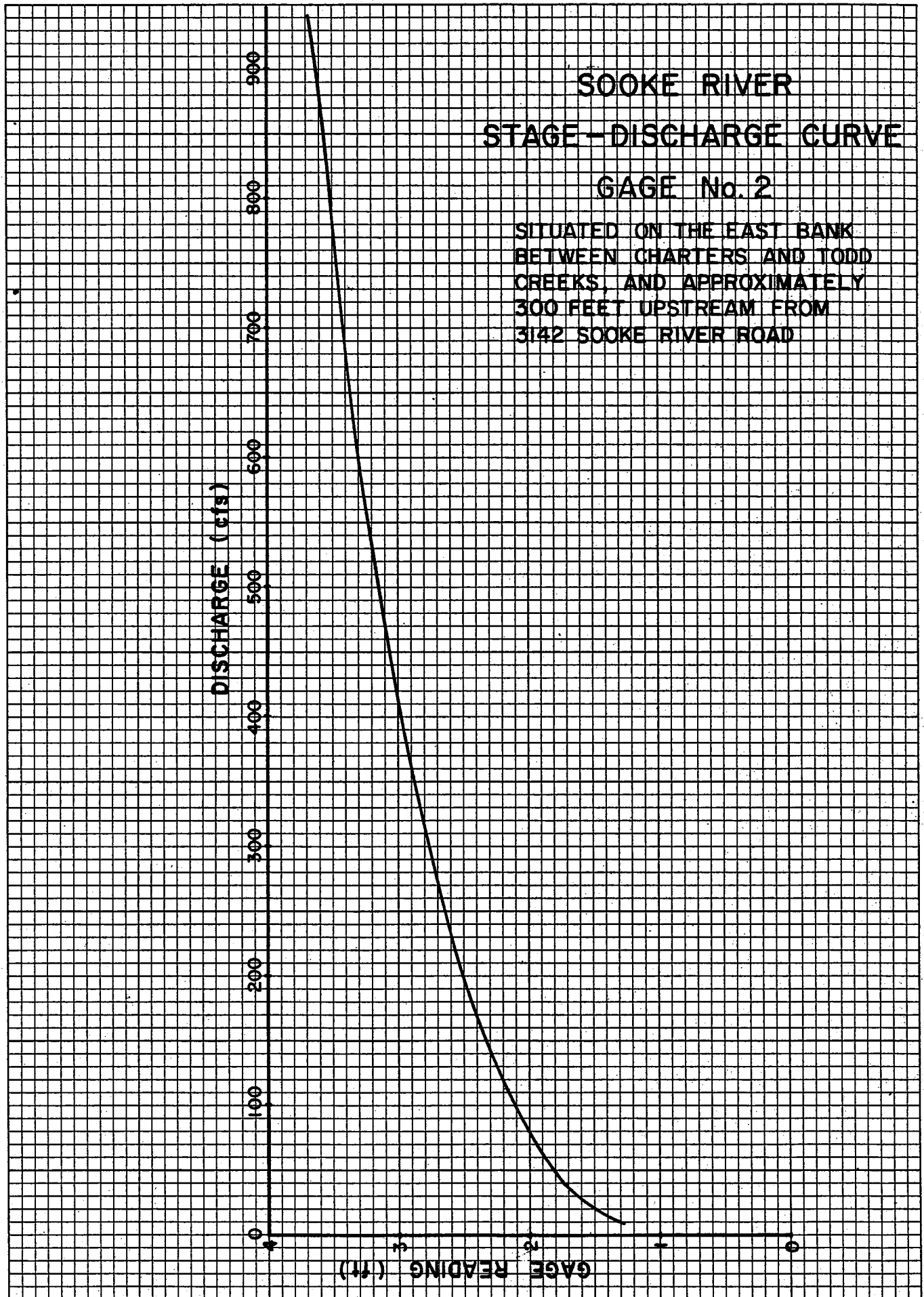
SOOKE RIVER
ABOVE TODD CREEK
HYDROGRAPH STA 8HA18
1964



SOOKE RIVER
ABOVE TODD CREEK

HYDROGRAPH STA 8HA18
1965





SUPPLEMENT TO
FISHERIES RESOURCE MAINTENANCE FLOW STUDY
OF THE SOOKE RIVER, VANCOUVER ISLAND, B.C.

On March 1, 1979, the Comptroller of Water Rights held a public hearing to consider the application by the Greater Victoria Water District to divert 25,000 acre feet of water from the Leech River. Presentations were made by the Water District, by our Department, and by others who could be affected by the proposed water diversion. Our presentation was based on the contents of the report, of which this is a supplement, and on information on fisheries values (given in the following table) requested by the Water Comptroller at the hearing and forwarded to him subsequent to the hearing.

On June 21, 1979, the Water Comptroller made his decision (Appendix S1). It varies from the recommendations given in our report as follows:

The Comptroller specified a "cut-off flow" (that is, the flow below which no diversion will be allowed) of 200 c.f.s. on the Sooke River, rather than 150 c.f.s. on the Leech River as our report recommended, although these values are nearly equivalent insofar as fisheries value is concerned.

A major difference in his decision is covered by clause (f) which permits diversion from the Leech River at any time of the year, rather than only during the period November 1 to April 1 as our report recommended. This could result in reduced upstream migration attraction flows in October if the Water District were to start diverting during that time (which they would likely want to do after a dry summer).

Clause (k), however, provides for some flexibility and participation in water management, allowing changes in the "cut-off flow" (either upward or downward) so that a higher "cut-off flow" could possibly be negotiated if conditions warranted.

The Comptroller agreed with the recommendation that the diversion dam be designed to pass flows as required, and he went further in specifying that two gauging stations be established and maintained by the Water District.

WHOLESALE VALUE ASSOCIATED WITH SALMON OF THE
SOOKE RIVER

Species	10 year ¹ average escape- ment 1968-1977 pieces	Catch escape- ment ratio ²	Estimated catch pieces	Wholesale value per fish \$ 1977	Estimated value of catch \$ 1977
chinook	966	3:1	2,898	24.64	71,407
coho	100	1.2:1	120	10.60	1,272
chum	32,800	1:1	32,800	15.13	496,264
TOTAL					\$568,943

¹ Average annual escapement 1968-1977.

² Catch escapement ratios were designed to estimate total coastal salmon populations and consequently tend to be very conservative.

79 JUN 22 AM 9 12
WATER RIGHTS BRANCH

File No. 0340847
21st June, 1979

Fisheries Pacific Region,
1090 West Pender St.,
Vancouver, B.C.
V6E 2P1

Attention: W.J. Schouwenburg

Dear Sirs:

Re: Application for Water Licence by Greater
Victoria Water District to authorize
construction of a dam and tunnel on the
Leech River.

08768

Enclosed is a copy of the Notice of Decision and the Water Licence which I have issued today authorizing the construction and operation of a dam and tunnel on the Leech River.

At the Hearing, concern was mainly directed at two aspects of the project, namely:

- (1) The need for additional water in view of the increasing demand on the Sooke Lake watershed.
- (2) The possibility of adverse effects on fish habitat and productivity, and on the environment in general.

I found that evidence and statistics provided by the Greater Victoria Water Board indicated a realistic need for additional water and that sufficient lead time is required to provide for the forecast demand.

With respect to the effect of the dam on fish habitat, evidence was produced by Federal Fisheries members, which convinced me that provision should be made in the Water Licence to ensure that there would be no reduction in the amount of water required to provide adequate water for the needs of the various fish species.

The terms of this Water Licence have taken all the foregoing concerns into consideration.

Yours truly,



H.D. DeBeck,
Comptroller of Water Rights.

Enclosures

APPENDIX S1



IN THE MATTER OF THE WATER ACT

and

IN THE MATTER OF AN APPLICATION BY GREATER VICTORIA WATER DISTRICT FOR
A WATER LICENCE TO DIVERT, STORE AND USE WATER OUT OF THE LEECH RIVER

and

IN THE MATTER OF CERTAIN OBJECTIONS TO THE SAID APPLICATION

NOTICE OF DECISION

TAKE NOTICE THAT following a Public Hearing held by me pursuant to the provisions of the Water Act at Sooke, British Columbia on 1st March, 1979, having heard and duly considered all evidence including exhibits produced at the said Hearing, and having carefully considered all arguments submitted both for and against the above mentioned application for a Water Licence, and having considered all representations made with respect to the effects on existing and potential resources, and of the environmental and social impacts of the project, I find:

THAT Greater Victoria Water District has shown good and sufficient reason for the construction of the proposed project and that the proposed project would be in the public interest;

AND THAT a Conditional Water Licence will issue to the Greater Victoria Water District authorizing construction of the proposed project subject to the terms and conditions set out in the said Conditional Water Licence, a copy of which is hereto attached.

Dated at Victoria, B.C. this 21st day of June, 1979.

H.D. DeBeck,
Comptroller of Water Rights.

LAND AND WATER MANAGEMENT
WATER RIGHTS BRANCH
MINISTRY OF THE ENVIRONMENT

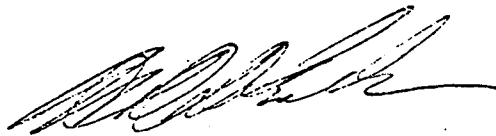
The Province of British Columbia - Water Act

CONDITIONAL WATER LICENCE

Greater Victoria Water District of 479 Island Highway, Victoria, B.C. V9B 1H7
is hereby authorized to divert, store and use water as follows:-

- (a) The source of the water-supply is Leech River and the reservoir is Sooke Lake.
- (b) The point of diversion and storage is located as shown on the attached plan.
- (c) The date from which this licence shall have precedence is 23rd February, 1977.
- (d) The purpose for which the water is to be used is waterworks.
- (e) The maximum quantity of water which may be diverted and stored is 25,000 acre feet per annum and such additional quantity as the Engineer may from time to time determine should be allowed for losses.
- (f) The period of the year during which the water may be diverted into storage is the whole year, subject to clause (k). The period during which water may be used is the whole year.
- (g) The land upon which the water is to be used and to which this licence is appurtenant is the waterworks undertaking of Greater Victoria Water District.
- (h) The works authorized to be constructed are diversion dam, tunnel, canal and dam which shall be located approximately as shown on the attached plan.
- (i) The construction of the said works shall be commenced on or before the 31st day of December, 1982, and shall be completed and the water beneficially used on or before the 31st day of December, 1992.
- (j) Hydrometric gauging stations shall be constructed, maintained and operated on the Sooke and Leech River to the satisfaction of the Comptroller of Water Rights.

- (k) This licence does not authorize the diversion of water at any time when the flow of water at a hydrometric guage, located on the Sooke River above Charters Creek is 200 cubic feet per second or less or such other amount as may be authorized by the Comptroller of Water Rights, after consultation with the licensee and with Federal and Provincial fisheries agencies.
- (l) The diversion dam authorized under clause (h) hereof shall be designed to allow a continuous flow in the Leech River in an amount to be determined from time to time by the Comptroller of Water Rights.
- (m) The works authorized under clause (h) hereof shall not be commenced until plans of same have been submitted to and have been approved by the Comptroller of Water Rights. Upon completion of construction, the licensee shall submit to the Comptroller of Water Rights, two copies of drawings of the dam and appurtenances as built, certified by the licensee's engineer.
- (n) The rights granted under this licence are subject to reserves established by Order-in-Council No. 156/1909 and by Order-in-Council No. 444/1915.



H.D. DeBeck,
Comptroller of Water Rights.

File No. 0340847

Date issued 21st June, 1979

Licence No. 52452

British

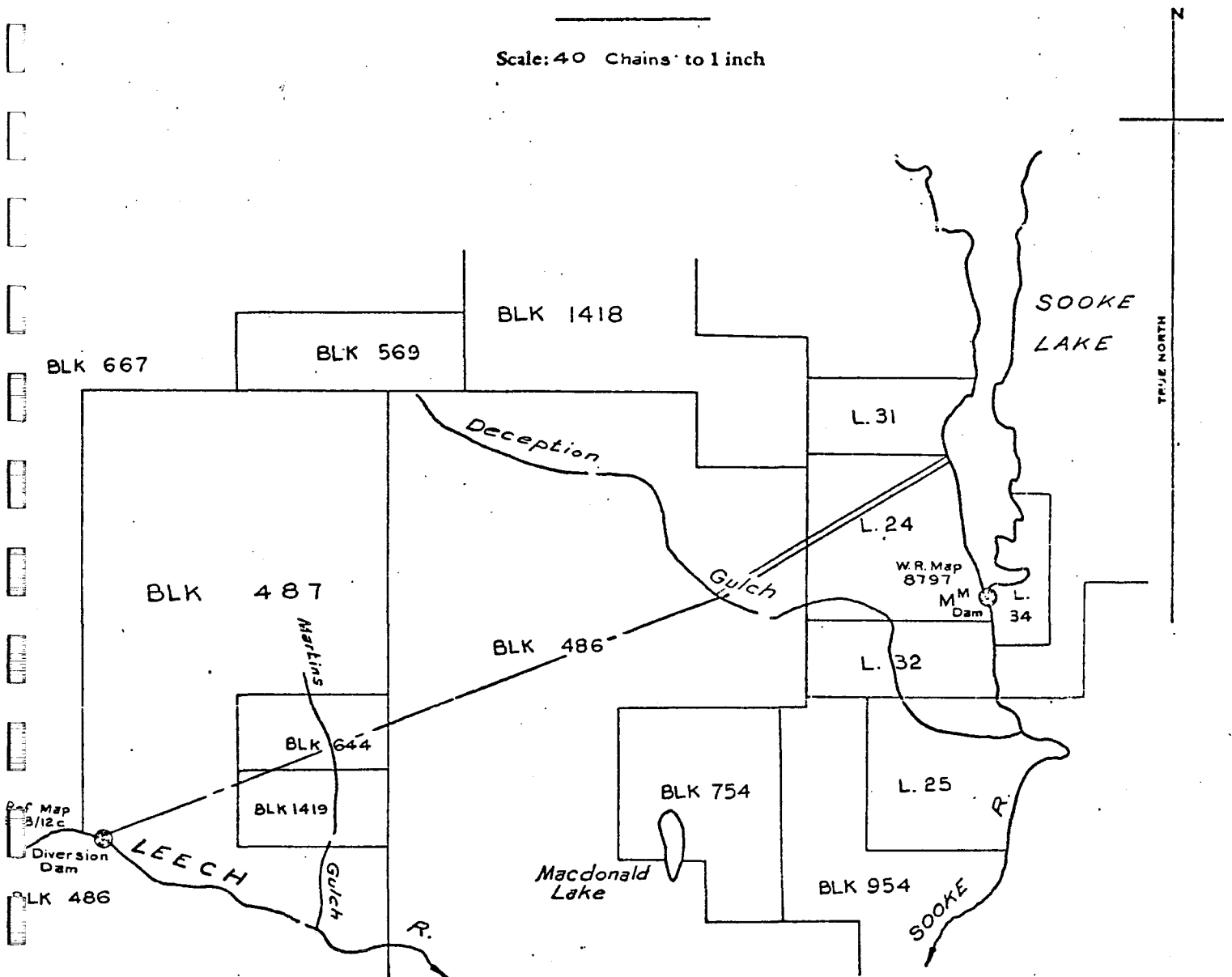


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Columbia

VICTORIA WATER DISTRICT

MALAHAT DISTRICT

Scale: 40 Chains to 1 inch



LEGEND

Point of Diversion
Ref. Map
W.R. Map
Tunnel
Canal

92 B/12 c
8797

Signature

Date 21st June 1979.

CL 52452
File 0340847