CHAPTER 4

Forest Hydrology

4.1 INTRODUCTION

One forest hydrology study of the Okanagan Basin was carried out to provide a preliminary appraisal of the watershed in terms of cover and characteristics by major biophysical zones, and to outline the effects of timber harvesting on water quantity within these zones.

Prior to undertaking a field investigation a brief office study was carried out to determine if there was any apparent trend In the 50 years of annual gross historic inflow to Okanagan Lake Basin which might be identified with forest harvesting. These inflows, together with the precipitation on the lake, as well as the nine year moving averages are shown In Figure 4.1 from which no discernable trend in runoff or precipitation is evident.

While there appears to be no significant change in the overall hydrological cat conditions within Okanagan Lake Basin, it is possible that local tributary runoff may be affected by forest harvesting and fires. Unfortunately such studies require a number of years of observations, in relatively virgin watersheds which are undergoing forest harvesting. No such background Information was available for the Okanagan Basin and in lieu of this a theoretical study was undertaken of Pearson Creek (a tributary of Mission Creek) on the eastern side of the basin which is shown in Figure 4.2.

4.2 PEARSON CREEK AND TREE FARM LICENCE N0.9

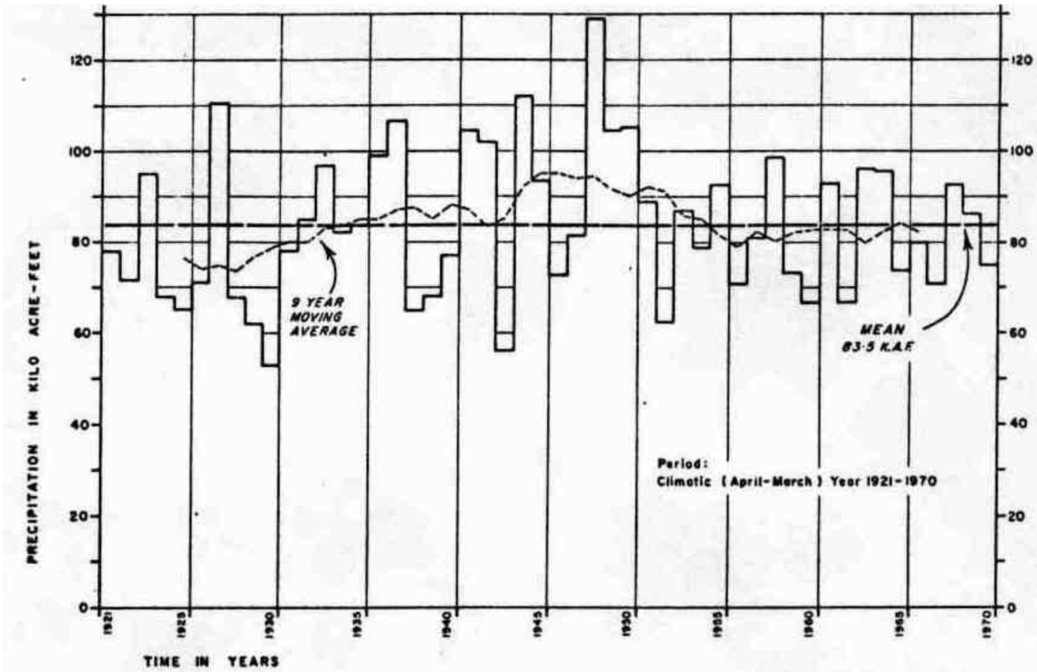
At present Pearson Creek with a drainage area of 120 square miles, Is relatively undisturbed, and has the following desirable characteristics with respect to its use in the development of a simulation computer model on which various degrees of deforestation can be assumed, and the resulting changes in runoff determined.

1) Most of the watershed area is forested and suitable for commercial forest harvesting.

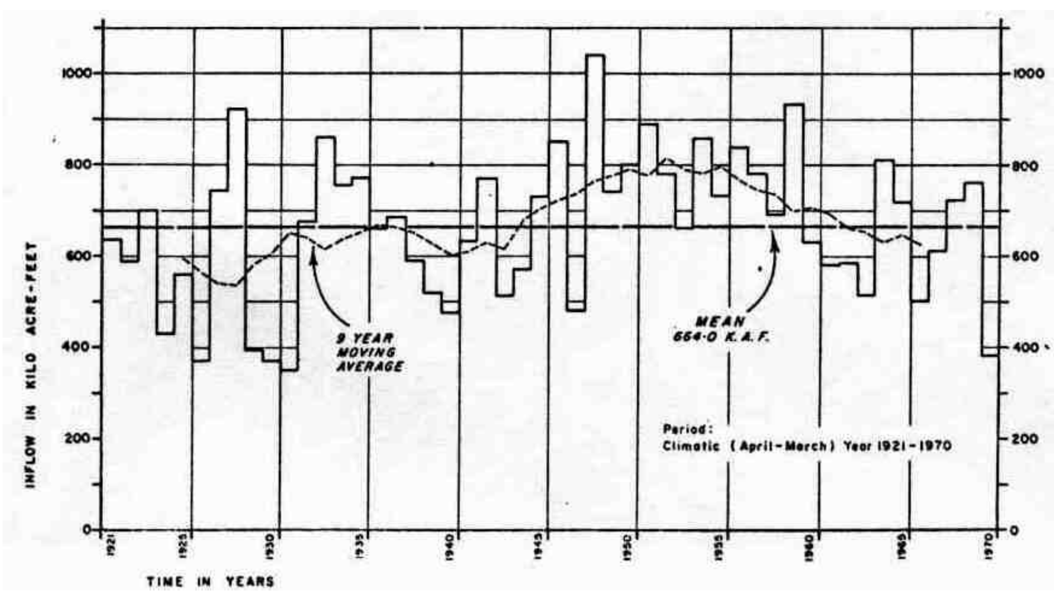
2) The area has yet to experience any major land use changes.

3) A reasonable spatial representation of the climate, soils, forest cover and drainage is present.

4) Preliminary analysis indicated that the main part of the watershed exhibited conditions of water surplus with more major portions exhibiting water deficits.

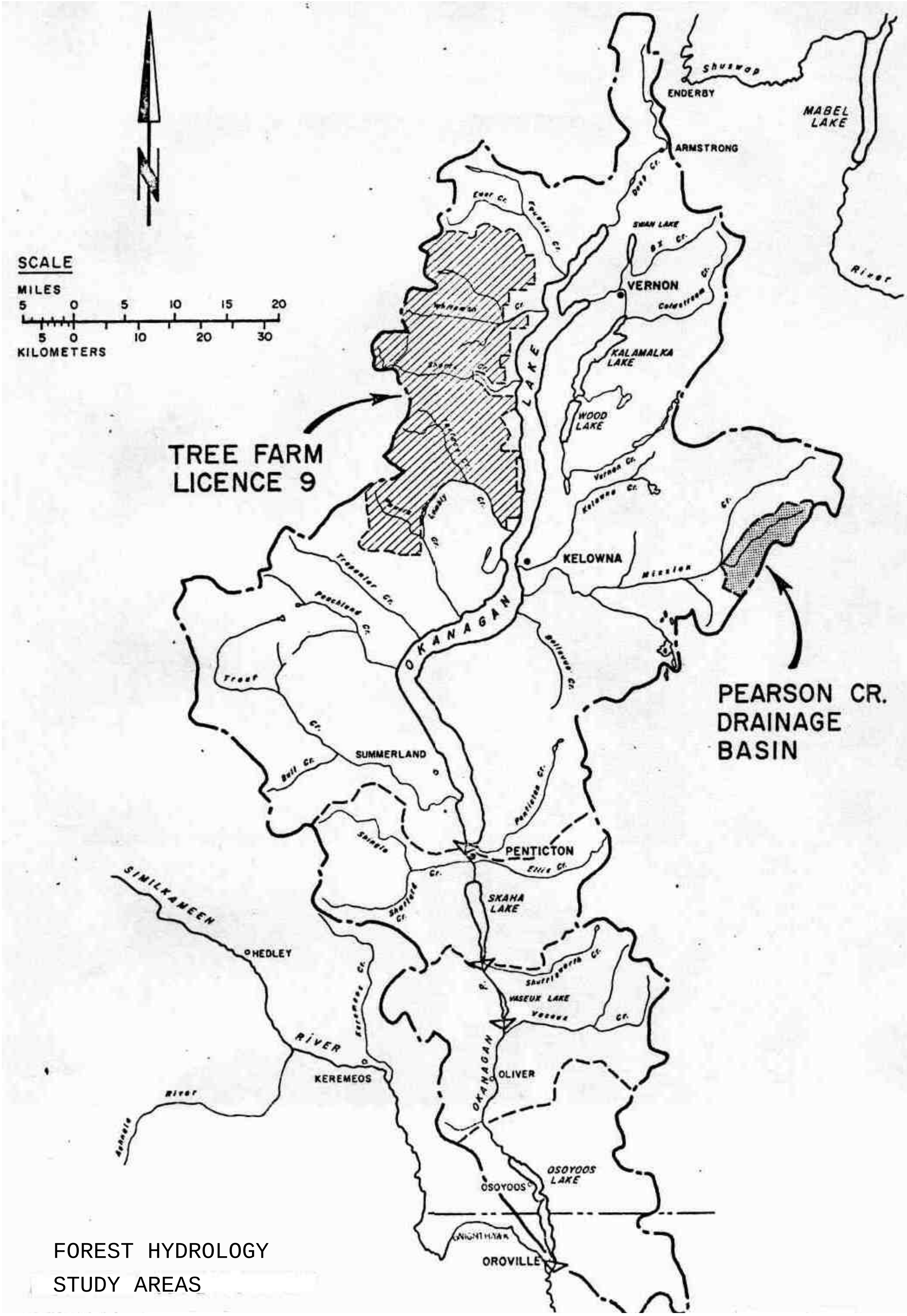


ANNUAL HISTORIC PRECIPITATION ON OKANAGAN LAKE



ANNUAL GROSS HISTORIC INFLOW, OKANAGAN LAKE BASIN

ANNUAL HISTORIC DATA , MEANS, AND
9 YEAR MOVING AVERAGES OF PRECIPITATION
ON OKANAGAN LAKE AND INFLOWS TO
OKANAGAN LAKE BASIN Figure 4.1



FOREST HYDROLOGY
STUDY AREAS

Figure 4.2

5) The Watershed is of a nature which makes it attractive for the establishment of a research basin for future studies.

Runoff for the period October, 1970 to September, 1971 was developed in a computer model based on precipitation, computed evapotranspiration and soil water storage changes. The simulated flows compare favourably with the total measured inflow for the year but showed relatively large differences in April, May and June. These differences were due in part to the estimated large groundwater flow at the gauging site, and the crudeness of the model with respect to rain-on-snow events. For the purpose of simulating the hydrologic effects of land use, it was felt that the differences in basin yields, as shown by the simulation model, were sufficiently accurate to indicate trends.

In the Pearson Creek Watershed model a systematic cutting pattern was assumed involving the removal of forest cover at the rate of one grid square of nature forest (640 acres) per year for the 17 years for which mature timber was available for harvesting. Assuming a clearcut and slashburn harvesting system and accounting for sequential changes in regrowth of cutover areas, the yearly incremental and total basin yield were calculated by the model. After 17 years of sequential forest harvesting in the Pearson Creek Watershed, a total basin yield increase of 2.91 inches or 13.68% was obtained. In this particular watershed the estimated streamflow difference from natural conditions would decrease as a result of a gradual increase in the evapotranspiration as forest regrowth occurred. First year yield increase is the largest with subsequent years reflecting the effects of gradual regrowth of the cutover areas and the redistribution of water surpluses from the cutover areas to the water deficit areas supporting vegetal growth.

From comparative studies of Terrace and Esperion Creeks, It was estimated that the water yield increases from forest harvesting on Tree Farm Licence No. 9 for different rotation length and also for the simulation model of Pear-son Creek would be as shown In Table 4.1. Tree Farm Licence No. 9 is located between Lambly Creek in the south and Naswhito Creek on the north with Okanagan Lake and Okanagan Lake Basin divide forming its eastern and western boundaries, respectively (Figure 4.2).

4.3 CONCLUSIONS

In the extrapolation of the above data to the three major zones of the Okanagan Basin the following water yield increases may accrue:

4.3.1 South of Penticton

In this zone, any water yield increases accruing from high elevation forest harvesting will not be reflected in increased streamflow. This is due to in situ redistribution of water from surplus sites to deficit sites. Any increase In harvesting intensity would Be reflected in localized site improvement by increasing the available soil water.

TABLE 4.1

WATER YIELD INCREASES FROM FOREST HARVESTING ON FOREST LAND OF TREE FARM LICENCE NO. 9 AND PEARSON CREEK FOR DIFFERENT ROTATION LENGTHS

Rotation Length	Pearson Creek (120 Square Mile Basin)	T.F.L. NO. 9 (309 Square Miles) Basin Yield Increase
(Years)	%	%
120	3.87	4.9
100	4.64	5.8
80	5.80	7.3
60	7.74	9.8
40	11.60	14.7

4.3.2 North of Penticton below 4000' elevation

This zone is typified as the Ponderosa pine-parkland community and is a water deficity hydrologic system. As such, any forest harvesting would not reflect any water yield increases to streamflow. Localized harvesting is probably best directed towards improving the carrying capacity of incorporated range lands. However, in this region soils are particularly sensitive to the disturbance effects of harvesting activites and extreme caution should be exercised in the location and construction of roads to ensure that adjacent streams do not receive high discharges of sediment. This area, because of its generally close proximity to Okanagan Lake, is particularly sensitive to stream temperature increases (approaching lethal limits for fishery) following their exposure by forest removal.

4.3.3 North of Penticton above 4000' elevation

It is in this zone that the greatest potential for water yield increases exists, as a consequence of forest harvesting. It is also the region of most intensive forest harvesting, both at present and in the predictable future. Within this zone, snowpack management considerations are an important aspect of land use hydrology. The zone includes approximately 300,000 acres of merchantable timber.

Water yield increases accruing from forest harvesting in this zone on a 120 year rotation basis have been estimated to be between 3.31% and 4.20%. These increases would only be realized within this zone (Englemann spruce and Sub-alpine fir forest type) and would likely be consumed in water deficit sites at lower elevations. This includes correction for sequential regrowth effects on increasing evapotranspiration from the time immediately following logging to prelogging evapotranspiratlon: a period of approximately 40 years for most sites. Similarly, for a hypothetical 40-year rotation the increases are between 9.93% and 12.60%. Forest fires may effect an increase in water yield through reduction of evapotranspiratlon. The average annual acreage burned over the Okanagan Basin is 5,377 with a range between 81 acres (1964) and 25,856 acres (1970). Yield increases calculated on the basis of water yield from the area north of Penticton and above 4,000 feet, have been estimated to be between 1.24% and 1.55% annually.

However, as large as these streamflow Increases may be, they are only for that area designated as merchantable forest north of Penticton above 4,000 feet (approximately 1/4 the total merchantable forest and 15% the total area of the Okanagan Basin). Forest harvesting in other zones of the Basin would have no net effect on streamflow quantity. By adjusting the reported percentage water yield increases to a Basin basis for a 120-year rotation, levels by which comparisons can be made and effects evaluated, are made possible. Thus, on the basis of total Okanagan Basin, annual water yield increases accruing from forest harvesting range from 0.50% to 0.64%. Similarly, the figures for the effect of fire are adjusted to be between 0.19% and 0.23%. Respective figures for the hypothetical 40-year rotation are 1.50% and 1.91% for forest harvesting and 0.19% and 0.23% for forest fires. These reported annual increases are not cumulative due to the effects of regrowth on evapotranspiration consumption.

The values reported for the 40-year rotation are never likely to be achieved because a 40-year rotation is too close to the regrowth time of 40 years and it is only relevant to discuss the values reported for the existing and future 120-year rotation forest harvesting rates. The following limitations must be noted with respect to the reported Increase in water yields following forest harvesting and/or fire:

a) Reported increases are too small to be measured by existing streamflow measurement techniques.

b) Total water yield increases in major tributaries of the Okanagan Basin will very likely go undetected due to the low percentage yield increase from sustained yield forest management. Any yield increase would only be reflected in very small (50 square kilometers) basins over which significant portion (75%) have been harvested or burned.

c) Water yield increases accruing from forest harvesting in the area only become usable if they reach a stream channel. Increased water transmitted downslope through the soft mantle would lively be consumed in water deficit sites below 4,000 feet elevation, thereby proving useless in augmenting water supplies for other purposes. It has been shown that most of the annual water yield increases occur in the spring and fall months thereby necessitating improvement and/or extension of reservoirs to hold water over to peak demand periods in the summer seasons.

In conclusion, it can be stated that although streamflow increases will accrue from forest harvesting in the Okanagan Basin, the reliability and predictability of these increases will be inhibitory to planning for water supply. Forest harvesting, with respect to water supply should be concentrated in the area of minimizing water quality deterioration and increasing the general environmental stability of those lands upon which forest land management is occuring.