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WATER USE IN THE SIMILKAMEEN RIVER BASIN

PREPARED BY:

IAN WELLS
MARK BETKOWSKI
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INLAND WATERS DIRECTORATE
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ABSTRACT

The purpose of this study was to estimate water use in the Similkameen River Basin of British Columbia. Because of the geographical diversity within the watershed, disaggregated estimates of water use by economic sector and drainage sub-area were necessary to provide a data base for long term water use forecasting and planning in the Basin. Disaggregated data were obtained from several sources including census data, national survey data by Environment Canada, consultation with local officials and field work to determine land use and water requirements. Annual water use in the Basin was calculated to be approximately 52 588 400 cubic metres. The agriculture sector was found to be the most important user of water in seven of the eight drainage sub-areas, accounting for 84% of the total water use in the Basin.

RESUME

Le but de cette étude fut d'estimé l'utilisation d'eau du bassin de la rivière Similkameen en Colombie Britannique enfin de former une base de donnée pour la prévision d'utilisation d'eau à long terme et pour la planification du bassin. DÛ à la diversité géographique du bassin, les estimés d'utilisation d'eau furent désagrégés par secteur économique et par sous-bassin hydrographique. Ces données furent relévés de plusieurs sources tel que, les données de récensement, de reléve national d'Environnement Canada, de consultation avec des fonctionnaires locaux et par une enquête sur le terrain pour déterminer l'utilisation des terres et les besoins d'eau. L'utilisation annuel d'eau pour le bassin est approximativement 52 588 400 mètres cube. Le secteur agricole fut le plus important consommateur d'eau pour sept des huit sous-bassin hydrographiques et ceci répresente 84% de l'utilisation totale d'eau pour le bassin.

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I. INTRODUCTION

A. Study Area

The Similkameen River Basin drains approximately 9 600 sq. km. of the Pacific Northwest, of which approximately 7 600 sq. km. are located in Canada and comprise the study area for this report (Figures 1 and 2). Rising in the Cascade Mountains, the Similkameen flows north through Manning Park to Princeton where it is joined by its major tributary, the Tulameen River. From Princeton, the river flows in a gentle arc southeasterly to its confluence with the Ashnola River. Here the valley flattens and widens and the river continues towards Keremeos, then turns south to cross the international border near Nighthawk, Washington. On its final reach, the Similkameen flows easterly for 40 km. before joining the Okanogan River at Oroville, Washington. The Similkameen traverses over 200 km. from its source to its mouth.

The southeast region of the Basin is one of the hottest and driest areas in Canada and irrigation is essential for agricultural crops during the summer months. The major crops produced in this area are tree fruits, vegetables and grapes. In the northern and western regions of the valley, alfalfa and hay production is predominant. Other major industries in the Similkameen River Basin in terms of employment and product value are forestry and mining, both of which require water for processing, cooling and sanitation. However, relative to agriculture, these sectors are not major consumers of water.

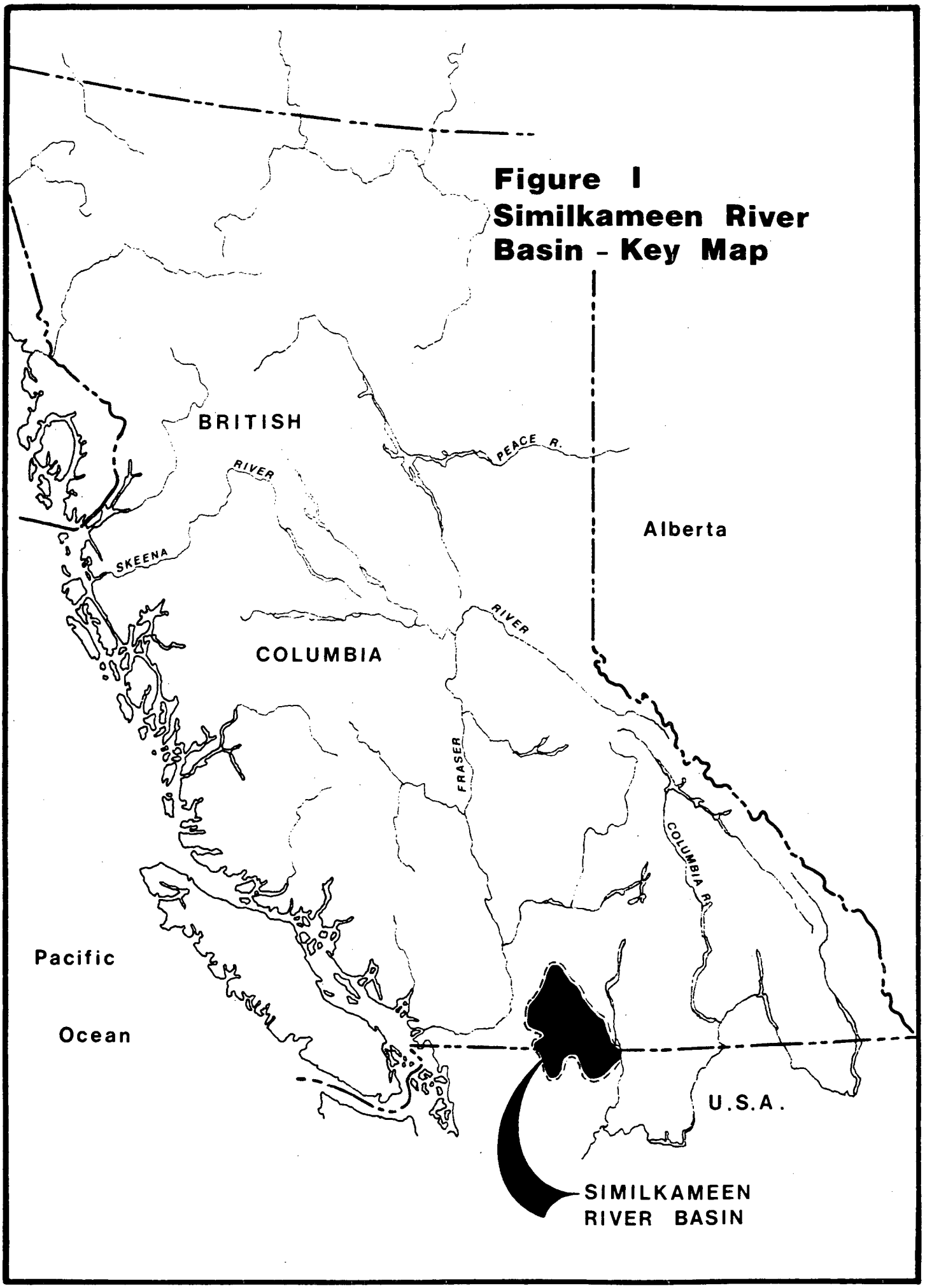

Figure I
Similkameen River Basin - Key Map

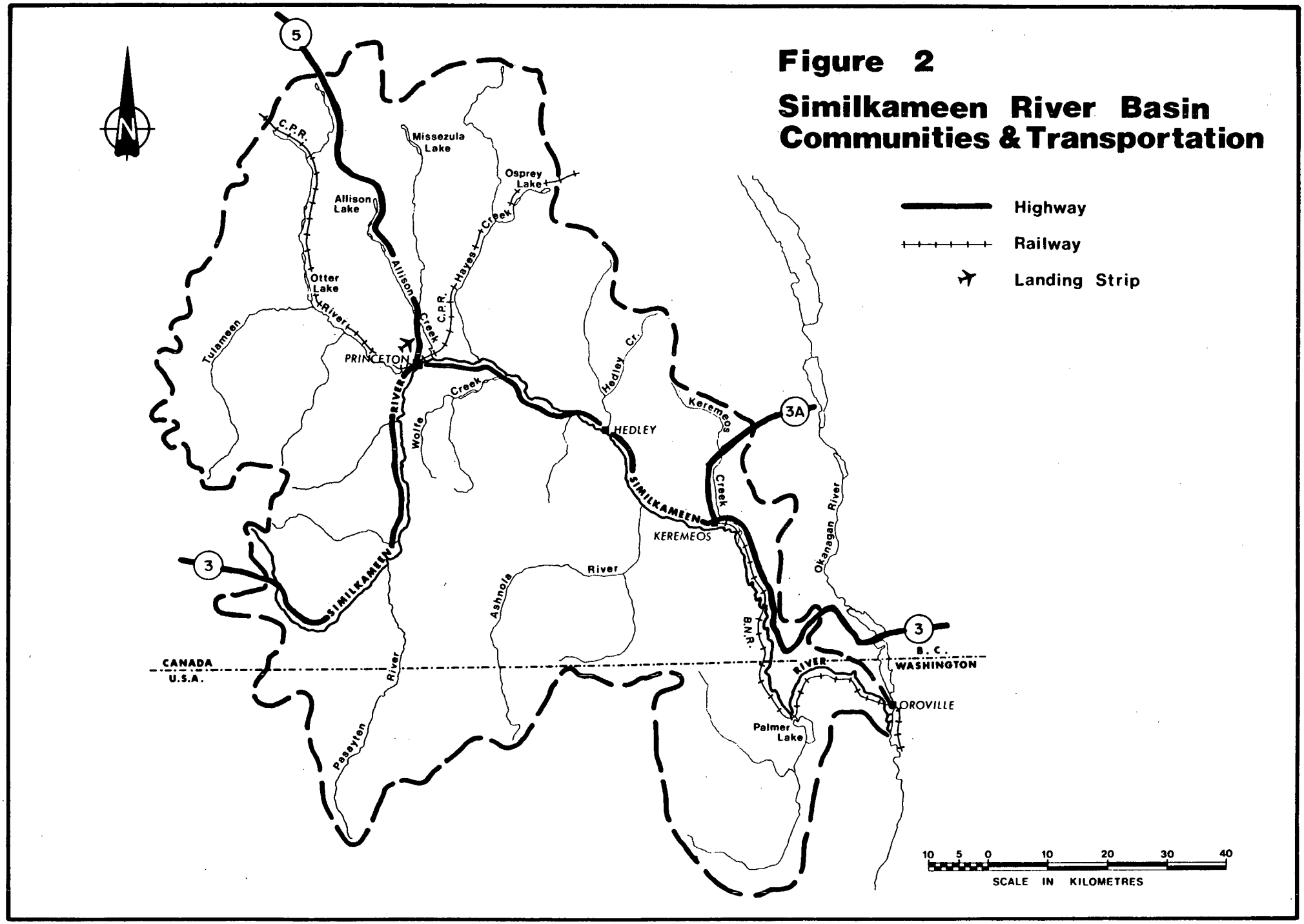
Figure 2
Similkameen River Basin
Communities & Transportation
Highway
Railway
Landing Strip
N
5
3
3A
3
C.P.R.
Missezula Lake
Osprey Lake
Allison Lake
Otter Lake
Allison Creek
Hayes Creek
C.P.R.
Tulameen River
PRINCETON
SIMILKAMEEN RIVER
Wolfe Creek
Hedley Cr.
HEDLEY
Keremeos Creek
SIMILKAMEEN
KEREMEOS
Okanagan River
Ashnola River
B.N.R.
CANADA
U.S.A.
Passayten River
B.C.
WASHINGTON
RIVER
OROVILLE
Palmer Lake
10 5 0 10 20 30 40
SCALE IN KILOMETRES

B. Study Objectives

The primary objective of this study was to estimate water use in the Similkameen River Basin disaggregated by economic sector and drainage sub-area. Obtaining water use data was a necessary first step for long term water use forecasting and planning in the Basin. Furthermore, identifying data sources and establishing methods for obtaining the data will prove useful in future studies of other transboundary international river basins of federal interest in British Columbia.

The water use estimates were classified into three economic sectors: 1) agricultural use; 2) domestic and commercial use; and 3) industrial use. This breakdown was consistent with water use data obtained for the Okanagan River Basin during previous studies. The level of disaggregation was found to be sufficient for long term water use forecasting and planning, while not being too expensive or time consuming to generate. Furthermore, for the Basin, which has a relatively small population and industrial base, this level of data should prove to be sufficient for long term water management planning. The water use estimates made in this study refer to total water withdrawn from surface and ground water sources. No attempt was made to account for return flows.

C. Drainage Areas

Estimates of water use were determined for both the Basin as a whole and in a disaggregated form for eight drainage areas (Figure 3). When water use data is aggregated over a whole basin, competing water uses are often not identifiable. By breaking the Basin into smaller geographic units, water use data associated with more specific tributaries were obtained. The disaggregated water use data should also be useful for determining water quality criteria and objectives for specific reaches of the Basin.

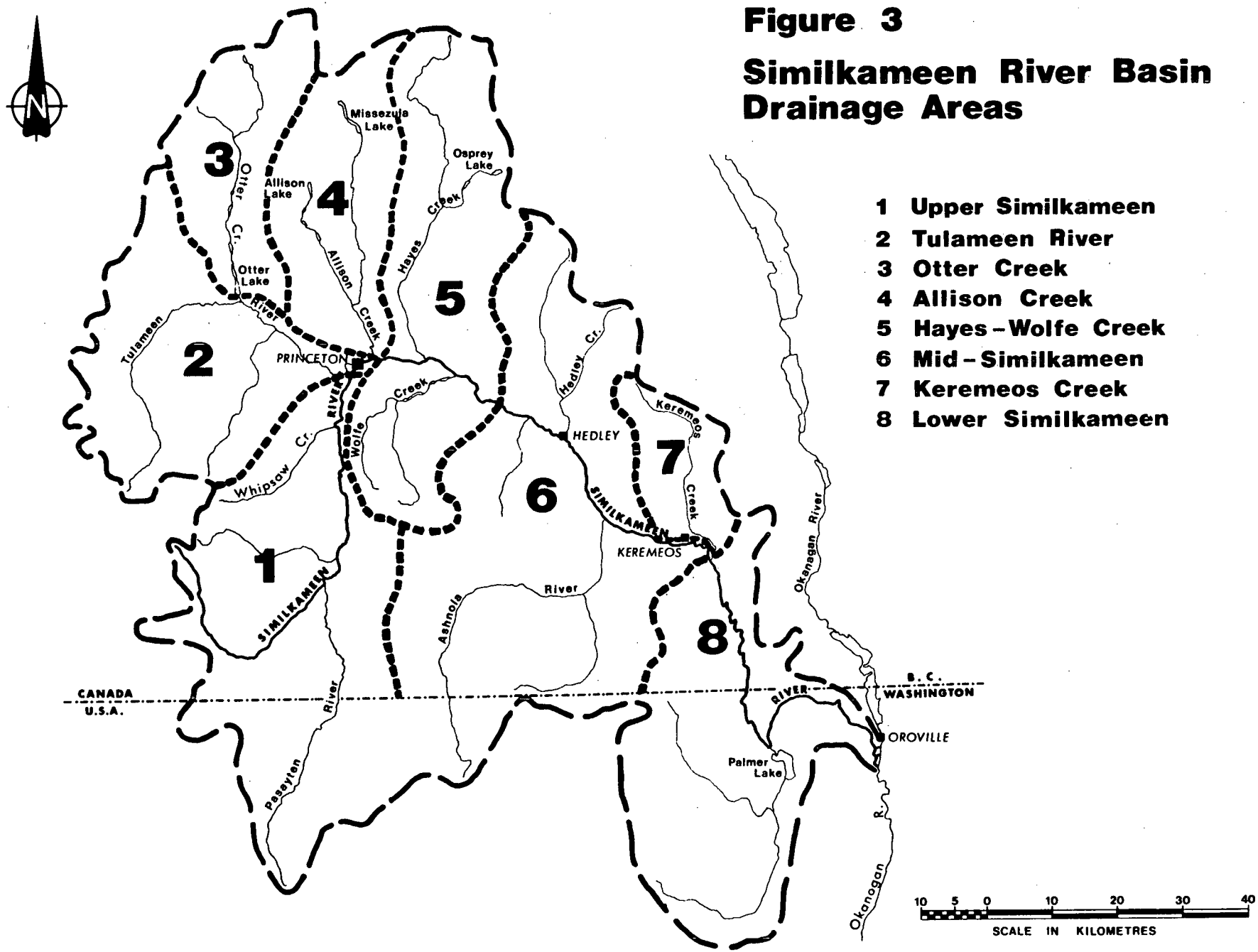

Figure 3

Similkameen River Basin Drainage Areas

The eight drainage areas include Upper Similkameen, Tulameen River, Otter Creek, Allison Creek, Hayes-Wolfe Creek, Mid-Similkameen, Keremeos Creek and Lower Similkameen. Table 1 denotes the size of each drainage area in hectares. This breakdown was selected on the basis of common land use patterns and natural geographic boundaries. While some of the drainage areas are natural hydrological units (such as the Tulameen River), others are aggregates of smaller tributaries flowing into the mainstem (such as the Hayes-Wolfe Creek drainage area). This aggregation was carried out when water use from individual tributaries was not significant, or the data was too difficult to obtain.

TABLE 1

SIMILKAMEEN RIVER BASIN
DRAINAGE AREA DIVISIONS

Drainage Area	Area in Hectares
Upper Similkameen	140 465
Tulameen River	97 572
Otter Creek	61 459
Allison Creek	63 933
Hayes-Wolfe Creek	105 798
Mid Similkameen	211 529
Keremeos Creek	25 413
Lower Similkameen	53 434
Total Basin Area in Canada	759 603

II. INDUSTRIAL WATER USE

A. Introduction

This category includes water use in the primary resource industries of mining and forestry. Manufacturing and secondary processing industries are also included in industrial water use. Other commercial water users in the service sector such as banks, restaurants, and retail outlets, are included in a separate domestic/commercial category.

The only significant manufacturing or processing firms in the Basin are sawmills. The major sawmills are located in the Princeton area, which is the closest urban center to the logging areas in the higher elevations of the Whipsaw Creek, Tulameen River, Hayes Creek and the Ashnola River sub-basins. Princeton also provides rail access to markets in the United States and highway access to lower mainland markets.

Sawmills are not large users of water relative to other industries since primary requirements are for cooling and sanitation rather than actual processing of the product. Furthermore, future water requirements are not projected to grow significantly since expansion is limited by annual allowable cut provisions and by relatively lower market prices for lumber. Water requirements may increase slightly if local firms are able to integrate processing and manufacture of finished wood products into their operations.

In 1984 there were three mines operating in the Basin: Newmont, Dankoe and Banbury (Figure 4). Newmont is a major copper producer with some gold and silver production, while Dankoe and Banbury are smaller gold and silver producers. Water is essential in the processing of the ore into concentrates, and all of the mines use

significant amounts in their operations. Newmont Mines, because of its large output, dominates the industrial demand for water. It is probable that mining activity and subsequent water demands will increase in the area since the Basin is highly mineralized and exploration activity by several companies is taking place. The presently operating mining companies are also in the process of identifying further ore reserves and Banbury Mines may expand production in the near future. At present, Mascot mines are planning an open pit mine on Copper Mountain north of Hedley, to be in operation by 1987, with a projected production of 1 500 tonnes per day.

B. Methods for Determining Industrial Water Use

Two basic steps were necessary to estimate industrial water use in the Basin. The first step was to determine the number, type and location of industrial establishments operating in the Basin. This was a relatively simple process for the Basin because of its small industrial base. Four sources[1] were used to determine the companies operating in the Basin:

1. B.C. Manufacturers Directory, 1983;
2. B.C. Lumber Trade Directory and Yearbook, 1983;
3. B.C. and Yukon Mining, Exploration & Development Review, 1982; and,
4. Employers Directory (computer printout) for British Columbia, Canada Employment and Immigration Commission, 1982

The second step in estimating total industrial water use was to determine the water use by each firm identified in the Basin. This was accomplished by consulting a number of sources. The first source

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1 Details on these sources are given in the bibliography.

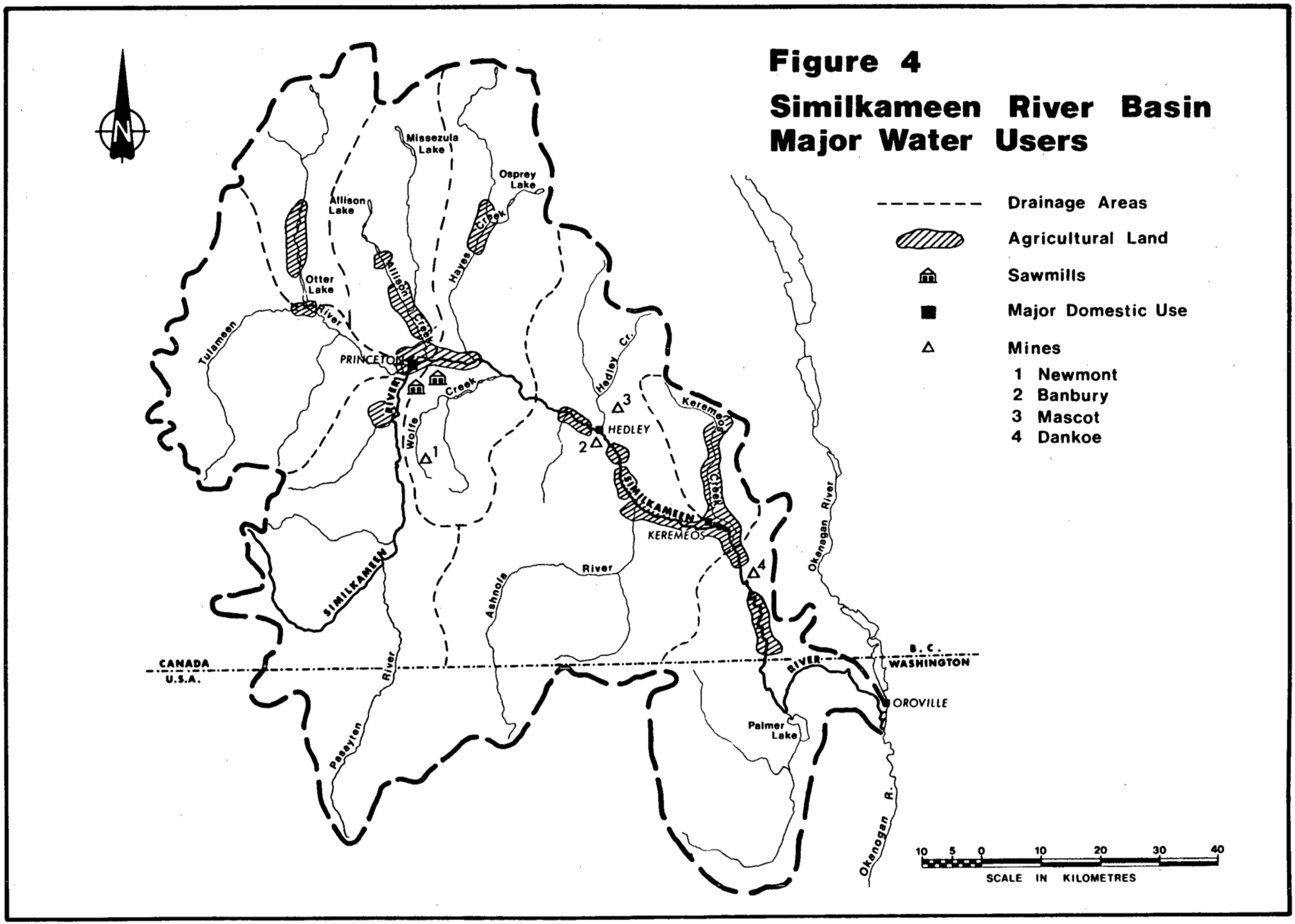
Figure 4
Similkameen River Basin
Major Water Users
Drainage Areas
Agricultural Land
Sawmills
Major Domestic Use
Mines
1 Newmont
2 Banbury
3 Mascot
4 Dankoe
N
Missezula Lake
Osprey Lake
Allison Lake
Otter Lake
Allison Creek
Hayes Creek
Tulameen River
PRINCETON
Wolfe Creek
Hedley Cr.
HEDLEY
Keremeos Creek
SIMILKAMEEN RIVER
KEREMEOS
Ashnola River
Okanagan River
CANADA
U.S.A.
B.C.
WASHINGTON
OROVILLE
Palmer Lake
Okanagan R.
Passayten River
10 5 0 10 20 30 40
SCALE IN KILOMETRES

was a national industrial water use survey carried out by Environment Canada[2]. This survey gave estimated annual water use for each responding company. However, most companies located in the Basin were not surveyed, so additional information sources were consulted. Telephone contact was made with plant managers and an estimate of water use was requested. In a few cases, managers could not be contacted or could not give water use estimate. Water use for these firms was estimated from regression models of water demand[3].

C. Water Use Estimates

In total, only six industrial firms were identified as significant users of water in the Basin. These are listed in Table 2 along with annual water use and drainage areas. Sawmills and other wood products have been aggregrated into a single category.

TABLE 2

SIMILKAMEEN RIVER BASIN
INDUSTRIAL WATER USE

Company	Drainage Area	Water Intake (Cubic Metres/Year)
Newmont Mines Ltd.[2]	Upper Similkameen	4 834 923
Dankoe Mines[2]	Lower Similkameen	165 969
Banbury Mines Ltd.[2]	Mid-Similkameen	8 298
Sawmills and Wood Products[1,3]	Tulameen River	3 499
TOTAL		5 012 689

Sources: [1] Water Use in Manufacturing Industries, 1976, Tate, op.cit.
[2] Phone Survey
[3] Calculated from regression models of water demand.

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2 The survey design and results are summarized in Water Use in the Canadian Manufacturing Industry, 1976 by D. Tate.

3 These models were estimated by the authors based on data for various industries in British Columbia obtained from the national industrial water use survey.

The total water withdrawn by these firms is about 5 012 684 cubic metres per year, of which Newmont Mines is the predominant user, accounting for 96% of the withdrawal. It can be seen that the sawmill and wood-product establishments are relatively small users of water, accounting for about one-tenth of one percent of the total.

III. AGRICULTURAL WATER USE

A. Introduction

Since 1930 the Similkameen River Basin has been an important tree fruit producing area. In recent years, significant increases have taken place in grape production in the southern areas of the Basin. In addition, the production of hay and forage has been steadily increasing over the last decade throughout arable regions of the Basin. As a result, agricultural water demands have increased steadily and account for the majority of total water use in the Basin. Because of the hot dry summer and porous sandy soils, irrigation requirements for tree fruits, grapes and vegetables are high. Irrigation requirements for hay and forage production are variable; with high requirements in the southern low elevation areas and slightly lower requirements in the northern tributary valleys. Irrigation requirements for these crops account for almost all of the agricultural water use in the Basin. Agricultural activity is concentrated mainly in the valley floors of the Basin, except on the plateau region north of Princeton (Figure 4).

Ranching is an important agricultural activity and there are a significant number of beef cattle in the Basin. Other livestock in the Basin include dairy cattle, poultry and horses. On a per animal basis, dairy cattle account for large amounts of water use because of flushing and cleaning requirements. However, in total, livestock water use is not large compared to irrigation water requirements.

B. Water Use for Irrigation

Two basic steps were required in estimation of water use for irrigation. The first step involved estimation of the actual area of land that is irrigated, while the second step involved estimation of appropriate application rates per unit area. The application rates

were then multiplied by the area of irrigated land to give water use. These calculations were carried out for each of the drainage areas outlined in Table 1.

Aerial photographs and field reconnaissance were used to determine the irrigated area within the Basin. Cultivated areas were identified from 1:20,000 black and white 1979 aerial photographs[4]. Cultivated areas were distinguishable from other areas because of their darker colour, regular spacing and shape. When the interpretation of the air photos was completed, the cultivated areas were transferred to 1:20,000 cadastral and planimetric maps of the Basin[5]. These maps were suitable for depicting agricultural land because of their similar scale to the aerial photographs and because of their inclusion of physical reference points useful for field mapping. For some residential areas, larger scale (1:5,000) water district maps were used[6]. Numerous irregular agricultural pockets were contained within these areas and the large scale maps were necessary for accurate plotting of the agricultural lands.

In order to update the cultivated areas to 1984 levels and to determine which cultivated areas were irrigated, three weeks of field reconnaissance were undertaken. During the field surveys, it was found that irrigated acreage was more easily identified during July, when the weather was hotter and drier. During the earlier June field trip, some difficulty was encountered in distinguishing irrigated hay lands from unirrigated pastures. In July, the irrigated areas were easily identified by their green growth and presence of trickle and sprinkler irrigation systems, while non-irrigated areas were typically of brown or faded colours.

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4 British Columbia Ministry of Environment, Surveys and Resource Mapping Branch, Air photo Library, 1984.

5 These maps were obtained from the British Columbia Ministry of Environment, Surveys and Resource Mapping Branch, Map Library.

6 Water district maps were obtained from the British Columbia Ministry of Environment, Water Management Branch, Licensing Section.

When transferring the updated irrigated areas to the maps, physical reference points on the cadastral maps such as roads, houses, creeks, railroads, trees and power lines were used to pinpoint the location of the plot land and estimate its size. Each parcel of irrigated agricultural land on the maps was planimetered to determine the area in hectares.[7] The parcels of land were then grouped by drainage area and totals computed for each drainage area and the Basin as a whole.

The classification of crop types used in the estimates of cultivated lands in the Basin was as follows:

1. Hay and Alfalfa;
2. Orchards and Vine Yards;
3. Vegetables; and,
4. Pasture.

Disaggregation of crop type was necessary because of different water requirements associated with various crops. The above classification was selected because it provided sufficient disaggregation while not requiring a great deal of field investigation to determine crop type. Further disaggregation such as breaking down orchards into soft-fruits and apples would have required considerably more field work.

In order to estimate the trend of agricultural expansion in the Basin, the 1976 agricultural area totals were compared to the 1984 totals. Table 3 provides a breakdown of land-use for hay, pastures, orchards, and vegetables in hectares for 1979 and 1984. The overall growth in cultivated land in the Basin from 1979 to 1984 was approximately 366 hectares. The growth in cultivated lands

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7 A map portfolio showing irrigated acreage and crop type is available for reference at the Vancouver office of Inland Waters Directorate, Environment Canada.

TABLE 3
SIMILKAMEEN RIVER BASIN
AGRICULTURAL LAND-USE
(hectares)

	YEAR	FRUIT	VEGETABLES	HAY	PASTURE	TOTAL
Upper Similkameen	79	0	0	161.0	0	161.0
	84	0	0	161.0	0	161.0
Tulameen River	79	0	0	115.7	0	115.7
	84	0	0	115.7	0	115.7
Otter Creek	79	0	0	241.6	0	241.6
	84	0	0	257.5	0	257.5
Allison Creek	79	0	0	316.0	0	316.0
	84	0	0	329.9	0	329.9
Hayes-Wolfe Creek	79	0	0	462.2	0	462.2
	84	0	0	462.2	0	462.2
Mid-Similkameen	79	317.4	17.7	666.9	6.5	1 008.5
	84	306.1	17.7	757.1	8.3	1 089.2
Keremeos Creek	79	187.3	25.2	390.2	0	602.7
	84	192.5	25.2	469.6	2.3	689.6
Lower Similkameen	79	649.8	16.8	902.9	30.1	1 599.6
	84	649.8	16.8	1 071.4	30.1	1 768.1
TOTAL ACREAGE	79	1 154.5	59.7	3 256.5	36.6	4 507.3
	84	1 148.4	59.7	3 624.4	40.7	4 873.2
DIFFERENCE 79-84		-6.1	0.0	+367.9	+4.1	+365.9

throughout the Basin was not uniform. The Tulameen River, Upper Similkameen and Hayes Creek drainage areas had no increase in cultivated hectares because the physical terrain and the soil type in these physical areas prohibited expansion. There was a minor increase in the cultivated area of the Otter Creek and Allison Creek drainage areas but future expansion seems limited since most of the potential cultivatable land is being used. The drainage areas which showed the greatest increase in cultivated hectares were Keremeos Creek, Mid-Similkameen, and Lower Similkameen. In these drainage areas, large fertile areas of land occupy the valley floor, and agricultural expansion has taken place through irrigation, drainage and flood control developments. Significant land remains for future expansion, much of it on Indian Reserves. Table 4 gives the current amount of irrigated land and water use on Indian Reserves in the Basin. This additional tabulation was carried out because of the potential for expanding irrigated crop production in these areas.

TABLE 4

SIMILKAMEEN RIVER BASIN

AGRICULTURAL LAND ON INDIAN RESERVES

(hectares)

	Fruit	Hay
Skemeoskuankin, Reserve #7	0	89.5
Lower Similkameen, Reserve #2	7.6	71.6
Narcisses Farm, Reserve #3	0	56.4
Blind Creek, Reserve #6	0	76.4
Alexis, Reserve #9	0	63.6
Ashnola, Reserve #10B	0	11.8
Ashnola, Reserve #10	0	97.0
Chuchuwayha, Reserve #2	0	70.2
Totals 1984	7.6	536.5
Annual Water Duty (metres)	.914	.914
Annual water use (cubic metres)	69 464	4 903 610

The final step in calculating irrigation water use in the Basin was to multiply the hectares of irrigated land of each drainage area by a per hectare application rate. The water duty estimates used in the study are 0.91 metres of water per year for pastures, orchards and hay, and 1.07 metres of water per year for vegetables. These estimates were based on information from soil and irrigation specialists and discussions with local irrigation district managers[8].

Once all the drainage area irrigation water use estimates had been completed, they were added together to give the total irrigation water use for the Basin. Table 5 gives the total irrigation water use in thousands of cubic metres for each drainage area and for the Basin as a whole.

C. Livestock Water Use

The first step in calculating livestock water use was to determine the types of livestock and their numbers within each drainage area and the Basin as a whole. The major source of this data was the 1981 Census of Agriculture. Through a special request to Statistics Canada, livestock numbers were supplied by enumeration area from which drainage area totals could be derived. Other data sources utilized were the provincial marketing boards and regional range management authorities. However, these other sources were not able to supply livestock numbers on a sufficiently disaggregated basis to estimate drainage area totals.

The enumeration areas from the agricultural census are generally small in area, usually encompassing a population of about 500 people. It was possible to approximate the drainage areas by

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8 Personal communications with E. Schultz, Agricultural Engineering Branch, B.C. Ministry of Agriculture and Food, and with Dr. Stevenson, Agriculture Canada, Summerland Research Station.

TABLE 5
SIMILKAMEEN RIVER BASIN
WATER USE FOR IRRIGATION
(thousands of cubic metres)

	YEAR	FRUIT	VEGETABLES	HAY	PASTURE	TOTAL
Upper Similkameen	79	0	0	1 472.2	0	1 472.2
	84	0	0	1 472.2	0	1 472.2
Tulameen River	79	0	0	1 056.7	0	1 056.7
	84	0	0	1 056.7	0	1 056.7
Otter Creek	79	0	0	2 208.5	0	2 208.5
	84	0	0	2 353.9	0	2 353.9
Allison Creek	79	0	0	2 888.5	0	2 888.5
	84	0	0	3 015.3	0	3 015.3
Hayes-Wolfe Creek	79	0	0	4 225.1	0	4 225.1
	84	0	0	4 225.1	0	4 225.1
Mid-Similkameen	79	2 767.6	188.6	6 096.0	59.7	9 111.9
	84	2 798.0	188.6	6 918.6	76.0	9 981.2
Keremeos Creek	79	1 712.3	268.7	3 566.6	0	5 547.6
	84	1 759.5	268.7	4 128.7	19.6	6 176.5
Lower Similkameen	79	5 939.4	179.3	2 750.9	275.7	9 145.3
	84	5 939.4	179.3	9 792.6	275.7	16 187.0
TOTALS	79	10 419.3	636.6	24 265.5	335.4	35 655.8
	84	10 496.9	636.6	32 963.1	371.3	44 467.9
DIFFERENCE 79-84		77.6	0.0	8 697.6	35.9	8 812.1

grouping enumeration areas. When enumeration areas overlapped drainage area boundaries, the livestock totals were divided on a percentage basis into the appropriate drainage area.

Total annual water use for each category of livestock in each drainage area was determined by multiplying the number of animals by annual water use coefficients. The livestock water use coefficients used in this study were based on coefficients used in the

Saskatchewan-Nelson River Basin[9] which has a similar summer climate to the Similkameen River Basin. These coefficients were somewhat

TABLE 6

SIMILKAMEEN RIVER BASIN

LIVESTOCK WATER USE COEFFICIENTS

Type of Livestock	Coefficients (Litres/Day/Head)
Milk Cows	154.00
Beef Cows and Heifers	64.00
Steers	51.00
Horses	68.00
Pigs	6.00
Sheep	3.50
Hens & Chickens	0.28
Other Poultry (turkey, geese, ducks)	0.50

Source: Prairie Provinces Water Board - Historical and Current Water Uses in the Saskatchewan-Nelson Basin, Appendix 3 - Agricultural Water Use (1982).

higher than general guidelines suggested for farmers in livestock manuals.[10] However, the larger coefficients were appropriate because of the hot summer climate in the Basin and because of the inclusion of wastage in the estimates of water use. The per animal use by milk cows is much greater than any other type of livestock because it includes animal intake plus use for washing and flushing equipment.

Table 7 shows the drainage area water use requirements for each category of livestock.

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9 Prairie Provinces Water Board - Historical and Current Water Uses in the Saskatchewan-Nelson Basin - Appendix 3 - Agricultural Water Use. (1982)

10 Sainsbury, David & Sainsbury, Peter - Livestock Health and Housing, Baltimore, Maryland: Williams and Wilkins Company (1970)

TABLE 7

ANNUAL LIVESTOCK WATER USE

(cubic metres)

	Milk Cows	Beef Cows and Heifers	Steers	Horses	Pigs	Chickens	Poultry	Total
Upper Similkameen	112	504	223	422	0	11	3	1275
Tulameen River	0	130	223	397	0	11	3	764
Otter Creek	112	11 812	372	993	0	7	5	13 301
Allison Creek	169	47 963	3 146	1 752	364	44	8	53 446
Hayes-Wolfe Creek	0	41 691	9 829	3 549	850	55	5	55 979
Mid-Similkameen	337	17 800	3 481	1 688	0	50	7 322	30 678
Keremeos Creek	0	14 671	2 420	1 713	0	59	7	18 870
Lower Similkameen	13 266	50 018	11 138	4 517	0	131	102	79 172
TOTALS	13 996	184 589	30 832	15 031	1 214	368	7 455	253 485

IV. DOMESTIC AND COMMERCIAL WATER USE

A. Introduction

The population of the Basin is estimated to be about 8,400 based on the 1981 Census. The majority of the population is located in Princeton and Keremeos with the remainder distributed between a number of smaller communities and rural areas. Although the population of the Basin is low, per capita water use is high because of lawn and garden watering requirements in the summer. Total domestic requirements are significant, with Princeton, Keremeos and Hedley accounting for the majority of domestic and commercial use (Figure 4).

Water use in the commercial sector (local service industries) is aggregated with domestic water use. This aggregation was carried out because of the difficulty in estimating commercial water use as a separate category. It is likely that any changes in future commercial water use will be highly correlated with changes in population, so aggregation of the two categories is reasonable when forecasting future water use. Furthermore, commercial activity in the Basin is limited, located for the most part in Princeton and Keremeos.

B. Population Estimates

The first step in calculating the population of the Basin was to determine which Census enumeration areas were within the Basin. This was accomplished by drawing the Similkameen River Basin on a Federal Government Electoral District Map which shows enumeration areas of the region. After completing a list of the enumeration areas, the population of each enumeration area was obtained from Population and Dwelling Counts for Enumeration Areas by Federal Electoral District - Census, 1981.[11] When an enumeration area overlapped the boundary

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[11] This information is accessible in microfilm form at Statistics Canada, Vancouver Office.

of the Basin, a percentage of the population equivalent to the percentage of the enumeration area within the Basin was included. The final step in calculating the population of the Basin was to sum the population totals of the relevant enumeration areas.

It was also necessary to determine the population of each drainage area within the Basin. To determine the drainage area populations, the enumeration areas in the Similkameen River Basin were grouped into the appropriate drainage areas. When an enumeration area was cut by drainage area boundaries, the population total of the enumeration area was divided on a percentage basis into the appropriate regions. Table 8 shows the population of the drainage areas and the Basin as a whole.

TABLE 8
SIMILKAMEEN RIVER BASIN
DRAINAGE AREA POPULATION

Drainage Area	Population
Otter Lake	339
Allison Creek	369
Hayes-Wolfe Creeks	550
Tulameen River	3,192
Upper Similkameen	269
Keremeos Creek	560
Lower Similkameen	1,183
Mid-Similkameen	1,942
Total Basin Population	8,404

The drainage area with the largest population is Tulameen River which contains Princeton, the largest community. The Mid-Similkameen drainage area, which contains the villages of Hedley and Keremeos, also has a significant number of residents. The other drainage areas are predominently rural with low and scattered populations.

C. Water Use Estimates

Domestic water use in the Similkameen River Basin was broken down into two categories: rural areas which are areas outside of municipalities and irrigation districts; and urban areas. Domestic water use estimates for rural areas include only in-house use. A per capita consumption figure of 455 litres per day was used to estimate domestic water use in rural areas.[12] Garden and lawn watering are not included in domestic water use estimates for rural areas because they have already been accounted for in the estimates of agricultural water use.

Domestic water use estimates for urban areas includes both in-house use and lawn and garden watering. In order to account for climatic differences between the western and eastern parts of the Basin, two different domestic water use estimates were used for the urban areas. The domestic water consumption figure used for the urban areas in the western part of the Basin was 1 410 litres per day per capita. This figure was calculated from data on Princeton water use contained in the National Inventory of Municipal Water Records. It was used to calculate the domestic water use for all the urban areas west of Hedley.

From Hedley east and south to the Canada/United States boundary, a different daily per capita consumption figure was used to determine domestic water use for urban areas. The daily domestic water consumption figure for this area was 1 715 litres per capita, calculated from records obtained from the Hedley Improvement District. In order to check the accuracy of this figure it was compared to domestic water consumption for the Oliver-Osoyoos area which is similar in climate to Hedley. It was found that the daily

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12 This is the same per capita consumption figure that was used for rural areas in the Okanagan basin. See Report on the Okanagan Basin Implementation Agreement, Canada-B.C., (1982).

per capita consumption figures for Hedley and the Oliver-Osoyoos area were almost identical. It was therefore concluded that the figure of 1 715 litres per capita was acceptable for calculating annual urban domestic water use in this portion of the Basin.

The daily domestic water use for each drainage area was calculated by multiplying the rural population of the drainage area by a per capita consumption of 455 litres per day and multiplying the urban population by a per capita consumption figure of either 1 410 litres or 1 715 litres per day. This figure was then converted to annual water use by multiplying by the number of days in the year. The overall annual domestic water use in the Similkameen River Basin was calculated by adding together the domestic water use of the drainage areas. Table 9 gives the annual domestic water use for each drainage area and for the Basin as a whole.

TABLE 9
SIMILKAMEEN RIVER BASIN
DOMESTIC WATER USE

Drainage Area	Population	Daily Water Use (cubic metres)	Annual Water Use (cubic metres)
Upper Similkameen	269	122	44 530
Tulameen River	3 192	4 364	1 592 860
Otter Creek	339	357	130 305
Allison Creek	369	201	73 365
Hayes-Wolfe Creeks	550	250	91 250
Mid-Similkameen	1 942	2 570	938 050
Keremeos Creek	560	844	308 060
Mid-Similkameen	1 942	2 570	938 050
Lower Similkameen	1 183	1 493	544 945
TOTALS	8 404	10 201	3 723 365

V. SUMMARY AND CONCLUSIONS

A. Total Water Use Estimates

Annual water use by drainage area in the Similkameen River Basin is shown in Table 10. Agriculture accounts for approximately 84 percent of all water use in the Basin while industry accounts for 9 percent and domestic/commercial accounts for 7 percent. Most of the agricultural demand occurs in the southern areas of the Basin particularly in the lower Similkameen drainage area. Industrial demand occurs primarily in the Upper Similkameen drainage area, mainly from Newmont Mines. Domestic/commercial demand is distributed more evenly throughout all the drainage areas. Total annual water use in the Similkameen River Basin is estimated at 52.59 million cubic metres, most of which occurs in the southern area of the Basin.

B. Conclusions

This study used a low-budget approach to obtain disaggregated water use data. Existing data sources and maps of the area were used wherever possible and field travel was kept to a minimum. Expensive procedures such as air photography of the Basin were not undertaken. Despite the low budget approach, the water use estimates made in the study are reasonably accurate. Irrigated lands were easy to identify and could be mapped accurately because of numerous reference points shown on published maps of the Basin. Population counts from the Census of Canada are believed to be highly accurate and little population growth has occurred in the Basin since 1981. There are only a few industrial establishments in the Basin and their water use could be determined using existing data or by telephone survey.

This study should be a useful guideline for low-budget studies of water use in other river basins. It is recognized that many river basins in British Columbia have greater populations and industrial

activities as well as more complex land use activities than the Similkameen Basin. Although this size and complexity will result in greater manpower requirements for estimating water use, most of the data sources and techniques used in the present study would still be applicable.

TABLE 10

SIMILKAMEEN RIVER BASIN
ANNUAL WATER-USE BY DRAINAGE AREA
(thousands of cubic metres)

	Agricultural	Industrial	Domestic	Total
Upper Similkameen	1 473.5	4 834.9	44.5	6 352.9
Tulameen River	1 057.5	3.5	1 592.9	2 653.9
Otter Creek	2 367.2	0.0	130.3	2 497.5
Allison Creek	3 068.7	0.0	73.4	3 142.1
Hayes-Wolfe Creeks	4 281.1	0.0	91.3	4 372.4
Mid-Similkameen	9 142.6	8.3	938.1	10 089.0
Keremeos Creek	6 195.4	0.0	308.1	6 563.5
Lower Similkameen	16 266.2	166.0	544.9	16 977.1
TOTALS	43 852.2	5 012.7	3 723.5	52 588.4

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