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PREPARED BY:
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NOVEMBER 1988

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ENVIRONMENT CANADA
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ABSTRACT

The Lower Kootenay River drains approximately 15 000 square kilometres of southeastern British Columbia. The Basin is dominated by Kootenay Lake which is flanked by the Selkirk Mountains on the west and the Purcell Mountains on the east. The hydrograph of the Kootenay River has been significantly altered by the construction and operation of eight dams and control structures: spring peaks have been reduced and winter flows increased. This has caused a new equilibrium in Kootenay Lake with fish productivity lower than historic levels. However, angler demand is being met except in localized areas subject to overfishing.

Major economic sectors in the Basin are forestry and mining with tourism and agriculture gaining in importance. Expansion in these sectors will likely cause resource use conflicts as the Basin supports significant wildlife and fisheries populations and wilderness recreation opportunities. In addition, the protection of water quality in community watersheds is of growing concern to the Basin's residents.

Environment Canada has been involved in many activities in the Basin over the years. Routine water quality and hydrometric monitoring is expected to continue, as is involvement with the Kootenay Lake Board of Control and the Columbia River Treaty Permanent Engineering Board. Increased federal involvement is not warranted at this time although it is recommended that water use activities in the United States portion of the Basin be examined for potential transboundary effects.

RESUME

La partie inférieure de la rivière Kootenay draine une superfécie approximativement 15 000 kilomètres carrés de la région sud-est de la Colombie-Britannique. Le lac Kootenay domine ce bassin et il est situé entre les montagnes Selkirk à l'ouest et Purcell à l'est. Le débit de la rivière a été modifé significativement par la construction et le fonctionnement de huit barrages, par exemple le débit au printemps est réduit et celui d'hiverest augmenté. Suite à la construction de ces barrages, le lac Kootenay s'est equilibré, c'est à dire la production de poissons a diminuée mais suffit à la demande de la pêche sportive sauf quelques regions òu la peche est excessive.

Les secteurs économiques les plus importants sont la sylviculture et l'exploitation minière. Le tourisme et l'agriculture deviennent de plus en plus importants. Une augmentation d'activitiés dans ces secteurs pourrait enduire des conflits d'utilisation de ressources, puisque le bassin supporte dejà des populations de poissons et d'animaux sauvages très importantes ainsi que plusieurs loisirs en plein air. Les habitants de la région s'inquietent dejà de la qualité des eaux du bassin versant.

Depuis plusieurs années, Environnement Canada s'intéresse à ce bassin par des activités de monitorage de routine de qualité et de quantité d'eau, ainsi que par sa participation sur le Comité de contrôle du lac Kootenay et le Comité technique permanent du fleuve Columbia. C'est entendu que ces activités continueront. Une augmentation d'implication fédéral dans ce bassin n'est pas justifiable pour le moment. Néanmoins, il est recommendé que les activités d'utilisation d'eau de la partie américaine du bassin soient évaluées s'il y a des effets transfrontaliers.

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1.0 INTRODUCTION

1.1 Study Area

The study area for this report is the Lower Kootenay River Basin in southeastern British Columbia, or that portion of the Kootenay River which drains north from the international boundary near Rykerts, British Columbia to the confluence with the Columbia River near Castlegar, British Columbia (Figure 1). The Yahk and Moyie River Basins in Canada are also included in the study area, although these tributaries join the Kootenay River in the United States. (spelled Kootenai in the United States). The Upper Kootenay River Basin, which drains from the headwaters of the Kootenay River near Banff, Alberta to the international boundary at Lake Koocanusa, is described in a separate background report (Canada, 1988a). The portion of the Kootenay River which loops through the United States linking the Upper and Lower Kootenay River Basins in Canada may be addressed in a future report.

The Lower Kootenay River flows north for 32 kilometres from the international boundary to Kootenay Lake in a wide, flat valley. The fjord-like Kootenay Lake is approximately 113 kilometres long and up to six kilometres wide. From Kootenay Lake the river flows west for ten kilometres to join the Columbia River at Castlegar, British Columbia. The Kootenay River contributes 40 percent of the Columbia River flow at the confluence and is the third largest of the Columbia's tributaries.

The Lower Kootenay Basin is bounded by the Selkirk Mountains on the west and the Purcell Mountains on the east; Kootenay Lake occupies the Purcell Trench which divides the two mountain systems. Major tributaries are the Duncan, Lardeau and Slocan Rivers. Nelson and Creston are the two largest communities each with populations less than 10,000.

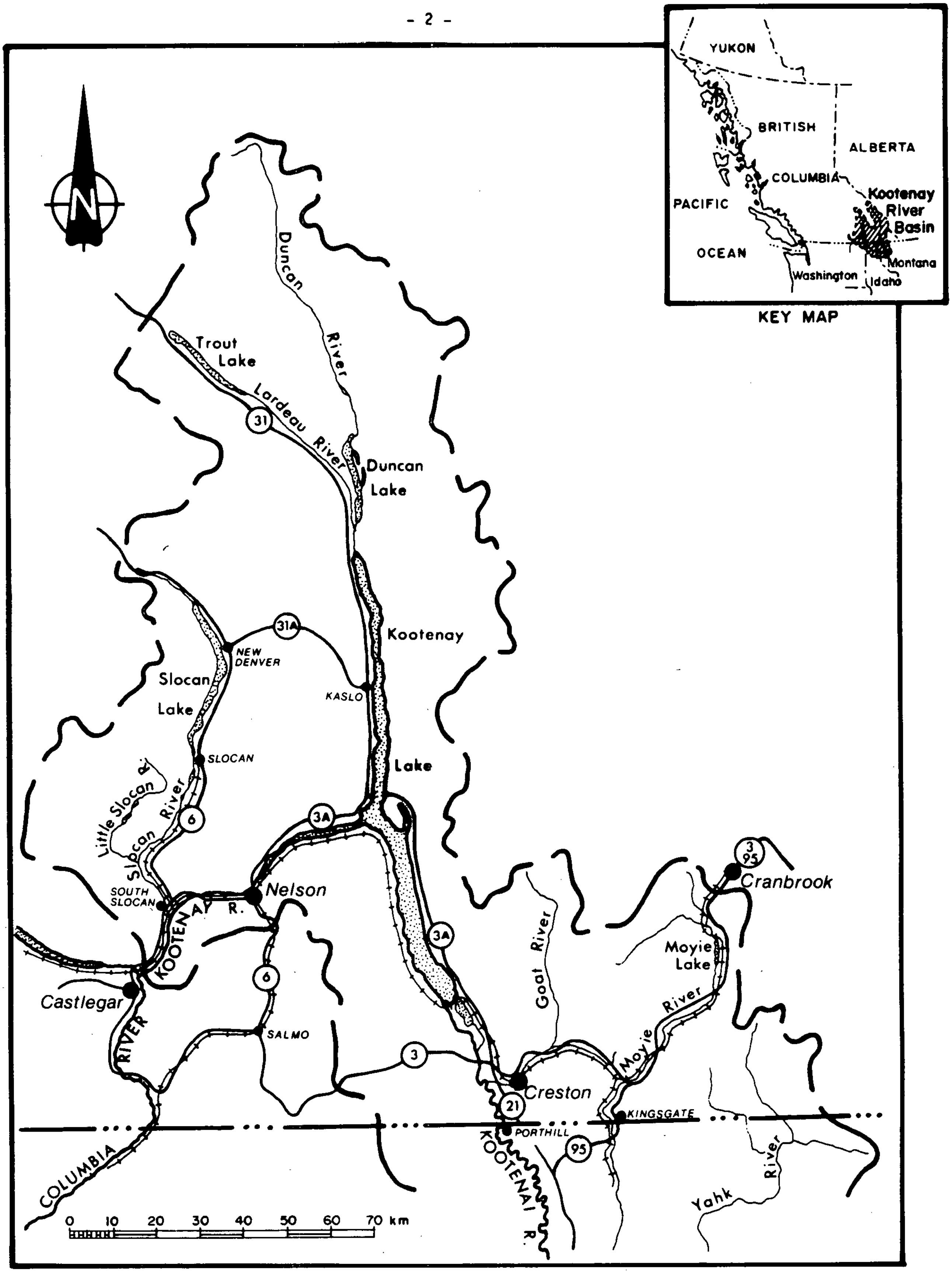

Figure 1 The Lower Kootenay River Basin

1.2 Objectives and Outline

The objectives of this report are to summarize the physical and biological characteristics of the Lower Kootenay River Basin, describe existing and potential resource uses and suggest areas that may require the attention of Inland Waters, Environment Canada.

Chapter Two of the report provides an overview of the Basin's water and related resources including physiography, climate, vegetation, wildlife and fisheries. Chapter Three discusses the economic development of the Basin with particular emphasis on the major industries of forestry and mining. An historical perspective and discussion of the Basin's communities and amenities is also included. The final chapter provides a summary and concluding remarks related to potential areas of concern or involvement for Inland Waters.

2.0 WATER AND RELATED RESOURCES

2.1 Physiography

The Lower Kootenay River Basin lies entirely within the Columbia Mountains, a transitional physiographic region between the Rocky Mountains on the east and the Interior Plateau on the west. The Columbia Mountains are further subdivided into the Purcell, Selkirk, Monashee and Cariboo Mountains. These mountain ranges are parallel and generally trend north-south; portions of the Purcell and Selkirk Mountains lie in the Lower Kootenay River Basin (Figure 2).

The Purcell Mountains occupy the eastern half of the Basin. These mountains trend northwest and are underlain by sedimentary and metamorphic rocks including quartzite, argillite and limestone with large granitic intrusions. The Purcells are extremely rugged in the northern part of the Basin with unglaciated peaks rising to 3243 metres (Mt. Hamill). Since the spine of the Purcells is only 30 kilometres east of Kootenay Lake, rivers and streams draining the Purcells westward into the lake are short and steep and follow narrow, deeply-incised, east-west trending valleys. The southern portion of the Purcells in the Basin is comprised of two mountain ranges: Yahk and Moyie. Their topography is uniform and subdued with rounded, glaciated summits rising to 2150 metres.

The western half of the Basin is occupied by the Selkirk Mountains which are comprised of the Bonnington and Nelson Ranges trending northeast near the international boundary; the Valhalla and Slocan Ranges trending north near Nelson; and the Duncan Ranges trending northwest in the northern portion of the Basin. The Selkirks, lying east of the Monashee Mountains, are composed of a complex variety of sedimentary and metamorphic rocks including gneiss, schist, argillite, slate, granite andesite and erosion-resistant quartzites and limestones which form the

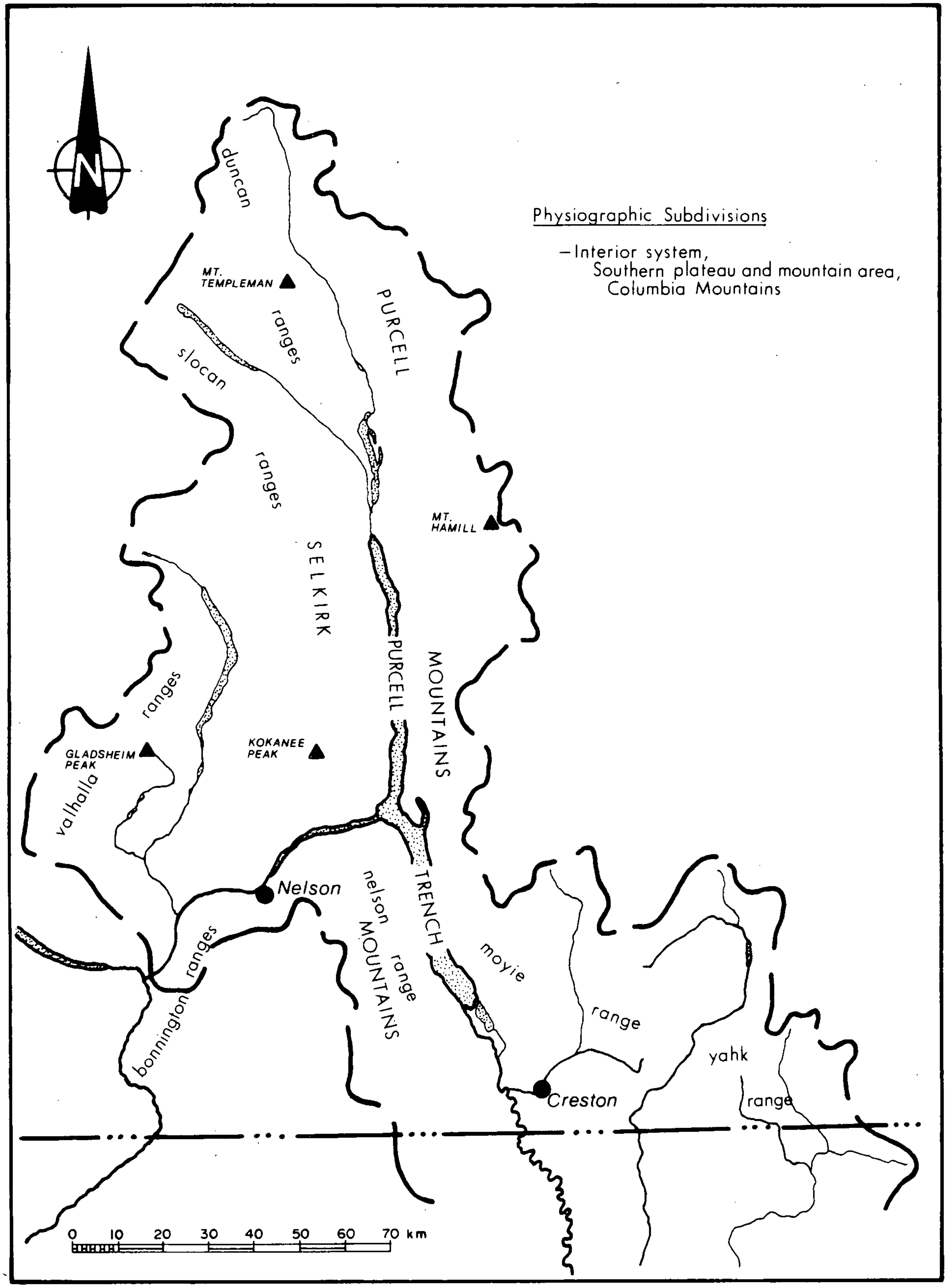

Figure 2 Physiographic Regions

highest peaks. North of Trout Lake, the Duncan Ranges are extremely rugged with peaks rising to 3070 metres (Mt. Templeman) and numerous icefields and glaciers.

Slocan River and Lake separate the Slocan Ranges on the east from the Valhalla Ranges on the west. Kokanee Park at 2804 metres is the highest peak in the Slocan Ranges while Gladsheim Peak at 2827 metres is the highest peak in the Valhallas; farther south summits are below 2438 metres. Kokanee Glacier, north of Nelson in the Slocan Ranges, covers more than five square kilometres. As in the Purcells, the topography becomes more subdued in the south; the Bonnington and Nelson Ranges south of Kootenay River were glaciated and contain practically no glaciers.

The Purcell Trench, a longitudinal valley varying from one to eleven kilometres in width, forms the boundary between the Selkirk and Purcell Mountains. The Kootenay River, Kootenay Lake, Duncan Lake and Duncan River are situated in the Purcell Trench. The Trench is generally filled with unconsolidated fluvio-glacial sediments deposited by retreating glacial ice. In Kootenay Lake, sediments are over 210 metres thick in places.

2.2 Climate

The Lower Kootenay River Basin is located within the Interior Wet Belt climate zone which is characterized by cold winters with high snowfall and warm, dry summers (RDCK, 1982). The Basin is situated between two drier zones, the Okanagan Valley and Rocky Mountain Trench.

The north-south trending Selkirk and Purcell Mountains significantly influence precipitation patterns in the Basin. Prevailing westerly winds drive moisture-laden Pacific air up the steep mountain slopes. As the air rises and cools, it releases moisture in the form of rain or snow on the mountains and renders leeward valleys relatively dry.

In the northern Purcells and Selkirks precipitation reaches 150 mm to

2000 mm annually, dropping to 1000 mm annually in the southern ranges. Kootenay Lake and Slocan Lake receive 760 mm annually, while Creston further south in the Purcell Trench receives only 500 mm as a result of the lower altitude and occasional influxes of warm, dry continental air from the United States. Summer thunderstorms are characteristic in the Basin and can drop a great amount of rain in a relatively short time, particularly on the western slopes of the Selkirks and Purcells (Daley et al, 1981). Snowfall follows a similar pattern, increasing with altitude and south to north, with 200 cm to 250 cm annually in the Kootenay and Slocan Valleys and 250 cm to greater than 500 cm in the mountains. Most precipitation falls as snow in the winter.

Temperatures in the Basin are also influenced by elevation and latitude. Mean annual temperatures in the valleys are 5°C in contrast to 10°C further west. This is, in part, because valley elevations are progressively higher from west to east across the province, and also because Arctic air more readily invades the eastern valleys.

Average summer temperatures in the valleys are 18°C but often rise to over 30°C as the deep, narrow valleys act as ovens. Summer temperatures cool to 15.5°C in northern portions of the valleys. Kootenay and Slocan Lakes provide a moderating effect on temperature especially in winter. Mean January temperatures are -4°C in Kootenay Lake and the West Arm compared to -8°C in Cranbrook. Mean winter temperatures are -7°C in the southern Selkirks and -12°C in the Purcells and northern Selkirks.

Most valleys have an average frost free season of 120 days and 1800 hours of sunshine annually. The frost free season in the Valhallas is 100 days, 80 days in the rest of the Selkirks and 60 days in the Purcells (British Columbia, 1977).

The West Arm and other tributaries of Kootenay Lake dissect the mountains and act as funnels for the cool descending air often creating strong winds. North-south winds along the Purcell Trench and Slocan Valley are also common, particularly in winter as cold, Arctic air masses occasionally invade from the north (Daley et al, 1981).

The federal Atmospheric Environment Service, Environment Canada and provincial Air Studies Branch, Ministry of Environment and Parks operate complementary climate networks throughout the Basin. Data for seven representative stations are provided in Appendix 1; stations are located on Figure 3.

2.3 Water

2.3.1 Hydrology

The Lower Kootenay River Basin drains approximately 15 180 square kilometres of southeastern British Columbia (Canada, 1985). The eastern portion of the Basin is drained by the Yahk and Moyie Rivers which rise in Canada but join the Kootenai River in the United States.

The Yahk River rises in the Yahk Ranges at about 2134 metres elevation and flows southwest for 98 kilometres before joining the Kootenai River in western Montana. Twenty-two percent of its 2046 square kilometres drainage area lies in Canada. The Moyie River rises in the Purcell Mountains southwest of Cranbrook and flows north then east through narrow valleys before turning south and entering the wide, immature valley containing Moyie Lake. The Moyie then flows southwest between the Moyie and Yahk Ranges joining the Kootenai River 13 kilometres east of Bonners Ferry, Idaho. The Moyie River drains 1955 square kilometres of which approximately 75 percent lies in Canada.

The Kootenai River enters the Purcell Trench at Bonners Ferry, Idaho, and meanders north about 80 kilometres in a wide, flat valley to the international boundary. From the boundary the Kootenay continues north for 32 kilometres to Kootenay Lake. This reach is actually a large alluvial fan which has been dyked in several areas for agriculture. The flow in this reach has been regulated since 1972 by Libby Dam in Montana.

Kootenay River contributes 60 percent of the inflow to Kootenay Lake; Duncan River and its major tributary, the Lardeau River, contribute 20

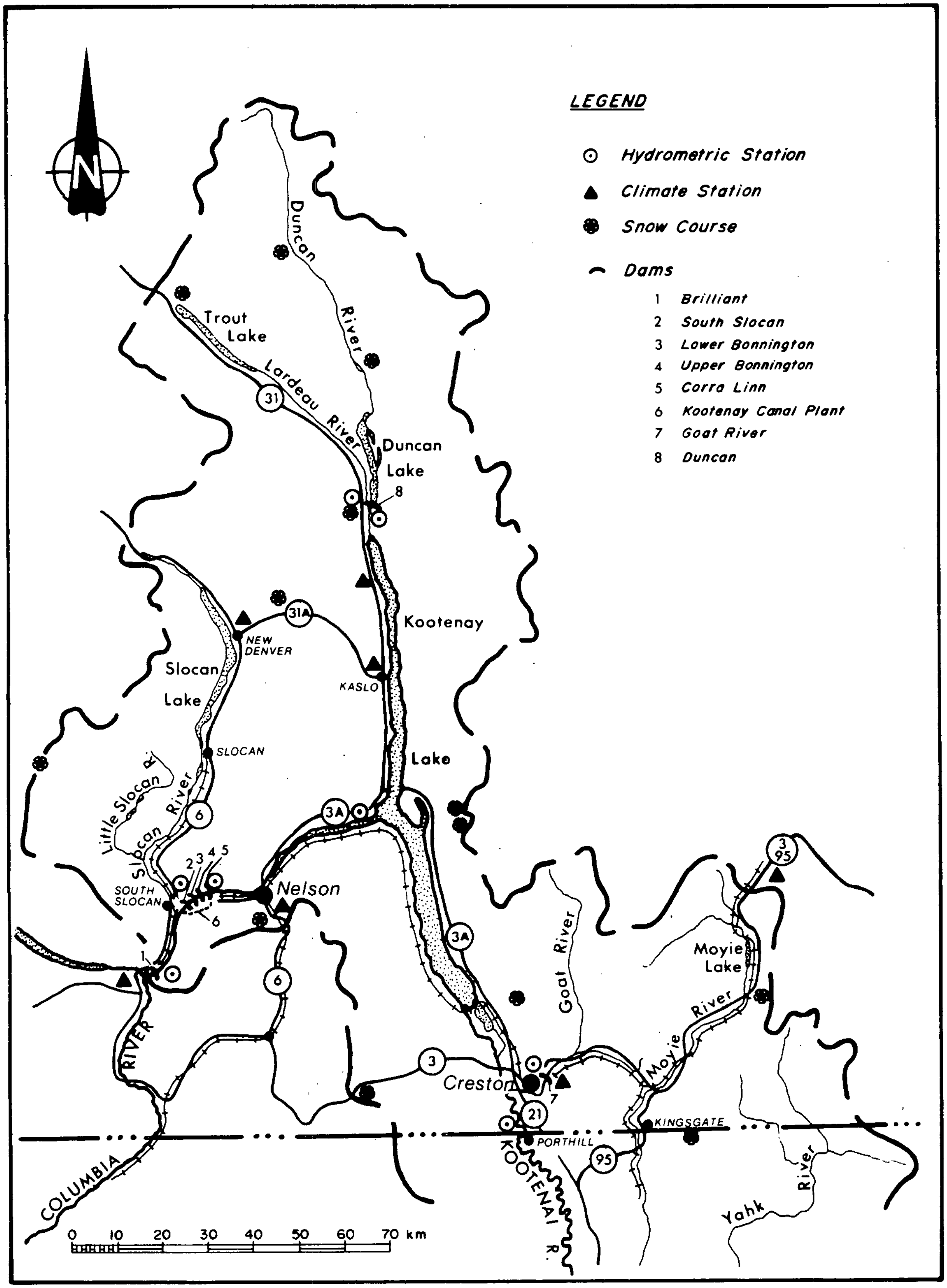

Figure 3 Selected Climate, Hydrometric and Snow Survey Stations and Dams

percent of the lake's inflow, while smaller tributaries supply the remaining 20 percent.

The fjord-type Kootenay Lake dominates the Basin: it is 113 kilometres long and a maximum of six kilometres wide. Lying at 529.7 metres above mean sea level, the lake is surrounded by steep mountains 2100 to 2700 metres high. As a result, there is little benchland and tributary streams are short with steep gradients. Similar to the rest of the Purcell Trench, the lake has a flat bottom; lake depths vary from 90 to 150 metres.

The Duncan and Lardeau Rivers drain over 4000 square kilometres in the northern portion of the Basin. Duncan Dam is situated approximately eight kilometres north of Kootenay Lake on Duncan River and forms the 40 kilometres long Duncan Lake. The Lardeau River rises in the Selkirk Mountains, flows north then southwest through the 29 kilometre-long Trout Lake and eventually joins the Duncan River below Duncan Dam.

About mid-point in Kootenay Lake, the 38-kilometre West Arm leads to the outlet of Kootenay Lake at Corra Linn Dam. This dam controls the level of the lake except under high flow conditions when water is diverted along the man-made Kootenay Canal from above Corra Linn to below South Slocan Dam.

From Corra Linn, the Kootenay flows southwest for approximately 22 kilometres before entering the Columbia River at Castlegar. In its natural state, this reach contained waterfalls and rapids which have now been eliminated by the construction of five dams for hydroelectric generation. The Slocan River is the only major tributary in this reach joining the Kootenay 16 kilometres upstream from its confluence with the Columbia River. The Slocan drains 3320 square kilometres of mountainous terrain in the western portion of the Basin. It rises in the Selkirk Mountains at elevations over 2500 metres and drops rapidly to Slocan Lake. The lake is 32 kilometres long, two kilometres wide and 200 to 300 metres deep.

A brief summary of the streamflow characteristics of the Kootenay River and its major tributaries is provided in Table 1; station locations are noted on Figure 3. The federal Water Resources Branch, Environment Canada, operates 31 hydrometric stations in the Basin and has additional information for 200 inactive stations. The average contribution to the flow of the lower Kootenay River upstream of the international boundary is 445 m^3/s equivalent to 41.6 centimetres over the entire Basin. The average annual runoff of the Kootenay River recorded near Glade, B.C., is approximately 793 m^3/s, equivalent to 50.8 centimetres over the entire Kootenay River Basin. The Kootenay River Basin contributes about 40 percent of the total flow of the Columbia River at Birchbank, B.C.

The greatest proportion of the Basin's streamflow originates from snow melt. Winter precipitation falls as snow on the Basin's mountains forming a natural reservoir from which runoff is generated during the spring and summer. Measurements of snowpack prior to snowmelt provide a good indicator of subsequent streamflow which in turn benefits hydroelectric irrigation and municipal water uses. The provincial Ministry of Environment and Parks has established 14 snow survey stations in the Basin and publishes data from these stations in six Snow Survey Bulletins issued from February to June each year. The stations are located on Figure 3, pertinent data provided in Table 2 and computed forecast and observed runoff figures for 1987 given in Table 3.

Ordinarily streamflow rise is gradual, beginning in April and continuing until late May or June, when maximum stage occurs. Occasionally, however, a period of high temperatures or excessive rains will increase the rate of rise and cause the peak stage to be higher than under normal melt conditions.

Rainstorms alone rarely cause high runoff in the Kootenay River Basin except in small drainage areas over which local storms of high intensity may centre. These storms have little effect on the flow of the Kootenay River but may cause flooding on smaller tributaries.

TABLE 1. MONTHLY AND ANNUAL MEAN DISCHARGES AND EXTREMES OF RECORD FOR SELECTED STATIONS

Station Number		08NH006	08NH021	08NH004	08NH007
Station Name		Moyie River at Eastport	Kootenai R. at Porthill	Goat R. near Erickson	Lardeau R. at Marblehead
Period of Record		1915-	1928- (reg. by Libby Dam since 1972)	1914-	1917-
Drainage Area (sq. km)		1480	35 500	1180	1620
Monthly Mean Discharge (m^3/s)	Jan	4.79	211	6.21	14.7
	Feb	5.14	203	6.25	13.4
	Mar	7.57	198	9.61	13.5
	Apr	36.9	488	38.8	29.1
	May	90.5	1160	102	116
	Jun	58.5	1260	85.5	201
	Jul	14.2	650	22.6	148
	Aug	3.87	304	7.44	57.6
	Sep	2.94	233	7.08	39.4
	Oct	4.24	254	9.16	31.0
	Nov	5.84	257	9.13	25.2
	Dec	5.95	230	7.83	18.5
Annual Mean Discharge (m^3/s)		20.0	453	26.3	60.0
Maximum Daily Discharge (m^3/s)		253 (May 54)	3540 (Jun 48)	450 (May 56)	416 (Jun 72)
Minimum Daily Discharge (m^3/s)		0.8508 (Jan 37)	39.15 (Feb 36)	1.058 (Nov 79)	7.76 (Apr 75)

(Canada, 1985)

TABLE 1. MONTHLY AND ANNUAL MEAN DISCHARGES AND EXTREMES OF RECORD FOR SELECTED STATIONS (cont'd)

Station Number		08NH118	08NJ013	08NJ158	08NJ001
Station Name		Duncan R. below Lardeau R.	Slocan R. near Crescent Valley	Kootenay L. Outfall near Corra Linn	Kootenay R. at Glade
Period of Record		1963- (reg. by Duncan Dam since 1967)	1914-	1937- (reg. by Corra Lin Dam since 1939)	1913-44
Drainage Area (sq. km)		4070	3320	45 600	49 200
Monthly Mean Discharge (m^3/s)	Jan	166	24.5	429	255
	Feb	139	22.3	442	235
	Mar	59.8	25.5	430	250
	Apr	61.3	65.4	548	542
	May	153	214	1450	1580
	Jun	274	310	2290	2460
	Jul	299	175	1530	1800
	Aug	249	69.2	723	845
	Sep	166	45.4	412	510
	Oct	111	42.5	439	388
	Nov	90.6	38.4	425	347
	Dec	173	29.9	435	295
Annual Mean Discharge (m^3/s)		162	88.5	798	795
Maximum Daily Discharge (m^3/s)		807 (Jun 67)	694 (Jun 74)	4930 (Jun 61)	4360 (Jun 16)
Minimum Daily Discharge (m^3/s)		14.1 (Nov 79)	8.5 (Jan 37)	104 (Sep 57)	110 (Feb 37)

(Canada, 1985)

TABLE 2. SNOW SURVEY STATIONS

Snow Course	Station Number	No. Years Record	Elev (m)	April 1 Water Equivalent (mm)					
				1987	1986	1985	Max.	Min.	Normal
Moyie Mountain	2C10	15	1940		331	400	729	170	471
Hawkins Lake	MT06	17	1970	683	688	716	1313	399	817
Kimberley (Upper)	2C11	18	2140	422	440	342	798	234	501
Duncan Lake	2D07	21	650		98	128	203	0	94
Ferguson	2D02	47	880	532	440	436	790	142	590
Nelson	2D04	49	930	276	238	430	622	137	393
Sandon	2D03	48	1070	241	207	369	585	71	361
Char Creek	2D06	21	1310	470	397	524A	940	302	607
Gray Creek (Lower)	2D05	39	1550	369	359	458	688	290	475
Arrow Creek	2D11	9	1620	640	474	711	901	474	750
Koch Creek	2B07	28	1860	561	549	645	1034	424	769
Mount Templeman	2D09	18	1860	858	984	805	1608	782	1064
Gray Creek (Upper)	2D10	18	1910	683	668	650	1123	524	806
East Creek	2D08	18	2030	767	887	677	1445	632	939

(British Columbia, 1987d)

TABLE 3. RUNOFF FORECASTS

(April 1 to September 30, 1987)

	1987 Forecast Runoff			Observed Runoff				
	Volume	% Normal	Expected Range[2]	1986	1985	Minimum (Period	Maximum 1941-86)	Normal (1961-85)
Kootenay Lake Inflow[3]	19 200	92	17 000 - 21 400	19 000	16 900	10 900	29 000	20 900
Moyie River at Eastport	510	93	390 - 630	408	405	184	895	548
Duncan Lake Inflow[3]	2 490	90	2 260 - 2 720	2 760	2 310	2 040	3 400	2 770
Slocan River near Crescent Valley	2 090	85	1 800 - 2 380	2 250	2 080	1 350	3 190	2 470

Notes:
1 Runoff is expressed in thousands of cubic decametres.
2 There is approximately an 80% chance that the observed 1987 runoff will be within the expected range shown.
3 Corrected for upstream storage.

(British Columbia, 1987d)

2.3.2 Dams

The hydrograph of the Lower Kootenay River Basin has been significantly flattened by the eight dams or control structures on the Kootenay River system (Figure 3).

On the Kootenay River, between Nelson and the confluence with the Columbia River, there are five dams, a canal and seven powerplants. The structures control the level and flow of water from Kootenay Lake.

Corra Linn, the first dam in the series, provides about 800,000 acre feet of storage in the West Arm of Kootenay Lake for use by its own powerplant and each of the downstream powerplants. Upper Bonnington is next downstream, followed by Lower Bonnington, South Slocan and Brilliant. The last four dams have only small headponds and depend on Corra Linn Dam to provide seasonal storage. The Kootenay Canal Project consists of a canal which starts above Corra Linn and supplies water to a powerplant downstream of South Slocan Dam. Duncan and Libby Dams, built under the Columbia River Treaty, regulate the inflow to Kootenay Lake and supply an additional 6.4 million acre-feet of upstream storage or 32 percent of the mean annual flow at Corra Linn. Data describing the projects are presented in Table 4; a brief discussion of each project follows.

Corra Linn Dam

Corra Linn was completed in 1931 and operated on a run-of-the-river basis until 1939. In 1939, the International Joint Commission allowed West Kootenay Power and Light Co. Ltd. (WKP) to enlarge Grohman Narrows enabling storage of up to 2.5 metres of water in Kootenay Lake (Daley et al, 1981). The regulation of Kootenay Lake by Corra Linn Dam is governed by a rule curve in terms of maximum permissible levels prescribed by the International Joint Commission. Corra Linn controls the level of Kootenay Lake except under high flow conditions when natural channel constrictions in the West Arm restrict the flow and thus control the lake level.

TABLE 4. DAM STATISTICS

Dam or Project	Libby	Goat	Duncan	Corra Linn	Upper Bonnington	Lower Bonnington	South Slocan	Kootenay Canal	Brilliant
Height (m)	113	25	40	21	15	18	21		34
Crest Length (m)	931	53	792	518	427	223	681		190
Spillway Capacity (cms)	4 108		1 351	7 790	6 232	6 091	6 091		7 252
Spillway Height (m)	98.1	22.3	22.6	10.1	4.9-6.7	11.6	10.7		28.7
Spillway Type	Gate controlled with stilling basin	Overflow	Gated chute	Overflow at crest gates	Overflow	Overflow with gates	Overflow		Overflow with gates
Sluiceway Capacity (cms)		Blocked-unusable	566.6		Included in spillway capacity				
Powerhouse Installed Capacity (MW)	525	1.28	Nil	40.5	55 & 8.67	42	47	500	109
Hydraulic Capacity (cms)	750			357	363 & 40	295	306	708	510
Reservoir - Usable Storage Capacity (acre-feet)	5,850,000	Nil	1,400,000	800,000*	Pondage only	Pondage only	Pondage only	800,000*	9,875
Area (km^2)	188		75	417*				417*	
Length (km)	148		45	105 & 35*	1.6	0.8	1.3	105 & 35*	16.1
Maximum Width (km)			2.4	6.4	0.4	0.24	0.3	6.4	0.8
Watershed Area (km^2)		1114	2396	46 102	46 102	46 102	46 102	46 102	49 469
Normal Range of Water Levels (m)									
High Water	750		577	532	515	495	474	532	450
Low Water	697		547	530	513	491	469	530	447

* Kootenay Lake is the reservoir of Corra Linn Dam and the Kootenay Canal Project
(CRTPEB 1987; B.C. 1977; B.C. 1976d)

The Corra Linn Dam affected fish and flooding. Water storage from late summer to early spring floods the narrows in the West Arm which adversely affects spawning and egg survival of rainbow trout and other salmonids. On the other hand, enlargement of Grohman Narrows and the operation of Corra Linn has protected lands bordering Kootenay Lake and the Kootenay River from flooding by reducing the level of Kootenay Lake during the spring freshet.

Upper Bonnington Dam

Upper Bonnington Dam is located 1.6 kilometres downstream from Corra Linn and owned by WKP. There are two powerplants at the dam: one owned by WKP (55 MW capacity) and the other owned by the City of Nelson (8.67 MW capacity) (British Columbia, 1976d). The original powerhouse was built in 1897 and rebuilt in 1907. The last extension to the powerhouse was completed in 1940. The purpose of the project was to produce electricity for Cominco's Trail operations and the City of Nelson.

Upper Bonnington is a run-of-the-river plant with upstream storage in Kootenay Lake provided by Corra Linn. The headpond behind the dam is very small, extending upstream for 1.6 kilometres to the Corra Linn Dam, with a maximum width of 0.5 kilometres. Pondage water levels normally fluctuate over a range of two metres with a maximum design water level of 517 metres.

Lower Bonnington Dam

Lower Bonnington Dam is located one kilometre downstream from Upper Bonnington and owned by WKP. The first hydro installation on the Kootenay River, it was replaced in 1924 and reconstructed in 1964. The powerplant has a capacity of 42 MW and was developed to generate electricity for Cominco's Trail operations.

Because of the small size of the headpond (one km x 243 m), Lower Bonnington is classed as a run-of-the-river plant. Pondage water levels normally fluctuate over a range of 4.3 metres with a maximum design water level of 496 metres.

South Slocan Dam

South Slocan Dam is located 1.2 kilometres downstream of Lower Bonnington and owned by WKP. The dam and 47 MW powerplant were completed in 1928 to provide power for Cominco's Trail operations. South Slocan is a run-of-the-river plant with upstream storage provided by Corra Linn Dam. The headpond is small, extending upstream for 1.2 kilometres to Lower Bonnington, with a maximum width of about 305 metres. Pondage water levels fluctuate over a range of 4.3 metres, while the maximum design water level is 475 metres.

Libby Dam

The Libby Dam is located on the Kootenay River, 80 kilometres downstream and 160 kilometres upstream of the international boundary in Montana. The purposes of the dam are flood control in Montana, Idaho and the lower Columbia River, hydroelectric power generation at the site and at downstream plants and recreation. The dam was authorized by the United States Congress in the Flood Control Act (1950) and by the joint Canada-United States Columbia River Treaty (1961). Construction of the dam began in 1966; full operation of water storage started in 1973.

The dam is a concrete gravity structure with a spillway section and reaches a maximum height of 113 metres above the streambed. The reservoir behind the dam, Lake Koocanusa, is 148 kilometres long at full pool elevation and extends 63 kilometres into British Columbia to the mouth of the Bull River.

In a year of average runoff, the reservoir will be full during August, September and October, with drawdown for power generation and flood control commencing in November and reaching a maximum in April. The reservoir level will then begin to rise again during May, June and July as a result of the storage of spring runoff. The minimum annual drawdown was 18 metres for the first 15 years of the project and 12 metres thereafter. The average annual drawdown will be about 30 metres while the maximum drawdown will be 52 metres. Thus the cycle of spring freshet storage and winter release has considerably flattened the Kootenay River hydrograph (Figure 4).

Brilliant Dam

Brilliant Dam is located 18 kilometres downstream of South Slocan Dam and owned by Cominco. The project was completed in 1944 to generate electricity for Cominco's various operations and consists of a 34-metre high concrete dam with a spillway and a 109 MW powerplant. Brilliant is also classed as a run-of-the-river plant. The headpond behind Brilliant is larger than those of South Slocan, Upper Bonnington and Lower Bonnington Dams, but is still too small to provide storage for any more than a part of one day's operation. The headpond is about 16 kilometres, has a maximum width of 0.8 kilometre and a usable storage capacity of 9,875 acre-feet. The creation of the headponds drowned out a 16-kilometre stretch of rapids in the Kootenay River. Pondage water levels normally fluctuate over a three-metre range, while the maximum design water level is 453 metres.

Kootenay Canal Project

The Kootenay Canal was constructed by B.C. Hydro and Power Authority to take advantage of the increased water flows in the Kootenay River from operation of Libby and Duncan Dams. The project consists of a 4.8 kilometre canal, with an intake at the Corra Linn Dam, supplying water to a 500 MW powerplant just downstream of South Slocan Dam. Water flowing in the canal bypasses the powerplants at Corra Linn, Upper Bonnington, Lower Bonnington and South Slocan Dams. The operating plan for the Kootenay River Canal Project is to send 142 cubic metres per second (m^3/s) down the Kootenay River via Corra Linn and channel the remainder (up to 708 m^3/s) through the canal. When the discharge in Kootenay River at Corra Linn exceeds 850 m^3/s, the excess water will be routed through the Kootenay River via Corra Linn.

Construction of the Kootenay Canal project began in September 1971 and the plant was fully operational in October 1976.

Duncan Dam

The Duncan Dam is located on the Duncan River, about eight kilometres upstream from the north end of Kootenay Lake (Figure 3). The dam was built by B.C. Hydro under the terms of the Columbia River Treaty. The primary purpose of the dam is storage of water for flood control on the Columbia River in the United States. The dam also provides some regulation for power generation at downstream plants, but there are no power generation facilities at the dam. Construction of the Duncan Dam was started in 1965 and completed in 1967.

The operation of the 1.4 million acre-feet of storage behind the dam for flood control is based on flood forecasts made during each winter. If required for flood control, the reservoir must be evacuated to provide 700,000 acre-feet of storage by April 1 and up to 1,270,000 acre-feet by May 1. Unless otherwise agreed to by Canada and the United States, the average weekly outflow from the dam is not to be less than 25 m^3/s. The Duncan Lake reservoir is generally full or nearly full by late July to early August and remains full until drawdown begins in November or December. Drawdown during December, January and February lowers the reservoir level by as much as 28 metres by March. The reservoir then remains at this low level until spring runoff during May, June and July brings it back to full pool elevation by August.

Before completion of the dam, the minimum daily flow in the Duncan River was 7.6 m^3/s whereas minimum flows of 2.8 m^3/s and less are now common.

Goat Dam

The Goat Dam is located on the Goat River, about 11 kilometres from its confluence with the Kootenay River. The dam and powerhouse are owned by the WKP and were completed in 1933. The dam was heavily damaged by a flood in 1956 and is rarely used anymore, with only minor amounts of water being passed through the turbines during spring and fall maintenance procedures. The balance of the flow in the Goat River at the dam is allowed to spill continuously over the spillway.

2.3.3 Water Quality

Water quality is generally considered good throughout the Basin, meeting drinking water standards except for turbidity during periods of high flow. Some areas receive localized water quality degradation due to forestry, mining or agricultural activities and community effluent discharges.

The provincial Waste Management Branch samples 20 sites two to three times a year upstream and downstream of development activities such as mines, agricultural activities and municipalities. Ten of these sites are on Kootenay Lake. Location of effluent discharge points and monitoring stations are available in 1:50 000 maps and data are available from the Branch. In addition, the provincial Ministry of Environment and Parks is preparing an environmental management plan for the West Arm which will address water quality and supply and waste disposal practices (British Columbia, 1987c).

The federal Water Quality Branch operates two stations in the Basin: one on the Moyie River is sampled six times a year and the other on the Kootenay River near Creston is sampled every two weeks. Data are available for these and several discontinued stations from the Branch. No significant water quality degradation has been detected.

Comprehensive water quality studies were undertaken by both federal and provincial agencies in the 1970s and early 1980s to determine the effects of Libby and Duncan Dams on the Kootenay River system. Generally, there was no significant change in Kootenay Lake's thermal regime nor nitrogen levels and water clarity was increased. The dams did cause downstream decreases in metals, fluoride, phosphorus, suspended solids, algal biomass and oxygen deficits (British Columbia, 1984a). These effects are felt as far downstream as Kootenay Lake where the loss of nutrients, particularly the 50 percent reduction in phosphorus, has caused a significant decline in the lake's lucrative sports fishery production. However, research has not concluded that the loss in fish productivity was a direct result of impoundments or due instead to the implementation of pollution control measures and the eventual closure of Cominco's fertilizer plant in Kimberley. Lack of suitable spawning and fishery habitat may be another contributor to declining fish populations. Kootenay Lake reached a new equilibrium at the lowered nutrient levels in the mid-1980s (British Columbia, 1984a). An aerial fertilization program at the outlet of Kootenay River at Kootenay Lake is being considered by the provincial Ministry of Environment and Parks (MOEP) with assistance from the federal Department of Fisheries and Oceans, to offset the nutrient loss and resulting decline in fish productivity. An alternative to the fertilization program would be to change the selective withdrawal system at Libby Dam to release the nutrient-rich bottom waters from the reservoir (Canada, 1988b).

2.3.4 Groundwater

Glacial deposits and terraces along stream channels are the principal sources of groundwater in the Basin; their productive capacity has not been determined. There are 899 recorded wells in the Basin, most are located near communities such as Creston, Nelson and Slocan. The Groundwater Service of the provincial MOEP Water Management Branch has observation wells in Castlegar, Salmo and Cranbrook which are usually sampled in the spring and fall (British Columbia, 1988b). Further information is available from the Groundwater Service in Victoria.

2.4 Vegetation and Soils

There are five biogeoclimatic zones represented in the Basin: Ponderosa Pine-Bunchgrass, Interior Douglas Fir, Interior Western Hemlock, Subalpine Engelmann Spruce-Subalpine Fir and Alpine Tundra (Figure 5) (Krajina, 1976).

The Ponderosa Pine-Bunchgrass Zone is confined to a small area adjacent to the Lower Kootenay River at the international boundary. It is the driest zone and in summer the warmest area in the Basin. Ponderosa Pine is the dominant conifer but some western red cedar and interior Douglas fir are also present. Deciduous species include balsam poplar, trembling aspen, water birch and paper birch. Bunchgrass is the major grass although sage brush is found in areas of over-grazing. Soils are Luvisolic and alluvial in origin.

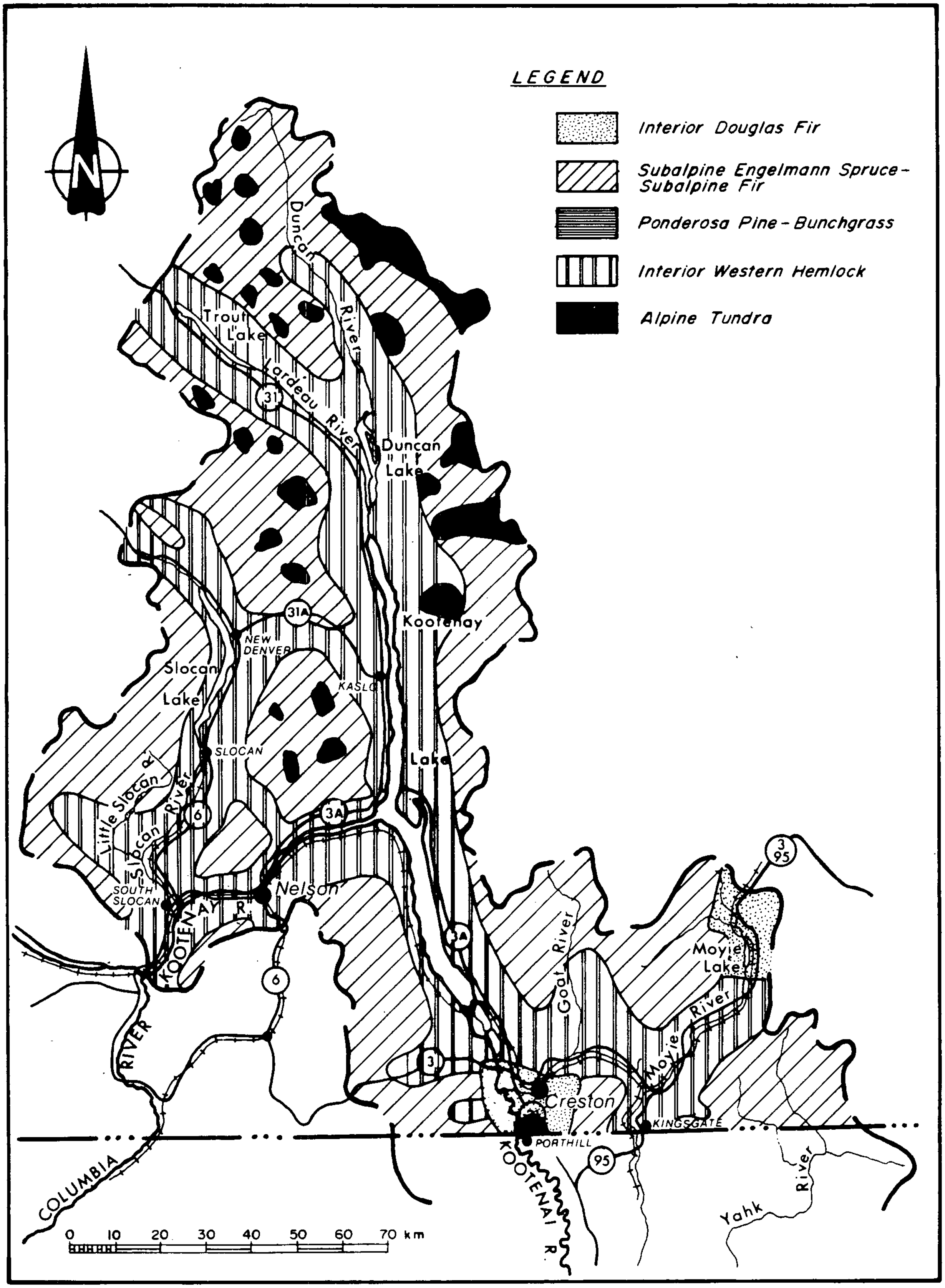

Figure 5 Biogeoclimatic Zones

The Interior Douglas Fir Zone surrounds the Ponderosa Pine-Bunchgrass Zone and extends along the Lower Kootenay Valley from the international boundary to Creston. This zone is slightly wetter and cooler and has two major conifers: interior Douglas fir and ponderosa pine. Other conifers present include lodgepole pine, western white pine, grand fir, western larch, western and red cedar, white spruce, Engelmann and black spruce and subalpine fir. In addition to the deciduous species found in the Ponderosa Pine-Bunchgrass Zone, mountain maple is frequent in this zone. The dominant soil order is Luvisolic although Gleysolic soils occur in poorly drained areas near Creston.

The Interior Western Hemlock Zone is the wettest and most productive forest zone in the Basin occupying valleys to 1770 metres. The zone is typified by large trees of many species including western hemlock, western birch, western red cedar, interior Douglas fir, grand fir, western white and lodgepole pine, Engelmann spruce and subalpine fir. Balsam poplar, trembling aspen and paper birch are frequent deciduous trees in this zone. The forest forms a dense canopy which yields little understory vegetation, although devils club, thimbleberry, scoulers willow, Queen's cup, sarsaparilla, tiger lily and twinflower are prevalent in many areas. Soils are generally deep and well-drained Podzols with glacial origins.

The Engelmann Spruce-Subalpine Fir Zone occurs at higher elevations from 1260 m to 1950 m and is generally drier than the Interior Western Hemlock Zone. Engelmann spruce and subalpine fir dominate this typical high-altitude British Columbia interior forest. Other species include lodgepole pine, western white pine, whitebark pine, limber pine and subalpine larch. Water birch, paper birch, trembling apsen, balsam poplar and mountain maple are frequent deciduous species. Shrubs include kinnikinnick and huckleberry while lupines and Indian paintbrush are common in meadow openings. Soils are Podzolic and similar to types found in the Interior Western Hemlock Zone.

The Alpine Tundra Zone lies above treeline which is generally at 1950 metres. This zone is dominated by bedrock and scattered glaciers and snowfields. Vegetation includes heaths, herbs, bryophytes, lichens and alpine flowers such as arnicas and saxifrages. Some dwarf or stunted conifers occur at lower elevations.

2.5 Wildlife and Fisheries

2.5.1 Wildlife

The Lower Kootenay River Basin provides diverse habitats for a wide range of wildlife species. The main factor limiting the distribution and abundance of wildlife is snow depth, particularly above 1100 metres. Human encroachment such as communities, resource extraction and recreational activities also has an impact on the Basin's wildlife populations.

The highest Canada Land Inventory (CLI) wildlife capability ratings (Class 2 and 3) are given to year-round habitat below 110 metres in the main valleys (Canada, 1970). Slightly higher slopes with a southerly exposure provide critical winter habitat (Figure 6). Elevations from 1100 to 1800 metres generally provide only summer range for ungulates (Class 5 and 6). The formation of the Duncan Dam reservoir flooded some of the Basin's best winter range (RDCK, 1982).

Mule deer are the most widely distributed and abundant ungulate in the Basin. They generally favour south- and west-facing slopes less than 1100 metres in elevation, particularly along the east shore of Kootenay Lake and the north shore of the West Arm. White-tailed deer are also common in the Basin. Elk occur in smaller numbers, wintering on southerly slopes in the Purcells and Selkirks; woodland cariboo are found in small herds at higher elevations in the Moyie Range and Kokanee Glacier Park. Mountain goats and bighorn mountain sheep prefer alpine habitats in the summer but move to low elevation cliff sites in winter. Moose are the least abundant ungulate, observed mostly in the Little Moyie and Goat River valleys.

Other mammals commonly found in the Basin include black and grizzly

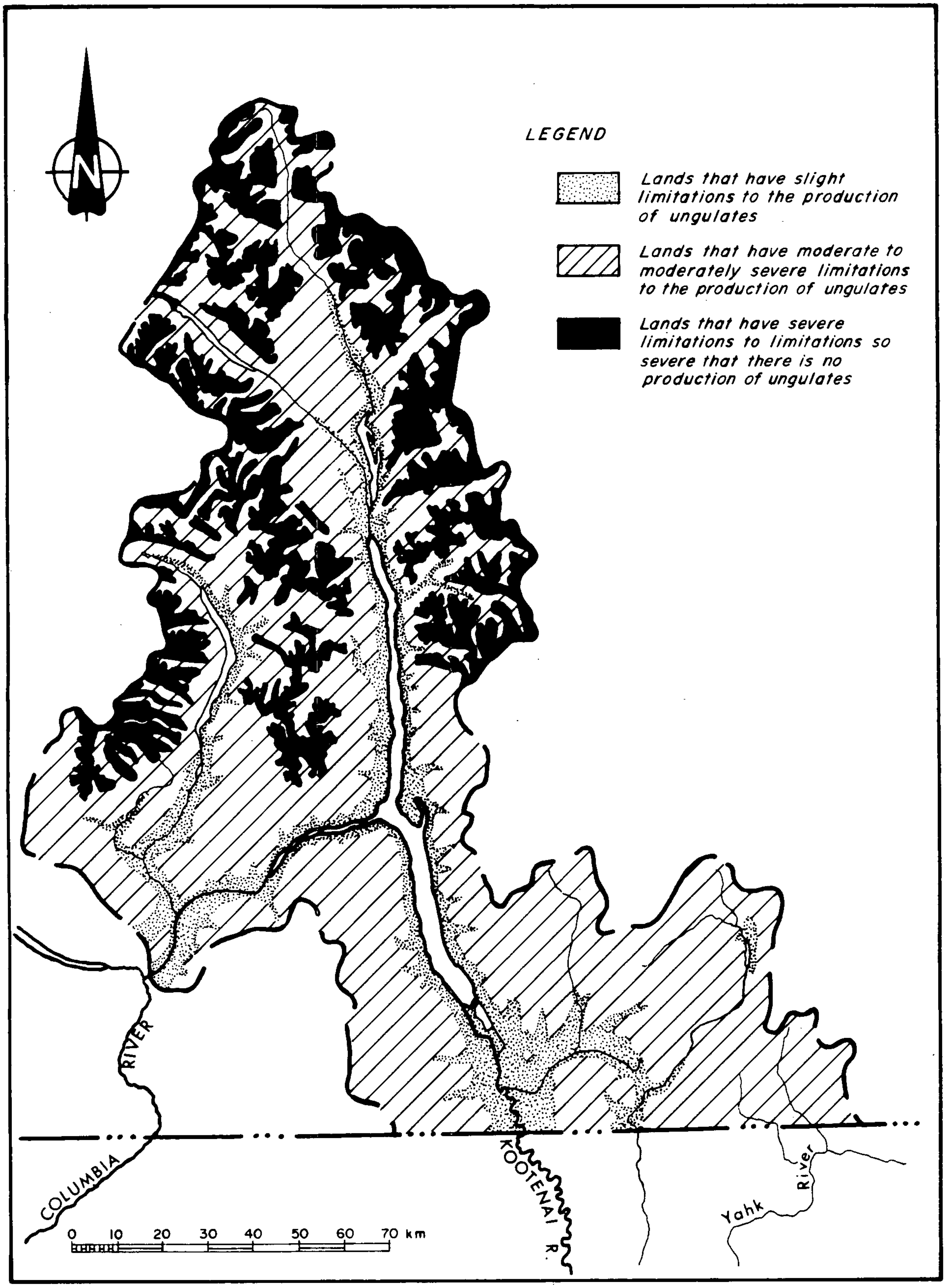

Figure 6 Wildlife Capability

bears, cougar, coyote, lynx and bobcat. Smaller mammals such as muskrat, squirrel, beaver, mink, marten and weasel provide a modest income to the Basin's trappers.

No rare or endangered species have been reported in the Basin.

Waterfowl production in the Basin is limited by the lack of wetlands and adverse climatic conditions. However, the Kootenay River floodplain from Kootenay Lake south to the international boundary is an outstanding exception. This area, referred to as the Creston Flats, provides the most important waterfowl migratory staging and production area in the British Columbia Interior. These wetlands are highly rated by the CLI asa mixture of Class 2, 3S and 3M. This prime habitat is a stop-over location on migratory bird routes. Ducks, geese, wading birds, song birds and raptors are all present in substantial numbers. Part of the area is managed by the Creston Valley Wildlife Management Authority, a unique federal-provincial project with participation from private conservation agencies (CVWMA, 1986).

To a lesser extent, the marshy lands between Duncan Lake and Kootenay Lake and upstream of Duncan Lake provide waterfowl habitat.

Upland game birds include blue spruce and ruffed grouse in wooded areas; sharp-tailed grouse in mixed grassland forest; ring-necked pheasants in the Creston Flats; and white-tailed ptarmigan in alpine areas. Mature cottonwood stands provide nesting sites for one of the world's largest concentrations of ospreys. Some 250 species of birds are found in the Kootenay area (Envirocon, 1973).

2.5.2 Fisheries

The Lower Kootenay River Basin supports a substantial fishery resource. Rainbow trout, Yellowstone cutthroat trout, mountain whitefish, Dolly Varden, Kokanee, largescale sucker, redside shiner, lake chub, burbot and white sturgeon are all indigenous to the region, with Kokanee being the most productive. Several species of sports fish have been introduced:

eastern brook and brown trout, longmouth and smallmouth bass and yellow perch. Walleye have recently migrated up the Columbia River from Washington State (British Columbia, 1984b).

The fishery is presently in good condition and most habitats are considered moderately productive (British Columbia, 1984b). The Basin's six large lakes and reservoirs provide the highest productivity particularly for Kokanee, rainbow trout and Dolly Varden char. In fact, Kootenay Lake supports the most important inland fishery in British Columbia, (RDCK, 1982).

Spawning and rearing generally occurs in the lake's accessible tributary streams and rivers. Rainbow and cutthroat trout spawn in the spring, while Dolly Varden, Kokanee, mountain whitefish and eastern brook trout spawn in the fall (Envirocon, 1973).

One group of rainbow trout found in Kootenay Lake, the Gerrard stock, matures at a late age and attains a very large size (8-20 kg) (Northcote, 1973). While most rainbow trout feed on zooplankton and other invertebrates, the Gerrard trophy stocks become piscivorous as mature fish and feed on Kokanee, thus attaining their large sizes (Daley et al, 1981).

The Basin has 35 low elevation small lakes of which 18 are productive and three are stocked, and 247 high elevation small lakes of which 178 are productive and 23 stocked. Generally the low elevation lakes are more productive due to higher nutrient levels and a longer growing season.

The Basin's main rivers - - the Slocan, Lardeau and Kootenay - - support mixed fisheries for rainbow trout, Dolly Varden char and mountain whitefish. The Kootenay mainstem also supports burbot, cutthroat trout and sturgeon. Streams are generally steep and unproductive supporting only modest populations of small Dolly Varden, whitefish and cutthroat.

3.0 EXISTING AND POTENTIAL RESOURCE USE

3.1 Historical Perspective

The Basin's first inhabitants were ancestors of the present day Lower Kootenay Indian band. They lived mainly in small groups along Kootenay Lake; fishing and hunting provided their main sustenance.

David Thompson was the first white man in the Basin, exploring and mapping the Kootenay System from 1807 to 1812 for the North West Company. Early explorations and the resulting fur trade had little lasting impact on the Basin but the discovery of gold in the East Kootenays in 1864 prompted completion of the Dewdney Trail and the Basin's first east-west link with the coast. The Trail brought many prospectors to the area and gold was discovered near Nelson shortly after. Lasting settlement in the Basin did not occur until the late 1880s and early 1890s when several high-grade mineral deposits (silver, lead, copper and gold) were discovered near Kootenay Lake. The flourishing mining activity prompted the emergence of Nelson as an important commercial centre and the original establishment of many communities including Kalso, Slocan, Moyie and Lardeau.

The transportation network was developed during this period of mining activity. Paddle wheelers navigated the major waterways and provided an important means of transport until 1916 when railways gained in importance. The completed railway network provided north-south links with the United States and east-west links with the rest of British Columbia and Canada.

The growth of mining towns and railway construction provided the initial stimuli for the forestry industry. Railway ties, mine posts and planks were in demand. When mining declined by the late 1920s, forestry had emerged as a stable economic base.

Between 1910 and 1920 Doukhobors from Saskatchewan settled in the Slocan and Kootenay valleys and began the Basin's first significant agricultural production. Agriculture flourished until the depression in the 1930s. Today, Creston Flats is the only major commercial agricultural area in the Basin. The Basin's economy is now based on forestry, mining, hydroelectric generation and, increasingly, tourism and recreation.

3.2 Population and Amenities

The Lower Kootenay River Basin is a mountainous, forested region dominated by Kootenay Lake and its tributaries. Most of the population has settled along the Kootenay River mainstem and West Arm, with smaller communities along Kootenay Lake and in the Slocan Valley. All of the Basin's communities have populations less than 10,000: Nelson with 8113 residents and Creston with 4098 are the largest communities. The Basin's communities and population figures are listed in Table 5 and shown on Figure 7. Labour force statistics are provided in Table 6. Recent closures of the Westar plywood and sawmill and David Thompson University in Nelson account for that city's negative population growth. Additional demographic information is available from the Regional District of Central Kootenay offices in Nelson.

The smaller communities are dependent on either forestry or mining activities for their economic survival, although tourism and recreation are gaining in importance. Creston offers a slightly more diversified economy with agriculture and small manufacturing, such as Columbia Brewing Co., providing stability. Nelson is the Basin's service and administrative centre with federal, provincial and regional district agencies providing many long-term jobs.

Most communities have a public water supply system from nearby surface waters. Many rural households have wells. All of Nelson's residents are linked to a primary sewage treatment system, while most of Creston's population is linked to a secondary sewage treatment system. Rural

TABLE 5. POPULATION

Sub-Basin	Municipality Type	1981	1986	% Change	Occupied Private Dwellings
MOYIE					
Rural			737		
SOUTH LAKE					
Rural			6,734		
Creston	Town	4,190	4,098	-2.2	1,797
NORTH LAKE					
Rural			1,256		
Kaslo	Village	854	858	0.5	376
WEST ARM					
Rural			7,501		
Nelson	City	9,143	8,113	-11.3	3,378
SLOCAN					
Rural			3,818		
New Denver	Village	657	596	-9.3	241
Silverton	Village	280	233	-16.8	95
Slocan	Village	351	294	-16.2	123
INDIAN RESERVES		74	76	2.7	24
TOTAL BASIN (1986)			34,314		

(Canada, 1987b)

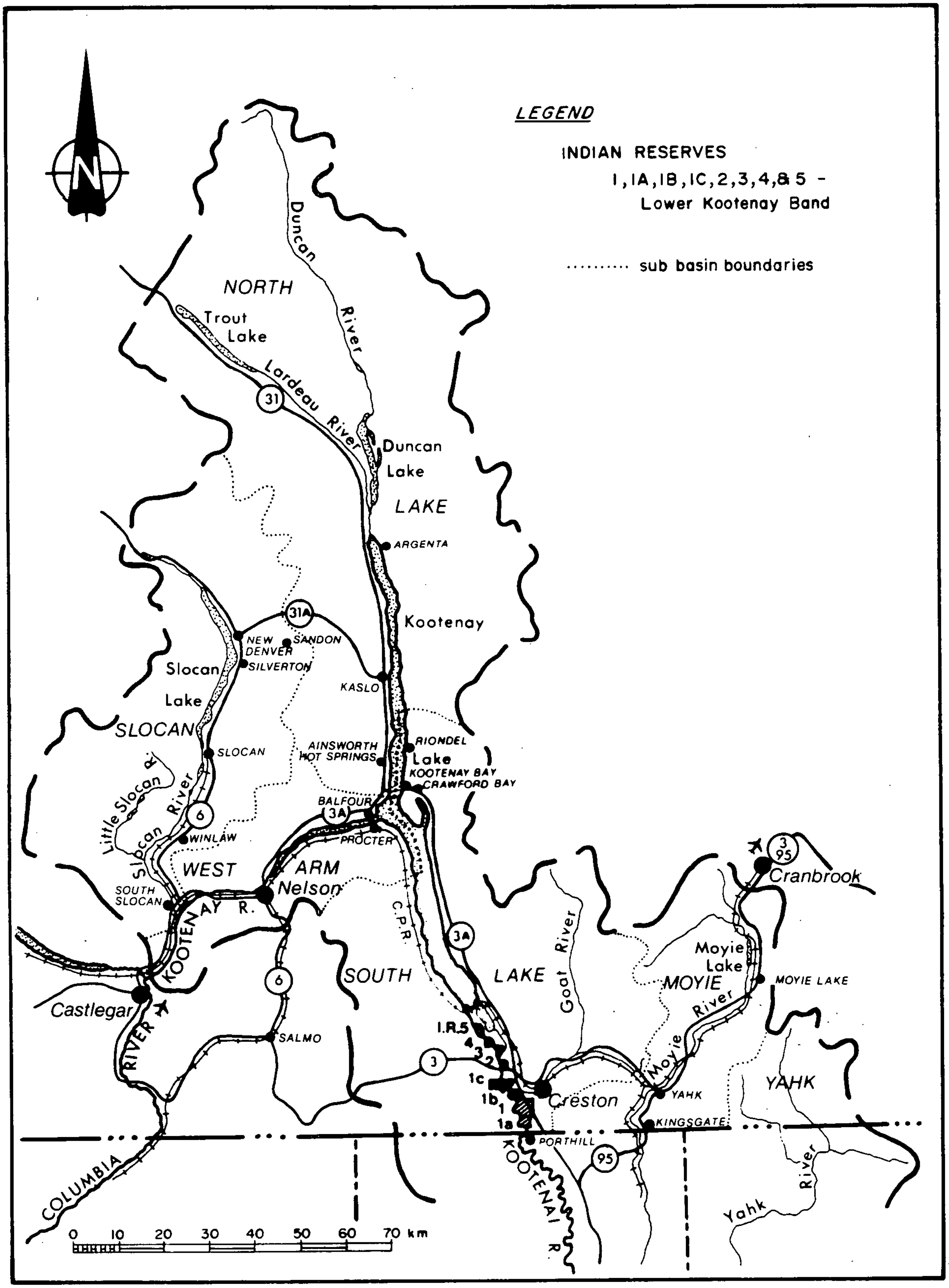

Figure 7 Communities, Transportation and Indian Reserves

TABLE 6. EXPERIENCED LABOUR FORCE BY INDUSTRY (1981)

	Number	Percent
Agriculture	560	3.5
Forestry	870	5.4
Fishing and Trapping	20	0.1
Mines, Quarries and Oil Wells	410	2.5
Manufacturing	2,045	12.7
Construction	1,540	9.6
Transportation, Communication and Utilities	1,480	9.2
Trade	2,460	15.3
Finance, Insurance and Real Estate	460	2.9
Service (Comm., Business and Personal)	4,595	28.5
Public Administration and Defence	1,045	6.5
Unspecified or Undefined	620	3.8
Total Experienced Labour Force	16,105	100.0

(British Columbia, 1986a)

populations rely on septic tanks for sewage disposal (Canada, 1986).

Power is provided throughout the Basin by West Kootenay Power and Light Co. Though the company's head office is in Trail, it employs over 400 workers at 11 dams in the Kootenay area. Nelson provides its own power and British Columbia Hydro supplies the northern portion of the Basin (B.C. Central Credit Union, 1985).

3.2.1 Transportation

Highways 3 and 3A traverse the southern portion of the Basin, while Highway 6 provides north-south linkages to the Trans Canada Highway and the United States, respectively. Greyhound provides scheduled bus passenger service. There are no major commercial airports in the Basin; residents must travel to Cranbrook for regularly scheduled flights. Several small airstrips and charter airplane and helicopter services are available in the Basin (Figure 7). There is no passenger rail service in the Basin, although freight and express service is provided by Canadian Pacific Railway's Crowsnest line from Alberta and Cranbrook to the Okanagan and Pacific Coast. Various spur tracks link the Slocan Valley with the main railway lines, and the Burlington Northern connects Nelson with the United States. Figure 7 shows the major rail and road networks in the Basin.

3.2.2 Indian Reserves

There are eight Indian Reserves in the Basin, all located on the Creston Flats (Figure 7 and Table 7). Indian Reserve 1A is leased to the Creston Valley Widlife Management Authority for migratory bird habitat. Indian Reserves 1, 1B and most of 1C are used for hunting and grazing with hunting permits and grazing rental income accruing to the Lower Kootenay Band. Most of the Band's 76 residents live on benchlands along the eastern boundary of these reserves. Part of 1C and all of IRs 2, 3, 4 and 5 have been reclaimed by various dyking projects and the land is leased for agriculture, mostly forage crops such as hay and alfalfa.

TABLE 7. LOWER KOOTENAY INDIAN RESERVES

Reserve No.	Size (Hectares)	Present Use
1	728	Waterfowl hunting; grazing
1A	158	Waterfowl habitat
1B	483	Waterfowl hunting; grazing
1C	541	Annual cropping; waterfowl hunting; grazing
2	198	Annual cropping
3	64	Annual cropping
4	39	Annual cropping
5	202	Annual cropping
TOTAL	2,413	

(Canada, 1972)

3.3 Forestry

The Basin's Interior Western Hemlock Zone produces the most productive forests in British Columbia's interior (RDCK, 1982). Figure 8 indicates areas of high and moderate productivity. Major commercial species include interior Douglas fir, Engelmann and white spruce, balsam, interior western hemlock, lodgepole pine, western larch and western red cedar.

For administrative purposes, the Basin contains all of the Kootenay Lake Timber Supply Area, formerly the Creston and Lardeau Public Sustained Yield Units (PSYU), and a portion of the Arrow Lakes Timber Supply Area, formerly the Slocan PSYU In addition, Tree Farm Licence (TFL) #3 (79 687 ha) is located in the Slocan sub-basin; it has a mature volume of six million m^3 and an annual allowable cut of 119 618 m^3 (RDCK, 1982). Table 8 provides a summary of basic data for the PSYUs. There is a generally well-balanced age class distribution in the PSYUs between immature, mature and overmature timber. Annual allowable cuts are now met in the Creston and Slocan PSYUs while some surplus is available in the Lardeau PSYU (Reid, Collins and Assoc., 1985).

Forestry and forest-related industries are the largest employer in the Basin and an important contributor to the Basin's economy. In the northern communities of Silverton, New Denver and Kaslo, logging is a major employer. Many logging contractors have been allocated timber quotas in the Basin; some of these send the logs out of the region for processing but many supply local mills.

There are six large sawmills operating in the Basin, each employing 20 or more workers. The largest sawmill is owned by Slocan Forest Products, holder of TFL #3, and employs 225-300 people. The Slocan mill manufactures lumber for a predominantly United States market and sends by-product chips to a pulpmill in Castlegar for fibre and to a power plant in Kettle Falls, Washington for fuel. Other sawmills include

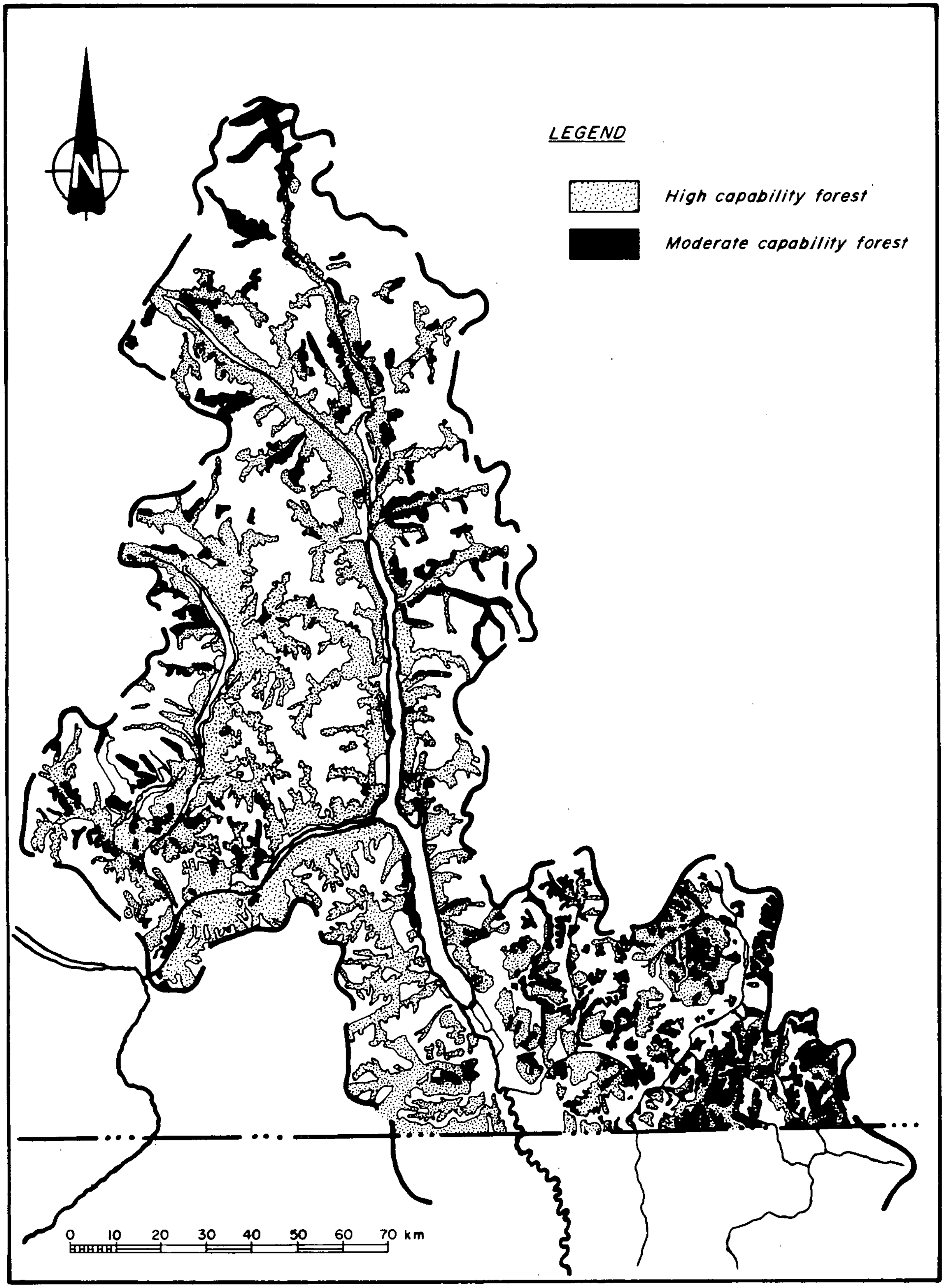

Figure 8 Forest Capability

TABLE 8. SUMMARY OF BASIC DATA FOR THE BASIN'S PUBLIC SUSTAINED YIELD UNITS

PSYU	Mature Volume (m^3)	Productive Area Mature (ha)	Productive Area Immature (ha)	Total Productive (Includes NSR & NCC) (ha)	Total Area Including Non-Forest (ha)	Commitment (m^3)	Volume Scaled (m^3)
Creston	12 767 930	49 514	146 621	209 027	274 678	291 700	230 130
Lardeau	53 884 630	151 089	202 430	377 126	739 692	466 830	293 725
Slocan	11 307 500	35 450	76 636	116 818	209 641	202 550	113 364
Basin Totals	77 960 060	236 053	425 687	702 971	1 224 011	961 080	637 219

(British Columbia, 1980b)

Kalesnikoff Lumbering, Meadow Creek Cedar, Wynndel Box and Lumber, Crestbrook Forest Industries and J.H. Huscroft. More information on these mills is provided in Table 9. There are also approximately 13 smaller mills in the Basin employing 38 workers.

Mill employment has been declining since 1973 despite increased productivity because of the transition to large, highly-mechanical centrally-located plants (British Columbia, 1986). For example, a large sawmill in Nelson which employed 350 people closed in 1983; there is a possibility the mill may reopen but the scale of future operations is unknown (British Columbia, 1986c).

Future logging or mill expansion is not likely since annual allowable cuts are now being met. The potential exists for increases in timber yields through increased utilization of problem forest types, restocking burned and logged areas and rehabilitating unproductive timber stands; however, any increases may be offset by reductions in annual allowable cuts due to measures such as watershed protection and recreation area and right-of-way designations. The use of waste products, such as converting sawdust into particle board, and production of specialty wood products may be areas of industry expansion.

While forestry and its related activities are important to the Basin's economy, many land and water use conflicts are apparent. The residents of the West Kootenay area are concerned over community watershed degradation, particularly in the Slocan Valley, and water quality contamination from toxic wood preservatives used in the Basin's mills. Pesticide applications and poor logging practices on steep slopes also contribute to public concern for water quality preservation in the Basin (Vancouver Sun, 1985 and 1987a; The New Catalyst Quarterly, 1987).

3.4 Mining

Mineral exploration and mining have played a significant role in the Basin's economic development. The 1860s' gold rush in the East Kootenay area resulted in the establishment of many of the Basin's communities

TABLE 9. SAWMILLS

Sub-Basin	Sawmill	Location	Employees	Product (000 m^3/yr.)	Demand
Slocan	Slocan Forest Products	Slocan	224	lumber;chips	480
	Kalesnikoff Lumbering Co.	Thrums	62	lumber	85
	Other Small Operations		5	lumber;poles; shake & shingle	-
West Arm	Other Small Operations		13	lumber; poles; shake & shingle	-
North Lake	Meadow Creek Cedar Co.	Kaslo	29	shake & shingle	60
	Other small operations		18	lumber;poles;shakes	-
South Lake	Wynndel Box and Lumber	Wynndel	118	lumber	100
	Crestbrook Forest Ind.	Creston	60	veneer & plywood	80
	J.H. Huscroft	Erickson	20	lumber	150
	Other Small Operations		2	lumber	-
Moyie	Other Small Operations		-	misc. lumber products	-

(Canada, 1987a)

such as Nelson, Kaslo, Slocan and Sandon. Most of the Basin is considered an area of moderate mineral potential with pockets of high potential in the Moyie sub-basin, southwest of Nelson, the east side of Kootenay Lake, Slocan Lake and north of Trout Lake (Figure 9). Detailed mineral inventory maps are available from the provincial Ministry of Energy, Mines and Petroleum Resources. Principal ores found in the Basin include silver, lead and zinc with lesser amounts of gold, cadmium, tungsten, copper and molybdenum.

In 1986 mineral exploration increased 24 percent over the previous year due to favourable market conditions (British Columbia, 1987a). Over 30 properties were explored in 1986; Table 10 lists the most promising and their locations are shown on Figure 9. A significant new mineral find was made by Mikado Resources Ltd. and Turner Energy and Resources Ltd. on their Abbott claim (Figure 9, #2) east of Trout Lake. Reserves are estimated at 45 000 tonnes grading 75.2 grams/tonne silver, 0.85 grams/tonne gold, 28.4 percent lead and 16.6 percent zinc. Mineralization is sufficiently high grade to be considered "direct-shipping ore". On the neighbouring property (#1), Mikado also completed 25 metres of underground development work and seven diamond-drill holes.

Diamond drilling by Noranda Exploration Company Ltd. at the LH property (#5) revealed two gold-bearing zones averaging 5.9 grams/tonne gold and 11.3 grams/tonne gold over 2.6 metres and 14 metres respectively. Prospecting for gold continues on the Caribou property (#3) at Hailstorm Mountain.

In the Nelson area, Ryan Exploration Company continued a drilling program on the Star gold claim (#6). Snowwater Resources Ltd. diamond-drilled a quartz vein on the Referendum mine property (#7) near Nelson. Lacana Mining Corporation relinquished its option on the Kena claims (#8) after completing 3049 metres of diamond drilling. Gold was found but continuity of values could not be established.

There were two producing metal mines in the Basin in 1986; Silvana and Tillicum Mountain (Table 11). The Silvana Mine, (#10), owned and

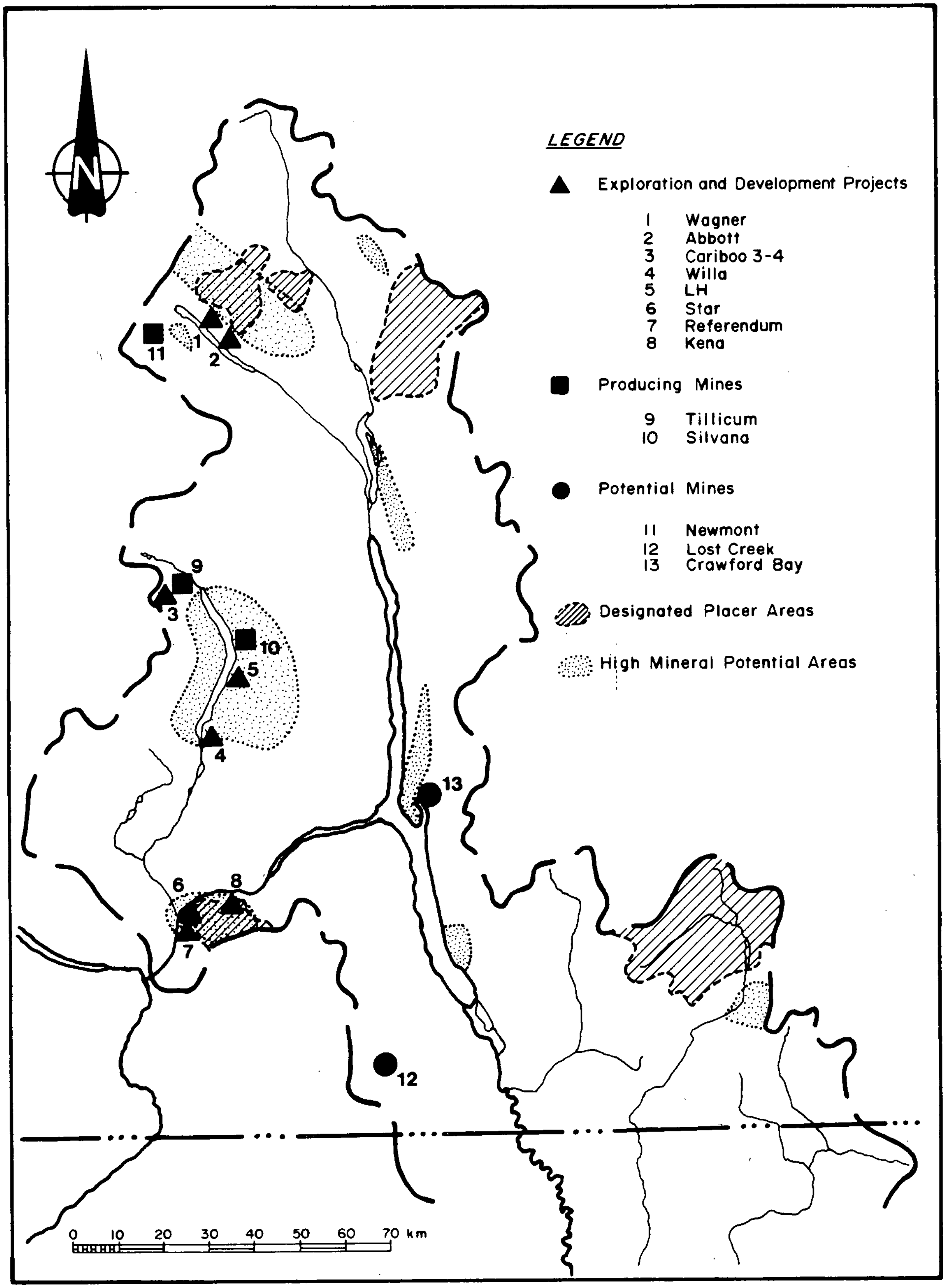

Figure 9 Mineral Potential, Exploration and Development

TABLE 10. MINERAL EXPLORATION ACTIVITY (1986)

Map No.	Property	Owner/Operator	Mining Division	Commodity Type	Deposit	Work Done
1	Wagner	Mikado Resources Turner Energy	Slocan	Ag,Pb,Zn, Cu,Au,Cd	vein	drifting, 14.3 m; raise, 10.7 m; 7 undergrnd. ddh
2	Abbott	Mikado Resources Turner Energy	Slocan	Ag,Pb,Zn, Cu,Cd,Au	replacement	portal rehabilitation; 152-m strike length diamond drilled
3	Cariboo	A. Strebchuk	Slocan	Au,Ag	vein	portal construction; drifting, 7 m;
4	Willa	BP Canada, Rio Algom,Northair Mines	Slocan	Au,Cu,Ag	diatreme	underground diamond drilling, 5233 m; drill-indicated reserves, West zone, 849 400 t @ 5.49 grams/t Au, 0.82% Cu; Willa zone 3.4 x 10^6 t @ 1.48 grams/t Au, 4.8 grams/t Ag, 0.32% Cu
5	LH	Andaurex Resources Noranda Expl.	Slocan	Au,Ag,As, Cu	vein	diamond drilling by Noranda
6	Star	Ryan Exploration	Nelson	Au,Ag,Cu	breccia	reverse circulation drilling, 762 m
7	Referendum	T. Cherry	Nelson	Au,Ag,Si	vein	surface trenching; diamond drilling
8	Kena	O. Janout Lacana Mining	Nelson	Au,Ag,Cu	vein	diamond drilling, 3049 m

(British Columbia, 1987a)

TABLE 11. ACTIVE MINES (1986)

Map No.	Property	Owner/Operator Division	Mining	Commodity Type	Deposit	Production and Development Data
9	Tillicum	Esperanza	Slocan	Au,Ag,Pb,Zn,	vein	surface diamond drilling, 611 m; underground diamond drilling, 171 m; drifting, 115.5 m; 3420t shipped
10	Silvana	Dickenson Mines	Slocan	Ag,Pb,Zn,Cd,	vein	produced 225 376 t Ag, Pb,Zn,Cd ore

(British Columbia, 1987a)

operated by Dickenson Mines Ltd. is the Basin's only significant producer employing 35 to 45 people (British Columbia, 1986b). In 1985, 22 693 tonnes of ore grading 648.2 grams/tonne silver, 6.59 percent zinc and 9.37 percent lead were mined and milled on site at Sandon. A total of 2896 metres of underground diamond drilling was completed. Ore reserves are currently estimated at 39 009 tonnes, a drop from 1984 estimates. Future operations will depend on increased ore reserves and favourable silver prices.

Also in the Slocan area, Esperanza Explorations Ltd. shipped 3420 tonnes of gold ore from Tillicum Mountain (#9), for custom milling in Greenwood. The shipment returned 27 grams/tonne gold representing 93 percent recovery and indicating that the run-of-mine grade is higher than predicted from diamond-drilling results. Exploration drilling totalled 611 metres from surface and 171 metres underground. A new level has opened up a high-grade gold mineralization. Plans for installation of an on-site mill with a minimum capacity of 90 tonnes/day are under consideration. Reserves are currently estimated at three million tonnes.

The Willa property (#4) and Newmont/Esso Minerals Ltd. Trout Lake property (#11) have been identified as potential producers (British Columbia and Yukon Chamber of Mines, 1987). Willa, a joint venture of Northair Mines, BP-Selco and Rio Algom, has reserves of seven million tonnes grading 0.4 percent copper, 1.5 grams/tonne gold and 6.6 grams/tonne silver. A prospectus has been released and the company is proceeding with detailed feasibility, design and environmental assessment work (Rescan, 1987).

Newmont's Trout Lake deposit represents a significant molybdenum discovery with 50 million tonnes grading 0.23 percent molybdenum sulphide. It is estimated the mine will employ 100 to 150 workers and produce 1000 tons/day; however, no start-up date has been confirmed.

Several other properties have appeared promising in recent years such as Cominco's zinc property near Duncan Lake and Little Tim silver mine east of Slocan (British Columbia, 1987a). In addition, there are over 40 small mines which operate intermittently depending on market prices. Tailings recovery and custom milling have been suggested as means to increase the economic opportunities offered by mining (Ethos, 1982). Mineral prospects which may gain in importance are uranium, platinum, cadmium and, of course, any new discoveries. Metal prices will always be a major factor; it is expected that mining will remain a significant though secondary industry in the Basin.

There has been considerable placer activity in the Basin particularly in the Moyie Lake Placer Area. (Figure 9 indicates designated placer areas in the Basin). Numerous placer leases are held on the Moyie River but the only placer activity in 1986 was by Queenstake Resources Ltd. which excavated several leases and reported fair gold values. Extensive upstream testing is planned before extending their pit.

There are also two industrial mineral properties operating in the Basin: a limestone quarry at Lost Creek (#12) and a dolomite quarry at Crawford Bay (#13). These structural materials are used locally in the production of lime, cement, stucco and fillers. Sand and gravel deposits are scattered throughout the Basin and used in highway and building construction. Deposits of facing-stone in the Creston area may be of commercial interest in the future.

3.5 Agriculture

Historically, agriculture has been important in many areas of the Basin. In the 1920s the Basin was a major producer of tree fruits, but disease and distance to markets resulted in the abandonment of agriculture for more lucrative work in mining and logging. Today commercial-scale agriculture is only of significance in the Creston area.

The highest capability lands for agriculture occur on the alluvial and lacustrine floodplains of the Kootenay and Slocan Rivers. Pockets of high to moderate capability are also present around Kaslo and the lower Duncan and Lardeau valleys (Figure 10). Most of the high and moderate

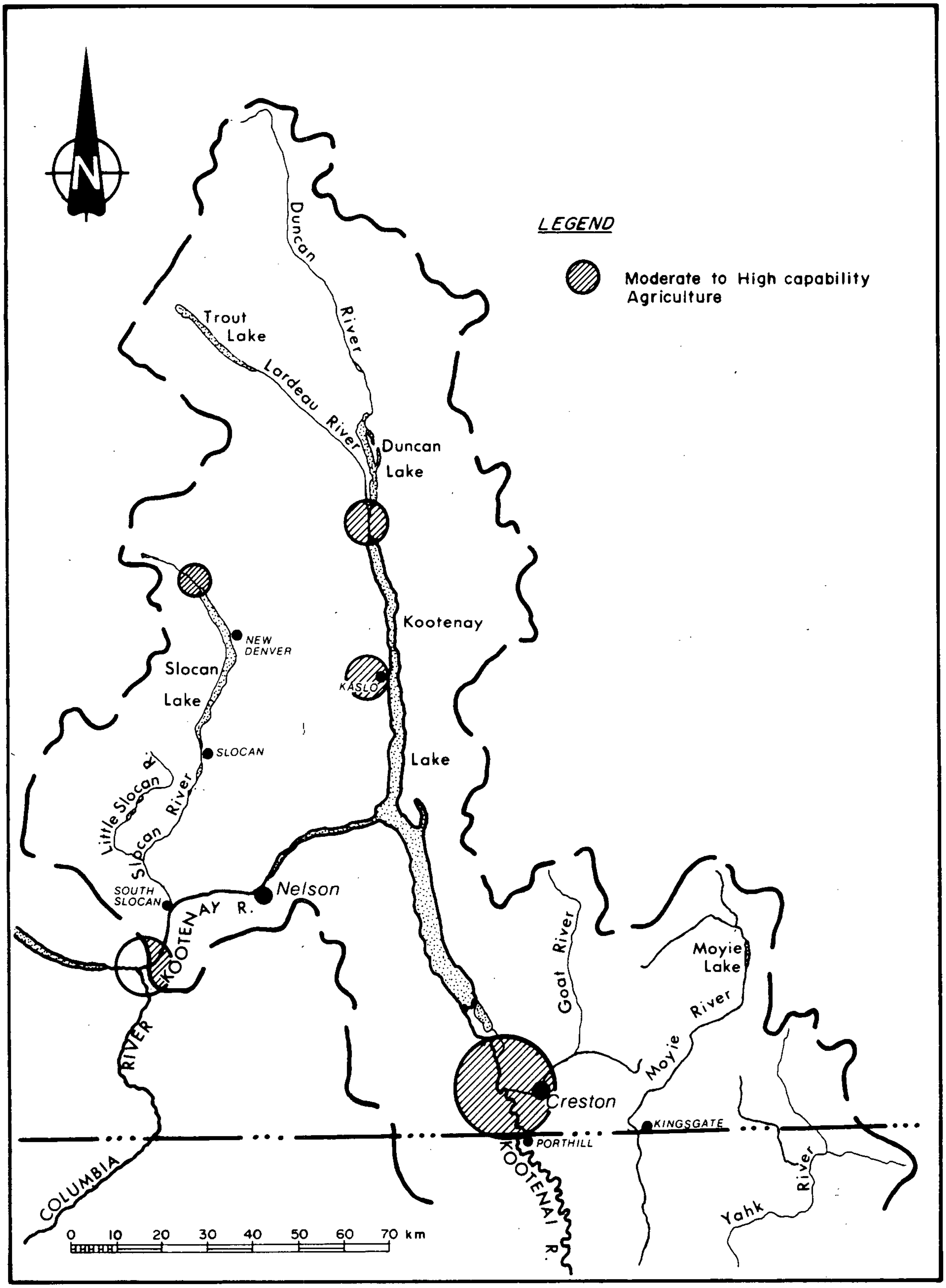

Figure 10 Agricultural Capability

capability lands are in the Agricultural Land Reserve.

Creston is the centre of agricultural activity in the Basin. The Creston Flats, covering 8097 hectares of reclaimed land, are well-suited to grain production, an important cash crop. Potatoes, field peas, beans, forage seeds, hay and alfalfa are also grown on the flats. The benches above the flats are important for tree fruits, particularly apples and berries. Tree fruit production is second only to the Okanagan (British Columbia, 1986a). The dairy industry, located south of the flats on more marginal lands, has expanded rapidly in recent years: from 1500 cows in 1979 to 2295 in 1981. Milk is trucked to dairies in Vernon and Nelson. Beef cattle, hogs, poultry and eggs are also produced in the Creston area. In 1981, 385 farms reported incomes greater than $250; of these, 142 reported incomes greater than $10,000. Total farm capital value for the Creston area was estimated at $127.6 million and sales receipts at $12.8 million in 1981 (British Columbia, 1986a).

Approximately 6073 hectares could be added to farmland in the Creston area through dyking, but this area is presently reserved for waterfowl habitat. There are four dyking and drainage districts in the flats: Duck Lake, Nick's Island, Reclamation and Creston. Dyking projects to reclaim over 8000 hectares of fertile land began in the 1930s and were upgraded in 1967. All improvements are subject to approval from the International Joint Commission to ensure that upstream interests of the United States are safeguarded.

In the Slocan and Nelson areas, total farm capital value was estimated at $29.9 million and sales receipts at $1.1 million in 1981 (British Columbia, 1986a). These areas generally have small, part-time or subsistence mixed farms with emphasis on cattle and forage. In 1981, 145 farms reported sales greater than $250, of these only 21 reported sales greater than $10,000.

Cultivated areas are given in Table 12 by sub-basin and general crop type; areas requiring irrigation are also indicated. Livestock populations by sub-basin are provided in Table 13.

TABLE 12. AREA OF CULTIVATED AND IRRIGATED LAND BY SUB-BASIN

Sub-Basin	Orchards and Vegetables (hectares)		Hay, Grains and Forage (hectares)	
	Cultivated	Irrigated	Cultivated	Irrigated
Slocan	22.0	16.9	861.2	137.8
West Arm	47.2	36.3	590.4	94.5
North Lake	11.2	8.6	223.2	35.7
South Lake	1327.4	1022.1	7626.0	1220.2
Moyie	0.0	0.0	94.0	15.0
TOTAL	1407.8	1083.9	9394.8	1503.2

(Canada, 1981b)

TABLE 13. LIVESTOCK POPULATIONS BY SUB-BASIN

	Sub-Basin					
Type of Livestock	Slocan	N. Lake	West Arm	So. Lake	Moyie	TOTAL
Milk Cows	66	25	53	2,295	7	2,446
Beef Cows	298	244	136	2,371	247	3,296
Steers	60	301	172	771	60	1,364
Pigs	38	20	73	4,458		4,589
Sheep	39			16		55
Horses	72	62	37	317	32	520
Chickens	1,457	1,132	2,343	31,562	461	36,955
Other Poultry	186	7	244	206	26	669

(Canada, 1981b)

Agricultural processing industries are quite limited in the Basin. There is a small dairy in Nelson and a brewery, slaughterhouse, vegetable and fruit packing plant and alfalfa dehydrating and pellet plant in Creston.

Expansion in agriculture and food processing is limited by the distance to markets, size of the local market, restricted land base and increasing pressure from other land uses such as settlements and recreation. Marketing board policies and the Canada-U.S. free trade agreement may also affect future agricultural activities. Most agricultural lands in the Creston area are already under production, but intensification of activities is possible. In the Slocan Valley, over 80 percent of the agricultural land is not in production (RDCK, 1981); it has been suggested that, with proper marketing and management, opportunities exist in the Slocan Valley for berries, apples, vegetables, forage, specialty meat products such as geese and rabbit, nursery/greenhouse operations, seed and goat milk and cheese (Ethos, 1982).

3.6 Parks, Recreation and Tourism

3.6.1 Parks

The Lower Kootenay River Basin is well represented by provincial parks (Table 14 and Figure 11). There are over 29 parks, recreation areas, reserves or wilderness conservancies in the Basin, not including a network of regional district and municipal parks and British Columbia Ministry of Forests and Lands recreation sites.

The Kootenay Lake System is the newest addition to the Basin's provincial parks providing 302 hectares of lakefront land with road or boat access. Another recent addition is the 316-hectare Gerrard Reserve near the headwaters of the Lardeau River which protects the spawning and rearing habitat of the internationally-known Gerrard strain of rainbow trout. These "whoppers" are British Columbia's largest trout frequently weighing eight to ten kilograms and sometimes reaching 16 kilograms (Vancouver Sun, 1987b).

TABLE 14. PROVINCIAL PARKS

Map #	Park	Class	Area	Location	Features
1	Brilliant Terrace	A	116	E of Castlegar	viewpoint
2	Bugaboo Alpine	RA	24 912	W of Brisco	wilderness camping; hiking; skiing
3	Bugaboo Glacier	A	362	W of Brisco	wilderness camping; hiking; skiing
4	Cody Caves	A	63	NW of Ainsworth	natural caves
5	Drewry Point	A	21	S of Balfour	boat access only; beach; camping
6	Fry Creek Canyon	RA	550	S of Johnson's Landing	-
7	Gerrard	Reserve	445	S of Trout Lake City	camping; spawning habitat
8	Grohman Narrows	A	10	W of Nelson	viewpoint; picnicking
9	James Johnstone	A	2	N of Nelson	beach
10	Kokanee Creek	A	260	E of Nelson	campsites; beach; picnicking
11	Kokanee Glacier	B	25 900	NE of Nelson	wilderness campsites
	Kootenay Lake System:				
12	Midge Creek	A	158	S of Balfour	boat access only; sandy beach; und. campsites
13	Kaslo Bay	A	2	Kaslo	sandy beach
14	Coffee Creek	A	52	N of Balfour	beach; und. campsites
15	Campbell Bay	A	25	Kaslo	boat access only; sand & pebble beach; anchorage
16	Lost Ledge	RA	38	Lardeau	und.campsites; beach
17	Davis Creek	RA	5	N of Kaslo	und.campsites; beach
18	Lardeau	C	12	Lardeau	-
19	Lockhart Beach	A	3	Crawford Bay	campsites; beach; picnicking
20	Moyie Lake	A	90	S of Cranbrook	campsites; beach; picnicking; boating
21	Pilot Bay	A	347	E of Balfour	boat access only; beach; und. campsites
22	Purcell (West)	Wilderness Conservancy	58 782	NE of Kootenay Lake	wilderness campsites; hiking
23	Roseberry	A	32	SE of Roseberry	campsites
24	Ryan	A	58	N of Yahk	-
25	Stagleap	A	1133	Creston	viewpoint; picnicking
26	Summit Lake	C	6	SE of Nakusp	campsites; beach; picnicking
27	Valhalla	A	49 600	W of Slocan Lake	wilderness campsites
28	Yahk	A	9	Yahk	campsites; picnicking
29	Appledale	C	5	S of Slocan	-

(British Columbia, 1987b)

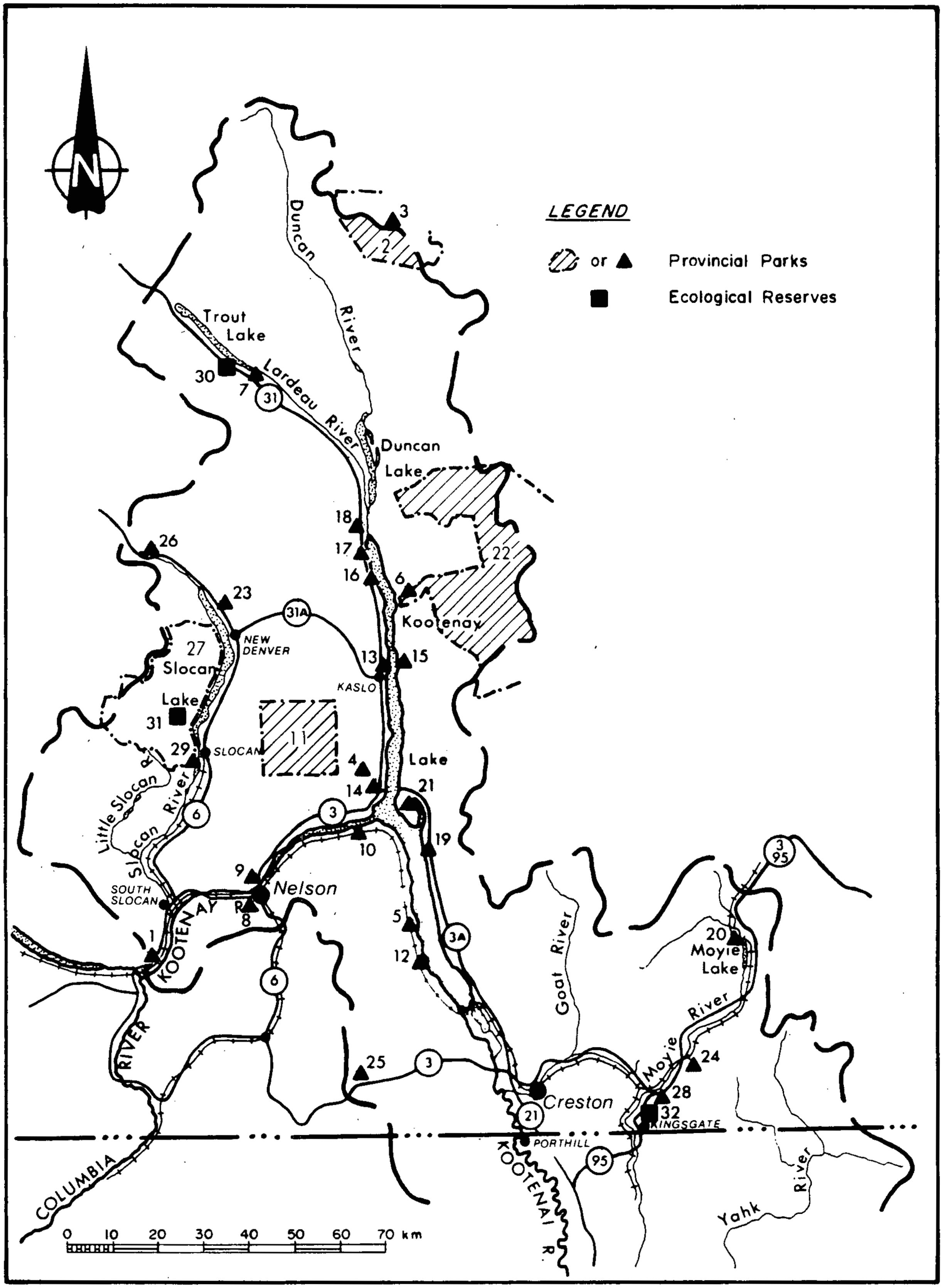

Figure 11 Provincial Parks and Ecological Reserves

There are three ecological reserves in the Basin. The 815-hectare Lew Creek Reserve near Trout Lake (Figure 11, #30) preserves an entire watershed representing three distinct biogeoclimatic zones; the 185-hectare Evans Lake Reserve in the Valhallas (#31) preserves yellow cedar habitat; and the 58-hectare Gilnockie Creek Reserve, a tributary to the Yahk River (#32) preserves a stand of western larch.

3.6.2 Recreation

Recreational opportunities seem endless in the Lower Kootenay Basin. Kootenay Lake is the focus of intensive water-oriented recreation, although the recreational capability of the main lake is limited by open water, cold water temperatures, winds and wave action. Alluvial fans at the mouths of the lake's tributaries offer good beaches and opportunities for camping, fishing and boating. This is also true of the tributaries to Slocan Lake and the West Arm. Generally, however the Basin's large lakes have steep forested banks and lack natural harbours.

Sportsfishing is a major attraction to residents and non-residents alike. Table 15 outlines angling activity and catch statistics for the Basin's lakes, rivers and streams. Most effort and catch is concentrated on Kootenay Lake where major species caught include rainbow trout, including the large Gerrard strain, Dolly Varden char and kokanee. Other important sportfish in the Basin include mountain whitefish, cutthroat trout, Eastern brook trout (particularly in Moyie Lake), ling cod (in Kootenay Lake), sturgeon (in the mainstem near Creston) and bass. The Basin's fishery is considered in good condition. Predictions that Libby Dam would significantly reduce productivity have not materialized; Kootenay Lake is generally thought to be in equilibrium now. While production is not as high as historic levels, the lake is producing a surplus of sportsfish although overfishing is a problem in the West Arm. Small lakes and streams have limited productivity and many are artificially stocked. The provincial Fish and Wildlife Branch is hoping to redirect demand from over-fished stream fisheries to non-target species (British Columbia, 1984).

TABLE 15. SPORTFISH ANGLING ACTIVITY AND HARVEST

	Effort (angler days)	Catch (number of fish)	1990 Angling Demand
Large Lakes and Reservoirs	226,000	366,000	305,700
Small Lakes			
- low elevation	50,000	55,400	67,700
- high elevation	17,000	23,400	23,000
Rivers and Streams	67,000	70,300	90,600
Total	360,000	515,100	487,000

(British Columbia, 1984b)

Hunting is also popular in the Basin, particularly for big game such as black bear, grizzly, mule deer, white-tailed deer, elk, moose, caribou, mountain goat and bighorn sheep. There are two licensed guide-outfitters in the Basin. Upland birds and waterfowl are also harvested. The provincial Fish and Wildlife Branch publish annual regulations regarding fish and game quotas, restrictions, seasons and hunting areas, etc.

There is a downhill ski area outside of Nelson but cross-country and heli-skiing are gaining in popularity. Other recreational activities include snowmobiling, four-wheeled driving on the Basin's many resource roads, canoeing and bird-watching, particularly in the Creston Flats area. In addition, the Basin's communities offer a varying range of sports facilities including swimming pools, curling rinks, soccer fields, golf courses, etc.

3.6.3 Tourism

Tourists are attracted to the Basin for its scenic values, recreational opportunities and historic sites. Predictably, most visitors are from British Columbia followed by Alberta and the United States. While the Basin has many assets, neighbouring regions such as the Okanagan and Rockies are still favoured tourist destinations. Indeed, the Basin receives the lowest tourist expenditures in British Columbia, sharing this rank with the Peace River and Cariboo (RDCK, 1982). Most of the Basin's visitors stay in campgrounds although there are many hotels and motels available, particularly in Nelson and Creston (Table 16).

While the Basin's recreation resources such as alpine wilderness areas and lakes are the major drawing card, other attractions include Ainsworth Hot Springs, Cody Caves near Balfour, Kootenay Trout Hatchery near Wardner, historic sites in the Slocan Valley, Nelson and Kaslo and a glass house near Boswell. Most historic interest is focussed on mining although the Indian culture, Doukhobor settlements and sites of Japanese internment in World War II are also of interest. There are museums in Kaslo, Sandon, New Denver, Nelson and Creston and heritage walking tours in Nelson. Creston offers tours of the Columbia Brewery, candle factory

TABLE 16. APPROVED VISITOR ACCOMMODATION

Municipality	Hotels/Motels Cottages	(# Units)	Campgrounds	(# Sites)
Slocan, New Denver, Silverton	7	(81)	5	(97)
Nelson	7	(179)	3	(76)
Balfour, Ainsworth, Mirror Lake	7	(50)	7	(210)
Kaslo	5	(48)	4	(87)
Argenta, Kootenay Bay, Crawford Bay, Gray Creek, Boswell	8	(65)	6	(316)
Creston	15	(250)	6	(237)
Yahk, Moyie Lake	3	(20)	4	(123)

(British Columbia, 1987e)

and ceramics workshop.

A tourism development strategy has been outlined for the region (Coriolis, 1985). The study suggested that the best opportunities are small-scale and incremental although the redevelopment of Nelson's waterfront and establishing a major agricultural exhibition centre at Creston should be encouraged. Opportunities identified in the study include improvements to Ainsworth Hot Springs, houseboat charters and lake cruises, development of a small-scale destination resort, horseback riding facilities, improved boat services and marinas. Better marketing strategies were also recommended to alleviate perceived problems of access and lack of activities or amenities. It is expected that tourism will increase in importance in the coming years as forestry, mining and government employment declines.

4.0 SUMMARY AND CONCLUDING REMARKS

4.1 Summary

The Upper Kootenay River rises in the Rocky Mountains and flows south for approximately 400 kilometres before crossing the international boundary into the State of Montana. The Kootenay (spelled Kootenai in the United States) swings west then northwest for 350 kilometres through the States of Montana and Idaho before re-entering Canada near Rykerts, British Columbia. The Lower Kootenay River flows north for 32 kilometres to Kootenay Lake and then flows 60 kilometres southwest from the lake to join the Columbia River at Castlegar, British Columbia. Major tributaries of the Lower Kootenay River are the Duncan, Lardeau and Slocan Rivers.

The Lower Kootenay River Basin is comprised of the Purcell Mountains on the east and the Selkirk Mountains on the west. The Purcell Trench, a north-south valley up to eleven kilometres wide, divides the two mountain systems; Kootenay Lake and Duncan Lake and River are situated in the Trench.

The Basin is located within the Interior Wet Belt climatic zone which is characterized by cold winters with high snowfall and warm, dry summers. Precipitation increases with altitude and from north to south: in the northern Purcells and Selkirks precipitation reaches 1500 mm to 2000 mm annually while Creston in the southern portion of the Purcell Trench receives 760 mm annually. Temperatures in the valleys average -3°C in January and -18°C in July; alpine temperatures are significantly cooler.

The Lower Kootenay River drains approximately 15 000 square kilometres and has a mean annual flow of 793 m^3/s at its mouth. The Kootenay River upstream of the international boundary at Rykerts contributes 445 m^3/s

of this flow. The greatest percentage of streamflow arises from snowmelt, hence the annual hydrograph peaks from May to June with minimum flows occurring in winter.

The river's hydrograph has been significantly flattened by the operation of eight dams and control structures. Five of these dams are located on the Kootenay River, between Nelson and the confluence with the Columbia River, and are operated by West Kootenay Power and Light Co., Cominco, the City of Nelson or British Columbia Hydro and Power Authority for hydroelectric generation. The seven powerplants have an installed capacity of over 800 MW of electricity for British Columbia residents and industry. Libby Dam located 160 kilometres upstream of the international boundary at Rykerts and Duncan Dam on the Duncan River were constructed under the Canada-United States Columbia River Treaty. There are no power generation facilities at Duncan Dam as its primary purpose is water storage for downstream flood control in the United States. Both dams store spring floodwaters for gradual release in the winter.

Construction of the Libby and Duncan Dams in the late 1960s and early 1970s was predicted to have various effects on water quality and biological productivity. However, many of these effects have not materialized or are insignificant. Kootenay Lake has reached a new equilibrium and while fish productivity is generally lower than pre-impoundment levels, this has not been conclusively tied to dam construction and operation. The provincial government is considering fertilizing parts of the lake but since there is still a surplus of fish production over angler demand it is unlikely this project will proceed in the near future. Generally water quality is considered good throughout this Basin except for turbidity during periods of high flow and localized water quality degradation from forestry, mining, agriculture or municipal activities.

There are four biogeoclimatic zones represented in the Basin: the dry Ponderosa-Pine Bunchgrass Zone near the international boundary; the slightly wetter, adjacent Interior Douglas Fir Zone; the productive Interior Western Hemlock Zone covering most of the Basin to 1770 metres;

and the Subalpine Engelmann Spruce-Subalpine Fir and Alpine Tundra Zones. These zones provide a diverse habitat for the Basin's wildlife, although snow depth at high elevations and human encroachment are limiting factors. Mule deer are abundant and widely distributed throughout the Basin. White-tailed deer, elk, woodland caribou, mountain goats and bighorn mountain sheep are also found in the Basin. Moose are less prevalent, observed mostly in the Moyie and Goat River areas. Other large mammals include black and grizzly bears and various wildcat species such as cougar, lynx and bobcat.

Waterfowl production is generally limited by lack of wetlands and adverse climatic conditions; however, the Creston Flats area is an outstanding exception. The flats, extending from Kootenay Lake south to the international boundary, provide the most important waterfowl migratory staging and production area in the British Columbia Interior. Part of the area is managed by the Creston Valley Wildlife Management Authority, a unique federal-provincial project with participation from private conservation agencies. Over 250 species of birds are found in the Basin, including one of the world's largest concentrations of ospreys.

The Basin also supports a substantial fishery resource: Kootenay Lake is the most important inland fishery in British Columbia. Kokanee, a land-locked salmon indigeneous to the Basin, is the most productive, followed by rainbow trout including the large Gerrard strain and Dolly Varden char. Several species of sportsfish have been introduced including eastern brook and brown trout, longmouth and smallmouth bass and yellow perch.

There are less than 35,000 residents in the Basin; the two largest communities - - Nelson and Creston - - have populations less than 10,000. As in neighbouring areas, mining brought the first settlers to the Basin in the late 1880s. Railway construction soon followed, prompting the emergence of the forest industry. When mining declined in the late 1920s, forestry provided a stable economic base and remains the major industry in the Basin today.

In addition to logging activities, there are six large sawmills operating in the Basin, each employing 20 or more workers. The largest sawmill is owned by Slocan Forest Products and employs 225 to 300 people. There are also approximately 13 smaller mills in the Basin employing 38 workers. Mill employment has been decreasing since 1973 because of the transition to large, highly-mechanized centrally-located plants. Future logging or mill expansion is not likely since annual allowable cuts are now being met and, in several areas, exceeded. The use of waste products and production of specialty wood products may be areas of industry expansion. While forestry and its related activities are important to the Basin's economy, controversial forest practices such as pesticide applications, logging on steep slopes, lack of reforestation and use of toxic wood preservatives in the mills are of increasing concern to the Basin's residents. Public awareness of environmental concerns is very high in the West Kootenays; many of British Columbia's most effective and well-organized environmental advocates live in the Basin.

There are two metal mines in the Basin, both in the Slocan area: Silvana, a silver, lead and zinc mine, and Tillicum Mountain, a new gold mine and mill. Silvana is the only signficant producer employing 35 to 45 people and mining and milling silver, zinc and lead. Two properties have considerable potential: Willa, a copper, gold and silver deposit in the Slocan Valley which is going through the provincial Mine Development and Review Process, and Trout Lake, a molybdenum property in the northwest corner of the Basin. There are over 40 small mines which operate intermittently depending on market prices; exploration activity is high. Tailings recovery and custom milling and "new" minerals such as platinum, cadmium and uranium may provide further economic opportunities. It is expected that mining will remain a significant secondary industry in the Basin.

Creston is the centre of agricultural activity in the Basin. The Creston Flats, covering over 8000 hectares of reclaimed land, are well-suited to grain production, an important cash crop. Potatoes, peas, beans, forage seeds, hay and alfalfa are also grown on the flats. The benches above the flats are important for tree fruits, particularly apples, and berries. The dairy industry is also important, with milk trucked to dairies in

Vernon or Nelson. Expansion in agriculture and food processing is limited by distance to markets, size of local market, restricted land base and increasing pressure from other land uses. Specialty products such as goat milk and cheese, geese, rabbits, nurseries and greenhouses have been suggested as possible areas of agricultural opportunity.

Tourism is, as yet, not a major sector in the Basin's economy. The Okanagan, with warmer water temperatures, and the Rockies, with more dramatic views, are still favoured tourist destinations. However, the West Kootenays have much to offer in the way of wilderness areas, water-based recreation particularly large-lake fishing, and historic sites. The Basin has over 28 provincial parks providing varying facilities and amenities from alpine wilderness camping and skiing to swimming, boating and fishing at lakeshore parks. Hunting is also popular in the Basin, as is bird-watching. It is hoped that small-scale expansion in the tourism sector will offset declines in forestry, mining and government employment.

4.2 Concluding Remarks

The Lower Kootenay River Basin is an area of limited economic opportunities. Future expansion in tourism and agriculture are expected to be small-scale; intensive forestry management may maintain long term stability in that industry; and mining is expected to remain a secondary industry.

Expansion in these sections without thoughtful management, will likely lead to resource use conflicts as the Basin has significant wildlife and fisheries populations and wilderness recreation opportunities. In addition, the protection of water quality in community watersheds is of growing concern to the area's residents. Most of the existing and potential resource use conflicts are the jurisdiction of the provincial government and will entail little involvement from Environment Canada. Since the Kootenay River flows into the Columbia before re-entering the United States, it is unlikely that resource use activities in the Basin will affect water quality at the international boundary.

Water use in the United States portion of the Kootenay River should be monitored for potential transboundary effects. Several projects including a mine, pulp mill and run-of-river hydro facility have been proposed for this reach of the river. The United States portion of the Kootenay River Basin should be assessed to ensure Canada's interests are safeguarded.

The construction and operation of dams and power plants on the Kootenay River has been a controversial issue in the past. Duncan and Libby Dams were expected to have significant adverse environmental effects on Kootenay Lake. Indeed, fish production is not as high as historic levels but this has not been directly attributed to dam operation. The closure of the fertilizer plant in Kimberley and a doubling of angler demand in recent years are also contributing factors. While there are no anadromous fish in the Basin, the provincial government may solicit funding from the federal Department of Fisheries and Oceans for a lake fertilization program.

Inland Waters has been involved in many water quality and limnological research projects in the Basin and, of course, carries out routine hydrometric and water quality monitoring at various locations. Inland Waters also provides assistance to the Kootenay Lake Board of Control, established by the International Joint Commission in the late 1930s to control the levels of Kootenay Lake, and to the Columbia River Treaty Permanent Engineering Board which monitors the provisions of the 1961 Canada-United States Columbia River Treaty. These activities will require ongoing involvement.

Several Indian Reserves are located in the Creston Flats area; the expertise of Inland Waters may be requested if further reclamation projects are carried out, although that is unlikely due to the area's importance as waterfowl habitat. Indeed, Environment Canada gives funding assistance to the Creston Valley Wildlife Management Authority as the flats provide critical habitat to migratory birds. There are no national parks on other federal lands in the Basin that might require federal involvement.

In summary, then, it appears that an increase in Environment Canada's involvement in the Basin is not warranted at this time. However, existing and potential water use activities in the United States portion of the Kootenay Basin should be examined.

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APPENDIX 1. CLIMATIC DATA FOR SELECTED STATIONS (Canada, 1981)

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
CRANBROOK A 49° 32'N 115° 46'W 918 m															
Daily Maximum Temperature	-3.9	1.6	5.9	12.3	18.2	22.1	26.8	25.8	19.6	12.2	2.8	-1.7	11.8	8	Température Maximale Quotidienne
Daily Minimum Temperature	-14.4	-10.1	-6.6	-1.3	2.7	6.8	8.9	8.2	3.5	-1.1	-6.9	-11.1	-1.8	8	Température Minimale Quotidienne
Daily Temperature	**-9.3**	**-4.3**	**-0.4**	**5.5**	**10.5**	**14.5**	**17.9**	**17.1**	**11.7**	**5.5**	**-2.2**	**-6.5**	**5.0**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	3.9	2.9	2.3	1.3	1.6	1.2	0.9	1.8	2.2	1.2	2.6	2.9	1.0	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	10.0	12.2	20.6	30.0	31.1	34.4	38.9	37.2	33.9	27.8	16.1	13.3	38.9		Température Maximale Extrême
Years of Record	29	30	30	29	28	29	29	29	29	29	29	29			Années de Relèves
Extreme Minimum Temperature	-41.1	-37.2	-30.0	-20.0	-12.2	-2.8	-0.6	0.0	-5.6	-12.2	-31.7	-34.4	-41.1		Température Minimale Extrême
Years of Record	29	30	30	28	28	29	29	29	29	29	29	27			Années de Relèves
Rainfall	9.7	10.5	6.6	20.3	40.1	54.7	27.5	41.3	29.7	19.3	15.6	12.3	287.6	8	Chutes de Pluie
Snowfall	48.3	26.2	18.8	10.0	0.6	0.0	0.0	0.0	0.4	12.8	23.4	52.2	192.7	8	Chutes de Neige
Total Precipitation	**54.0**	**37.5**	**27.9**	**27.8**	**43.0**	**45.5**	**27.5**	**34.6**	**28.8**	**25.0**	**40.0**	**59.6**	**451.2**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	27.2	22.8	15.9	8.5	20.3	24.3	15.1	24.9	25.4	20.3	26.7	37.3	102.2	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	12.7	43.2	15.2	22.9	27.9	35.6	24.1	34.3	34.8	22.6	14.2	19.3	43.2		Chute de Pluie Record en 24 heures
Years of Record	29	28	30	28	27	29	28	28	29	29	29	29			Années de Relèves
Greatest Snowfall in 24 hours	21.1	38.6	33.0	17.8	33.3	0.0	0.0	0.0	2.5	22.9	42.2	35.6	42.2		Chute de Neige Record en 24 heures
Years of Record	29	29	30	29	28	29	29	29	29	29	28	29			Années de Relèves
Greatest Precipitation in 24 hours	21.1	43.2	33.0	22.9	34.0	35.6	24.1	34.3	34.8	22.9	42.2	35.6	43.2		Précipitation Record en 24 heures
Years of Record	29	28	30	28	27	29	28	28	29	29	28	29			Années de Relèves
Days with Rain	2	3	4	7	9	10	7	7	8	7	5	3	72	8	Jours de Pluie
Days with Snow	12	8	7	4	0	0	0	0	1	2	7	13	54	8	Jours de Neige
Days with Precipitation	13	9	9	9	10	10	6	8	9	9	10	13	115	8	Jours de Précipitation
NEW DENVER 49° 59'N 117° 23'W 564 m															
Daily Maximum Temperature	-0.7	3.1	6.7	13.2	19.0	22.2	26.8	25.8	19.5	11.8	4.4	0.9	12.7	8	Température Maximale Quotidienne
Daily Minimum Temperature	-6.0	-3.7	-2.2	1.1	5.3	9.1	11.3	11.5	7.8	3.7	-0.7	-3.7	2.8	8	Température Minimale Quotidienne
Daily Temperature	**-3.4**	**-0.3**	**2.3**	**7.2**	**12.2**	**15.7**	**19.1**	**18.7**	**13.7**	**7.8**	**1.8**	**-1.4**	**7.8**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	2.7	1.5	1.0	1.2	1.0	1.4	1.0	2.1	1.7	1.0	1.5	2.2	0.4	5	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	10.6	11.1	16.7	27.2	31.7	34.4	36.1	37.2	32.2	21.5	18.3	11.5	37.2		Température Maximale Extrême
Years of Record	13	13	13	13	14	14	13	14	14	14	14	14			Années de Relèves
Extreme Minimum Temperature	-23.5	-19.5	-15.6	-7.2	-2.0	2.2	1.1	1.7	-1.1	-6.7	-14.0	-28.9	-28.9		Température Minimale Extrême
Years of Record	13	13	13	13	13	14	12	13	14	14	14	14			Années de Relèves
Rainfall	28.5	35.4	41.9	42.9	54.1	63.9	48.8	53.9	52.2	64.6	61.1	40.3	587.6	1	Chutes de Pluie
Snowfall	83.8	38.4	13.5	0.8	0.0	0.0	0.0	0.0	0.0	0.6	15.7	71.0	223.8	1	Chutes de Neige
Total Precipitation	**112.3**	**73.8**	**55.4**	**43.7**	**54.1**	**63.9**	**48.8**	**53.9**	**52.2**	**65.2**	**76.8**	**112.1**	**812.2**	**1**	**Précipitations Totales**
Standard Deviation, Total Precipitation	42.6	33.2	18.6	19.0	22.4	21.0	25.9	36.4	28.5	34.1	32.7	40.4	119.6	1	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	50.8	44.5	34.3	33.3	34.3	41.1	34.5	42.7	52.3	38.6	36.1	38.1	52.3		Chute de Pluie Record en 24 heures
Years of Record	53	53	51	56	56	53	50	50	47	48	51	52			Années de Relèves
Greatest Snowfall in 24 hours	36.3	29.2	30.0	6.9	0.0	0.0	0.0	0.0	T	15.2	27.9	52.1	52.1		Chute de Neige Record en 24 heures
Years of Record	52	52	54	57	56	57	53	55	54	55	52	51			Années de Relèves
Greatest Precipitation in 24 hours	50.8	44.5	34.3	33.3	34.3	41.1	34.5	42.7	52.3	38.6	36.1	52.1	52.3		Précipitation Record en 24 heures
Years of Record	50	52	52	56	56	53	50	50	47	48	50	48			Années de Relèves
Days with Rain	5	7	10	11	12	13	10	10	10	13	12	8	121	1	Jours de Pluie
Days with Snow	14	9	5	*	0	0	0	0	0	*	4	12	44	1	Jours de Neige
Days with Precipitation	19	15	14	11	12	13	10	10	10	13	16	19	162	2	Jours de Précipitation

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

NELSON 2
49° 30'N 117° 17'W 604 m

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-0.6	3.2	7.3	14.0	19.5	23.0	27.4	26.2	20.2	12.4	4.4	0.8	13.2	3	Température Maximale Quotidienne
Daily Minimum Temperature	-5.5	-3.2	-1.4	1.9	5.8	9.6	12.0	11.8	7.9	3.7	-0.9	-3.7	3.2	3	Température Minimale Quotidienne
Daily Temperature	**-3.1**	**0.0**	**2.9**	**8.0**	**12.7**	**16.4**	**19.8**	**19.0**	**14.1**	**8.1**	**1.8**	**-1.5**	**8.2**	**3**	**Température Quotidienne**
Standard Deviation, Daily Temperature	2.4	1.9	1.3	0.9	1.3	1.5	1.4	2.0	1.6	1.2	1.9	1.9	0.7	3	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	9.4	12.2	18.3	28.3	32.8	35.0	38.3	38.3	33.9	23.4	15.6	9.4	38.3		Température Maximale Extrême
Years of Record	25	25	24	23	24	23	25	23	25	25	26	26			Années de Relèves
Extreme Minimum Temperature	-25.6	-20.0	-15.0	-5.0	-1.7	0.5	4.4	1.1	-0.6	-5.6	-17.2	-29.4	-29.4		Température Minimale Extrême
Years of Record	25	25	24	23	23	24	25	24	25	24	26	26			Années de Relèves
Rainfall	21.3	19.0	32.2	35.1	45.9	54.1	35.8	38.4	42.2	51.3	45.2	32.0	452.5	3	Chutes de Pluie
Snowfall	77.0	35.7	13.9	0.6	0.0	0.0	0.0	0.0	0.0	0.5	25.3	61.9	214.9	3	Chutes de Neige
Total Precipitation	**98.3**	**55.3**	**46.1**	**35.8**	**45.9**	**54.1**	**35.8**	**38.3**	**42.2**	**52.2**	**70.5**	**94.4**	**668.9**	**3**	**Précipitations Totales**
Standard Deviation, Total Precipitation	35.4	28.3	22.1	24.4	26.2	24.1	26.7	29.3	24.0	35.6	40.3	37.3	125.0	3	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	21.6	16.5	18.3	22.8	22.6	30.0	24.8	31.2	25.1	30.0	24.0	24.9	31.2		Chute de Pluie Record en 24 heures
Years of Record	19	20	22	20	18	21	18	20	22	21	21	22			Années de Relèves
Greatest Snowfall in 24 hours	31.2	34.3	19.1	5.1	0.0	0.0	0.0	0.0	0.0	5.1	23.6	33.5	34.3		Chute de Neige Record en 24 heures
Years of Record	[illegible]	20	[illegible]	[illegible]	21	24	[illegible]	24	25	24	22	21			Années de Relèves
Greatest Precipitation in 24 hours	31.2	34.3	[illegible]	[illegible]	22.6	30.0	24.8	31.2	25.1	30.0	24.0	33.5	34.3		Précipitation Record en 24 heures
Years of Record	[illegible]	[illegible]	[illegible]	[illegible]	18	21	18	20	22	21	21	21			Années de Relèves
Days with Rain	3	5	6	7	9	10	7	6	7	8	7	6	83	3	Jours de Pluie
Days with Snow	10	5	3	*	0	0	0	0	0	*	4	8	30	3	Jours de Neige
Days with Precipitation	13	10	10	8	9	10	7	6	7	9	10	14	113	3	Jours de Précipitation

LARDEAU
50° 12'N 116° 58'W 550 m

	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-1.1	2.6	6.4	13.2	18.6	21.9	25.7	24.7	19.2	12.1	4.5	0.9	12.4	8	Température Maximale Quotidienne
Daily Minimum Temperature	-6.4	-3.9	-2.3	1.1	4.7	8.3	10.0	9.9	6.1	2.5	-1.2	-3.7	2.1	8	Température Minimale Quotidienne
Daily Temperature	**-3.9**	**-0.8**	**2.0**	**7.2**	**11.6**	**15.0**	**17.9**	**17.3**	**12.6**	**7.2**	**1.7**	**-1.4**	**7.2**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	3.2	1.4	1.6	1.2	1.0	1.3	1.2	1.7	1.7	0.9	1.6	2.2	0.4	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	9.4	11.7	15.6	28.9	30.0	33.9	36.1	35.0	32.2	21.1	16.1	8.3	36.1		Température Maximale Extrême
Years of Record	19	19	19	19	19	19	18	19	19	19	19	19			Années de Relèves
Extreme Minimum Temperature	-26.1	-20.0	-17.8	-8.3	-2.2	0.6	3.3	3.3	-3.9	-8.3	-16.1	-30.0	-30.0		Température Minimale Extrême
Years of Record	19	19	19	19	19	19	18	19	19	19	19	19			Années de Relèves
Rainfall	22.5	37.8	31.5	33.9	46.2	50.6	39.1	46.9	46.2	51.3	52.8	36.0	494.8	8	Chutes de Pluie
Snowfall	83.8	36.8	13.2	2.7	0.1	0.0	0.0	0.0	0.0	0.6	19.7	70.9	227.8	8	Chutes de Neige
Total Precipitation	**107.2**	**74.8**	**45.0**	**35.3**	**46.3**	**50.6**	**39.1**	**46.9**	**46.2**	**51.9**	**75.3**	**106.8**	**725.2**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	38.5	34.4	15.3	15.7	18.1	19.2	19.7	37.5	25.4	31.5	35.1	44.2	99.4	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	25.4	36.6	18.5	21.1	26.2	20.1	21.6	37.1	24.1	34.0	25.4	23.5	37.1		Chute de Pluie Record en 24 heures
Years of Record	19	17	18	17	17	17	17	17	19	19	17	18			Années de Relèves
Greatest Snowfall in 24 hours	45.7	25.2	15.2	6.9	2.5	0.0	0.0	0.0	T	7.6	21.6	35.6	45.7		Chute de Neige Record en 24 heures
Years of Record	17	19	19	19	19	19	18	19	19	19	15	18			Années de Relèves
Greatest Precipitation in 24 hours	45.7	36.6	22.9	21.1	26.2	20.1	21.6	37.1	24.1	34.0	25.4	37.0	45.7		Précipitation Record en 24 heures
Years of Record	17	18	18	17	17	17	17	17	19	19	16	18			Années de Relèves
Days with Rain	3	6	7	7	8	10	8	8	9	9	10	7	92	8	Jours de Pluie
Days with Snow	11	6	3	1	0	0	0	0	0	0	3	9	33	8	Jours de Neige
Days with Precipitation	14	11	9	8	9	10	8	9	9	10	13	15	125	8	Jours de Précipitation

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

CASTLEGAR A
49° 18'N 117° 38'W 495 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-1.1	2.4	7.4	14.5	20.0	23.5	28.6	27.6	21.3	12.8	4.7	0.5	13.5	8	Température Maximale Quotidienne
Daily Minimum Temperature	-6.5	-4.3	-2.2	1.8	6.0	9.7	11.8	11.2	7.6	3.3	-1.3	-4.4	2.7	8	Température Minimale Quotidienne
Daily Temperature	**-3.8**	**-0.8**	**2.7**	**8.1**	**13.2**	**16.9**	**20.3**	**19.7**	**14.4**	**8.1**	**1.7**	**-1.9**	**8.2**	**8**	**Température Quotidienne**
Standard Deviation, Daily Temperature	2.4	1.5	1.2	1.1	1.1	1.5	1.1	1.9	1.8	0.9	1.3	2.2	0.5	4	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	10.0	12.2	21.7	28.2	31.7	35.6	39.6	40.0	35.6	27.2	19.4	11.6	40.0		Température Maximale Extrême
Years of Record	15	15	15	15	15	15	15	15	15	15	15	16			Années de Relèves
Extreme Minimum Temperature	-25.7	-19.4	-14.5	-7.5	-1.7	2.2	4.1	3.3	-3.9	-7.8	-20.2	-30.6	-30.6		Température Minimale Extrême
Years of Record	15	15	15	15	15	15	15	15	15	15	15	16			Années de Relèves
Rainfall	16.1	20.3	33.4	41.7	53.8	62.9	35.6	45.7	36.4	53.2	49.7	31.8	480.6	8	Chutes de Pluie
Snowfall	83.4	43.5	27.6	8.4	0.0	0.0	0.0	0.0	0.0	1.4	30.1	75.7	270.1	8	Chutes de Neige
Total Precipitation	**84.5**	**63.4**	**58.0**	**44.0**	**53.8**	**62.9**	**35.6**	**45.7**	**36.4**	**54.0**	**80.9**	**99.8**	**719.0**	**8**	**Précipitations Totales**
Standard Deviation, Total Precipitation	31.3	37.3	22.7	24.7	21.6	28.9	21.8	40.5	27.9	38.8	44.3	38.6	69.7	4	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	20.3	26.2	24.4	27.7	23.4	42.1	36.8	42.9	25.1	30.5	33.8	38.1	42.9		Chute de Pluie Record en 24 heures
Years of Record	15	15	15	15	15	15	15	15	15	15	15	15			Années de Relèves
Greatest Snowfall in 24 hours	43.7	27.7	19.6	6.9	T	0.0	0.0	0.0	T	12.7	26.4	46.0	46.0		Chute de Neige Record en 24 heures
Years of Record	15	15	15	15	15	15	15	15	15	15	15	16			Années de Relèves
Greatest Precipitation in 24 hours	32.0	30.5	25.7	27.7	23.4	42.1	36.8	42.9	25.1	30.5	33.8	38.6	42.9		Précipitation Record en 24 heures
Years of Record	15	15	15	15	15	15	15	15	15	15	15	16			Années de Relèves
Days with Rain	4	6	9	10	11	12	7	8	9	11	11	7	105	8	Jours de Pluie
Days with Snow	15	9	7	2	0	0	0	0	0	0	6	14	53	8	Jours de Neige
Days with Precipitation	17	13	12	10	11	12	7	8	9	11	15	18	143	8	Jours de Précipitation

KASLO
49° 55'N 116° 55'W 588 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-0.6	2.9	6.2	12.3	17.9	21.4	25.6	24.7	18.9	11.7	4.5	0.9	12.2	1	Température Maximale Quotidienne
Daily Minimum Temperature	-6.7	-4.3	-2.8	0.7	4.8	8.5	10.7	10.5	6.7	2.5	-1.7	-4.5	2.0	1	Température Minimale Quotidienne
Daily Temperature	**-3.7**	**-0.7**	**1.8**	**6.5**	**11.3**	**15.0**	**18.2**	**17.6**	**12.8**	**7.1**	**1.4**	**-1.8**	**7.1**	**1**	**Température Quotidienne**
Standard Deviation, Daily Temperature	2.4	1.7	1.5	1.0	1.3	1.4	1.2	1.7	1.5	1.0	1.6	1.8	0.6	1	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	9.4	15.6	18.3	27.8	36.7	34.4	37.8	35.6	33.9	23.9	16.7	10.6	37.8		Température Maximale Extrême
Years of Record	71	71	71	69	70	71	72	70	72	73	72	73			Années de Relèves
Extreme Minimum Temperature	-27.2	-26.1	-21.7	-13.3	-6.1	-1.1	2.8	2.2	-6.1	-11.1	-18.3	-31.1	-31.1		Température Minimale Extrême
Years of Record	70	71	71	70	70	71	71	71	71	73	73	73			Années de Relèves
Rainfall	31.7	36.4	41.3	42.7	49.2	58.7	44.8	50.7	46.6	62.8	69.0	47.2	581.1	1	Chutes de Pluie
Snowfall	85.6	41.5	17.8	1.1	0.0	0.0	0.0	0.0	0.0	0.8	22.4	78.1	247.3	1	Chutes de Neige
Total Precipitation	**117.3**	**77.8**	**59.0**	**43.7**	**49.2**	**58.7**	**44.8**	**50.7**	**46.6**	**63.5**	**91.4**	**125.3**	**828.0**	**1**	**Précipitations Totales**
Standard Deviation, Total Precipitation	46.8	37.3	20.8	20.8	22.0	24.7	19.5	31.5	25.9	34.6	47.4	50.1	111.6	1	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	50.3	29.0	33.8	50.8	26.7	38.6	37.3	41.7	38.9	43.9	42.4	28.7	50.8		Chute de Pluie Record en 24 heures
Years of Record	71	70	71	71	69	70	71	70	72	73	72	73			Années de Relèves
Greatest Snowfall in 24 hours	38.1	50.8	27.9	12.7	2.0	0.0	0.0	0.0	T	13.2	35.8	66.0	66.0		Chute de Neige Record en 24 heures
Years of Record	71	70	71	71	69	70	71	72	72	73	73	73			Années de Relèves
Greatest Precipitation in 24 hours	50.3	50.8	33.8	50.8	26.7	38.6	37.3	41.7	38.9	43.9	42.4	66.0	66.0		Précipitation Record en 24 heures
Years of Record	[illegible]	[illegible]	[illegible]	71	69	70	71	70	72	73	72	73			Années de Relèves
Days with Rain	6	7	10	11	13	14	11	11	11	14	12	9	129	1	Jours de Pluie
Days with Snow	14	8	5	1	0	0	0	0	0	*	5	12	45	1	Jours de Neige
Days with Precipitation	18	14	14	12	13	14	11	11	11	14	16	19	167	1	Jours de Précipitation

BRITISH COLUMBIA/COLOMBIE-BRITANNIQUE

CRESTON
49° 6'N 116° 31'W 597 m

	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEP SEPT	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE	CODE CODE	
Daily Maximum Temperature	-0.8	2.8	6.7	13.2	18.8	22.2	26.8	25.8	20.1	12.2	4.3	0.8	12.7	1	Température Maximale Quotidienne
Daily Minimum Temperature	-6.4	-3.6	-1.9	2.1	6.2	9.8	12.4	11.8	7.5	2.9	-1.6	-4.2	2.9	1	Température Minimale Quotidienne
Daily Temperature	**-3.7**	**-0.4**	**2.4**	**7.7**	**12.5**	**16.0**	**19.6**	**18.9**	**13.8**	**7.6**	**1.4**	**-1.7**	**7.8**	**1**	**Température Quotidienne**
Standard Deviation, Daily Temperature	2.8	1.8	1.7	1.2	1.4	1.5	1.2	1.9	1.7	1.0	1.7	2.1	0.7	1	Écart Type de la Température Quotidienne
Extreme Maximum Temperature	12.2	13.9	19.4	30.0	36.7	37.8	39.4	36.7	35.6	25.6	17.8	13.3	39.4		Température Maximale Extrême
Years of Record	68	68	68	68	68	69	69	69	69	69	69	69			Années de Relèves
Extreme Minimum Temperature	-32.8	-31.1	-21.7	-15.0	-6.7	-1.7	1.7	-0.6	-7.2	-20.0	-23.3	-30.6	-32.8		Température Minimale Extrême
Years of Record	68	68	68	67	68	69	69	69	69	69	69	69			Années de Relèves
Rainfall	21.2	22.3	26.9	33.8	45.2	52.9	24.6	40.2	36.8	37.0	46.4	31.4	418.7	1	Chutes de Pluie
Snowfall	50.5	22.8	9.7	1.5	0.3	0.0	0.0	0.0	0.0	1.0	19.3	44.2	149.3	1	Chutes de Neige
Total Precipitation	**72.9**	**45.0**	**36.5**	**35.3**	**45.4**	**52.9**	**24.6**	**40.2**	**36.8**	**38.0**	**65.7**	**75.6**	**568.9**	**1**	**Précipitations Totales**
Standard Deviation, Total Precipitation	30.7	25.1	16.9	15.1	28.1	24.4	17.2	26.4	23.4	23.7	40.4	32.9	95.1	1	Écart Type des Précipitations Totales
Greatest Rainfall in 24 hours	22.9	26.7	34.3	26.9	38.4	46.5	28.7	48.8	56.4	27.4	39.6	22.4	56.4		Chute de Pluie Record en 24 heures
Years of Record	68	68	68	68	67	69	69	69	69	69	69	69			Années de Relèves
Greatest Snowfall in 24 hours	38.1	27.9	25.4	15.7	8.1	0.0	0.0	0.0	0.0	16.5	45.7	43.9	45.7		Chute de Neige Record en 24 heures
Years of Record	68	68	68	68	68	69	69	69	69	69	69	69			Années de Relèves
Greatest Precipitation in 24 hours	38.1	31.8	34.3	26.9	46.5	46.5	28.7	48.8	56.4	27.4	45.7	43.9	56.4		Précipitation Record en 24 heures
Years of Record	68	68	68	68	67	69	69	69	69	69	69	69			Années de Relèves
Days with Rain	6	6	8	9	11	12	7	8	8	10	10	7	102	1	Jours de Pluie
Days with Snow	10	6	3	*	*	0	0	0	0	*	4	10	33	1	Jours de Neige
Days with Precipitation	15	11	11	9	11	12	7	8	8	10	13	15	130	1	Jours de Précipitation