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Finlay River Kokanee (*Oncorhynchus nerka*) Spawning Survey 1990

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ABSTRACT

A kokanee spawning survey was conducted on the lower 40 km of the Finlay River in northern British Columbia, between October and November, 1990. The Finlay River, which flows into the north end of Williston Lake, is to date the only system were kokanee from the lake have been found to spawn.

The survey was conducted to provide information for future enhancement projects. The program objectives were to determine the location, timing and numbers of spawners as well as habitat information and data on kokanee morphology and age. A total of 6,573 kokanee were found holding in schools in eight sloughs and back channels along the main river. Total escapement was estimated at 10,000 kokanee.

The back channels and sloughs were up to 5°C warmer than the mainstem and possibly provided a more stable environment for incubation than the main river. It appeared that the kokanee had moved into these areas before the start of the study. Local residents suggest this may have occurred as early as September. Only a few kokanee spawned during the study and the remainder still appeared to be about a month away from spawning when the survey was ended in the first week of November.

The majority of the kokanee were males (81%). Of the 104 kokanee sampled, 98% were three years old and the rest were aged as two. Mean nose-fork length was 30.2 cm (n = 101, s = 1.29 cm). Fecundity in 25 females averaged 496 eggs (s = 111 eggs).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

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PART I

INTRODUCTION

1.0 BACKGROUND

The British Columbia Ministry of the Environment (MOE) retained Aquatic Resources Ltd. to conduct a kokanee (*Oncorhynchus nerka*) spawning survey of the lower Finlay River during the fall of 1990. Williston Reservoir, the largest body of freshwater in B.C., was created in 1968 after the W.A.C. Bennett Dam near Hudson's Hope, was completed. Sections of the Peace, Finlay and Parsnip Rivers were transformed into lake habitat. Lacustrine fish species, including kokanee, have gradually increased in the reservoir since the area was flooded.

Kokanee are a non-anadromous form of sockeye and are thought to have been independently derived in different localities from local sockeye populations (Ricker 1940). Kokanee occur in the headwaters of the Finlay River in Thutade Lake approximately 130 km upstream from the mouth. This stock may have been the origin of the present population in Williston Lake. The Thutade Lake population probably originated from Skeena River sockeye stocks. Kokanee also occur in the headwaters of the Parsnip River, which flows into the southern end of Williston Lake. The Arctic Lake population probably originated from Fraser River sockeye stocks (Nelson 1968). To date no Williston Lake kokanee have been found spawning in the Parsnip River.

The Ministry of the Environment in conjunction with B.C. Hydro have been conducting programs to increase recreational fishing opportunities within the Williston Lake area. Kokanee have been the target of some programs due to their value as both sport and forage fish. So far, studies have determined that there are now substantial numbers of kokanee rearing in the reservoir, however little information has been collected on the spawning population. To date, spawners have only been observed in the Finlay River. A survey conducted October 10-13, 1989 in the lower 60 km of the river by the Ministry of the Environment, found 3,000 to 6,000 kokanee schooled up in sloughs and side channels off of the main river (B. Blackman, MOE pers. comm.). At that time there was little evidence of any spawning activity. In 1990, Aquatic Resources Ltd. was retained to collect more information on kokanee spawners in the Finlay River.

The objectives of the 1990 spawning survey were:

1. To determine timing of kokanee spawning and the strength of the run in the lower 40 km of the Finlay River.
2. To describe the habitat and map the distribution of kokanee populations.
3. To collect information on morphological characteristics and age structure of the population.

1.1 STUDY AREA

The Finlay River flows south through the Rocky Mountain Trench into the northern end of Williston Lake, 360 km northwest of Prince George (Figure 1). The Finlay River is large with channel widths in the lower 30 km averaging 260 m. Average discharge rates for September to January at Fort Ware are 180, 159, 85.3, 51.3 and 40.6 $m^3 \cdot sec^{-1}$ respectively for the years 1961 to 1988 (O. Nagy, Water Survey of Canada, pers. comm.). Peak flows follow snow melt in the spring and thereafter discharge declines gradually through the summer and fall to reach minimum levels in the late winter.

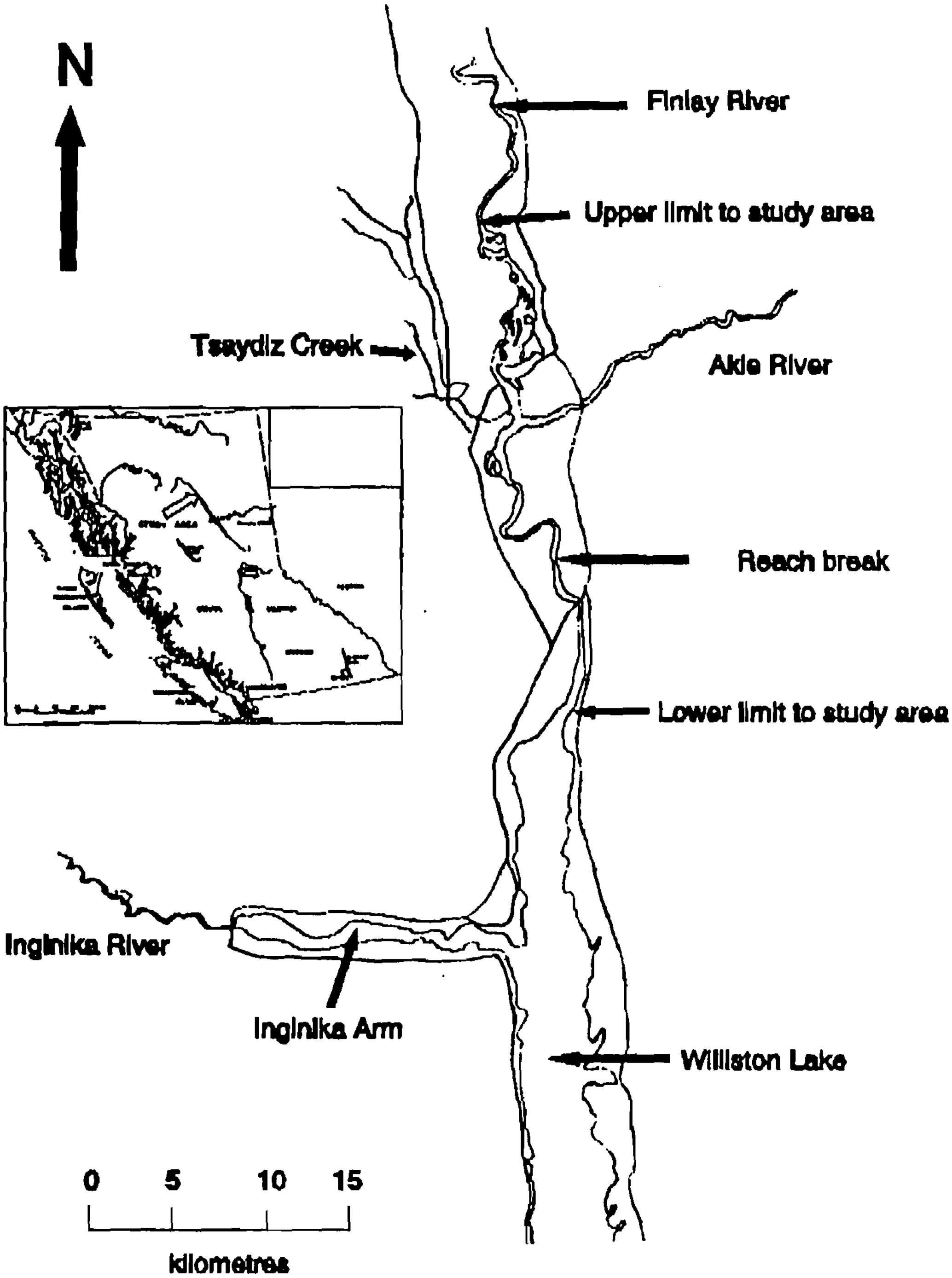
The area can be accessed either by landing barge from MacKenzie or by a logging road that connects the area with highway 97 a few kilometres north of McLeod Lake. The logging road runs along the west side of Williston Lake for approximately 280 km to Ingenika Arm. Prior to freeze up in November, a barge is required to cross the arm. Later in the winter, the Ingenika River can be crossed by a temporary bridge. The construction of a permanent bridge across the Ingenika River is planned for 1991. Logging roads extend along both sides of the Finlay River as far as Fort Ware, 88 km upstream. A bridge across the lower Finlay River was completed in October 1990, giving road access to both sides of the river.

The Finlay River lies within a forest management unit held by Finlay Forest Industries Ltd. (Fletcher Challange). They constructed a sawmill and pulpmill in MacKenzie at the south end of the lake after being awarded the timber licence in 1965. Logs from the Finlay River watershed are boomed at the northern end of the lake and towed to MacKenzie. The watershed has only been logged for the past few years.

Native settlements are located 70 km upstream at Fort Ware and at Ingenika Point 14 km south of the Finlay River mouth. The Ingenika band is currently relocating their village closer to the mouth of the river.

Figure 1

Map of study area and insert showing location of study area in B.C.



PART II

METHODS

2.1 BIOPHYSICAL SURVEY

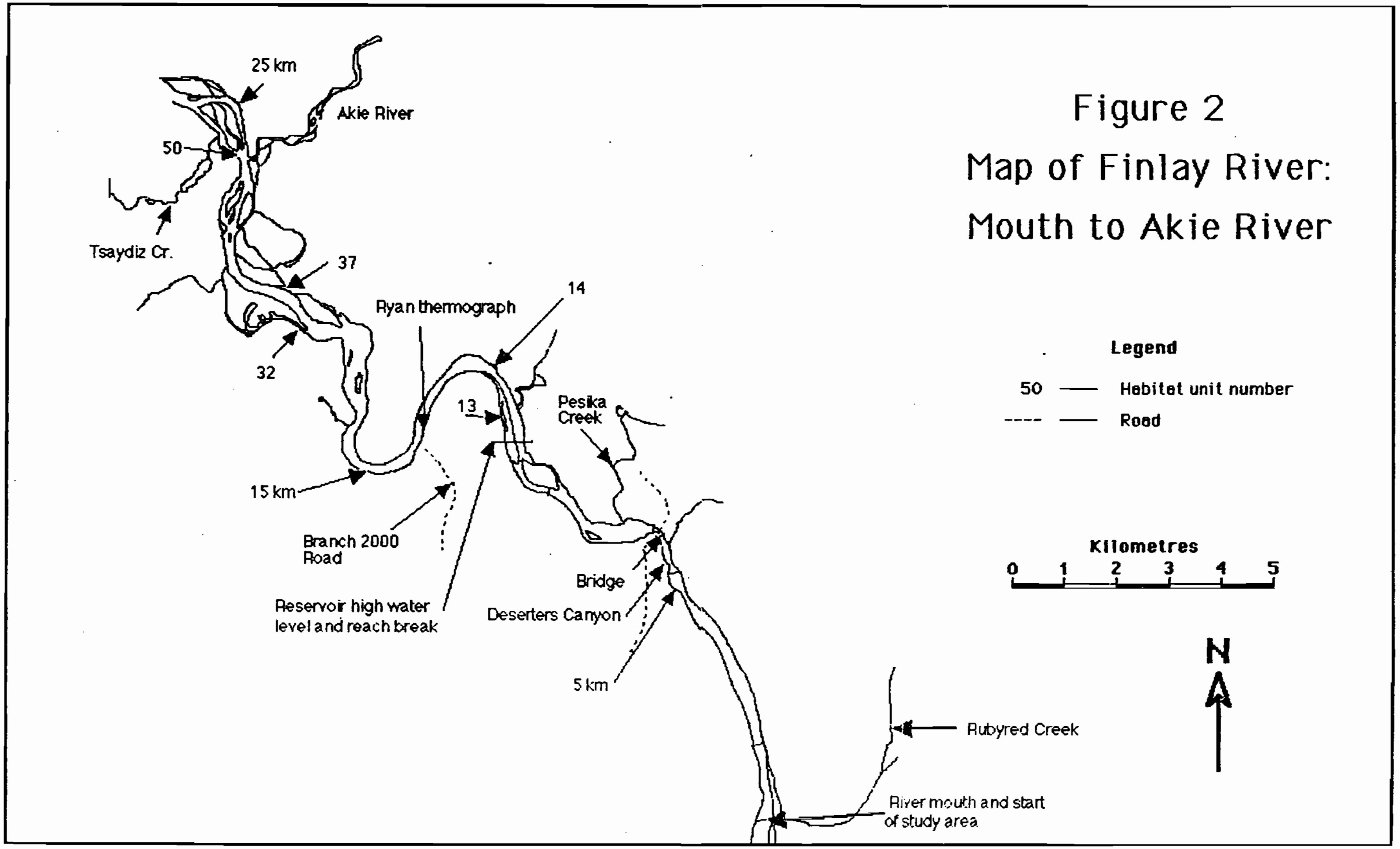
Habitat was described and mapped during the first part of the survey. The boundaries to the habitat units of the Finlay River were traced on aerial photographs in the field and the unit parameters (Table 1) were recorded.

Table 1
Summary of habitat parameters examined.

Parameter	Method	Precision
Wetted Width	Rangefinder	±3%
Channel width	airphoto measurements	±3%
Mean depth-mainstem	Sounder	±0.5 m
Mean depth-side chan.	Visual inspection	±5%
Substrate composition	Visual inspection	±5%
Cover and debris	Visual inspection	±5%
Water Temperature	Pocket thermometer	±0.5°C
Max. Velocity	Floating chip and	±5%
	Visual	±10%

Habitat information for the tributaries was recorded on Fish Habitat Inventory and Information Program cards (DFO/MOEP 1987).

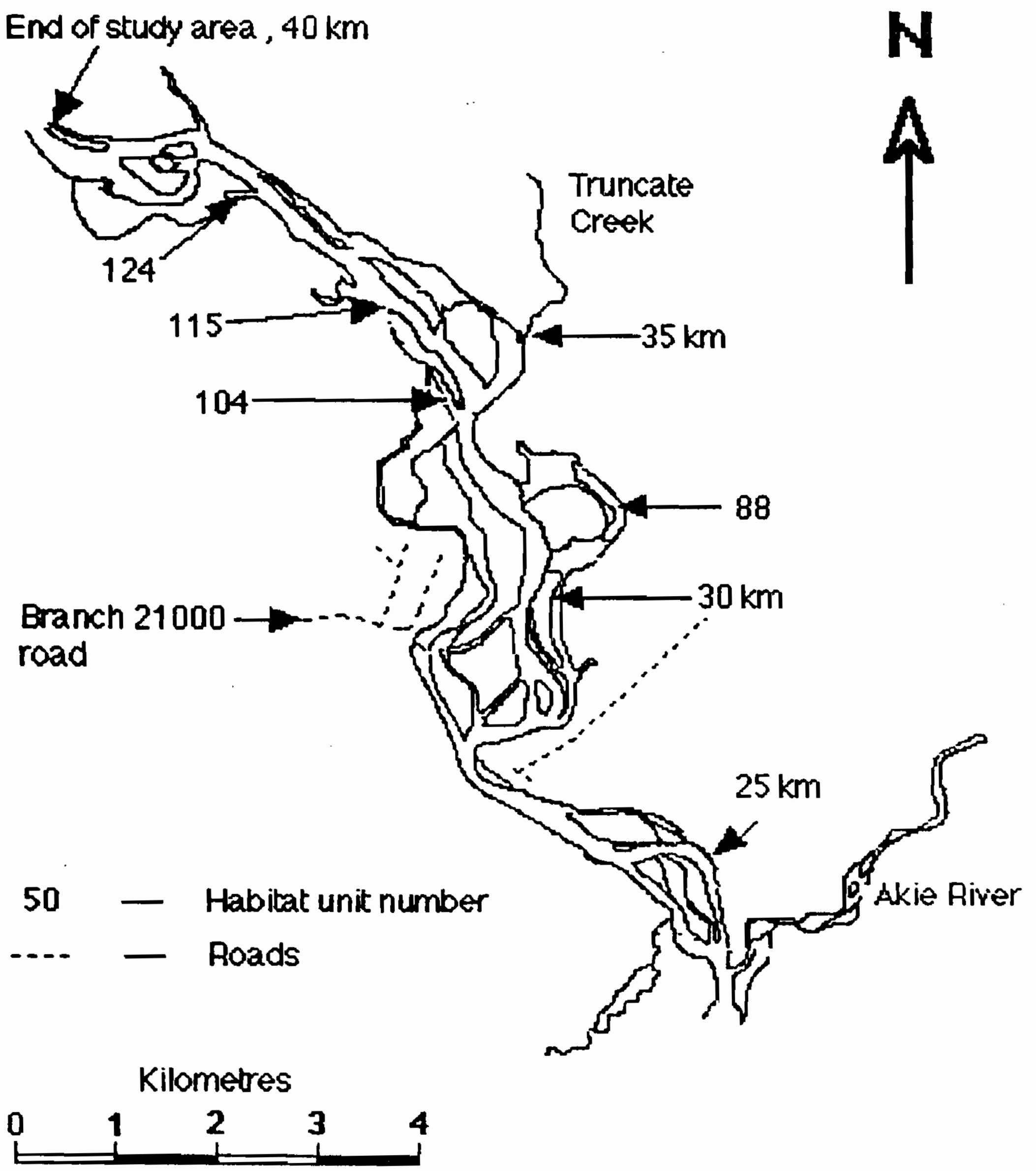
A Ryan thermograph was installed in the mainstem to monitor water temperatures during the study. The thermograph was initially installed near the Finlay River bridge on October 15 but was moved five more kilometres upstream (Figure 2) the next day to an area where the reservoir did not affect stream flows. The thermograph was removed at the end of the study on November 7, 1990. Water temperatures were also taken daily in the mainstem with a calibrated pocket thermometer and opportunistically in the tributaries, side channels and sloughs.



25 km
Akie River
50
Tsaydiz Cr.
37
32
Ryan thermograph
14
13
Pesika Creek
15 km
Branch 2000 Road
Reservoir high water level and reach break
Bridge
Deserters Canyon
5 km
Rubyred Creek
River mouth and start of study area
Figure 2
Map of Finlay River:
Mouth to Akie River
Legend
50 Habitat unit number
Road
Kilometres
0 1 2 3 4 5
N

Figure 3

Map of the Finlay River from the Akie River to the end of the study area.



2.2 SPAWNING SURVEY

Escapement estimates were based on visual counts of kokanee in the spawning and holding areas. The study area was traversed once a week during the October 10 - November 7 field program. A jet boat was the main mode of transportation along the mainstem of the river, while most of the side channels and sloughs were surveyed on foot. Access to the main concentrations of fish was afforded by truck and by foot during the times that ice prevented the use of the jet boat. On occasion, snorkel surveys were conducted to supplement stream side observations. Information on the size and location of some of the kokanee concentrations was also obtained from B.C. Hydro and MOE staff conducting surveys by helicopter during the study.

2.3 FISH SAMPLING

Kokanee samples were collected by 15 m x 3 m tangle net with 6 cm stretch mesh and by 20 m x 3.7 m seine with 3.8 cm stretch mesh. Both post-orbital hypural and nose-fork lengths were measured (±3 mm). Fish and gonad weights were measured with an Ohaus Dial-O-gram triple beam balance (2610 g model, ±0.05 g).

Aging samples included scales and otoliths. Scales were taken from the preferred area, approximately five from each side of the fish, and placed on slides. Otoliths were removed and placed in numbered otolith bags which were subsequently stored in glycerine along with a thymol crystal to prevent mold growth.

The development of each fish was categorized into either bright, transitional, mature, partially spent or spent. Fish that still had silver in the scales were classified as being bright. Transitional fish were those that had spawning colours and had eggs that had not yet ovulated (were still in the skeins) if they were females or, if males, did not express milt when the abdomen was squeezed. Males that expressed milt or females in which the eggs were loose and were ready to spawn were classified as mature. Partially spent fish had less than 100% and at least 10% of the testes or eggs retain when captured. Spent fish had less than 10% of the testes or eggs remaining.

Mature egg diameters were measured by water hardening a number of eggs and then placing 10 eggs on a measuring board. The length of a row of 10 eggs was measured (±0.5 mm) and the number was divided by 10 to give an average egg diameter.

Only the eggs of unspawned transitional or bright females were counted as the eggs were not loose and could not be forced out of the abdomen during capture. The eggs of mature females were not counted due to the possibility that some eggs could have been lost. The skeins were boiled to separate the eggs and then all the eggs were counted using a tally wacker.

The gonadosomatic index for males and female kokanee was calculated using the formula:

$$GSI = (\text{gonad weight})/(\text{body weight})*100$$

PART III

RESULTS AND DISCUSSION

3.1 PHYSICAL CONDITIONS

3.1.1 Weather

Air temperatures during the study were generally cooler than the temperatures collected at Ingenika Point over the 20 year standard time period 1961 to 1980 (Atmospheric Environment Service, Pers. comm.) (Table 2). Mean air temperatures from October 13 to 31, 1990 averaged 2.5°C below the 20 year average for the month of October and air temperatures from November 1 to 7, 1990 averaged -7.0°C for November (Figure 4).

Table 2
Adjusted average[1] total monthly precipitation and mean daily temperatures at Ingenika Point

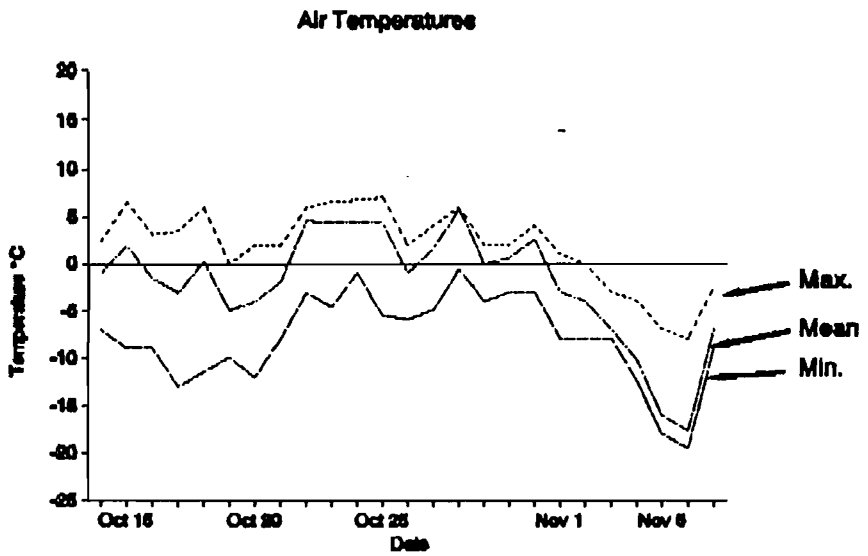
Month	Temperature (°C) Mean Maximum	Mean Minimum	Mean	Precip. (mm)
Sept.	13.8	3.5	8.6	41.5
Oct.	7.1 (3.8)	-1.2 (-2.3)	3.0 (0.5)	34.8
Nov.	-2.2 (-3.4)	-5.8 (-11.9)	-2.3(-9.3)	37.2
Dec.	-10.0	-18.2	-14.1	64.6
Jan.	-12.9	-22.7	-17.8	47.5

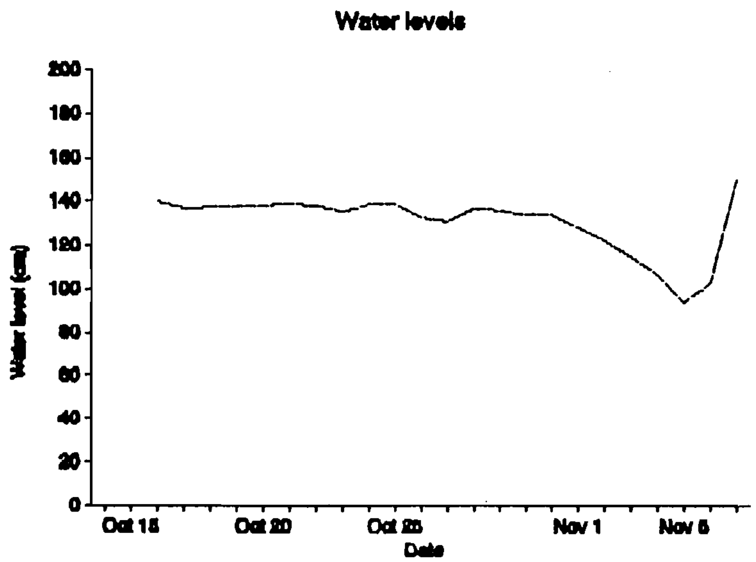
[1] 20 year standard time period 1961 to 1980 (Atmospheric Environment Service)
[2] The temperature data in brackets represents the data collected October 13 to November 7, 1990 near the lower Finlay River.

Over the course of the study, the Arctic front moved south of the Finlay River area during two periods to produce relatively cool air temperatures. The first occasion occurred during the beginning of the study October 14 - 21 when mean daily air temperatures averaged -1.8°C. The second occasion occurred from November 1 to the end of the project on November 7 with air temperatures averaging -9.3°C. In between these two periods, temperatures averaged 2.5°C.

Figure 4

Lower Finlay River air temperatures and water levels, Oct. - Nov. 1990





Approximately 10 cm of snow fell during the first cold period at the beginning of the study. Most of this melted when the air temperature warmed up after October 20. Another 12 cm of snow fell between the end of October and the end of the study on November 7. The lower Finlay River is an area with low precipitation (Table 2). The 20 year average total monthly precipitation (water equivalent) for October and November is less than 40 mm which is equivalent to approximately 40 cm. snow.

3.1.2 Stream Conditions.

3.1.2.1 Water levels

Air temperatures had a large impact on stream conditions. Water levels generally decreased throughout the project from a high of 140 cm on October 16, when the staff gauge was first installed, to a low of 94 cm on November 5 (Figure 5). Water levels fell fairly gradually over the first 2.5 weeks to October 31 and then dropped rapidly from 134 cm to 94 cm once the second cold period occurred on November 1. The water level then increased dramatically on November 6 and 7 to levels higher than that at the start of the project. The formation of ice ridges across the river caused levels to rise and flows to become rerouted in some areas.

Ice started to form along the banks of the river and slush formed in the channel on October 17 during the first cold period. By October 18 there was too much ice in the river to use the jetboat. With increasing air temperatures on October 21, the ice in the river started to break up and by October 22 the river was virtually ice free. With the second cold period which started November 1, the river again started to freeze and by November 6 the whole channel was frozen over in many areas.

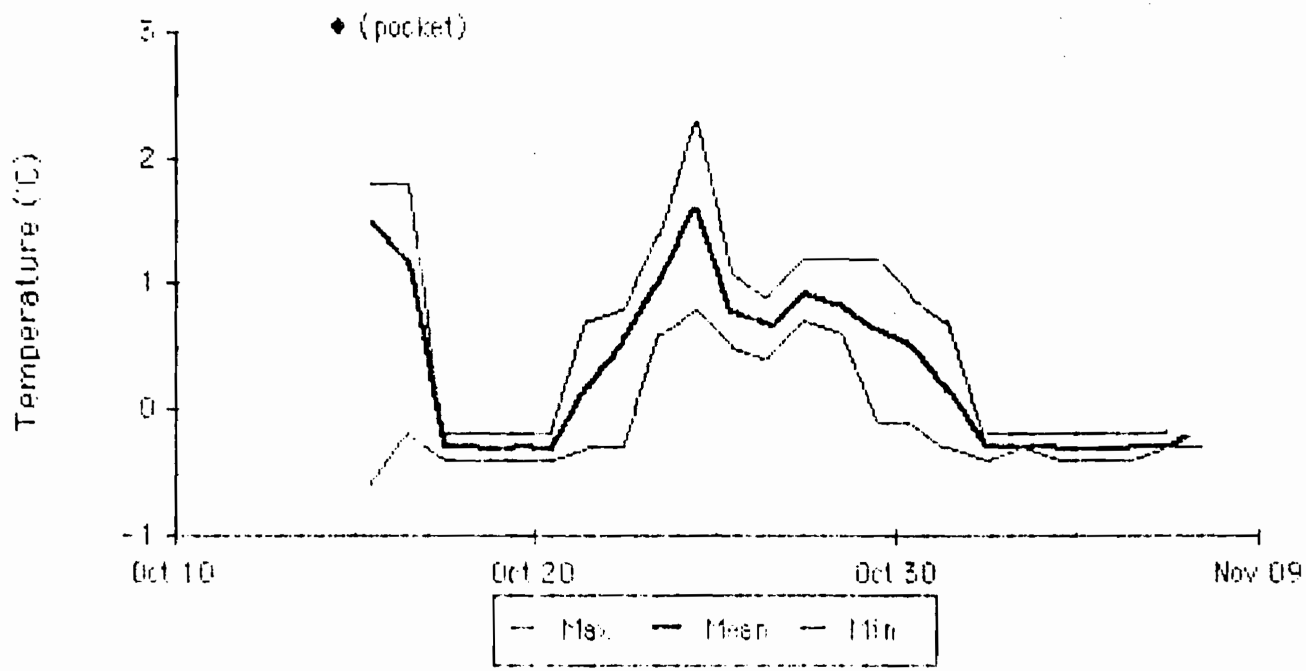
3.1.2.2 Water temperatures

Water temperatures in the mainstem were also directly related to air temperatures (Figure 5). During the first cold period, water temperatures decreased from 3°C on October 14 to an average temperature of -0.3°C from October 17 to 20. The river temperature only varied between -0.2 to -0.4°C. when air temperatures remained below 0°C during both cold periods. Water temperatures averaged 0.7°C and reached a maximum temperature of 2.3°C between the two cold periods.

Pesika Creek, Tsaydiz Creek and the Akie River water temperatures were occasionally checked with a pocket thermometer. The temperatures of these systems were always within 0.5°C of the Finlay River. The sloughs and back channels along the mainstem had the warmest water temperatures of any of the

Figure 5

Daily mean, maximum and minimum temperatures in the lower Finlay River, 1990.



habitat in the study area (Table 3). Many of these areas had temperatures of up to 7°C during October when mainstem river temperatures were near 0°C. The water temperatures of the slough and back channels averaged 3.7 °C while mainstem temperatures averaged 0.3 °C.

Table 3
Water temperature data collected from various sloughs and back channels along the lower Finlay River compared to mean daily mainstem temperatures.

Date	Habitat Number	Habitat Temp. (°C)	Mainstem Temp. (°C)
Oct. 18	104	5.0	-0.3
Oct..20	104	5.0	-0.3
	124	3.0	-0.3
Oct. 21	32	5.0	0.2
Oct. 23	67	2.0	1.0
Oct. 25	88	3.5	0.8
	104	5.5	0.8
	124	3.5	0.8
Oct. 27	37	3.0	0.9
	32	4.5	0.9
Oct. 29	37	1.0	0.7
	48	5.0	0.7
	50	4.5	0.7
	99	7.0	0.7
	104	5.0	0.7
	124	4.5	0.7
	55	6.0	0.7
Oct. 30	13	1.0	0.5
Nov. 2	104	5.0	-0.3
	115	3.0	-0.3
Nov. 3	67	2.5	-0.3
	26	2.0	-0.3
	32	4.0	-0.3
Nov. 4	26	2.0	-0.3
	32	4.0	-0.3
Nov. 5	50	2.5	-0.3
Nov. 6	37	3.5	-0.3
Nov. 7	104	0.5	-0.1
Average		3.7	0.3

3.2 HABITAT

The Finlay River was surveyed from the mouth of Rubyred Creek to a point approximately 40 km upstream (Figure 1). This section meanders irregularly, is largely unconfined, and is of low gradient (0.1%). The channel is generally braided and unstable with 2.5 to 4 m banks that are either fine, steep and eroding or gravel-cobble, flat and aggrading. There are numerous debris jams and scattered debris as a consequence of the unstable nature of the system. A total of 5 km^2 of wetted habitat was surveyed. Of that total, 88% was mainstem habitat and 12% was side channel habitat. Many of the side channels had little or no flow thus the proportion of side channel habitat would likely be greater at higher water levels.

Most of the mainstem consisted of long stretches of glide separated by short sections of riffle. Glide habitat made up 96% of the three types of habitat in the mainstem. Pool and riffle each made up 2% (Table 4). The substrate consisted primarily of gravel (46%) with 9% fines, 36% cobble, 8% boulder and 1% bedrock. The mainstem had an average wetted width of 94 m, an average depth of 1.9 m and an average maximum velocity of 1.5 m.

Table 4
Summary of habitat information from the mainstem of the Finlay River between the mouth and 40 km, October 14 to November 7, 1990.

Habitat	All	Glide	Pool	Riffle
Total habitats	51	31	3	17
Ave. Wet. Width (m)	94	103	60	84
Ave. Length (m)	697	1066	381	79
Total Area (km^2)	4,443	4,265	83	95
Ave.Max.Depth (m)	2.7	3.55	4.3	0.9
Ave. Depth (m)	1.9	2.5	3.2	0.6
% Fines	9	12	5	6
% Small Gravel	11	14	20	5
% Large Gravel	35	37	45	31
% Cobble	36	27	30	49
% Boulder	8	10	0	7
% Bedrock	1	0	0	2
Ave.Max.Vel.($m \cdot s^{-1}$)	1.5	1.2	1.2	2.2
% Debris Cover	1.6	2.3	5.0	0.0
Visibility (m)	3.1	3.2	3	3.1

Side channel habitat differed from mainstem habitat in that there was a smaller proportion of glide (43%) and a substantial proportion of slough (31%) and back channel (13%) due to the lack of flow or no flow in many side channels (Table 5). Slough and back channel are sluggish bodies of water in side channels that have little or no flow. Back channels are open to the mainstem while sloughs are isolated or connected by a small channel. Side channels contained a higher proportion of fines (29%), were shallower (average depths = 0.9 m) and narrower (average wetted widths = 26 m) than the mainstem. A total of 19 sloughs and 10 back channels were surveyed. These areas generally had little flow and primarily fine substrate (52 and 55% respectively). The sloughs averaged 390 m in length and 0.7 m deep and the back channels averaged 264 m long and 1.0 m deep.

Table 5
Summary of habitat information from the side channels of the Finlay River from the mouth to 40 km, October 14 to November 7, 1990.

Habitat	All	Back Channel	Glide	Riffle	Slough	Pool	Glide-Riffle*
Total habitats	81	10	23	19	19	4	6
Ave. Wet. Width (m)	26	24	27	34	24	24	7.5
Ave. Length (m)	287	264	352	58	390	187	538
Area (km^2)	0.585	0.075	0.253	0.034	0.182	0.015	0.026
Ave.Max.Depth(m)	1.2	2.1	1.0	0.8	1.3	2.5	0.41
Ave. Depth (m)	0.9	1.0	0.6	0.3	0.7	1.6	0.22
% Fines	29	52	21	3	55	25	32
% Small Gravel	14	8	15	14	13	10	28
% Large Gravel	35	29	47	36	18	30	5
% Cobble	21	9	17	46	13	20	0
% Boulder	1	2	0	1	1	15	0
%Bedrock	0	0	0	0	0	0	
Ave.Max.Velocity ($m \cdot s^{-1}$)	0.8	0	1.0	1.7	0.0	0.3	0.5
% Debris Cover	1.4	0.7	1.3	0.9	2.1	2.5	1.6
Visibility (m)	3.1	2.9	3.2	3.0	4.0	3.0	-

* - Glide-riffle-pool complex

The lower river was divided into two reaches. The first reach extends from the mouth to a point 10 km upstream (Figure 1). This section of the river is influenced by Williston Lake. In 1990, the reservoir level had been drawn down from peak levels during the early summer causing the river to be affected 8 km upstream at the time of the survey. Reach 1 was all glide habitat and was characterized by slow velocity (average = 0.7 $m \cdot s^{-2}$) and fine substrate. Depth ranged from an average of 14 m near the mouth to 1 m at the top of the reach (average = 6 m). Reach 1 had an average wetted width of 138 m. From 4 km to 6 km the river narrows to a channel width of 50 m as the river flows through Deserters Canyon. It is at this point the river is crossed by a bridge. Reach 2 is generally shallower (average depth = 1.1 m), has a higher velocity (average velocity = 1.7), is narrower (average wetted width = 82 m) and has coarser substrate.

3.3 KOKANEE DISTRIBUTION AND TIMING

3.3.1 Distribution

Kokanee were observed in eight different areas of the lower Finlay River (Table 6 and 7, Figures 2 and 3). All of these areas were slough and back channel habitat that had little or no flow and had warm water temperatures relative to the mainstem. These sloughs and back channels were situated in side channels which probably had flow during higher water levels in the spring but had since been cut off from the main channel. All fall flow in these slough appeared to be form from groundwater seepages. A total of 6,573 kokanee observed in the lower Finlay River and the total escapement would probably approach 10,000 kokanee if an allowance was made for those that may have escaped observation.

Table 6
Location of kokanee concentrations, habitat type and the size of the concentrations in the lower Finlay River, October-November 1990.

Habitat Number	Habitat type	Max. # of Kokanee observed	UTM[1] reference
14	Back channel	50	10.3762.63178
32	Back channel	?	10.3717.63189
37	Back channel	273	10.3719.63198
50	Slough	1,000	10.3712.63226
88	Slough	200	10.3703.63270
104	Back channel	3,000	10.3685.63282
115	Back channel	50	10.3677.63294
124	Back channel	2,000	10.3665.63306

[1]Universal transverse Mercator grid and habitat unit

Kokanee were observed above the study area during surveys conducted by helicopter by MOE and B.C. Hydro employees on October 17, October 25 and November 1. On October 25, a total of 5,200 kokanee were observed in four areas. Two schools totaling 3,000 kokanee were observed in the mainstem near Fishing Lakes, 163 km upstream. A school of 700 kokanee was observed in a slough near the Fox River, 90 km upstream. One thousand kokanee were observed in the mainstem near the mouth of Kwadacha River 86 km upstream and 500 kokanee were observed in a side channel at the mouth of the Del Creek, 47 km upstream.

Figure 6 Fifty kokanee were observed in Habitat 14 (upper photo). Kokanee were observed rising in Habitat 32 (lower photo) but the water was too deep and murky for counting.

Habitat 14, 11 km from the mouth of the river was the location closest to the mouth that concentrations of kokanee were observed (Figure 6). A school of approximately 50 kokanee were observed in Habitat 14 on October 28 (Table 7). This was a small back channel (Figure 2), approximately 60 m long, 25 m wide and 1.3 m deep near the mouth. The substrate was primarily gravel. The water temperature in this area was 1°C; only slightly warmer than the mainstem. There were no redds observed and all the females sampled (5) were in the transitional stage of maturity. Thus it is not clear whether these fish were likely to spawn in this area or move further upstream. The school was last observed on October 30, 1990. A week later the area was frozen over.

Table 7
Stream survey and carcass recovery data
collected from the lower Finlay River, October-November 1990.

Habitat number	Date	Number holding	Number spawning	Carcasses	Redds
14	Oct 28	50	0	0	0
	Oct 30	38	0	0	0
32	Oct 21	unknown	0	0	0
37	Oct 27	267	6	0	0
50	Oct 29	1,000	0	0	0
88	Oct 25	0	0	8	nd
	Oct 29	0	0	6	40
	Nov 2	200	0	0	nd
104	Oct 17	3,000*	0	0	0
	Oct 18	3,000	0	0	0
	Oct 20	3,000	0	14	0
	Oct 25	30	0	2	0
	Oct 29	70	0	0	30
	Nov 1	3,000*	0	0	nd
	Nov 2	1,000	0	0	30
	Nov 7	10	0	0	nd
115	Oct 31	0	0	0	0
	Nov 2	50	0	0	0
124	Oct 17	2,000*	0	0	0
	Oct 20	2,000	0	0	0
	Oct 25	2,000	0	0	0
	Oct 29	70	0	0	2
	Oct 30	2,000	0	0	2

* - MOE helicopter survey data
nd - no data

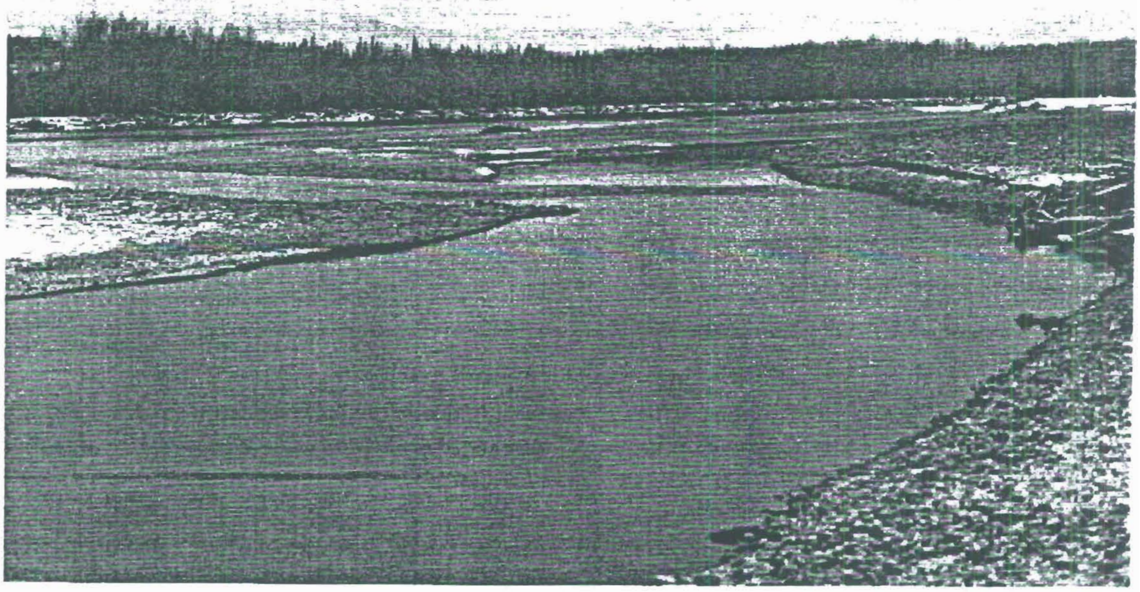
A member of the Ingenika Band reported seeing kokanee 1 km lower downstream from Habitat 14 in a slough (Habitat 13) across from Pesika Creek in 1989. This slough was isolated from the mainstem during the fall of 1990 which is probably the reason no kokanee were observed there in 1990.

Habitat 32, approximately 19 km upstream of the Finlay River mouth was the next habitat upstream that kokanee were observed This back channel was the largest in the lower Finlay with a length of 950 m and an average width of 35 m. The substrate was estimated to contain 60% fines, 30% gravel and 10% cobble. Groundwater seepage into the back channel produced warm water temperatures ranging from 5°C on October 21 to 4°C on November 4. Kokanee were observed rising in a 5 m deep pool at the end of the habitat on October 21. However their numbers were never determined due to the depth and poor water visibility (2.5 m). No fish were caught in a series beach seine sets. A tangle net set overnight caught eight, 1.0 - 2.9 kg bull trout and one female kokanee. All of the bull trout stomachs contained kokanee.

Habitat 37, another small back channel, discharges into a small side channel at the 20 km mark (Figure 7). This habitat was 45 m long, 12 m wide and had a maximum depth of 1.5 m. The substrate was 95% gravel. Although there was no groundwater flow into the back channel evident, water temperatures were warmer than that of the mainstem by 2.0 - 3.5°C. On November 6, water temperatures were 3.5°C along the bottom even with ice covering most of the habitat. Kokanee and a few redds were first observed in this habitat on October 27. The fish may have been there at the start of the study as they were very difficult to see. Virtually all of the kokanee in this back channel were captured by beach seine on October 27. Approximately 10% of the 273 kokanee captured were spent or partially spawned. The rest of the females were transitional and appeared to be at least a month from spawning.

A school of approximately 1,000 kokanee was observed in Habitat 50 opposite the mouth of the Akie River on October 29. Kokanee also may have been in this habitat at the start of the study. This slough was 150 m long, 28 m wide, had a maximum depth of 2.0 m and a substrate of 60% fines, 30% gravel and 10% cobble. Much of the fines were surface sediment. Water temperatures ranged from 6°C on October 29 to 2.5°C on November 4 at a depth of 0.5 m. The slough was completely frozen over on November 4. The slough was connected to the mainstem by a small channel 7 m long, 5 m wide and 0.1 m deep. Members of the Ingenika band report seeing kokanee at this location in previous years (George Pierre, pers. comm.).

Figure 7 A school of 270 kokanee was observed in the upper end of the small back channel, Habitat 37 (upper photo). Habitat 50, a slough near the Akie River mouth, contained about 1000 kokanee (lower photo).



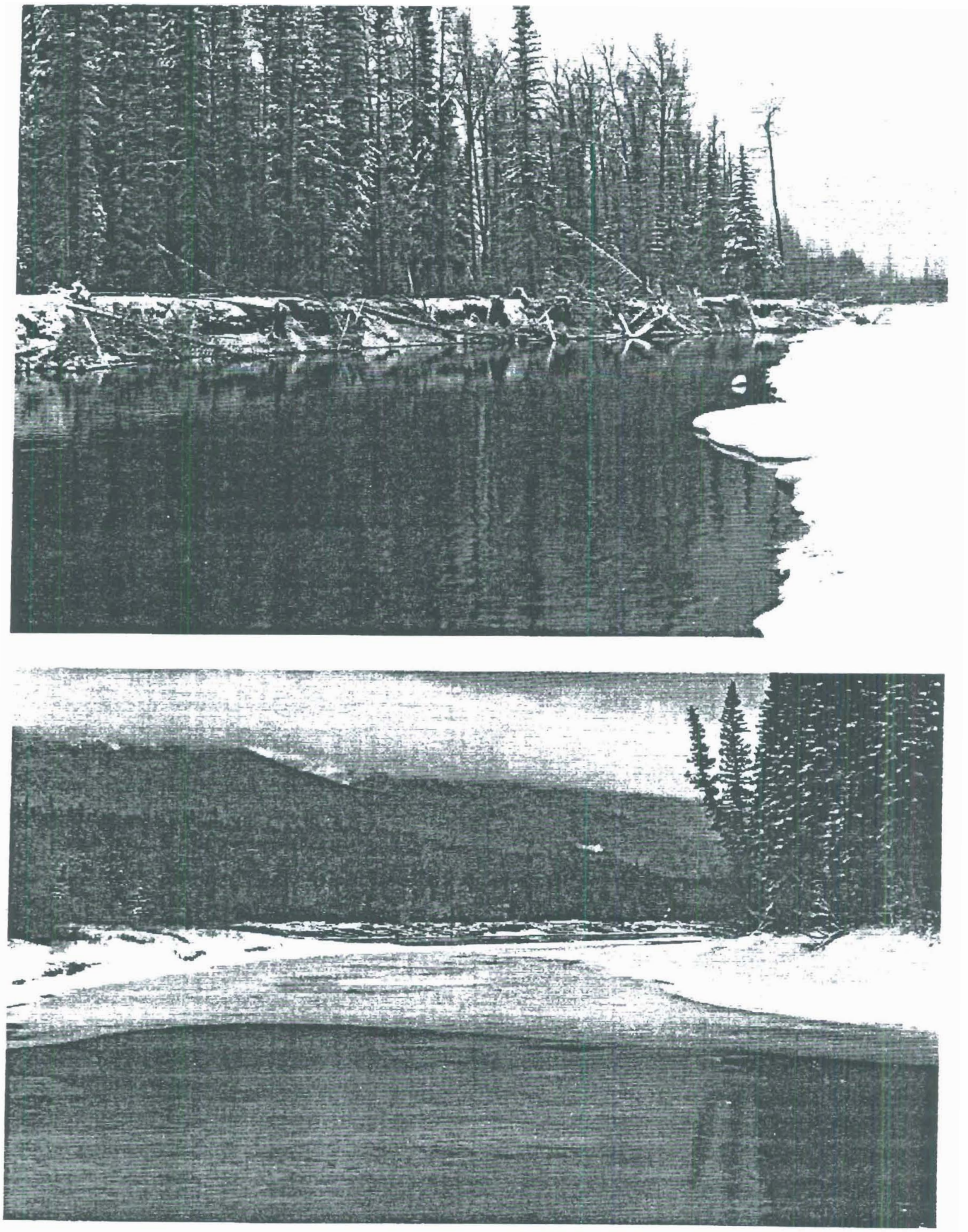
Habitat 88 is a slough situated in an area where the main channel used to flow, approximately 30 km upstream. A large number of redds (40) and relatively few kokanee that varied between zero and 200 fish were observed in this habitat (Table 7). A portion of the habitat was frozen over and may have provided cover for more kokanee than what were observed.

Habitat 88 was 1,200 m long, 30 m wide, had a maximum depth of 2.5 m and substrate that consisted of 80% fines, 10%, gravel and 10% cobble. The large proportion of fines that was recorded was mainly surface sediment. The large flow of groundwater into the habitat appeared to be responsible for relatively warm water temperatures that varied from 3.5°C on October 25 to 4.5°C on October 29.

The largest concentration of kokanee was observed in a back channel (Habitat 104, Figure 8) situated approximately 32 km upstream. The school of 3,000 kokanee, observed on October 17 was one of the first large concentrations of fish to be observed during the study. This back channel was 600 m long, 25 m wide, had a maximum depth of 3 m and substrate that consisted of 20% fines, 50% gravel and 30% cobble. Water temperatures varied between 5 and 5.5°C between October 18 and November 2. Water temperatures decreased to 0.5°C on November 7 as a result of ice buildup in the river which raised water levels and caused the main river to start flowing into the back channel. The numbers of kokanee in this habitat appeared to fluctuate from one week to the next. A week after 3,000 kokanee were observed only 30 kokanee were seen and then on November 2, 1000 kokanee were seen. Again the fluctuation in numbers was possibly a result of the kokanee taking refuge under the ice that covered the back channel near the entrance. The back channel was initially ice free when the fish were first observed. Although no spent or partially spawned fish were captured, approximately 30 redds indicated that some spawning appeared to be taking place.

Approximately 50 kokanee were observed on November 2 in a small back channel (Habitat 115) located 37 km upstream. The back channel was 100 m long, 12 m wide, had an maximum depth of 0.7 m and substrate of 20% fines and 80% gravel. There was little groundwater flow evident and the water temperature ranged from 4°C in the open water at the end to 3°C under the ice at the entrance on November 2. Substrate temperatures were 5°C. No redds were evident.

Figure 8 Habitat 104 (upper photo) contained the largest concentration of kokanee observed in the lower Finlay River area. Habitat 124 also contained substantial numbers of kokanee (lower photo).



The second largest concentration of kokanee was observed in Habitat 124, a back channel located approximately 38 km upstream. This back channel was 214 m long, 30 m wide, had a maximum depth of 2 m and a substrate composition of 80% fines, 15% gravel and 5% cobble. Most of the fines were surface sediment. Water temperatures taken on October 20 and 25 were 3.0°C and 3.5°C, respectively. A small, groundwater stream flowed into the upper end of the back channel. Two thousand kokanee were observed in Habitat 124 on October 17, 20 and 25 (Table 7). On October 29 only 70 kokanee were observed and then the next day 2,000 were again observed indicating that these fish were also moving in and out of the cover of ice near the entrance. Two large redds at the end of the habitat indicated that some spawning activity was taking place.

3.3.2 Timing

Most of the kokanee had probably moved into the slough and back channel habitats by the time the project started. Members of the Ingenika Band reported commonly seeing kokanee as early as September and spawning taking place as late as January (George Pierre pers. comm.). There was little indication that kokanee were continuing to move into these areas during the study, although the kokanee numbers appeared to fluctuate in some habitats from one week to the next. Ice had started to form during the beginning of the program and the fluctuation in numbers was probably due to kokanee moving in and out from under the ice.

No spent fish were among the 19 carcasses examined. This suggests that the peak of spawning would occur sometime after the November 7 end of the project. Information collected from the local residents and the condition of the fish during the study it indicates that kokanee move into the system in September, start spawning in mid-October, peak in December and finish in January. Due to the lack of data, this timing is only conjecture.

Periodically during the survey, a 15 m x 3 m tangle net with 6 cm stretch mesh was set in the mainstem, 2 km above the limit of influence of the Williston Lake reservoir (Table 8). The net was set for periods of up to two days between October 15 to October 31 in Habitat 11 in an attempt to determine if kokanee were still migrating upstream during the study. A total of 17 males and 1 female was captured. The female was at a transitional state of maturity and the males were mainly mature.

Table 8
Habitat 11 gillnet catches from October 15 to 31, 1990.

Date (October)	Days Fishing	Kokanee Males Trans	Kokanee Males Mature	Kokanee Females Trans	Kokanee Females Mature	White-fish	Bull trout
15	1	3	4	0	0	0	0
16	1	0	1	0	0	0	0
23	1	0	1	0	0	0	0
24	1	0	0	0	0	0	0
25	1	0	0	1	0	0	1
26	1	0	0	0	0	3	1
28	2	0	1	0	0	0	2
30	2	1	5	0	0	2	0
31	1	1	0	0	0	0	1
Total		5	1	1	0	5	5

The small catches in the tangle net suggest, at most, limited migration from the lake during the study. Kokanee may also have been milling around the area attempting to return to Habitat 13 where kokanee were observed spawning in previous years by local residents.

3.4 MORPHOLOGICAL CHARACTERISTICS

3.4.1 Sex ratio and maturity

Only 77 of a total of 412 kokanee (19%) sampled were females (Table 9). All of the groups of kokanee that were sampled throughout the lower Finlay River between October 15 and November 2 had a higher proportion of males than females. The percentage of females ranged from 4 to 21% and did not appear to change over the duration of the study. Sexual development in the males may have made them slightly more susceptible to gillnetting and may have biased the result somewhat. However the seines, which are less selective, showed similarly low numbers of females.

The sex ratio of kokanee sampled from Williston Lake in 1988 by gillnet was 1:1. A total of 77 kokanee were sampled from the lower Finlay River during 1989 in which the male to female sex ratio was 1:1.75 (64% females) (B. Blackman, MOE pers. comm.)

Table 9
Sex ratio of kokanee sampled from various habitats in the lower Finlay River, October 15 to November 2, 1990.

Date	Habitat number	Capture technique	Females	Males	Percent Females
Oct 15-31	11	gillnet	1	17	6
Oct 18	104	gillnet	7	26	21
Oct 25	124	gillnet	4	20	17
Oct 27	37	beach seine	59	216	21
Oct 30	11	beach seine	5	33	13
Nov 2	104	gillnet	1	23	4
Total			77	335	19

Of the 34 females sampled, 29 were in a transitional state of maturity (Table 10). Generally, these fish were showing spawning colours, but contained eggs which had not yet ovulated. Three spent females and two mature females were sampled. Most of the females did not appear to be very close to spawning condition. The maturity of the females indicates that, at the time of the study, a small percentage of the females were spawning, but the majority had yet to start and probably would not be ready for at least another month.

The three spent females had retained an average of 2.3 eggs (s = 3.2 eggs)

Table 10
Maturity of kokanee sampled from the lower Finlay River between October 15 and November 2, 1990.

	Maturity				
Sex	Bright	Transitional	Mature	Part spent	Spent
Male	0	4	66	0	0
Female	0	29	2	0	3

Most of the males were mature and would express milt when the abdomen was squeezed. Only four of the 70 males sampled were in a transitional state of maturity.

3.4.2 Size and age composition.

A total of 104 kokanee were sampled for age structure and morphological characteristics of which 34 were females and 70 were males. The sex ratio of the sample does not represent the sex ratio of the population sampled because an attempt was made to sample an equal number of both sexes. Scale samples indicate that the majority of the kokanee sampled were three years old (98.1%) and the rest were two years old. Some of the scales were difficult to age as a portion had been resorbed. The mean nose-fork length for all kokanee sampled was 30.2 cm (n = 101, s = 1.29 cm) (Table 11). There was no significant difference between the lengths of female and male kokanee sampled (t-test, $P \geq 0.05$) but there was a significant difference between weights. Mean weights of male and females were 0.381 kg (n = 70, s = 0.052 kg) and 0.329 kg (n = 34, s = 0.043 kg) respectively.

Table 11
Breakdown of length and weight in kokanee sampled from the lower Finlay River, October - November, 1990 and October 1989.

			Nose-Fork Length (cm)			Weight (kg)		
Year	Sex	Age	Mean	n	Stdev	Mean	n	Stdev
1990								
	All	All	30.2	101	1.29	0.364	104	0.055
	All	3	30.2	99	1.24	0.366	102	0.055
	All	2	27.4	2	0.14	0.287	2	0.010
	Females	All	29.9	31	1.29	0.329	34	0.043
	Males	All	30.3	70	1.29	0.381	70	0.052
	Females	3	30.0	30	1.23	0.331	33	0.043
	Females	2	27.5	1	-	0.278	1	-
	Males	3	30.3	69	1.25	0.383	69	0.052
	Males	2	27.3	1	-	0.296	1	-
1989*								
	All	3	294	77		0.341	77	
	Females	3	293	49		0.328	49	
	Males	3	295	28		0.364	28	

* - B. Blackman (MOE) pers. comm.

Kokanee sampled during 1990 were similar in size to those sampled in 1989.

The unimodal frequency distribution of nose-fork lengths (Figure 9) generally reflects the uniform age structure of the population. The mode for both sexes occurs between 30 and 31 cm.

Parameters relating length and weight are contained in Table 12. A significant correlation exists between nose-fork length and weight for both sexes at $P \leq 0.001$.

FIGURE 9

LENGTH -FREQUENCY DISTRIBUTIONS OF KOKANEE SAMPLED FROM THE LOWER FINLAY RIVER

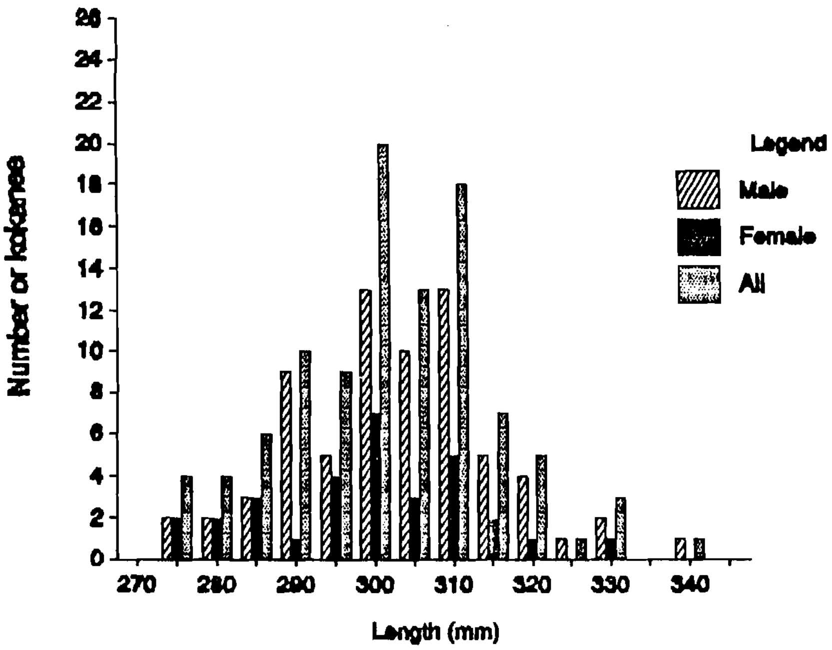


Table 12.
Linear regression parameters[1] for kokanee length/weight relationships by sex.

Sex	n	a	b	r
Males	68	-4.721	2.941	0.890
Females	30	-4.527	2.845	0.884
All	101	-4.831	2.980	0.853

[1] $\text{Log}_{10}(\text{weight}) = b(\text{Log}_{10}(\text{length})) + a$

The parameters relating nose-fork length and post-orbital hypural lengths in the equation:

$$\text{Nose-fork length} = b(\text{POH length}) + a$$

are contained in Table 13. A significant correlation exists between nose-fork length and length for both sexes at $P \leq 0.001$.

Table 13.
Linear regression parameters for nose-fork and POH length for kokanee by sex.

Sex	n	a	b	r
Males	68	1.969	1.167	0.901
Females	30	7.215	0.940	0.886

3.4.3 Fecundity, egg size and gonadosomatic indices

Twenty-five female kokanee, ranging in size from 27.7 cm to 31.8 cm in length (nose-fork) were sampled for fecundity. These fish had an average nose-fork length of 29.9 cm (s = 1.17) and an average fecundity of 496 eggs (s = 111). Females sampled in 1989 had fecundities that averaged 508 eggs (n=5) (B. Blackman (MOE) pers. comm.).

The regression of number of eggs on length (cm) was calculated for the samples collected (Table 14). There was a significant correlation ($P \leq 0.05$) between both nose-fork length and POH length and fecundity, although the correlation was not strong. Fecundity and fork length were related as:

$$\text{Log}_{10}(\text{fecundity}) = b(\text{Log}_{10}(\text{length})) + a$$

Table 14
Length/fecundity relationships[1] for kokanee sampled from the lower Finlay River October-November 1990.

Length	n	a	b	r_s	$r_{0.05(2).25}$
Nose-fork	25	-2.77	3.70	0.55	0.40
POH	25	-1.36	2.92	0.53	0.40

[1] Linear regression parameters and Spearman's rank correlation coefficients (r_s) for log(fecundity) and log(length (mm)

The mean nose-fork length of the females sampled for fecundity (29.9 mm) was the same as the nose-fork length of all 34 females sampled during the study, therefore the average fecundity for the total sample would be 496 eggs. With an estimated escapement of 10,000 kokanee to the lower Finlay River of which only 19% or 1,900 of them were females, the total egg deposition would have been 940,000 eggs.

Water hardened egg diameters were only measured from two mature or partially spent kokanee because most of the 34 kokanee sampled had not ovulated. The egg diameters of both kokanee were 5.4 mm.

The average female gonad weight was 42.1 g (n = 29,s = 9.9) and weights ranged from 22.8 to 60.2 g. For males, average gonad weight was 11.6 g (n = 70, s = 2.4) and ranged from 3.7 to 16.8 g.

The gonadosomatic index for male and female kokanee sampled from the Finlay River is significantly different between males and females (Bartlett's test for homogeneity of variances $P \leq 0.05$). Average GSI for females was 12.51 and from males was 3.04 (Table 15). There was no significant difference (Bartlett's test $P<0.05$) in GSI over time for males (October 19 to November 11) and females (October 19 to October 26)

Table 15
Gonadosomatic Index by sex for kokanee sampled from the Finlay River, October to November 1990.

Sex	n	mean	Stdev	Minimum	Maximum
All	99	5.81	4.49	1.03	17.57
Male	70	3.04	0.46	1.03	3.86
Female	29	12.51	2.04	7.20	17.57

3.5 CONCLUSIONS

Slough and back channel habitat were the only areas where concentrations of kokanee were observed in the lower Finlay River. The gravel in these areas did not appear to be as suitable for spawning as gravel in the mainstem glides as there was a higher proportion of fines. In addition, these areas appeared to have less water percolation due to the low current velocity. The slough and back channels did, however, have two characteristics that possibly made these areas more favourable for spawning.

First, water temperatures were up to 5°C warmer than those of the mainstem. Even when these habitats were covered with ice, the water temperatures were still warmer. Subgravel temperatures were possibly even warmer than the water temperatures. On November 2 subgravel temperatures in a back channel (Habitat 115) were 5°C while water temperatures were 3°C.

The instability of the mainstem is a second factor that may make the mainstem unsuitable for spawning. Water levels started to increase and flows changed as the river froze over in early November. Water levels rose an estimated 50 cm on November 6 and 7 at the location of the Ryan thermograph (Figure 2). Ice buildup in the mainstem caused water to flow in parts of the channel that were previously dry while other areas received less flow. Flow instability during the winter may make the mainstem unsuitable for spawning.

One or both of these two factors (temperature and stability) may be responsible for higher egg to fry survival rates in the sloughs and back channels.

Not only was the mainstem unstable, but some of the sloughs and back channels appear to be unstable as well. The conditions of Habitat 105, a back channel, changed during the study and may have been less favourable to spawning kokanee as water temperatures and probably subgravel temperatures dropped due to the rerouting of the mainstem flows when ice built up in the main channel. In another instance, a member of the Ingenika Band reported observing kokanee spawning in a slough near Pesika Creek (Habitat 13). However, the channel had changed so that this year kokanee were blocked from reaching this area. The instability of the system is probably an important limiting factor to kokanee production.

Warm subgravel temperatures of the sloughs and back channels at least partially account for the late timing of spawning. The timing of runs of coho, chum and sockeye, that spawn in groundwater fed sources typically, are later than runs that spawn in mainstem habitat (D. Marshall, DFO pers. comm.). In addition, the optimum timing of emergance of fry may be late possibly due to late spring plankton blooms in Williston Lake.

3.6 RECOMMENDATIONS

3.6.1 Broodstock acquisition

The collection of mature females from the lower Finlay River may be difficult in the future. In 1990, most of the areas where kokanee were holding froze over before many of the fish were mature. By November 7 it appeared that the majority of females were at least another month from spawning, so it is possible that, even though 1990 was cooler than normal (Table 2), freeze up comes before the females mature during most years.

Kokanee in the transitional stage of maturity could be collected in October and held at another location until they matured. Possibly the best areas for broodstock collection would be habitats 104 and 124. These two back channels had the highest concentrations of kokanee and the channels would be accessible by jetboat. Fish could be captured using a 20 m x 3 m beach seine with 5 cm or less stretch mesh.

The slough opposite the mouth of the Akie River (Habitat 50) may also be a good location to capture broodstock. This slough, only 30 m from the main river behind a large log jam, would be inaccessible by boat, but a beach seine could be carried or flown to the site and then set using a person in a dry suit or with ropes from the shore in this small habitat.

Due to the unstable nature of the system, some of the areas where kokanee were observed in 1990 may not be accessible or favourable for spawning in future years. The locations of concentrations of kokanee must be determined on an annual basis before broodstock is collected.

There are three sites that a jet boat can be launched. The best site is the barge landing at a gravel pit near the mouth of the river (Figure 1), however this launch is also the farthest from the two back channels. Another location a boat could be launched is approximately 14 km upstream along the right bank at the end of the Branch 2000 road. The road goes to the edge of the bank, but the bank is reposed and approximately 6 m high. A boat could easily be slid down the bank into the river at this location but it would have to be winched back up. The third site is located approximately 27 km upstream along the left bank 3 km above the Akie River. A logging spur, branching off of the mainline, extends to the river's edge.

The bank is flat in this area and some work, such as small tree removal and bank excavation may have to be done to drive a truck and boat to the water.

3.6.2 Enhancement opportunities.

There are several techniques that could be employed to enhance the kokanee population of Williston Lake using Finlay River broodstock. These include the use of hatcheries, spawning channels and the transfer of adults into inaccessible sloughs. The Finlay River is the only system that Williston Lake kokanee have been found to utilize for spawning (B. Blackman, pers. comm.). The area suitable for spawning within the Finlay River appears to be small as only the back channels and sloughs appear to be utilized. The total area of the sloughs and back channels surveyed was 257,000 m^2 and of that only a portion has spawning potential as much of the area has unsuitable substrate or insufficient depth. Using a density of 5.2 kokanee$\cdot m^{-2}$, thought to be the ideal density of spawners in the Meadow Creek spawning channel (Acara 1977), the maximum ideal escapement to the Lower Finlay would be 1.3 million kokanee. However, as not all the back channels and slough habitat is suitable for spawning the number would be much lower. The rearing area of Williston Lake likely exceeds the number of progeny that could be produced by a maximum escapement to the lower Finlay River as such a small proportion of it appears to be suitable for spawning. An enhancement program may therefore be necessary to help more fully utilize the available rearing area.

3.6.2.1 Hatcheries

Finlay River kokanee should be tested for disease, particularly the infectious hematopoietic necrosis (IHN) virus, before any hatchery program is embarked. The virus, which has been found in almost all stocks of sockeye, examined (Amend and Wood 1972; Grischkowky and Amend 1976), has been the main reason for the failure of many sockeye hatcheries (Williams and Amend 1976). Of the salmonids, sockeye are the most susceptible to the disease (Leong 1984). The susceptibility of sockeye to the virus has lead to severe losses when sockeye are cultured using standard hatchery techniques. The spatial separation of eggs and fry appears to limit the spread of the disease in the wild, although there has been evidence of severe impacts on wild stocks as well (Williams and Amend 1976).

The disease is usually only evident at the extreme ends of the fish's life cycle (Mulcahy et al. 1982). Mortalities generally occur only in the egg to fry stage (Amend 1974), with few exceptions (Traxer 1986 and Williams and Amend

1976). Although most sockeye carry the virus, epizootics only seem to occur with heavy exposure. If epizootics do not occur the virus can not be detected until the fish start to spawn (Mulcahy et al. 1982). The virus can be detected in some stocks of mature fish, but it becomes most evident, especially in females, after spawning has been completed (Saft 1987). This characteristic of the virus appears to be a mechanism for the transmission of the virus to the next generation. During spawning, heavy concentrations of the virus appear in the visceral organs, gonadal fluids and gills. The virus can be transmitted to other adults at this stage under crowded conditions (Mulcahy et al. 1983). The virus is also transmitted vertically through the egg to the next generation. Infection can spread through the eggs and fry under hatchery conditions resulting in losses.

3.6.2.2 Spawning channels

The Finlay River kokanee population appears to be unique in that the run spawns much later and during cooler temperatures than other kokanee stocks. To be successful, a spawning channel that utilized Finlay River broodstock would have to have a similar temperature regime or some means of assuring the accumulation of thermal units at a rate similar to that of the natural stock. For optimal survivals, fry migration in the spring should to be synchronized to the spring plankton bloom in Williston Lake. Bilton and Robins (1973) found that two weeks was the maximum time that Fulton River sockeye fry could survive without food before large mortalities occurred.

The limited temperature data collected during 1990 suggests that the areas where the Finlay River kokanee spawn were warmer than that of the mainstem. Therefore a spawning channel in the Finlay River area may require groundwater that approximates the subgravel temperatures that occurs in the sloughs and back channels.

The Salmonid Enhancement Program of Fisheries and Oceans Canada has constructed a number of small groundwater fed spawning channels for coho, chum and sockeye (D. Marshall, DFO pers. comm.). These spawning channels are constructed from side channels that are graded below the water table. As a result, groundwater, that is relatively warm in the winter and cool in the summer, percolates through the gravel. Dykes are often constructed to prevent the channels from becoming destroyed during freshets. Improved groundwater-fed channels in British Columbia are typically 300-1000 m long, 5-6 m wide, 20 - 40 cm deep and have discharges of 0.085 to 0.14 m^3s^{-1} (Sheng et al. 1990). The timing of fish that spawn in groundwater channels is often later than stocks that spawn in the main river because of warmer subgravel temperatures. Assessments indicated that these spawning channels were highly productive compared to natural streams (Lister et al. 1980; King and Young 1986 and 1986b; Bonnell 1990; Sheng et al. 1990).

The Finlay River may be particularly well suited for the enhancement of kokanee through the use of improved groundwater-fed side channels. Kokanee already spawn in a number of groundwater-fed side channels at the present time and it appears that the instability of these areas from one year to the next is possibly decreasing the productivity of the system. Productivity could be improved by stabilizing these areas through the construction of dykes. Some of the spawning areas also have a fairly high percentage of fines, so the addition of gravel would also improve the spawning habitat. The low gradient of the system is one factor that could limit the improvement of flow into the spawning areas. The gradient in the lower 40 km of the river is only 0.1%.

The habitats 13, 104 and 88 would be the most amenable to improvement. All three of these areas are relatively close to road access and have or have been utilized by kokanee for spawning. Habitat 13 has the best road access with a logging road (Branch 2000) leading almost to the edge of the habitat. Although this habitat did not have kokanee spawning in 1990, it has supported kokanee spawning in the past. A channel would have to be dug from this slough to the main channel and a dyke constructed between the slough and the river. Habitat 104 is about 1.5 km from the Branch 21,000 road (Figure 3). The construction of a dyke would probably greatly increase the productivity of this back channel. Near the end of the study ice ridges in the main channel started to divert cold mainstem water into this back channel. Habitat 88 is the closest of the three habitats from a mainline logging road at 0.7 km. However, this large slough is the farthest from the mainstem and may require the most dyking and channelization to stabilize the area.

3.6.2.3 Outplanting Adults

The transfer of kokanee from areas that have a high concentration of spawners to other back channels and sloughs that have few or no spawners would increase the amount of spawning habitat available. Kokanee appear to be concentrated in relatively few areas, although there are a number of back channels and sloughs. The system is unstable which cause some suitable habitats to appear and disappear from year to year.

3.6.3 Future Studies

If an enhancement program is to be undertaken the following studies are recommended:

1) A zooplankton watch in Williston Lake should be conducted to determine the timing of the spring bloom. Any enhancement program should be structured so that the emergence of kokanee fry would coincide with the spring bloom.

2) A spring fry trapping program using 2x3 incline plane traps should be conducted to establish the timing of the outmigration of kokanee fry. Baseline information on the size and condition of the juveniles could also be collected at this time.

3) Incubation temperatures in the spawning areas should be collected. Subgravel temperatures over the winter could be monitored using a Ryan thermograph planted in the gravel of a back channel used for spawning. In addition, surface temperatures in the back channel and mainstem and subgravel temperatures of the mainstem would be useful for comparative purposes. Temperature information may provide more clues as to why the kokanee are utilizing the sloughs and back channels. The time of emergence of the kokanee fry could also be estimated.

4) The peak of spawning during 1990 appeared to occur after the end of the study and after freeze up during the beginning of November. It was difficult observe the movements and state of spawning once freeze up occurred. A radio tagging program could be conducted to determine if in fact the kokanee are spawning in the back channels and sloughs or just holding there only to move into the mainstem or further upstream at a later date. Radio tags should be placed on kokanee as they are entering the system.

5) Radio tags would allow the movements of the kokanee to be tracked but they would not enable the timing of spawning to be determined once freeze up occurred. Once spawning locations are determined from the radio tags, one way to determine timing after freeze up would be to select a back channel or slough with a good concentration of kokanee and to periodically use scuba gear to examine fish condition. Diving under river ice has proved useful in monitoring movements of chinook under ice cover in the Nechako River (C. Levings, DFO pers. comm.).

6) A sample of kokanee from the lower Finlay River should be analyzed for disease. The samples should be as close as possible to the end of their life cycle as many diseases become more evident as the immune system breaks down.

PART IV

SUMMARY

1) The Finlay River is, to date, the only system where kokanee from Williston Lake have been found to spawn. A spawning survey was commissioned by the B.C. Department of the Environment to conduct a kokanee spawning survey of the lower Finlay River between October 10 and November 10, 1990.

2) The objectives of the survey were to determine the location of spawning, the numbers of spawners and the timing of spawning. In addition, habitat information was to be collected and information on the morphological characteristics and the age structure of the populations was to be collected.

3) The weather during the survey was cooler than normal for October and November. As a result of the cool air temperatures, water temperatures in the Finlay River mainstem dropped to near zero during two periods. One period was for a week during the beginning of the study and another was during the last week of the study. The river started to ice up on both occasions.

4) While mainstem water temperatures were close to zero temperatures in the back channels and sloughs were up to 6°C warmer.

5) Water levels decreased slowly throughout the project until the second cold period. During the second cold period the levels dropped more rapidly until the river froze over. They then rose rapidly to reach higher levels than before the start of the study. Water levels rose and flows became rerouted as the channel became blocked with ice.

6) The lower Finlay River contained 4.4 km^2 of mainstem habitat (wetted area) and 0.6 km^2 of side channel habitat. The mainstem consisted of long glides separated by short sections of riffle. The side channels, many of which had no or little flow, chiefly consisted of glides, back channels and sloughs.

7) Schools of kokanee were primarily observed in the sloughs and back channels. A total of 6,600 kokanee were found in eight back channels and sloughs. Although the substrate in these areas did not appear as suitable for spawning as in the mainstem, these areas tended to be warmer and were possibly more stable during the winter. It was estimated that there were as many as 10,000 kokanee spawning in the sloughs and back channels along the lower Finlay River.

8) It appeared that the kokanee were in the system before the start of the study and spawning had only just started by the end of the study. Judging from information from the local residents and the maturity of the fish, it appears that the kokanee arrive in the system in September, start spawning in late October peak in December and finish in January. The late timing of the run may be due to relatively warm subgravel temperatures and a late optimum time of emergance.

9) The majority of the kokanee in the lower Finlay River were males. The male to female sex ratio of 412 kokanee examined was 1 : 4.4 (19% females). Most of the males were mature while most of the females were no longer bright and had not yet ovulated (transitional state of maturity).

10) Almost all (98%) of the 104 kokanee sampled were three years of age. The rest were 2 years old. The overall nose-fork length was 30.2 cm (n = 101, s = 1.29 cm). Females averaged 29.9 cm (n = 31, s = 1.3 cm) long and males averaged 30.3 cm (n = 70, s = 1.3 cm) long.

11) Twenty-five females sampled for fecundity had an average of 496 eggs (s = 111 eggs). The average length of the females sampled for fecundity was the same as the average for all 31 females sampled. The total potential egg deposition of an escapement of 10,000 kokanee would have been 931,000 eggs.

12) It would be difficult to collect mature kokanee for broodstock acquisition because the system will likely freeze up before the females mature. To collect broodstock it may be necessary to seine kokanee in the back channels and sloughs in October before freeze up. Many of the females would then have to be held for at least a month until they matured.

13) Three possible methods of enhancement would be a hatchery program, the improvement of groundwater-fed side channels, and outplanting adults into inaccessible or under utilized sloughs and back channels. The Finlay River kokanee should be tested for IHN before a hatchery program is embarked. Sockeye are very susceptible to IHN virus so special hatchery procedures may have to be followed if the fish are infected. Small groundwater fed spawning channels for coho, chum and sockeye have been constructed by the Salmonid Enhancement Program. Similar channels could possibly be constructed along the Finlay River for kokanee.

14) If an enhancement program is planned, future studies could include: disease sampling, monitoring of subgravel temperatures on the spawning grounds, a downstream trapping program of juveniles in the spring, radio tracking of spawning adults, and the determination of time that spawning peaks and ends.

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KOKANEE MORPHOLOGICAL AND AGE DATA

Date	Fish #	Otolith #	Sex	Weight (kg)	Length POHL(cm)	Length N-F(cm)	Scale #	Maturity	Fecundity (# eggs)	Age	Gonad wt. (g)	Egg diam. (mm)
10/15/90	1	V1	M	0.35	23.8	30.0	1	T	.	3	13.6	
10/15/90	2	V2	M	0.30	23.3	29.5	2	T	.	3	11.7	
10/15/90	3	V3	M	0.36	25.1	31.2	3	T	.	3	3.7	
10/15/90	4	V4	M	0.49	26.2	33.2	4	M	.	3	16.8	
10/15/90	5	V5	M	0.41	24.8	31.2	5	M	.	3	11.3	
10/15/90	6	V6	M	0.47	25.6	32.8	6	M	.	3	14.4	
10/15/90	7	V7	M	0.31	23.2	29.0	7	M	.	3	10.9	
10/15/90	8	V8	M	0.29	22.7	27.9	8	M	.	3	7.2	
10/19/90	9	V9	M	0.40	23.8	30.2	9	M	.	3	13.7	
10/19/90	10	V10	M	0.34	23.6	29.2	10	M	.	3	11.1	
10/19/90	11	V11	M	0.41	25.3	31.0	11	M	.	3	15.9	
10/19/90	12	V12	M	0.36	24.5	30.7	12	M	.	3	11.0	
10/19/90	13	V13	M	0.39	24.6	30.0	13	M	.	3	13.6	
10/19/90	14	V14	M	0.41	25.2	30.8	14	M	.	3	13.4	
10/19/90	15	V15	M	0.39	24.7	30.0	15	M	.	3	13.1	
10/19/90	16	V16	M	0.43	24.6	31.6	16	M	.	3	15.7	
10/19/90	17	V17	M	0.39	24.4	30.5	17	M	.	3	10.6	
10/19/90	18	V18	M	0.43	26.0	32.3	18	M	.	3	13.9	
10/19/90	19	V19	M	0.43	25.5	30.9	19	M	.	3	15.0	
10/19/90	20	V20	M	0.43	24.6	30.9	20	M	.	3	11.3	
10/19/90	21	B1	M	0.44	25.8	31.8	21	M	.	3	14.2	
10/19/90	22	B2	M	0.35	25.1	30.4	22	M	.	3	11.8	
10/19/90	23	B3	M	0.41	25.2	31.1	23	T	.	3	12.1	
10/19/90	24	B4	M	0.38	25.6	31.7	24	M	.	3	12.3	
10/19/90	25	B5	M	0.34	23.1	28.9	25	M	.	3	11.3	
10/19/90	26	B6	M	0.39	24.5	30.0	26	M	.	3	13.4	
10/19/90	27	B7	M	0.38	24.9	30.6	27	M	.	3	11.8	
10/19/90	28	B8	M	0.37	24.1	30.1	28	M	.	3	12.8	
10/19/90	29	B9	M	0.40	24.7	30.8	29	M	.	3	12.3	
10/19/90	30	B10	M	0.43	24.4	30.5	30	M	.	3	14.8	
10/19/90	31	B11	M	0.39	24.5	30.9	31	M	.	3	10.4	
10/19/90	32	B12	M	0.30	22.2	27.7	32	M	.	3	10.1	
10/19/90	33	B13	M	0.33	23.3	28.8	33	M	.	3	8.9	
10/19/90	34	B14	F	0.35	24.0	30.0	34	T	.	3	50.8	
10/19/90	35	B15	F	0.37	25.6	31.0	35	T	.	3	46.9	
10/19/90	36	B16	F	0.44	26.4	33.0	36	T	.	3	58.5	
10/19/90	37	B17	F	0.34	24.4	30.1	37	T	573.00	3	60.2	
10/19/90	38	B18	F	0.37	25.7	31.0	38	T	504.00	3	48.9	
10/19/90	39	B19	F	0.31	25.0	30.0	39	T	.	3	42.6	
10/19/90	40	B20	F	0.32	24.6	30.2	40	T	491.00	3	33.0	
10/19/90	41	B21	M	0.48	26.0	31.6	41	M	.	3	13.7	
10/19/90	42	B22	F	0.27	23.1	28.7	42	T	420.00	3	30.0	
10/26/90	43	B23	M	0.30	23.0	28.5	43	M	.	3	7.6	
10/26/90	44	B24	M	0.38	24.2	31.1	44	M	.	3	8.1	
10/26/90	45	B25	M	0.42	24.3	30.2	45	M	.	3	15.2	
10/26/90	46	B26	M	0.37	24.7	30.1	46	M	.	3	10.8	
10/26/90	47	B27	M	0.35	23.9	29.0	47	M	.	3	11.1	
10/26/90	48	B28	M	0.41	24.2	30.5	48	M	.	3	12.2	
10/26/90	49	B29	M	0.35	24.1	29.5	49	M	.	3	10.5	
10/26/90	50	B30	M	0.41	24.9	30.7	50	M	.	3	14.1	
10/26/90	51	B31	M	0.32	23.0	28.9	51	M	.	3	10.1	
10/26/90	52	B32	M	0.37	24.4	30.0	52	M	.	3	9.1	
10/26/90	53	B33	M	0.47	25.7	32.0	53	M	.	3	16.1	
10/26/90	54	B34	M	0.40	24.5	30.4	54	M	.	3	9.9	
10/26/90	55	B35	M	0.32	22.3	28.4	55	M	.	3	8.6	
10/26/90	56	B36	M	0.35	24.0	29.5	56	M	.	3	10.1	
10/26/90	57	B37	M	0.39	25.1	30.6	57	M	.	3	10.0	
10/26/90	58	B38	M	0.35	23.2	29.3	58	M	.	3	9.1	
10/26/90	59	B39	M	0.42	24.9	31.9	59	M	.	3	12.7	
10/26/90	60	B40	M	0.36	23.9	30.0	60	M	.	3	10.8	
10/26/90	61	B41	M	0.34	23.9	29.7	61	M	.	3	9.5	
10/26/90	62	B42	M	0.38	23.7	30.2	62	M	.	3	11.8	
10/26/90	63	B43	M	0.30	21.9	27.3	63	M	.	2	10.9	

KOKANEE MORPHOLOGICAL AND AGE DATA

				Weight	Length	Length			Fecundity		Gonad wt.	Egg diam.
10/26/90	64	B44	M	0.30	23.5	29.2	64	M	.	3	10.4	
10/26/90	65	B45	F	0.33	23.8	29.3	65	T	486.00	3	34.4	
10/26/90	66	B46	F	0.32	23.7	29.6	66	T	233.00	3	22.8	
10/26/90	67	B47	F	0.35	24.7	30.4	67	T	525.00	3	39.0	
10/26/90	68	B48	F	0.28	22.4	30.2	68	T	453.00	3	36.7	
10/26/90	69	B49	F	0.35	25.3	30.6	69	T	392.00	3	44.4	
10/28/90	70	B1	F	0.39	25.4	31.8	70	T	711.00	3	56.2	
10/28/90	71	B2	F	0.43	25.2	31.5	71	T	536.00	3	55.2	
10/28/90	72	B3	F	0.30	24.1	.	72	S	1.00	3	.	
10/28/90	73	B4	F	0.36	25.2	31.3	73	M	650.00	3	47.2	
10/28/90	74	B5	F	0.32	24.5	29.2	74	M	.	3	.	5.40
10/28/90	75	B6	F	0.28	21.7	27.5	75	M	.	2	.	5.40
10/28/90	76	B7	F	0.29	24.5	.	76	S	6.00	3	.	
10/28/90	77	B8	F	0.30	23.4	28.7	77	T	461.00	3	35.4	
10/28/90	78	B9	F	0.35	24.0	29.5	78	T	562.00	3	41.5	
10/28/90	79	B10	F	0.33	25.1	30.8	79	T	551.00	3	40.7	
10/28/90	80	B11	F	0.32	23.8	30.0	80	T	534.00	3	45.1	
10/28/90	81	B12	M	0.32	23.1	28.8	81	M	.	3	9.4	
10/28/90	82	B13	F	0.31	24.2	29.6	82	T	544.00	3	44.4	
10/28/90	83	B14	F	0.38	24.6	31.0	83	T	566.00	3	44.9	
10/28/90	84	B15	F	0.26	22.1	27.8	84	T	213.00	3	23.3	
10/28/90	85	B16	F	0.28	22.8	28.5	85	T	410.00	3	24.9	
10/28/90	86	B17	F	0.34	24.1	29.9	86	T	613.00	3	49.1	
10/28/90	87	B18	F	0.26	21.7	27.7	87	T	428.00	3	31.4	
10/28/90	88	B19	F	0.32	24.7	30.3	88	T	478.00	3	39.4	
10/28/90	89	B20	F	0.32	25.1	.	89	S	0.00	3	.	
10/28/90	90	B21	F	0.29	22.5	27.8	90	T	526.00	3	39.7	
10/28/90	91	B22	M	0.28	22.5	27.8	91	M	.	3	7.2	
11/03/90	92	B23	M	0.39	23.8	30.2	92	M	.	3	13.3	
11/03/90	93	B24	M	0.32	22.7	28.3	93	M	.	3	7.8	
11/03/90	94	B25	M	0.36	23.3	30.1	94	M	.	3	9.0	
11/03/90	95	B26	M	0.43	24.8	31.6	95	M	.	3	12.1	
11/03/90	96	B27	M	0.32	23.2	28.9	96	M	.	3	9.0	
11/03/90	97	B28	M	0.40	24.8	30.8	97	M	.	3	11.4	
11/03/90	98	B29	M	0.39	23.8	30.6	98	M	.	3	11.6	
11/03/90	99	B30	M	0.41	24.7	30.9	99	M	.	3	10.8	
11/03/90	100	B31	F	0.36	25.4	30.9	100	T	551.00	3	49.6	
10/30/90	101	B32	M	0.49	25.4	31.6	101	M	.	3	14.4	
10/30/90	102	B33	M	0.49	24.8	31.8	102	M	.	3	13.2	
10/30/90	103	B34	M	0.45	25.6	33.8	103	M	.	3	14.3	
10/30/90	104	B35	M	0.41	25.2	30.8	104	M	.	3	12.2	

1990 WEATHER DATA COLLECTED FROM THE LOWER FINLAY RIVER

Date	Time	Present temp (oC)	Min. temp. (oC)	Max. temp. (oC)	Mean temp. (oC)	Precip. (mm)	Type of Precip.	Wind strength (kn)	Wind direction
Oct. 13	10:15	4.5				0		10	S
14	8:20	-6.0	-7.0	2.5	-1.0	0		0	
15	8:00	-7.0	-9.0	6.5	2.0	0		0	
16	8:00	-4.5	-9.0	3.0	-1.5	5	snow	0	
17	7:55	-11.5	-13.0	3.5	-3.0	0		1	N
18	8:10	2.5	-11.5	6.0	0.3	5		2	N
19	8:05	-10.0	-10.0	0.0	-5.0	25	snow	0	
20	8:05	-7.0	-12.0	2.0	-4.0	0		0	
21	7:55	0.0	-8.0	2.0	-2.0	trace	rain	5	S
22	8:05	0.0	-3.0	6.0	4.5	0		2	S
23	8:10	2.0	-4.5	6.5	4.3	0		20	S
24	7:55	4.0	-1.0			2	rain		
25	8:00	-3.0	-5.5	7.0	4.3	0		0	
26	8:05	-5.0	-6.0	2.0	-1.0	2	snow	2	N
27	8:00	4.0	-5.0	4.0	1.5	trace	rain	20	S
28	8:05	-0.5	-0.5	6.0	5.8	3	snow	0	
29	7:45	-2.0	-4.0	2.0	0.0	1	snow	0	
30	7:50	-2.0	-3.0	2.0	0.5	30	snow	0	
31	8:00	-3.0	-3.0	4.0	2.5	0		0	
Nov. 1	7:40	-7.0	-8.0	1.0	-3.0	0		0	
2	7:40	-5.0	-8.0	0.0	-4.0	0		0	
3	7:50	-7.0	-8.0	-3.0	-7.0	25	snow	0	
4	7:45	-12.5	-12.5	-4.0	-10.3	50	snow	15	N
5	7:40	-18.0	-18.0	-7.0	-16.0	0		5	N
6	7:45	-8.0	-19.5	-8.0	-17.8	0		10	S
7	7:40	-2.5	-9.0	-2.5	-7.0	15		15	S
Mean Oct		-2.34	-6.39	3.82	0.5				
Mean Nov		-8.57	-11.86	-3.36	-9.3				
Mean total		-4.29	-7.96	1.70	-2.4				

1990 FINLAY RIVER HYDROLOGY DATA

DATE	TIME	MAINSTEM WATER LEVEL (cm)	MAINSTEM TEMP (oC)	HABITAT	TEMP (oC)	HABITAT	TEMP (oC)	HABITAT	TEMP (oC)
OCT 14		-	3.0						
15	11:00	-	2.0	PESIKA CR	2.0				
16	10:00	140	1.5	AKIE R.	2.0	TSAYDIZ CR	1.5		
17	10:00	137	0.0						
18	9:35	-	0.0	104	5.0				
19		-							
20	9:30	-	-0.3	104	5.0	124	3.0		
21	11:00	139	0.5	32	5.0				
22	9:30	138	1.0	TSYADIZ CR	0.0	AKIE R.	1.0		
23	10:00	135	0.5	67	2.0				
24	13:00	139	1.5	PESIKA CR	1.5				
25	8:00	139	0.5	88	3.5	104	5.5	124	3.5
26	8:00	133	0.5						
27	8:00	131	1.0	37	3.0	32	4.5		
28	8:00	137	1.0						
29	7:45	136	0.5	37	1.0	48	5.0	50	4.5
29				99	7.0	104	5.0	124	4.5
				55	6.0				
30	7:50	134	0.0	13	1.0				
31	10:00	134	0.0						
NOV 1	7:40	-	0.0						
2	7:40	123	0.0	104	5.0	115	3.0		
3	7:50	-	0.0	67	2.5				
4	7:50	107	0.0	26	2.0	32	4.0		
5	7:40	94	0.0	50	2.5	TSAYDIZ CR	0.5		
6	7:45	103	0.0	36	3.5				
7	7:50	150	0.0	104	0.5				

Thermograph record from Finlay River mainstem, Fall 1990

M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)
Oct 15 11	1.2	17 Oct 13	-0.2	Oct 19 15	-0.2	Oct 21 17	0.6	Oct 23 19	0.9	Oct 25 21	0.7
Oct 15 12	1.4	17 Oct 14	-0.2	Oct 19 16	-0.2	Oct 21 18	0.7	Oct 23 20	1	Oct 25 22	0.8
Oct 15 13	1.4	17 Oct 15	-0.2	Oct 19 17	-0.2	Oct 21 19	0.6	Oct 23 21	1.1	Oct 25 23	0.8
Oct 15 14	1.6	17 Oct 16	-0.4	Oct 19 18	-0.3	Oct 21 20	0.5	Oct 23 22	1.1	Oct 26 00	0.8
Oct 15 15	1.6	17 Oct 17	-0.3	Oct 19 19	-0.3	Oct 21 21	0.5	Oct 23 23	1.1	Oct 26 01	0.8
Oct 15 16	1.6	17 Oct 18	-0.2	Oct 19 20	-0.3	Oct 21 22	0.4	Oct 24 00	1.2	Oct 26 02	0.7
Oct 15 17	1.7	17 Oct 19	-0.3	Oct 19 21	-0.3	Oct 21 23	0.4	Oct 24 01	1.4	Oct 26 03	0.7
Oct 15 18	1.7	17 Oct 20	-0.3	Oct 19 22	-0.3	Oct 22 00	0.4	Oct 24 02	1.2	Oct 26 04	0.7
Oct 15 19	1.8	17 Oct 21	-0.2	Oct 19 23	-0.3	Oct 22 01	0.4	Oct 24 03	1.2	Oct 26 05	0.7
Oct 15 20	1.6	17 Oct 22	-0.3	Oct 20 00	-0.3	Oct 22 02	0.3	Oct 24 04	1.3	Oct 26 06	0.7
Oct 15 21	1.8	17 Oct 23	-0.4	Oct 20 01	-0.3	Oct 22 03	-0.1	Oct 24 05	1.3	Oct 26 07	0.6
Oct 15 22	1.8	18 Oct 00	-0.3	Oct 20 02	-0.4	Oct 22 04	-0.2	Oct 24 06	1.2	Oct 26 08	0.5
Oct 15 23	1.7	18 Oct 01	-0.4	Oct 20 03	-0.3	Oct 22 05	-0.2	Oct 24 07	1.1	Oct 26 09	0.5
Oct 16 00	1.7	18 Oct 02	-0.3	Oct 20 04	-0.3	Oct 22 06	-0.1	Oct 24 08	1.2	Oct 26 10	0.5
Oct 16 01	1.6	18 Oct 03	-0.3	Oct 20 05	-0.3	Oct 22 07	-0.2	Oct 24 09	1.1	Oct 26 11	0.4
Oct 16 02	1.6	18 Oct 04	-0.3	Oct 20 06	-0.3	Oct 22 08	-0.2	Oct 24 10	1.1	Oct 26 12	0.4
Oct 16 03	1.6	18 Oct 05	-0.3	Oct 20 07	-0.4	Oct 22 09	-0.2	Oct 24 11	1.1	Oct 26 13	0.6
Oct 16 04	1.6	18 Oct 06	-0.4	Oct 20 08	-0.3	Oct 22 10	-0.2	Oct 24 12	1.4	Oct 26 14	0.6
Oct 16 05	1.6	18 Oct 07	-0.3	Oct 20 09	-0.3	Oct 22 11	-0.3	Oct 24 13	1.6	Oct 26 15	0.6
Oct 16 06	1.5	18 Oct 08	-0.3	Oct 20 10	-0.2	Oct 22 12	-0.2	Oct 24 14	1.7	Oct 26 16	0.7
Oct 16 07	1.5	18 Oct 09	-0.3	Oct 20 11	-0.3	Oct 22 13	0.5	Oct 24 15	1.9	Oct 26 17	0.7
Oct 16 08	1.4	18 Oct 10	-0.3	Oct 20 12	-0.3	Oct 22 14	0.6	Oct 24 16	2.2	Oct 26 18	0.7
Oct 16 09	1.4	18 Oct 11	-0.2	Oct 20 13	-0.4	Oct 22 15	0.7	Oct 24 17	2.3	Oct 26 19	0.7
Oct 16 10	-0.6	18 Oct 12	-0.3	Oct 20 14	-0.3	Oct 22 16	0.7	Oct 24 18	2.2	Oct 26 20	0.7
Oct 16 11	1.4	18 Oct 13	-0.3	Oct 20 15	-0.3	Oct 22 17	0.7	Oct 24 19	2.1	Oct 26 21	0.7
Oct 16 12	1.4	18 Oct 14	-0.3	Oct 20 16	-0.3	Oct 22 18	0.8	Oct 24 20	2.1	Oct 26 22	0.7
Oct 16 13	1.6	18 Oct 15	-0.3	Oct 20 17	-0.3	Oct 22 19	0.7	Oct 24 21	2	Oct 26 23	0.7
Oct 16 14	1.6	18 Oct 16	-0.3	Oct 20 18	-0.3	Oct 22 20	0.7	Oct 24 22	2	Oct 27 00	0.7
Oct 16 15	1.6	18 Oct 17	-0.3	Oct 20 19	-0.2	Oct 22 21	0.7	Oct 24 23	1.9	Oct 27 01	0.7
Oct 16 16	1.7	18 Oct 18	-0.3	Oct 20 20	-0.3	Oct 22 22	0.7	Oct 25 00	1.8	Oct 27 02	0.7
Oct 16 17	1.8	18 Oct 19	-0.3	Oct 20 21	-0.4	Oct 22 23	0.7	Oct 25 01	1.7	Oct 27 03	0.7
Oct 16 18	1.8	18 Oct 20	-0.3	Oct 20 22	-0.4	Oct 23 00	0.7	Oct 25 02	1.6	Oct 27 04	0.7
Oct 16 19	1.6	18 Oct 21	-0.3	Oct 20 23	-0.3	Oct 23 01	0.6	Oct 25 03	1.4	Oct 27 05	0.7
Oct 16 20	1.7	18 Oct 22	-0.4	Oct 21 00	-0.3	Oct 23 02	0.6	Oct 25 04	1.2	Oct 27 06	0.7
Oct 16 21	1.6	18 Oct 23	-0.3	Oct 21 01	-0.3	Oct 23 03	0.6	Oct 25 05	1.2	Oct 27 07	0.7
Oct 16 22	1.5	19 Oct 00	-0.3	Oct 21 02	-0.3	Oct 23 04	0.4	Oct 25 06	1.2	Oct 27 08	0.8
Oct 16 23	1.4	19 Oct 01	-0.3	Oct 21 03	-0.3	Oct 23 05	0.5	Oct 25 07	1.1	Oct 27 09	0.8
Oct 17 00	1.4	19 Oct 02	-0.2	Oct 21 04	-0.3	Oct 23 06	0.5	Oct 25 08	1	Oct 27 10	0.9
Oct 17 01	1.2	19 Oct 03	-0.3	Oct 21 05	-0.3	Oct 23 07	0.5	Oct 25 09	0.9	Oct 27 11	0.9
Oct 17 02	1.2	19 Oct 04	-0.4	Oct 21 06	-0.3	Oct 23 08	0.5	Oct 25 10	0.8	Oct 27 12	1.2
Oct 17 03	1.1	19 Oct 05	-0.3	Oct 21 07	-0.4	Oct 23 09	0.5	Oct 25 11	0.8	Oct 27 13	1
Oct 17 04	0.9	19 Oct 06	-0.3	Oct 21 08	-0.3	Oct 23 10	0.6	Oct 25 12	0.7	Oct 27 14	1.1
Oct 17 05	0.7	19 Oct 07	-0.3	Oct 21 09	-0.3	Oct 23 11	0.6	Oct 25 13	0.9	Oct 27 15	1.1
Oct 17 06	0.7	19 Oct 08	-0.3	Oct 21 10	-0.3	Oct 23 12	0.6	Oct 25 14	1	Oct 27 16	1.1
Oct 17 07	0.6	19 Oct 09	-0.3	Oct 21 11	-0.3	Oct 23 13	0.7	Oct 25 15	1.1	Oct 27 17	1.1
Oct 17 08	-0.1	19 Oct 10	-0.3	Oct 21 12	-0.2	Oct 23 14	0.7	Oct 25 16	1.1	Oct 27 18	1.2
Oct 17 09	-0.1	19 Oct 11	-0.3	Oct 21 13	-0.1	Oct 23 15	0.7	Oct 25 17	0.9	Oct 27 19	1
Oct 17 10	-0.2	19 Oct 12	-0.3	Oct 21 14	0.4	Oct 23 16	0.7	Oct 25 18	0.9	Oct 27 20	1.2
Oct 17 11	-0.2	19 Oct 13	-0.2	Oct 21 15	0.6	Oct 23 17	0.8	Oct 25 19	0.9	Oct 27 21	1.1
Oct 17 12	-0.2	19 Oct 14	-0.2	Oct 21 16	0.6	Oct 23 18	0.9	Oct 25 20	0.8	Oct 27 22	1

Thermograph record from Finlay River mainstem, Fall 1990

M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)	M D hr	T (°C)
Oct 27 23	1.1	Oct 30 01	-0.1	Nov 01 03	-0.3	Nov 03 05	-0.3	Nov 05 07	-0.3	Nov 07 09	-0.3
Oct 28 00	1	Oct 30 02	0.7	Nov 01 04	-0.3	Nov 03 06	-0.3	Nov 05 08	-0.4	Nov 07 10	-0.2
Oct 28 01	0.8	Oct 30 03	0.6	Nov 01 05	-0.3	Nov 03 07	-0.3	Nov 05 09	-0.3	Nov 07 11	-0.3
Oct 28 02	0.9	Oct 30 04	0.7	Nov 01 06	-0.3	Nov 03 08	-0.3	Nov 05 10	-0.3	Nov 07 12	-0.3
Oct 28 03	0.8	Oct 30 05	0.7	Nov 01 07	-0.3	Nov 03 09	-0.3	Nov 05 11	-0.2	Nov 07 13	-0.3
Oct 28 04	0.8	Oct 30 06	0.7	Nov 01 08	-0.3	Nov 03 10	-0.3	Nov 05 12	-0.3	Nov 07 14	-0.3
Oct 28 05	0.7	Oct 30 07	0.6	Nov 01 09	-0.2	Nov 03 11	-0.3	Nov 05 13	-0.3	Nov 07 15	-0.2
Oct 28 06	0.7	Oct 30 08	0.6	Nov 01 10	-0.3	Nov 03 12	-0.4	Nov 05 14	-0.3	Nov 07 16	0.7
Oct 28 07	0.7	Oct 30 09	-0.1	Nov 01 11	-0.3	Nov 03 13	-0.3	Nov 05 15	-0.2		
Oct 28 08	0.7	Oct 30 10	0.5	Nov 01 12	-0.3	Nov 03 14	-0.3	Nov 05 16	-0.3		
Oct 28 09	0.7	Oct 30 11	0.4	Nov 01 13	-0.2	Nov 03 15	-0.2	Nov 05 17	-0.3		
Oct 28 10	0.7	Oct 30 12	0.3	Nov 01 14	-0.2	Nov 03 16	-0.3	Nov 05 18	-0.3		
Oct 28 11	0.7	Oct 30 13	-0.1	Nov 01 15	-0.2	Nov 03 17	-0.3	Nov 05 19	-0.2		
Oct 28 12	0.7	Oct 30 14	0.3	Nov 01 16	-0.2	Nov 03 18	-0.3	Nov 05 20	-0.3		
Oct 28 13	0.9	Oct 30 15	0.4	Nov 01 17	-0.3	Nov 03 19	-0.3	Nov 05 21	-0.3		
Oct 28 14	1.2	Oct 30 16	0.5	Nov 01 18	-0.3	Nov 03 20	-0.4	Nov 05 22	-0.3		
Oct 28 15	1.1	Oct 30 17	0.5	Nov 01 19	-0.3	Nov 03 21	-0.3	Nov 05 23	-0.3		
Oct 28 16	1.1	Oct 30 18	0.5	Nov 01 20	-0.2	Nov 03 22	-0.3	Nov 06 00	-0.3		
Oct 28 17	1.2	Oct 30 19	0.5	Nov 01 21	-0.3	Nov 03 23	-0.3	Nov 06 01	-0.3		
Oct 28 18	1.1	Oct 30 20	0.6	Nov 01 22	-0.4	Nov 04 00	-0.2	Nov 06 02	-0.2		
Oct 28 19	1.1	Oct 30 21	0.6	Nov 01 23	-0.3	Nov 04 01	-0.2	Nov 06 03	-0.3		
Oct 28 20	1.1	Oct 30 22	0.6	Nov 02 00	-0.3	Nov 04 02	-0.3	Nov 06 04	-0.3		
Oct 28 21	1	Oct 30 23	0.6	Nov 02 01	-0.4	Nov 04 03	-0.4	Nov 06 05	-0.3		
Oct 28 22	0.9	Oct 31 00	0.6	Nov 02 02	-0.3	Nov 04 04	-0.3	Nov 06 06	-0.3		
Oct 28 23	0.9	Oct 31 01	0.6	Nov 02 03	-0.3	Nov 04 05	-0.3	Nov 06 07	-0.3		
Oct 29 00	0.8	Oct 31 02	0.6	Nov 02 04	-0.3	Nov 04 06	-0.3	Nov 06 08	-0.3		
Oct 29 01	0.7	Oct 31 03	0.6	Nov 02 05	-0.3	Nov 04 07	-0.3	Nov 06 09	-0.3		
Oct 29 02	0.7	Oct 31 04	0.6	Nov 02 06	-0.2	Nov 04 08	-0.4	Nov 06 10	-0.4		
Oct 29 03	0.7	Oct 31 05	0.7	Nov 02 07	-0.3	Nov 04 09	-0.3	Nov 06 11	-0.2		
Oct 29 04	0.7	Oct 31 06	0.5	Nov 02 08	-0.4	Nov 04 10	-0.3	Nov 06 12	-0.3		
Oct 29 05	0.7	Oct 31 07	0.9	Nov 02 09	-0.3	Nov 04 11	-0.3	Nov 06 13	-0.3		
Oct 29 06	0.7	Oct 31 08	0.5	Nov 02 10	-0.2	Nov 04 12	-0.3	Nov 06 14	-0.3		
Oct 29 07	0.7	Oct 31 09	0.4	Nov 02 11	-0.3	Nov 04 13	-0.3	Nov 06 15	-0.3		
Oct 29 08	0.6	Oct 31 10	0.5	Nov 02 12	-0.2	Nov 04 14	-0.3	Nov 06 16	-0.3		
Oct 29 09	0.6	Oct 31 11	0.5	Nov 02 13	-0.3	Nov 04 15	-0.3	Nov 06 17	-0.3		
Oct 29 10	0.6	Oct 31 12	0.5	Nov 02 14	-0.3	Nov 04 16	-0.4	Nov 06 18	-0.3		
Oct 29 11	0.6	Oct 31 13	0.6	Nov 02 15	-0.3	Nov 04 17	-0.3	Nov 06 19	-0.3		
Oct 29 12	0.7	Oct 31 14	0.6	Nov 02 16	-0.3	Nov 04 18	-0.3	Nov 06 20	-0.2		
Oct 29 13	0.7	Oct 31 15	0.6	Nov 02 17	-0.3	Nov 04 19	-0.3	Nov 06 21	-0.3		
Oct 29 14	0.8	Oct 31 16	0.6	Nov 02 18	-0.3	Nov 04 20	-0.3	Nov 06 22	-0.3		
Oct 29 15	0.8	Oct 31 17	0.6	Nov 02 19	-0.3	Nov 04 21	-0.3	Nov 06 23	-0.2		
Oct 29 16	0.8	Oct 31 18	0.7	Nov 02 20	-0.3	Nov 04 22	-0.3	Nov 07 00	-0.3		
Oct 29 17	0.7	Oct 31 19	0.6	Nov 02 21	-0.3	Nov 04 23	-0.3	Nov 07 01	-0.3		
Oct 29 18	1.2	Oct 31 20	0.5	Nov 02 22	-0.3	Nov 05 00	-0.3	Nov 07 02	-0.3		
Oct 29 19	0.8	Oct 31 21	0.4	Nov 02 23	-0.3	Nov 05 01	-0.3	Nov 07 03	-0.3		
Oct 29 20	0.8	Oct 31 22	0.5	Nov 03 00	-0.3	Nov 05 02	-0.3	Nov 07 04	-0.3		
Oct 29 21	0.8	Oct 31 23	0.3	Nov 03 01	-0.3	Nov 05 03	-0.3	Nov 07 05	-0.3		
Oct 29 22	0.7	Nov 01 00	-0.2	Nov 03 02	-0.3	Nov 05 04	-0.2	Nov 07 06	-0.3		
Oct 29 23	0.7	Nov 01 01	-0.3	Nov 03 03	-0.3	Nov 05 05	-0.3	Nov 07 07	-0.3		
Oct 30 00	0.7	Nov 01 02	-0.3	Nov 03 04	-0.3	Nov 05 06	-0.3	Nov 07 08	-0.3		

Lower Finlay River habitat data

DATE	Oct.14/90	OCT.14/90	OCT.14/90	OCT.14/90	OCT.14/90	OCT.14/90	OCT.14/90	OCT.14/90
REFERENCE #	1	2	3	4	5	6	7	8
HABITAT	GLIDE	GLIDE	GLIDE	GLIDE	GLIDE	GLIDE	GLIDE	GLIDE
AREA	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	14.0	10.0	10.0	10.0	5.1	4.0	1.0	1.5
AVE. DEPTH (m)	14.0	10.0	10.0	9.0	2.0	3.0	0.8	0.8
% FINES					100	100	5	10
% LARGE GRAVEL					0	0	75	40
% SMALL GRAVEL					0	0	10	35
% COBBLE					0	0	10	15
% BOULDER					0	0	0	0
% BEDROCK					0	0	0	0
CHAN. WIDTH (m)	295.0	185.0	90.0	52.0	450.0	55.0		
WET WIDTH (m)	275.0	165.0	90.0	52.0	450.0	30.0	25.0	78.0
VELOCITY (m/s2)	0.25	0.20	0.25	0.50	0.25	0.00	2.00	1.00
% COVER (LOD)					10	10	0	0
PHOTO	1-20		1-21		1-22			
VISIBILITY (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TEMP (oC)	3.0	3.0	3.0	3.0				
FLOOD SIGN (m)	4.0	4.0	4.0	5.0	5.0	5.0	4.0	4.0
LENGTH (m)	1,227	2,818	682	909	2,227	455	200	393

DATE	OCT.14/90	OCT.28/90	OCT.14/90	OCT.28/90	NOV.1/90	OCT.28/90	OCT.14/90	OCT.15/90
REFERENCE #	9	10	11	12	13	14	15	16
HABITAT	GLIDE	BACK CHAN.	GLIDE	BACK CHAN.,	SLOUGH	BACK CHAN,	RIFFLE	GLIDE
AREA	MAINSTEM	SIDE CHAN.	MAINSTEM	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	MAINSTEM	MAINSTEM
MAX. DEPTH (m)	2.0	2.0	2.0	2.5	1.0	1.0	0.3	1.8
AVE. DEPTH (m)	1.0	1.5	1.5	2.0	0.7		0.2	1.0
% FINES	5	100	10	70	30		80	0
% LARGE GRAVEL	70	0	30	10	30		20	30
% SMALL GRAVEL	20	0	10	10	10		0	20
% COBBLE	5	0	40	10	30		0	30
% BOULDER	0	0	10	0	0		0	20
% BEDROCK	0	0	0	0	0		0	0
CHAN. WIDTH (m)								250.0
WET WIDTH (m)	80.0	20.0	88.0	40.0	40.0	25.0	80.0	105.0
VELOCITY (m/s2)	1.80	0.00	1.40	0.00	0.00	0.00	1.60	1.00
% COVER (LOD)	0	0	0	0	0	0	0	0
PHOTO			1-23					
VISIBILITY (m)	3.0	1.5	3.0	2.5			3.0	3.0
TEMP (oC)			2.5			1.0	3.0	2.0
FLOOD SIGN (m)	2.0						2.5	2.5
LENGTH (m)	982	100	1,964	100	300	71	89	600

DATE	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90
REFERENCE #	17	18	19	20	21	22	23	24
HABITAT	RIFFLE	GLIDE	RIFFLE	GLIDE	GLIDE	POOL	POOL	GLIDE
AREA	MAINSTEM	MAINSTEM	MAINSTEM	SIDE CHAN.	MAINSTEM	MAINSTEM	MAINSTEM	MAINSTEM
MAX. DEPTH (m)	0.4	2.0	1.0	1.0	1.6	4.0	5.0	1.7
AVE. DEPTH (m)	0.3	1.5	0.9	0.5	0.8	3.0	3.0	0.8
% FINES	0	0	0	5	0	5		5
% LARGE GRAVEL	80	10	20	45	10	45		25
% SMALL GRAVEL	10	10	0	20	50	20		10
% COBBLE	10	30	70	30	20	30		30
% BOULDER	0	50	10	0	20	0		30
% BEDROCK	0	0	0	0	0	0		0
CHAN. WIDTH (m)	250.0							
WET WIDTH (m)	300.0	100.0	100.0	10.0	110.0	50.0	91.0	95.0
VELOCITY (m/s2)	1.50	1.10	2.00	0.80	1.10	0.80	0.90	1.50
% COVER (LOD)	0	0	0	2	0	0	0	0
PHOTO								
VISIBILITY (m)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
TEMP (oC)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
FLOOD SIGN (m)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
LENGTH (m)	30	500	89	250	338	304	679	3,143

DATE	OCT.15/90	OCT.27/90	OCT.27/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.15/90
REFERENCE #	25	26	27	28	29	30	31	32
HABITAT	POOL	BACK CHAN.	RIF.&GLIDE	DEBRIS AC.	DEBRIS AC.	GLIDE	RIFFLE	BACK CHAN.
AREA	SIDE CHAN.	SIDE CHAN.	TRIBUTARY			SIDE CHAN.	MAIN STEM	SIDE CHAN.
MAX. DEPTH (m)	3.6	1.5	0.3			1.5	0.5	5.0
AVE. DEPTH (m)	3.0	1.0	0.2			1.0	0.3	0.8
% FINES	0	80	10			0	0	60
% LARGE GRAVEL	10	5	10			30	65	20
% SMALL GRAVEL	10	5	10			20	10	10
% COBBLE	20	5	20			50	25	10
% BOULDER	60	5	50			0	0	0
% BEDROCK	0	0	0			0	0	0
CHAN. WIDTH (m)								
WET WIDTH (m)	30.0	28.0	4.0			34.0	100.0	35.0
VELOCITY (m/s2)	0.50	0.00	0.40			1.50	2.00	0.00
% COVER (LOD)	0	0				0	0	0
PHOTO								2-18
VISIBILITY (m)	3.0	3.0				3.0	3.0	2.5
TEMP (oC)	2.0	3.0	0.0			2.0	2.0	2.0
FLOOD SIGN (m)	2.5					2.5	2.5	2.0
LENGTH (m)	125	196	0	143	107	750	50	946

DATE	NOV.4/90	OCT.15/90	OCT.15/90	OCT.15/90	OCT.29/90	OCT.15/90	OCT.15/90	OCT.16/90
REFERENCE #	33	34	35	36	37	38	39	40
HABITAT	SLOUGH	GLIDE	RIFFLE	GLIDE	BACK CHAN.	GLIDE	BACK CHAN.	GLIDE
AREA	SIDE CHAN.	MAINSTEM	MAINSTEM	SIDE CHAN.	SIDE CHAN.	MAINSTEM	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)		3.5	0.5	0.3	1.5	5.0	1.5	0.4
AVE. DEPTH (m)		2.0	0.4	0.2	0.7	1.5	0.5	0.2
% FINES		0	0	5	15	0	50	5
% LARGE GRAVEL		30	20	50	50	20	40	60
% SMALL GRAVEL		10	0	45	10	10	10	15
% COBBLE		40	80	0	15	40	0	20
% BOULDER		20	0	0	10	30	0	0
% BEDROCK		0	0	0	0	0	0	0
CHAN. WIDTH (m)	28.0							
WET WIDTH (m)	28.0	90.0	100.0	18.0	12.0	150.0	30.0	15.0
VELOCITY (m/s2)	0.00	1.50	2.00	0.60	0.00	1.10	0.00	0.80
% COVER (LOD)	3	5	0	0	0	3	2	1
PHOTO					2-23			
VISIBILITY (m)		3.0	3.0	3.0	3.0	3.0	3.0	3.0
TEMP (oC)		2.0	2.0	2.0	1.0	2.0	2.0	1.5
FLOOD SIGN (m)		2.5	2.5	2.5		2.5	2.5	2.5
LENGTH (m)	518	946	50	429	45	2,786	179	70

DATE	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.29/90	OCT.29/90
REFERENCE #	41	42	43	44	45	46	47	48
HABITAT	RIFFLE	GLIDE	DEBRIS AC.	GLIDE	POOL	DEBRIS AC.	GLIDE-RIF.	SLOUGH
AREA	MAINSTEM	MAINSTEM		MAINSTEM	MAINSTEM		SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	2.0	2.0		2.0	4.0		0.2	1.0
AVE. DEPTH (m)	1.0	1.5		1.7	3.5		0.1	0.5
% FINES	0	0		0			80	80
% LARGE GRAVEL	25	40		45			10	5
% SMALL GRAVEL	5	40		5			10	5
% COBBLE	50	10		30			0	5
% BOULDER	20	10		20			0	5
% BEDROCK	0	0		0			0	0
CHAN. WIDTH (m)								
WET WIDTH (m)	47.0	150.0		45.0	40.0		2.0	17.0
VELOCITY (m/s2)	5.00	1.00		2.00	2.00		0.30	0.00
% COVER (LOD)	0	2		5	15		0	0
PHOTO								
VISIBILITY (m)	3.0	3.0		3.0	3.0			
TEMP (oC)	1.5	1.5		1.5	1.5			5.0
FLOOD SIGN (m)	2.5	2.5		2.5	2.5			
LENGTH (m)	107	661	0	500	161	143	125	100

DATE	OCT.29/90	OCT.29/90	OCT.29/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.29/90	OCT.16/90
REFERENCE #	49	50	51	52	53	54	55	56
HABITAT	GLIDE	SLOUGH	RIFFLE	RIFFLE	GLIDE	RIFFLE	SLOUGH	DEBRIS AC.
AREA	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	MAINSTEM	MAINSTEM	MAINSTEM	SIDE CHAN.	
MAX. DEPTH (m)	0.2	2.0	0.1	0.8	3.1	0.9	0.8	
AVE. DEPTH (m)	0.2	1.3	0.1	0.5	1.3	0.6	0.4	
% FINES	90	60	0	0	10	5	90	
% LARGE GRAVEL	10	10	10	30	40	5	5	
% SMALL GRAVEL	0	10	5	0	20	10	0	
% COBBLE	0	20	85	50	20	70	5	
% BOULDER	0	0	0	20	10	10	0	
% BEDROCK	0	0	0	0	0	0	0	
CHAN. WIDTH (m)								
WET WIDTH (m)	2.0	28.0	5.0	130.0	66.0	65.0	17.0	
VELOCITY (m/s2)	0.30	0.00	0.20	1.80	1.00	1.50	0.00	
% COVER (LOD)	0	2	5	0	1	0	1	
PHOTO		2-24, 26	2-25					
VISIBILITY (m)				3.0	3.0	3.0		
TEMP (oC)		4.5		1.5	1.5	1.5	6.0	
FLOOD SIGN (m)				2.5	2.5	2.5		
LENGTH (m)	30	150	7	54	786	71	100	107

DATE	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.16/90	OCT.31/90
REFERENCE #	57	58	59	60	61	62	63	64
HABITAT	GLIDE	RIFFLE	GLIDE	DEBRIS AC.	RIFFLE	DEBRIS AC.	GLIDE	GLIDE-RIF.
AREA	MAINSTEM	MAINSTEM	MAINSTEM		MAINSTEM		MAINSTEM	SIDE CHAN.
MAX. DEPTH (m)	2.0	0.6	2.0		0.6		2.0	0.2
AVE. DEPTH (m)	1.3	0.4	1.0		0.5		1.2	0.1
% FINES	0	0	0		0		5	30
% LARGE GRAVEL	30	30	30		10		35	20
% SMALL GRAVEL	10	0	10		0		10	50
% COBBLE	40	60	50		70		40	0
% BOULDER	20	10	10		20		10	0
% BEDROCK	0	0	0		0			0
CHAN. WIDTH (m)								60.0
WET WIDTH (m)	46.0	85.0	50.0		50.0		130.0	4.0
VELOCITY (m/s2)	1.30	2.00	1.50		2.00		1.20	0.20
% COVER (LOD)	5	0	2		0		3	1
PHOTO							3-6	
VISIBILITY (m)	3.0	3.0	3.0		3.0		3.0	
TEMP (oC)	1.5	1.5	1.5		1.5		1.5	
FLOOD SIGN (m)	2.5	2.5	2.5		2.5		2.5	
LENGTH (m)	625	71	589	89	89	143	2,125	893

DATE	OCT.31/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90
REFERENCE #	65	66	67	68	69	70	71	72
HABITAT	SLOUGH	GLIDE	SLOUGH	GLIDE&RIF.	GLIDE&RIF.	POOL	RIFFLE	POOL
AREA	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	TRIBUTARY	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	1.0	1.5	3.0	0.4	1.0	1.2	0.3	2.0
AVE. DEPTH (m)	0.5	0.4	1.0	0.3	0.3	0.6	0.2	0.8
% FINES	50	20	75	5	50	10	0	20
% LARGE GRAVEL	20	55	10	50	40	50	80	40
% SMALL GRAVEL	15	20	5	45	10	10	10	10
% COBBLE	15	5	10	0	0	30	10	30
% BOULDER	0	0	0	0	0	0	0	0
% BEDROCK	0	0	0	0	0	0	0	0
CHAN. WIDTH (m)	35.0							
WET WIDTH (m)	18.0	15.0	22.0	15.0	4.0	18.0	9.0	16.0
VELOCITY (m/s2)	0.00	0.40	0.10	0.80	0.50	0.30	1.00	0.30
% COVER (LOD)	5	0	0	1	1	5	2	5
PHOTO								
VISIBILITY (m)		4.0						
TEMP (oC)	3.0		2.0					
FLOOD SIGN (m)								
LENGTH (m)	536	143	732	696	0	250	136	304

DATE	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90
REFERENCE #	73	74	75	76	77	78	79	80
HABITAT	GLIDE	RIFFLE	GLIDE	DEBRIS AC.	RIFFLE	RIFFLE	GLIDE	GLIDE
AREA	MAINSTEM	SIDE CHAN.	SIDE CHAN.		SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	2.0	0.5	1.0		0.3	0.4		0.8
AVE. DEPTH (m)	1.5	0.4	0.6		0.3	0.3		0.6
% FINES	10		0		0	10		10
% LARGE GRAVEL	50		80		35	60		60
% SMALL GRAVEL	20	10	10		35	10		10
% COBBLE	20	30	10		30	20		20
% BOULDER	0	0	0		0	0		0
% BEDROCK	0	0	0		0	0		0
CHAN. WIDTH (m)								
WET WIDTH (m)	38.0	25.0	25.0		70.0	40.0	23.0	29.0
VELOCITY (m/s2)	2.00	2.50	1.50		2.00	2.00		1.00
% COVER (LOD)	2	0	2		0	0		0
PHOTO	2-10							
VISIBILITY (m)	3.0	3.0	3.0		3.0	3.0		3.0
TEMP (oC)	0.0	0.0	0.0		0.0	0.0		0.0
FLOOD SIGN (m)	2.5	2.5	2.5		2.5	2.5		2.5
LENGTH (m)	1,036	75	304	0	30	70	429	429

DATE	OCT.17/90	OCT.17/90	OCT.17/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90	OCT.23/90
REFERENCE #	81	82	83	84	85	86	87	88
HABITAT	RIFFLE	RIFFLE	GLIDE	DEBRIS AC.	GLIDE	SLOUGH	DEBRIS AC.	SLOUGH
AREA	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.		SIDE CHAN.	SIDE CHAN.		SIDE CHAN.
MAX. DEPTH (m)	0.5	1.0	2.0		1.0	1.2		2.5
AVE. DEPTH (m)	0.3	0.6	0.8		0.4	0.7		1.0
% FINES	0	0	20		80	40		80
% LARGE GRAVEL	30	30	60		10	20		5
% SMALL GRAVEL	10	10	20		10	10		5
% COBBLE	60	60	0		0	30		10
% BOULDER	0	0	0		0	0		0
% BEDROCK	0	0	0		0	0		0
CHAN. WIDTH (m)								
WET WIDTH (m)	30.0	23.0	38.0		9.5	13.0		30.0
VELOCITY (m/s2)	1.50	2.50	1.50		0.00	0.00		0.00
% COVER (LOD)	0	2	2		10	5		2
PHOTO								
VISIBILITY (m)	3.0	3.0	3.0		4.0	4.0		
TEMP (oC)	0.0	0.0	0.0					2.5
FLOOD SIGN (m)	2.5	2.5	2.5					
LENGTH (m)	30	30	1,036	286	179	375	143	1,196

DATE	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.25/90	OCT.25/90	OCT.25/90	OCT.25/90
REFERENCE #	89	90	91	92	93	94	95	96
HABITAT	DEBRIS AC.	RIFFLE	RIFFLE	GLIDE	DEBRIS AC.	GLIDE	SLOUGH	RIFFLE
AREA		MAINSTEM	SIDE CHAN.	SIDE CHAN.		SIDE CHAN.	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)		1.5	0.2	0.5		0.5	0.4	0.1
AVE. DEPTH (m)		1.2	0.2	0.5		0.4	0.3	0.1
% FINES		0	0	10		40	60	10
% LARGE GRAVEL		50	10	70		40	30	70
% SMALL GRAVEL		10	10	10		20	10	20
% COBBLE		40	80	10		0	0	0
% BOULDER		0	0	0		0	0	0
% BEDROCK		0	0	0		0	0	0
CHAN. WIDTH (m)								
WET WIDTH (m)		50.0	85.0	85.0		8.0	20.0	4.0
VELOCITY (m/s2)		3.00	1.20	0.50		0.00	0.00	0.30
% COVER (LOD)		0	0	1		2	0	0
PHOTO								
VISIBILITY (m)		3.0	3.0	3.0				
TEMP (oC)		0.0	0.0	0.0				
FLOOD SIGN (m)		2.5	2.5	2.5				
LENGTH (m)	54	70	80	429	125	214	304	71

DATE	OCT.29/90	OCT.29/90	OCT.29/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.17/90	OCT.18/90
REFERENCE #	97	98	99	100	101	102	103	104
HABITAT	GLIDE-POOL	SLOUGH	SLOUGH	GLIDE	GLIDE	GLIDE	RIFFLE	BACK CHAN.
AREA	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	MAINSTEM	SIDE CHAN.	MAINSTEM	MAINSTEM	SIDE CHAN.
MAX. DEPTH (m)	0.5		1.2	4.0	0.6	1.8	0.3	3.0
AVE. DEPTH (m)	0.3		0.7	1.0	0.5	1.0	0.3	2.0
% FINES	50	10	15	10	5	5	0	20
% LARGE GRAVEL	20	60	15	65	35	75	15	40
% SMALL GRAVEL	30	30	40	10	10	10	5	10
% COBBLE	0	0	30	15	50	10	80	30
% BOULDER	0	0	0	0	0	0	0	0
% BEDROCK	0	0	0	0	0	0	0	0
CHAN. WIDTH (m)								
WET WIDTH (m)	8.0	20.0	30.0	110.0	25.0	50.0	30.0	25.0
VELOCITY (m/s2)	0.10	0.00	0.00	1.50	2.00	2.00	2.00	0.00
% COVER (LOD)	1	2	2	2	1	2	0	5
PHOTO								
VISIBILITY (m)				3.0	3.0	3.0	3.0	3.0
TEMP (oC)			7.0	0.0	0.0	0.0	0.0	5.0
FLOOD SIGN (m)				2.5	2.5	2.5	2.5	2.5
LENGTH (m)	411	89	357	1,018	1,000	982	150	607

DATE	OCT.20/90	OCT.29/90	OCT.29/90	OCT.29/90	OCT.29/90	OCT.29/90	OCT.20/90	OCT.20/90
REFERENCE #	105	106	107	108	109	110	111	112
HABITAT	RIFFLE	SLOUGH	DEBRIS AC.	RIFFLE	SLOUGH	GLIDE&RIF.	GLIDE	GLIDE
AREA	MAINSTEM	SIDE CHAN.		SIDE CHAN.	SIDE CHAN.	TRIBUTARY	MAINSTEM	SIDE CHAN.
MAX. DEPTH (m)	1.3			0.1		0.5	3.0	1.0
AVE. DEPTH (m)	0.8			0.1		0.2	1.0	0.8
% FINES	0			0	60	10	10	5
% LARGE GRAVEL	30			10	10	20	60	55
% SMALL GRAVEL	10			45	10	40	10	10
% COBBLE	60			45	20	30	20	30
% BOULDER	0			0	0	0	0	0
% BEDROCK	0			0	0	0	0	0
CHAN. WIDTH (m)						25.0		
WET WIDTH (m)	100.0	20.0		8.0	25.0	2.0	85.0	23.0
VELOCITY (m/s2)	3.00	0.00		0.40	0.00	0.50	0.60	1.70
% COVER (LOD)	0	5			2	5	2	1
PHOTO								
VISIBILITY (m)	4.0						4.0	4.0
TEMP (oC)								
FLOOD SIGN (m)								
LENGTH (m)	80	375	393	20	839		1,625	107

DATE		OCT.20/90	OCT.31/90	OCT.20/90	NOV. 7/90	OCT.31/90	OCT.31/90	OCT.20/90
REFERENCE #	113	114	115	116	117	118	119	120
HABITAT	RIFFLE	DEBRIS AC.	BACK CHAN.	GLIDE	SLOUGH	DEBRIS AC.	SLOUGH	GLIDE
AREA	SIDE CHAN.		SIDE CHAN.	MAINSTEM	SIDECHAN.		SIDE CHAN.	MAINSTEM
MAX. DEPTH (m)			0.7	1.0				1.5
AVE. DEPTH (m)			0.3	0.8				1.2
% FINES			20	0				5
% LARGE GRAVEL			70	30				65
% SMALL GRAVEL			10	10				10
% COBBLE			0	30				20
% BOULDER			0	0				0
% BEDROCK			0	0				0
CHAN. WIDTH (m)								
WET WIDTH (m)	23.0		12.0	70.0	27.0		40.0	65.0
VELOCITY (m/s2)			0.00	2.50				1.20
% COVER (LOD)			0	0				1
PHOTO								
VISIBILITY (m)				4.0				4.0
TEMP (oC)								
FLOOD SIGN (m)								
LENGTH (m)	36	71	100	125	446	71	70	714

DATE	OCT.20/90	OCT.20/90	OCT.20/90	OCT.20/90	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90
REFERENCE #	121	122	123	124	125	126	127	128
HABITAT	GLIDE	GLIDE	DEBRIS AC.	BACK CHAN.	SLOUGH	GLIDE-RIF.	SLOUGH	RIFFLE
AREA	MAINSTEM	MAINSTEM		SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	1.5	3.0		2.0	1.0	0.2	1.0	1.0
AVE. DEPTH (m)	0.8	2.0		0.7	0.6	0.1	0.8	0.6
% FINES	0	5		80	100	10	25	0
% LARGE GRAVEL	30	65		10	0	60	35	40
% SMALL GRAVEL	10	10		5	0	20	25	10
% COBBLE	60	20		5	0	10	10	50
% BOULDER	0	0		0	0	0	5	0
% BEDROCK	0	0		0	0	0	0	0
CHAN. WIDTH (m)					35.0	22.0	22.0	
WET WIDTH (m)	100.0	100.0		30.0	15.0	6.0	20.0	30.0
VELOCITY (m/s2)	2.50	0.80		0.00	0.00	0.10	0.00	1.80
% COVER (LOD)	1	1		0	2		2	0
PHOTO				2-16, 17				
VISIBILITY (m)	4.0	4.0		4.0			CLEAR	
TEMP (oC)				3.0				
FLOOD SIGN (m)								
LENGTH (m)	125	1,393	393	214	339	536	339	143

DATE	OCT.30/90	OCT.31/90	OCT.30/90	OCT.31/90	OCT.31/90	OCT.31/90	OCT.30/90	OCT.30/90
REFERENCE #	129	130	131	132	133	134	135	136
HABITAT	RIFFLE	RAPIDS	GLIDE	GLIDE	SLOUGH	RIFFLE	RIFFLE	GLIDE
AREA	SIDE CHAN.	MAINSTEM	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	MAINSTEM	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	4.0	1.5	0.8	0.3		0.9	0.8	1.5
AVE. DEPTH (m)	0.3	0.8	0.5	0.1		0.8	0.5	0.7
% FINES	0	0	0	90		5	0	5
% LARGE GRAVEL	15	15	20	5		35	15	60
% SMALL GRAVEL	5	5	10	5		10	5	20
% COBBLE	80	20	70	0		50	70	15
% BOULDER	0	30	0	0		0	10	0
% BEDROCK	0	30	0	0		0	0	0
CHAN. WIDTH (m)					35.0			
WET WIDTH (m)	60.0	49.0	28.0	3.0	30.0	49.0	17.0	26.0
VELOCITY (m/s2)	2.00	2.50	1.80	0.50	0.00	1.70	2.50	1.40
% COVER (LOD)	0	0	0	0	2	0	0	2
PHOTO		3-2				3-2		
VISIBILITY (m)								
TEMP (oC)								
FLOOD SIGN (m)								
LENGTH (m)	20	100	232	321	250	100	50	375

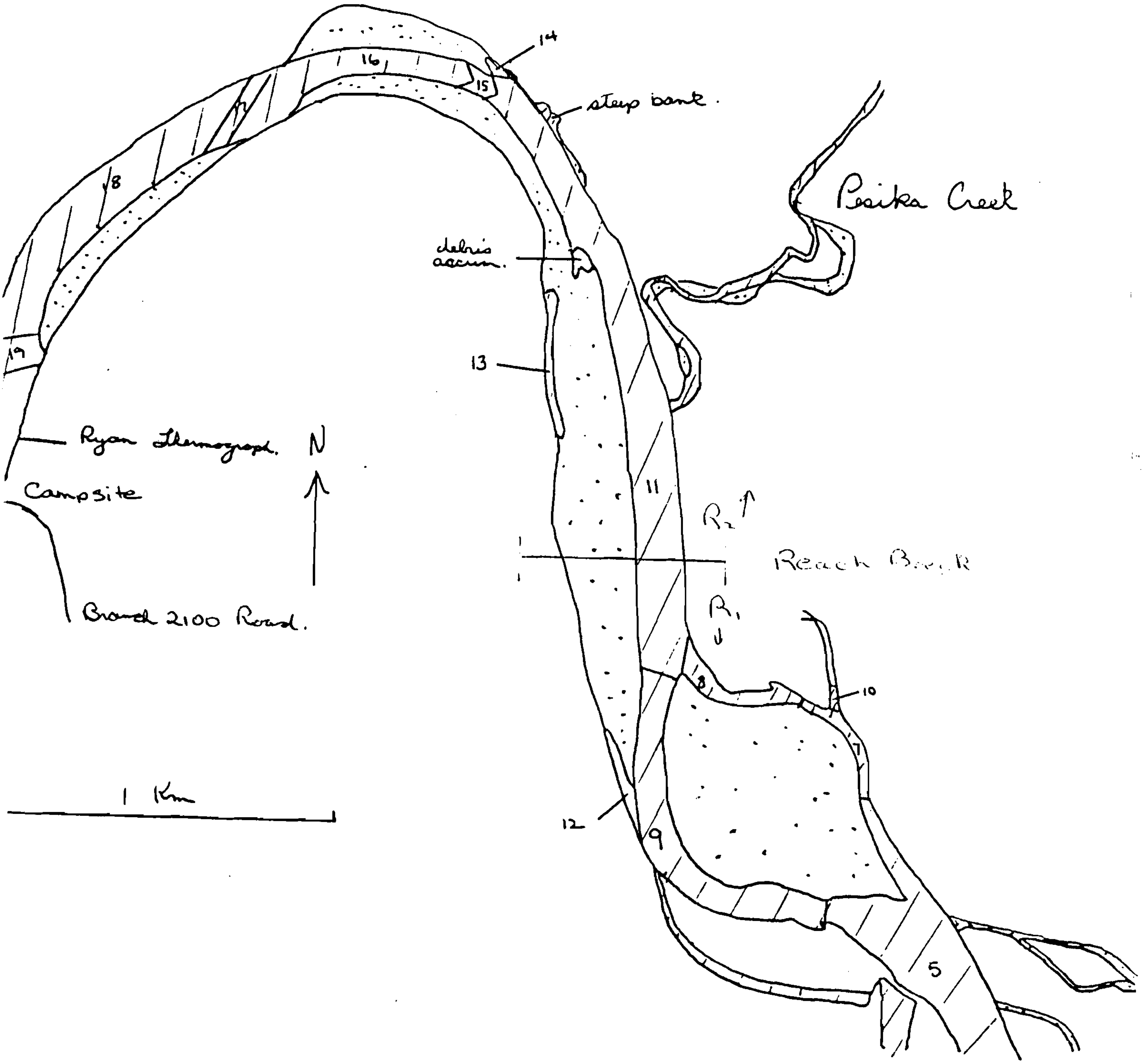
DATE	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90	OCT.30/90
REFERENCE #	137	138	139	140	141	142	143	144
HABITAT	POOL	RIFFLE	GLIDE	RIFFLE	GLIDE	RIFFLE	GLIDE	RIFFLE
AREA	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.	SIDE CHAN.
MAX. DEPTH (m)	3.0	0.6	2.5	1.5	1.5	0.8	1.0	0.6
AVE. DEPTH (m)	2.0	0.3	1.0	0.4	1.0	0.4	0.6	0.4
% FINES	70	5	15	5	20	5	10	5
% LARGE GRAVEL	20	25	55	45	60	35	60	35
% SMALL GRAVEL	10	20	20	10	10	10	10	10
% COBBLE	0	50	10	40	10	50	20	50
% BOULDER	0	0	0	0	0	0	0	0
% BEDROCK	0	0	0	0	0	0	0	0
CHAN. WIDTH (m)								
WET WIDTH (m)	30.0	80.0	34.0	50.0	28.0	25.0	30.0	30.0
VELOCITY (m/s2)	0.20	1.80	1.30	2.50	1.20	1.70	1.50	2.00
% COVER (LOD)	0	2	2	1	2	2	0	2
PHOTO								
VISIBILITY (m)								
TEMP (oC)								
FLOOD SIGN (m)								
LENGTH (m)	70	30	411	70	232	50	125	50

DATE	OCT.30/90	OCT.30/90	OCT.31/90	OCT.31/90	OCT.31/90	OCT.31/90	OCT.31/90	OCT.31/90
REFERENCE #	145	146	148	149	150	151	152	153
HABITAT	DEBRIS AC.	GLIDE-RIF..	GLIDE	RIFFLE	RIFFLE	BACK CHAN.	GLIDE	RIFFLE
AREA		SIDE CHAN.	MAINSTEM	MAINSTEM	SIDE CHAN.	SIDE CHAN.	MAINSTEM	MAINSTEM
MAX. DEPTH (m)		1.0	3.0	1.5	0.7	1.0	1.3	0.7
AVE. DEPTH (m)		0.5	1.5	0.5	0.4	0.3	0.9	0.5
% FINES		15	10	0	5	30	5	5
% LARGE GRAVEL		55	50	45	65	50	35	35
% SMALL GRAVEL		10	20	5	10	10	10	10
% COBBLE		20	20	50	20	10	50	50
% BOULDER		0	0	0	0	0	0	0
% BEDROCK		0	0	0	0	0	0	0
CHAN. WIDTH (m)								
WET WIDTH (m)		10.0	48.0	40.0	24.0	8.0	55.0	55.0
VELOCITY (m/s2)		1.50	1.00	2.50	2.00	0.00	1.50	1.70
% COVER (LOD)		5	2	0	0	0	1	0
PHOTO								
VISIBILITY (m)								
TEMP (oC)								
FLOOD SIGN (m)								
LENGTH (m)	214	571	393	70	50	150	179	70

DATE	OCT.31/90
REFERENCE #	154
HABITAT	GLIDE
AREA	MAINSTEM
MAX. DEPTH (m)	2.0
AVE. DEPTH (m)	1.0
% FINES	20
% LARGE GRAVEL	20
% SMALL GRAVEL	10
% COBBLE	50
% BOULDER	0
% BEDROCK	0
CHAN. WIDTH (m)	
WET WIDTH (m)	90.0
VELOCITY (m/s2)	1.60
% COVER (LOD)	1
PHOTO	
VISIBILITY (m)	
TEMP (oC)	
FLOOD SIGN (m)	
LENGTH (m)	589

Lower Finlay River habitat maps

Section 1



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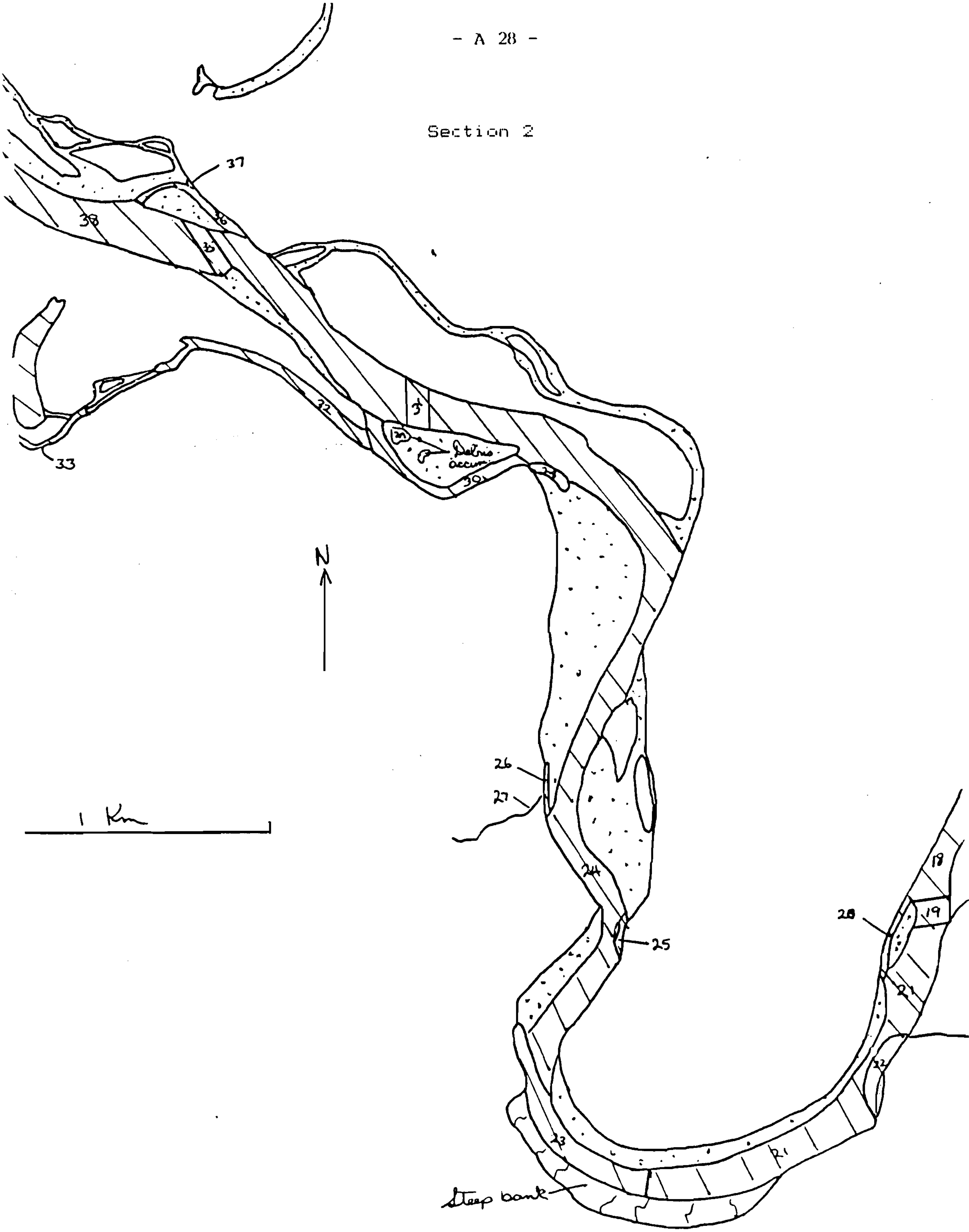
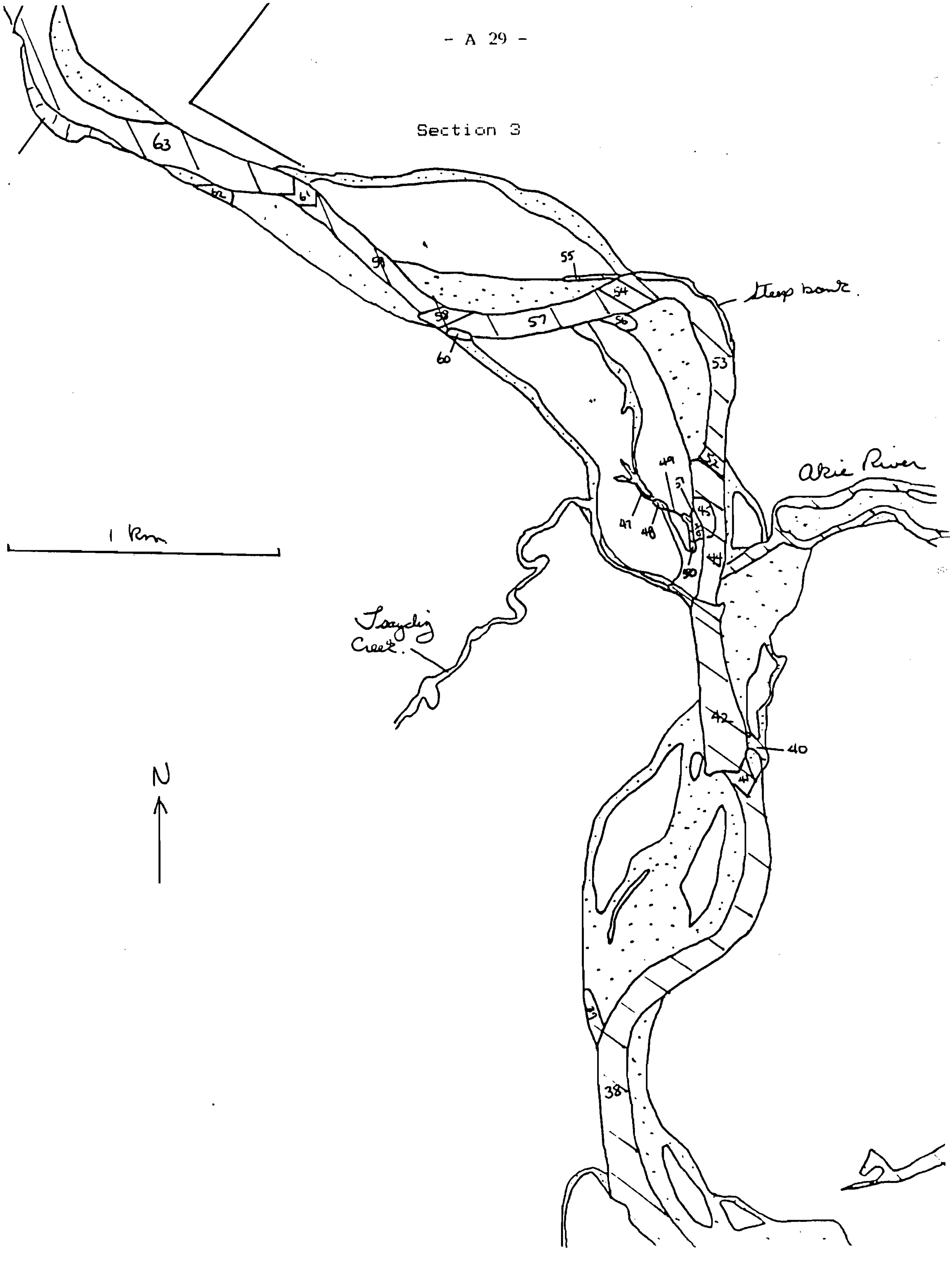
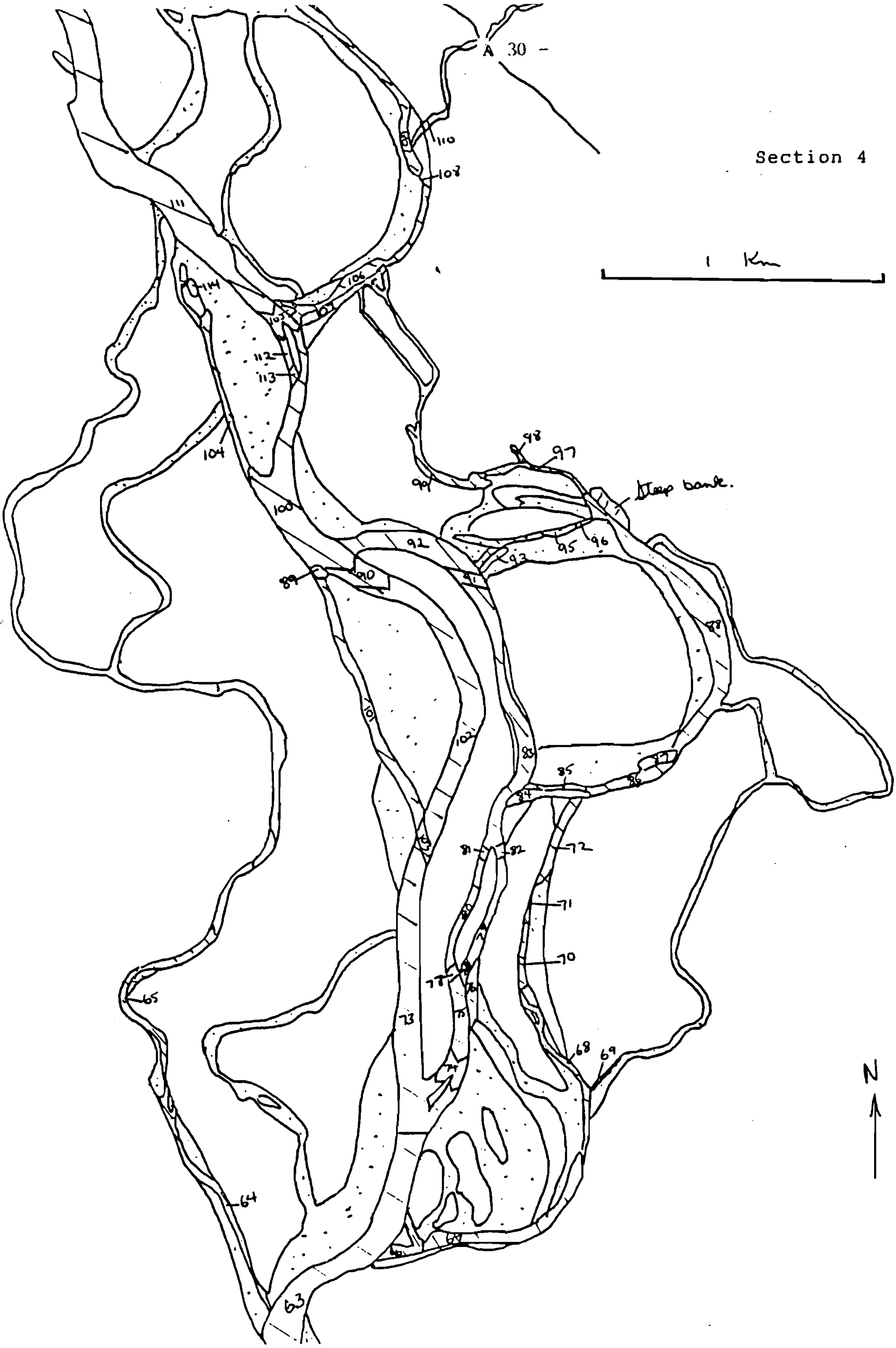

37
38
36
35
33
32
30
Debris accum.
N
1 Km
26
27
24
25
18
19
20
21
22
23
Steep bank

Section 3


63
62
61
59
55
54
58
57
56
60
53
Steep bank.
Akie River
52
49
51
47
48
45
50
44
1 Km
Tsaydiz
Creek.
42
40
41
N
38

Section 4



A 30 -
1 Km
N
Steep bank.
63
64
65
68
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70
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72
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