Environmental Services

ENUMERATION OF SPAWNING SALMON IN AQUATIC SYSTEMS ALONG THE ALASKA HIGHWAY GAS PIPELINE IN SOUTHERN YUKON TERRITORY, 1980

Foothills Pipe Lines (South Yukon) Ltd.

ENUMERATION OF SPAWNING SALMON IN AQUATIC SYSTEMS ALONG THE ALASKA HIGHWAY GAS PIPELINE IN SOUTHERN YUKON TERRITORY, 1980

THE
ALASKA HIGHWAY
GAS PIPELINE PROJECT

Foothills Pipe Lines (South Yukon) Ltd.

WHITEHORSE:
308 STEELE STREET
Y1A 2C5

CALGARY:
1600 BOW VALLEY SQUARE II
205 - FIFTH AVENUE S.W.,
CALGARY, ALBERTA.
T2P 2W4

This document has been prepared for Foothills Pipe Lines (South Yukon) Ltd. by an independent consultant. Copies of the original report have been printed in the present form to allow for wider distribution.

Citation:
Environmental Management Associates. 1980. Enumeration of spawning salmon in aquatic systems along the Alaska Highway gas pipeline in southern Yukon Territory, 1980. Report prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary, Alberta.

ENUMERATION OF SPAWNING SALMON IN AQUATIC SYSTEMS ALONG THE ALASKA HIGHWAY GAS PIPELINE IN SOUTHERN YUKON TERRITORY, 1980

Prepared for:

FOOTHILLS PIPE LINES (SOUTH YUKON) LTD.
CALGARY, ALBERTA

Prepared by:

D.A. Fernet

ENVIRONMENTAL MANAGEMENT ASSOCIATES
CALGARY, ALBERTA

DECEMBER 1980

TABLE OF CONTENTS

LIST OF FIGURES

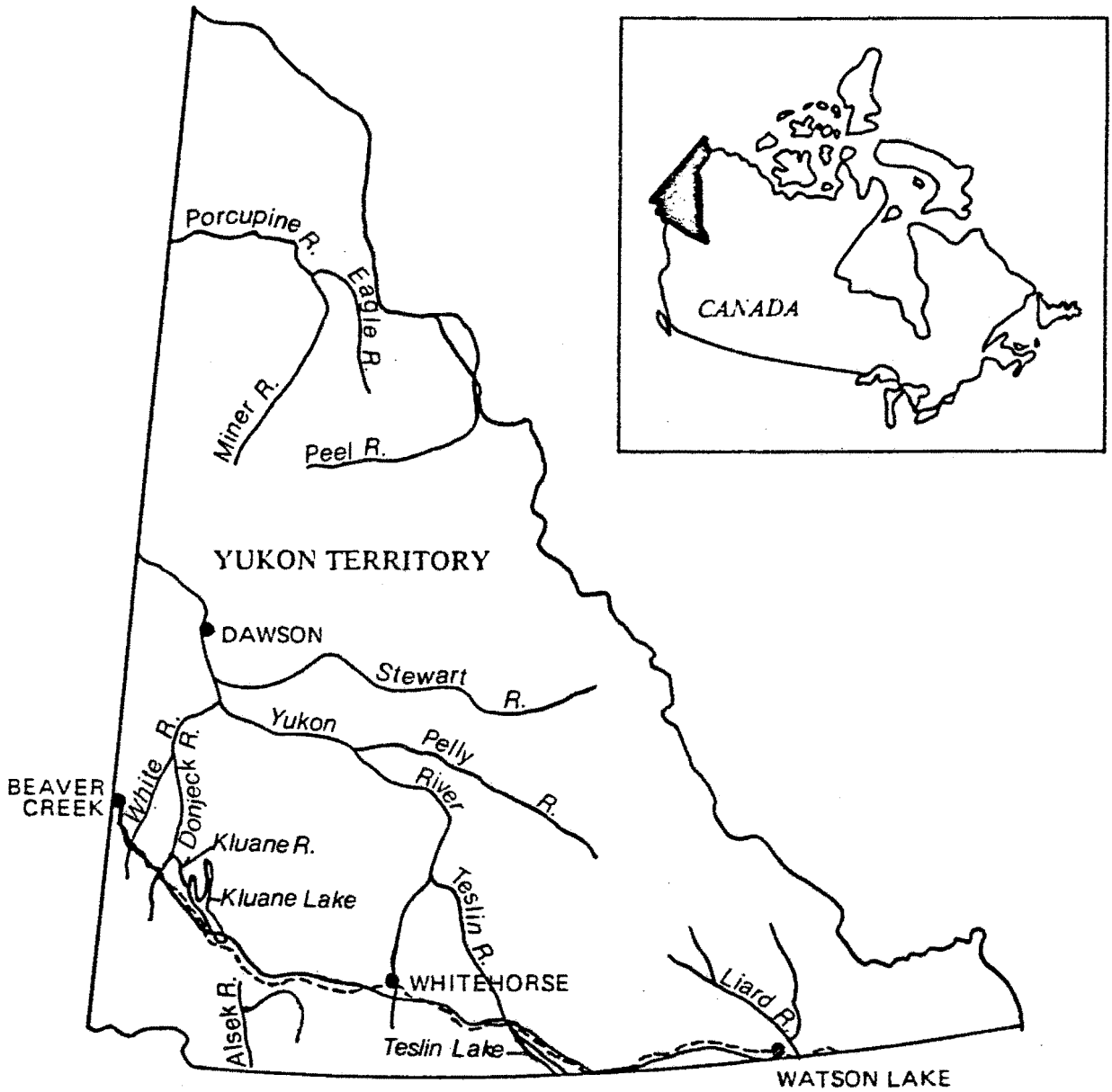
LIST OF TABLES

1.0 INTRODUCTION

Foothills Pipe Lines (South Yukon) Ltd. (Foothills) is in the design stage for construction of the Alaska Highway gas pipeline in southern Yukon Territory. The pipeline route enters Yukon Territory near Beaver Creek and generally parallels the Alaska Highway before entering British Columbia near Watson Lake (Figure 1). Construction, operation and abandonment of the pipeline has the potential for adversely affecting fish populations in Yukon Territory.

Chinook (Oncorhynchus tshawytscha) and chum salmon (O. keta) occur sporadically in the upper reaches of the Yukon River system in Yukon Territory and northern British Columbia. Both species support small commercial fisheries in Yukon Territory, and salmon originating in the headwaters of the Yukon River contribute to larger freshwater and saltwater commercial fishery operations in Alaska (Boland 1973). Both species are also exploited by subsistence fishermen, and chinooks are occasionally taken by sport fishermen in Yukon Territory (Sinclair and Sweitzer 1973). Of the six fishes identified as important in relation to the project, chinook and chum salmon are the two most important in terms of protection planning for construction of the Alaska Highway gas pipeline.

In order to provide data to evaluate potential effects of construction on salmon spawning areas, Foothills retained Environmental Management Associates to conduct investigations in 1980 of chinook and chum salmon spawning areas in watercourses crossed by the Alaska Highway gas pipeline, or in watercourses where the pipeline crosses tributary streams which enter a system where salmon spawn within the influence of discharges from these tributaries.



The Alaska Highway Gas Pipeline Route In Yukon Territory

----Alaska Highway

——Pipeline Route

Figure 1

ENVIRONMENTAL MANAGEMENT ASSOCIATES
1980

2.0 TERMS OF REFERENCE

Watercourses that are likely to be affected by the Alaska Highway gas pipeline which are utilized for spawning by chinook or chum salmon were to be surveyed to gather information on the distribution and numbers of spawners in regions upstream and downstream of proposed pipeline crossing locations. Specifically, those watercourses to be surveyed for chinook salmon were:

Takhini River	Teslin River
Ibex River	Morley River
Yukon River	Smart River
M'Clintock River	Swift River

Watercourses to be surveyed for chum salmon were:

Koidern River	Kluane River

One flight of each watercourse was to be conducted during the peak of spawning behavior. The optimum time for conducting the programs was to be decided by fisheries field crews who were investigating new pipeline crossing locations in close proximity to chinook and chum salmon spawning areas (Environmental Management Associates 1980).

3.0 METHODS

The chinook salmon enumeration was conducted on August 20, 21 and 22, 1980. The aerial survey was flown using a Bell 206B helicopter. The chum salmon program was flown on October 25, 1980 in a Bell 206 Long Ranger II helicopter. The surveys were conducted by three personnel, two observers and one recorder, in addition to the helicopter pilot. Altitudes and air speeds were recorded for each river flown; in general, altitudes of 15 to 25 m were maintained, with airspeeds ranging from 0 to 50 km/h. One pass was made over each watercourse, in a zig-zag pattern if necessary, to provide complete visual coverage of the area under investigation.

Locations of adult salmon were recorded on 1:50,000 NTS maps, and the number of living or dead salmon recorded for each location. Enumeration sites and numbers of salmon observed at each location are presented in the results section of this report.

The efficiency of the enumeration for each river flown was recorded at the termination of each flight. The efficiency was determined from: an evaluation of the climatic conditions under which the survey was flown; morphology of the watercourse; and, water clarity.

4.0 RESULTS

4.1 CHINOOK SALMON SURVEYS

4.1.1 Takhini River

The Takhini River was flown on August 20, 1980, from the confluence of the Takhini and Yukon rivers to the outlet of Kusawa Lake. The river was surveyed at an altitude ranging from 15 to 25 m, at an airspeed of 30 to 65 km/h. Cloud cover ranged from 10 to 30 percent, and windspeed was 0 to 10 km/h. Conditions for the survey were excellent. Water visibility was relatively poor from the river mouth to the point where Mendenhall River enters the Takhini. Above this confluence, however, visibility was excellent. The efficiency of the enumeration for the river was estimated to be 90 percent.

The results of the survey are presented in Table 1, and the location of observations are illustrated in Figure 2. A total of 163 live and 7 dead salmon were counted. The majority of the fish (160) were located between the outlet of Kusawa Lake and the point at which the Mendenhall River enters the Takhini. Six individuals were identified below the proposed pipeline crossing; four of these fish were observed in a group 2.8 km below the crossing. These fish appeared to be migrating upstream rather than spawning in this locale.

4.1.2 Ibex River

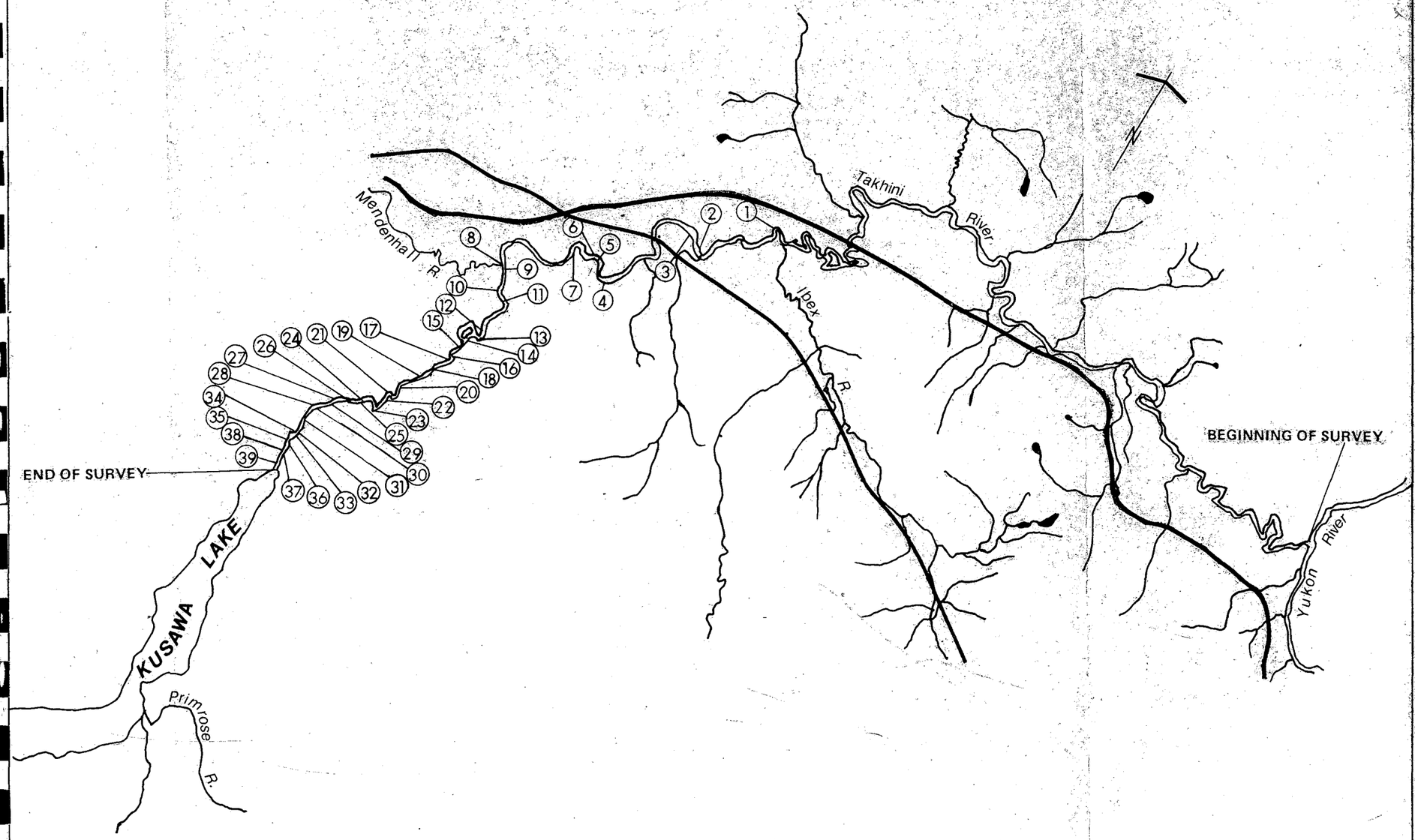
The Ibex River was flown from the Takhini-Ibex confluence to a point 11 km upstream, where the habitat in the river becomes unsuitable for spawning by chinook salmon. The river was surveyed at an altitude of 15 to 25 m, at an airspeed of 30 to 65 km/h. Cloud cover was 30 percent and there was no wind. Survey conditions and water visibility were excellent. The efficiency of the enumeration was judged to be 60 percent,

TABLE 1

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, TAKHINI RIVER, AUGUST 20, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	1		1
2	1		1
3	4		4
4	1		1
5	1		1
6	1		1
7	1		1
8	1		1
9	13		13
10	2		2
11	2		2
12	2		2
13	4		4
14	2		2
15	2		2
16	5		5
17	2		2
18	2		2
19	1		1
20		1	1
21	8		8
22	51	1	52
23	2		2
24	5		5
25	5	1	6
26		1	1
27	6		6
28	10	1	11
29	2		2
30	2	1	3
31	1		1
32	3		3
33	1		1
34	1		1
35	2		2
36	6		6
37	4		4
38	5		5
39	1	1	2
TOTAL	163	7	170

Locations Of Chinook Salmon Enumerated In Takhini River, August 20, 1980



Alaska Highway

Pipeline Route

① Enumeration Site

0 5 10 15 Km

Figure 2

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

due to the meandering of the river in the lower reaches, and the bank vegetation overhanging the watercourse.

The results of the survey are presented in Table 2. The map locations where chinooks were sited are illustrated in Figure 3. Ten salmon were counted in the lower reaches of the Ibex, of which one was dead. These fish were spawning in the Ibex River.

4.1.3 Yukon River

The Yukon River was flown in two sections on the morning of August 20, 1980. The first part of the flight commenced at Whitehorse and continued downstream to the confluence with the Takhini River. The second section was flown from Whitehorse upstream to the Lewis Dam. The conditions for the survey were excellent, with cloud cover ranging from 10 to 30 percent, and the windspeed varying from 0 to 20 km/h. The initial section from Whitehorse downstream was flown at an altitude of 30 m maintaining a speed of 65 km/h. The efficiency of the survey was judged to be 90 percent, as water clarity was good and the river relatively shallow. The flight from Schwatka Lake to Lewis Dam was covered at an altitude of 30 to 40 m, and airspeed of 130 km/h. This section of the river is deeper and the substrate is not generally visible. The efficiency of the survey in this region was estimated to be less than 10 percent.

Only one chinook salmon was observed during the Yukon River survey. The location of this fish is illustrated in Figure 4, as map location 1. The fish appeared to be migrating upstream.

4.1.4 M'Clintock River and Michie Creek

The M'Clintock River and Michie Creek were surveyed on August 20, 1980. The M'Clintock was flown from the river mouth at Marsh Lake upstream

TABLE 2

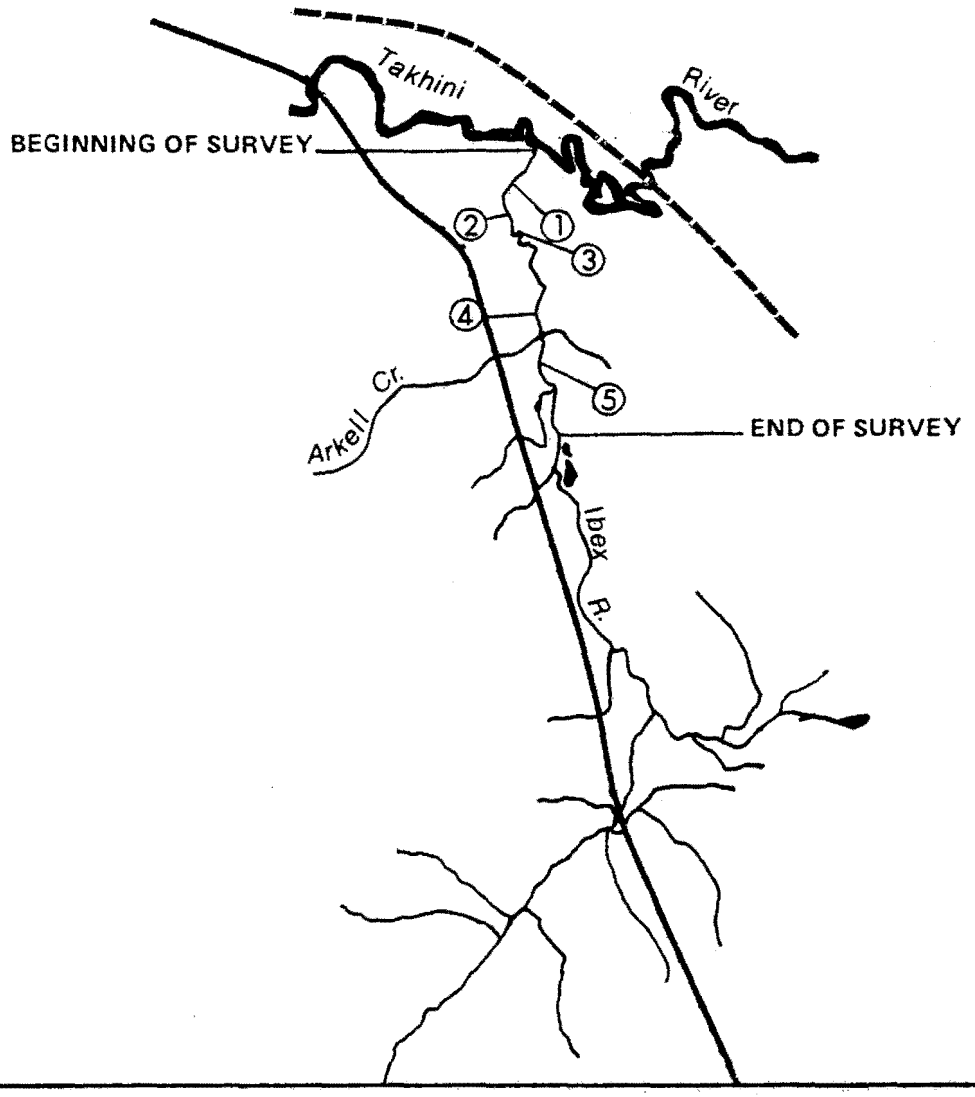
RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, IBEX RIVER, AUGUST 20, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	1		1
2	2		2
3	1		1
4	3		3
5	2	1	3
TOTAL	9	1	10

TABLE 3

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, MICHIE CREEK, AUGUST 20, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
2	2		2
3		1	1
4	503	29	532
TOTAL	505	30	535



Locations Of Chinook Salmon Enumerated In Ibex River, August 20, 1980

Alaska Highway

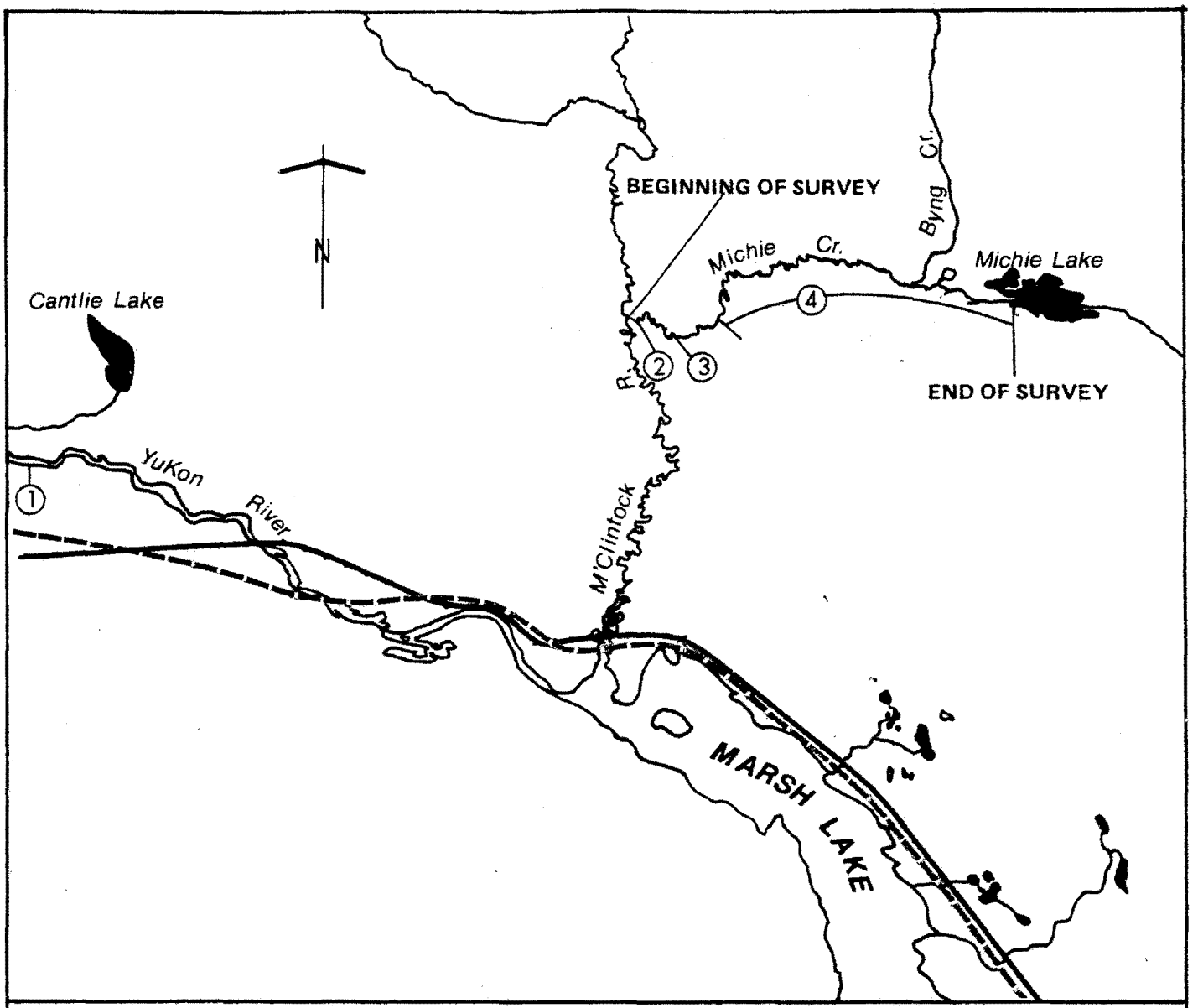
Pipeline Route

① Enumeration Site

Figure 3

0 5 10 15 Km

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980



Locations Of Chinook Salmon Enumerated In Yukon River and Michie Creek, August 20, 1980

——— Alaska Highway

——— Pipeline Route

① ——— Enumeration Site

0 5 10 15 Km

Figure 4

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

to the confluence with Michie Creek. Michie Creek was covered from its mouth upstream to the outlet of Michie Lake. Both watercourses were surveyed from an altitude of 15 to 45 m, at an airspeed of 30 km/h. The conditions for the survey were excellent, with 30 percent cloud cover and winds of 20 km/h. The efficiency of the aerial survey on M'Clintock River was judged to be less than 5 percent due to the turbidity of the river. The efficiency of the enumeration on Michie Creek was estimated to be 50 percent, due to extensive meadering and bank cover which hindered observation. Water clarity in Michie Creek was excellent.

No salmon were observed in the section of the M'Clintock River surveyed. The results of the count on Michie Creek are presented in Table 3 and Figure 4. Chinook salmon were observed almost continually from Michie Lake outlet to a point approximately 14 km downstream. These results have been grouped under map location 4. A total of 505 living and 30 dead chinook salmon were counted in the reach of Michie Creek between the lake outlet and creek mouth.

4.1.5 Teslin River

The Teslin River was surveyed on August 20, 1980. The reconnaissance was conducted in two phases. The first component consisted of surveying the reach of river from Roaring Bull Rapids upstream to 100 Mile Creek. The remaining area covered extended from the Teslin Lake outlet downstream to 100 Mile Creek. The river was observed from an altitude of 25 m, at airspeeds of 30 to 65 km/h. Although conditions for the survey were excellent, the efficiency of the enumeration was judged to be less than 1 percent. Water clarity in the Teslin River was good, but watercourse depth hindered observation of fish.

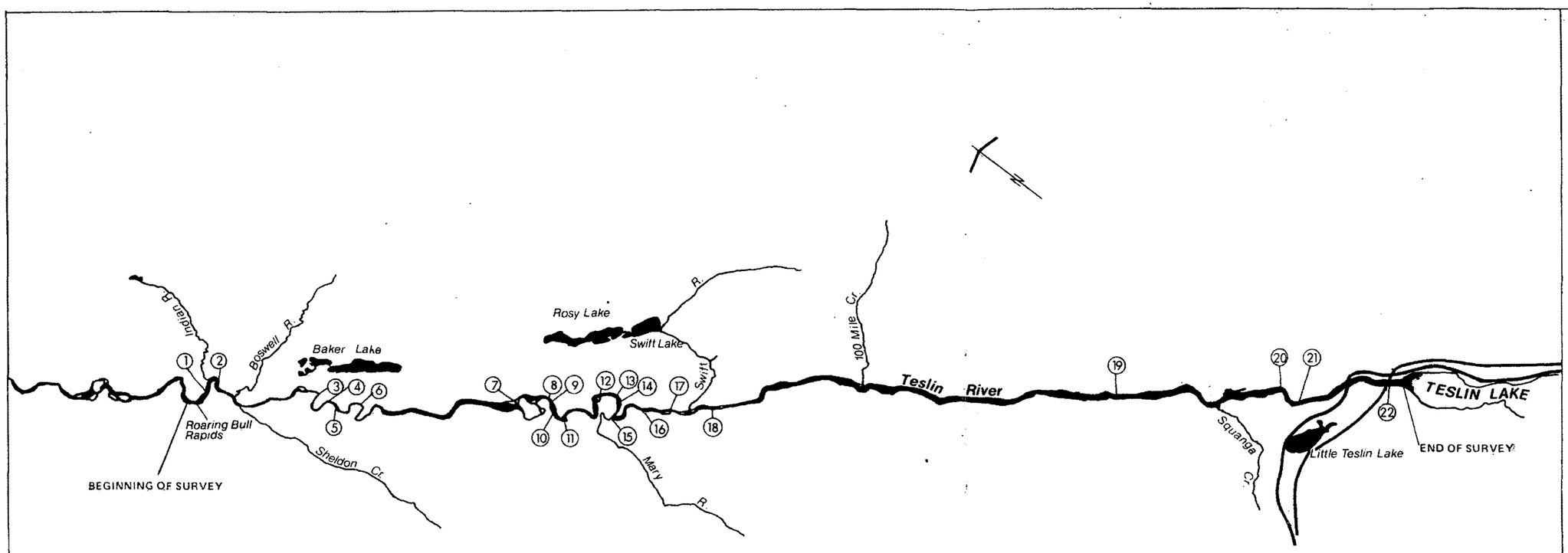
The results of the aerial survey are presented in Table 4, and the locations at which salmon were identified are illustrated on Figure 5. A total of 194 salmon were counted, of which 181 were living and 13 were dead.

TABLE 4

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, TESLIN RIVER, AUGUST 20, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	8		8
2		1	1
3		2	2
4	2		2
5	1	1	2
6		1	1
7	7		7
8	4		4
9		1	1
10	1		1
11	1	1	2
12	8		8
13	2		2
14		2	2
15	4		4
16	2		2
17	1		1
18	2		2
19		1	1
20	137	2	139
21	1		1
22		1	1
TOTAL	181	13	194

Locations Of Chinook Salmon Enumerated In Teslin River, August 20, 1980



Alaska Highway

Pipeline Route

① Enumeration Site

0 5 10 15 Km

Figure 5

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

Only one major spawning area was apparent, which is the documented spawning grounds 5.5 km downstream of Johnsons Crossing, where 140 fish were counted. Spawning areas likely exist near the mouth of Mary River, and upstream of Roaring Bull Rapids adjacent Baker Lake. The spawning area in the upper Teslin River is located 8.75 km downstream of the proposed pipeline crossing of this watercourse.

4.1.6 Morley River

The Morley River was surveyed on August 21, 1980. This watercourse was flown from the river mouth at Morley Bay to a point 19 km upstream of Morley Lake, at an altitude of 15 to 25 m and airspeed of 40 km/h. The conditions for the survey were excellent, with no cloud cover or wind. The waters of the Morley River were clear and colorless. The efficiency of the aerial census was judged to be 100 percent.

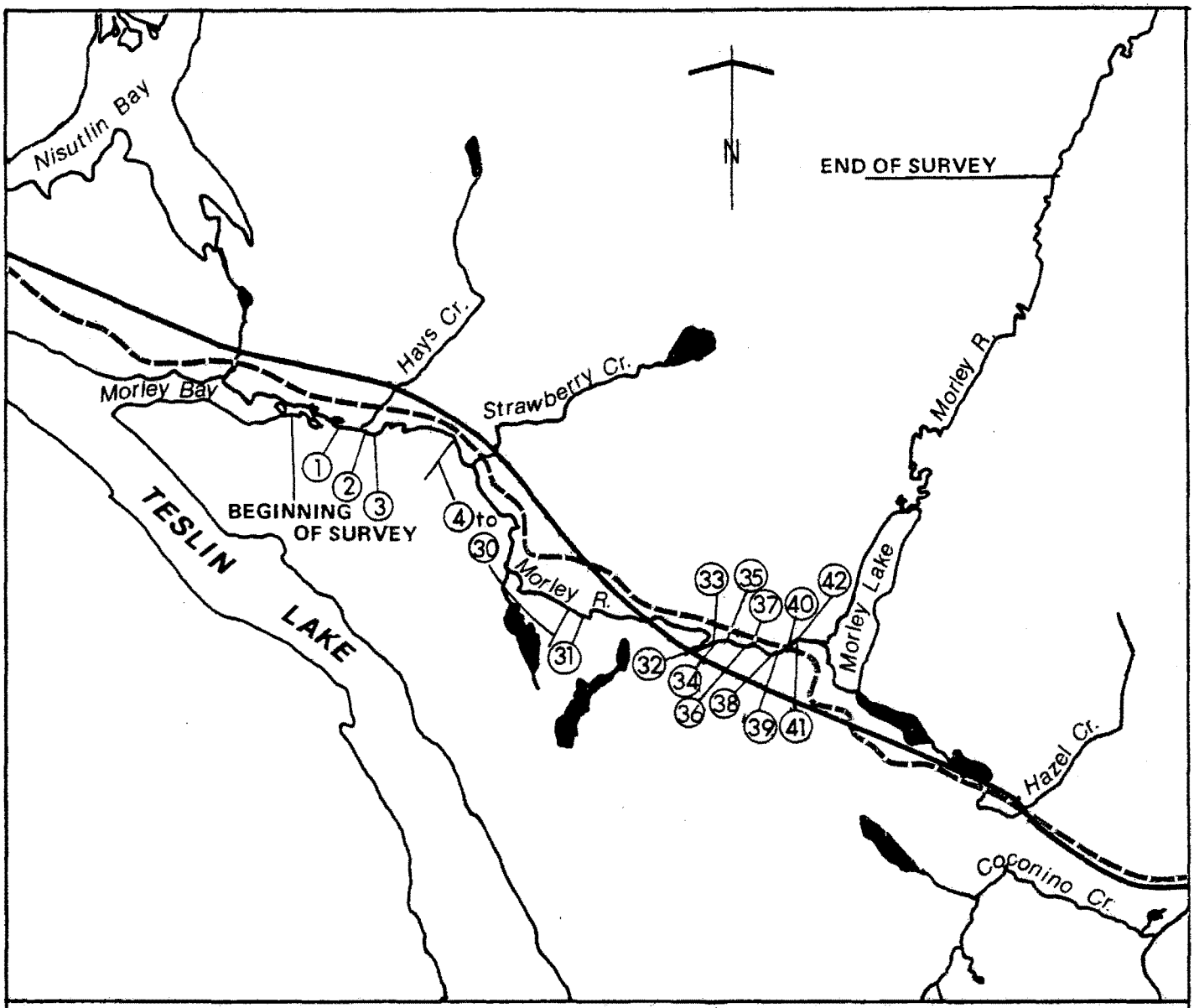
The results of the Morley River survey are presented on Table 5, and the locations of salmon sitings illustrated on Figure 6. Due to an error in recording map locations between sitings number 4 and 30, the results of these observations have been totalled, and the reach of the watercourse where this occurred is indicated on Figure 6. A total of 262 chinook salmon were counted between the outlet of Morley Lake and the river mouth. Of this number, 70 were carcasses and 192 were living fish. Major concentrations of spawning fish were observed near the lake outlet, and at map location 30. No salmon were identified in the immediate vicinity of the proposed crossing of Morley River; however, the spawning concentration near map location 30 is situated approximately 3.3 km downstream of this crossing area.

In addition to the salmon counted downstream of the lake, three fish were observed migrating upstream in the reach of the river surveyed above Morley Lake. The locations at which these three individuals were observed were not recorded.

TABLE 5

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, MORLEY RIVER, AUGUST 21, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1		1	1
2		1	1
3		2	2
4 to 30	104	56	160
31		1	1
32	5		5
33		1	1
34	6		6
35	4		4
36	19	4	23
37	12		12
38	5	2	7
39	1		1
40	5	1	6
41	25	1	26
42	6		6
TOTAL	192	70	262



Locations Of Chinook Salmon Enumerated In Morley River, August 21, 1980

Alaska Highway

Pipeline Route

① Enumeration Site

0 5 10 15 Km

Figure 6

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

4.1.7 Swift River

The Swift River was surveyed completely from the headwater region to the river mouth at Teslin Lake. The section from the origin of the river to the outlet of Swan Lake was flown on August 21, while the remaining part of the river was surveyed on August 22, 1980. On both dates, the sky was virtually cloud-free, and the winds generally calm. Visibility was excellent, as the river waters were clear and colorless. The survey was conducted at altitudes ranging from 15 to 30 m. In areas of habitat suitable for use by spawning chinook salmon, airspeeds from 0 to 60 km/h were maintained. In regions where the river was wide and shallow with a sandy bottom, airspeed and elevation were increased slightly. The efficiency of the reconnaissance was judged to be 100 percent due to the favorable conditions for observation.

The results of the Swift River survey are presented in Table 6 and Figure 7. No fish were observed in the Swift River upstream of Swan Lake. A total of 420 salmon were enumerated, of which 357 were living and 63 were carcasses. Major concentrations of fish were located on spawning areas downstream of Swan Lake outlet near the mouth of Logjam Creek, near the outlet of Swift Lake, and 5 km upstream from the mouth of Swift River. No chinook salmon were recorded in the region of the proposed pipeline crossing of the Swift River.

4.1.8 Smart River

The Smart River was surveyed from Cabin Lake to Dorsey Lake on August 21, and from Cabin Lake downstream to the river mouth at Swift River on August 22, 1980. Both surveys were flown at altitudes of 15 to 25 m, with airspeeds ranging from 30 to 65 km/h. Conditions were excellent for aerial reconnaissance on both days, as the sky was generally cloudless, and there was little or no wind. The waters of the Smart River were clear and colorless; the estimated efficiency of the survey was 100 percent.

TABLE 6

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, SWIFT RIVER, AUGUST 21 AND 22, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	78		78
2	8		8
3	141	1	142
4		2	2
5	62	18	80
6	1	11	12
7		2	2
8		1	1
9		1	1
10		3	3
11	4		4
12		1	1
13		1	1
14	1		1
15		2	2
16	1		1
17	1	2	3
18		1	1
19	8	1	9
20	11	3	14
21	11	4	15
22	1		1
23		1	1
24		1	1
25	10		10
26	14		14
27	5	1	6
28		6	6
TOTAL	357	63	420

Locations Of Chinook Salmon Enumerated In Swift River, August 21 and 22, 1980

Alaska Highway

Pipeline Route

① Enumeration Site

Figure 7

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

The results of the Smart River survey are presented in Table 7 and Figure 8. No fish were observed in the reach of the Smart River between Dorsey and Cabin lakes. Forty-nine chinook salmon were counted in the remainder of the river surveyed, of which 44 were living and 5 were dead. Two spawning areas were identified, one 2.5 km below Cabin Lake, and the second midway between Cabin Lake and Swift River (map locations 5 and 6). No salmon were observed in the region of the proposed pipeline crossing of the Smart River.

4.1.9 McNaughton Creek

McNaughton Creek was not identified in the terms of reference for investigation of salmon spawning areas, as no chinook salmon activity had been documented in this watercourse. However, during investigations of new pipeline crossing locations, chinook salmon fry and juveniles were collected near the proposed crossing locations on Swift River and McNaughton Creek (Environmental Management Associates 1980). This creek was surveyed because no chinook salmon spawning areas were located in this region of Swift River.

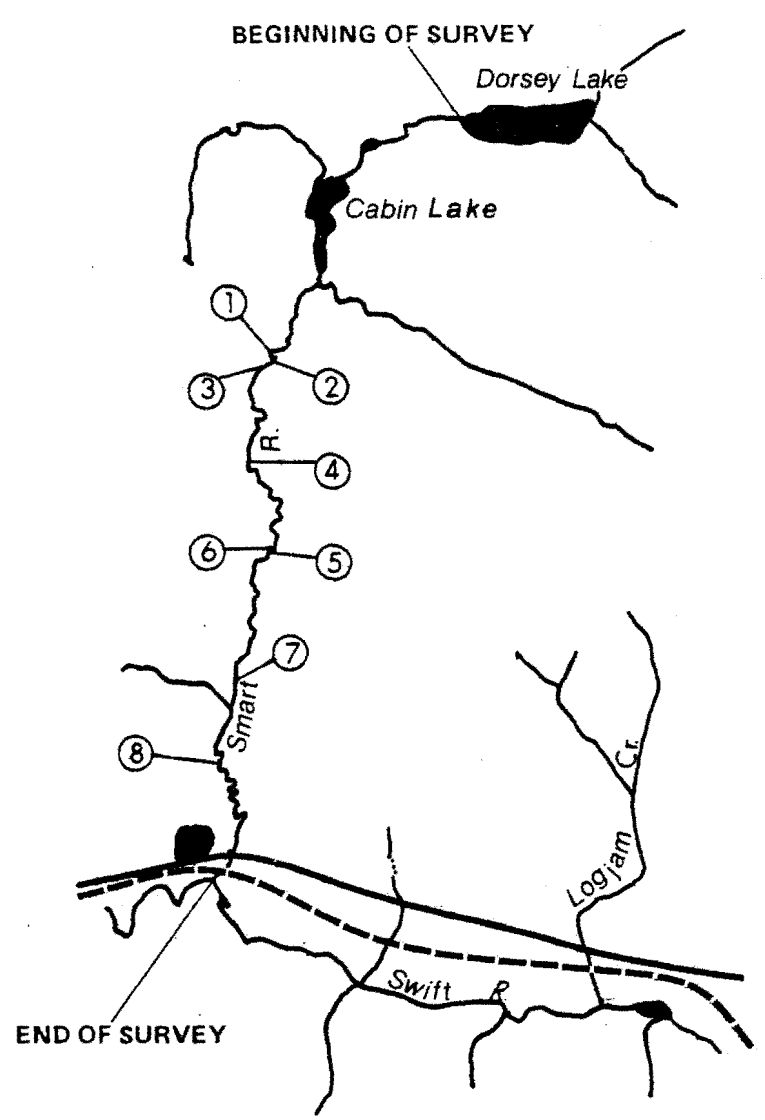
McNaughton Creek was flown on August 21, 1980, from the creek mouth upstream to the outlet of McNaughton Lake. The creek was flown at an altitude of 15 to 25 m, at 30 to 65 km/h. There was no cloud cover when the creek was flown, and the wind was calm. The waters of McNaughton Creek were clear and colorless. The efficiency of the aerial survey was judged to be 100 percent.

The results of the reconnaissance are presented on Table 8 and Figure 9. A total of 28 chinook salmon were counted in the creek, of which 17 were living and 11 were dead. The spawners were noted to be dispersed throughout the middle region of the creek. No spawners were identified in the lower reaches of the creek, near the proposed pipeline crossing.

TABLE 7

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, SMART RIVER, AUGUST 21 AND 22, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	25	1	26
2	2	1	3
3	1		1
4		1	1
5	11	2	13
6	3		3
7	1		1
8	1		1
TOTAL	44	5	49



Locations Of Chinook Salmon Enumerated In Smart River, August 21 and 22, 1980

Alaska Highway

Pipeline Route

① Enumeration Site

0 5 10 15 Km

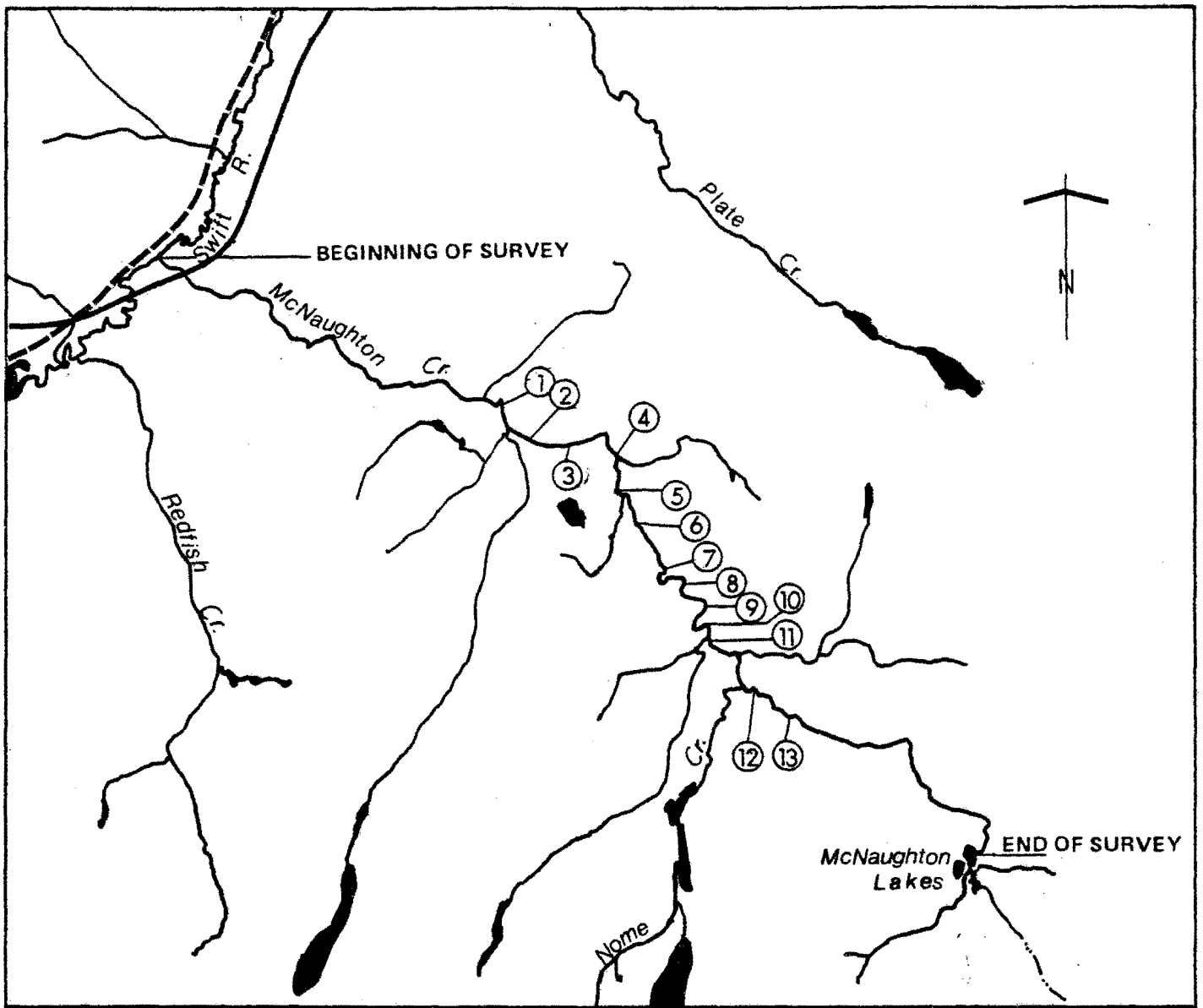
Figure 8

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

TABLE 8

RESULTS OF THE AERIAL RECONNAISSANCE FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, MCNAUGHTON CREEK, AUGUST 21, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	5	4	9
2	2		2
3		1	1
4		2	2
5	1		1
6		1	1
7	2		2
8	1		1
9		1	1
10	2		2
11	1		1
12	1	2	3
13	2		2
TOTAL	17	11	28



Locations Of Chinook Salmon Enumerated In McNaughton Creek, August 21, 1980

——— Alaska Highway

——— Pipeline Route

① ——— Enumeration Site

0 5 10 15 Km

Figure 9

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

4.2 CHUM SALMON SURVEYS

4.2.1 Kluane River

Kluane River was surveyed from the outlet of Kluane Lake to a point 4 km downstream of the mouth of Swede Johnson Creek. The survey was conducted on October 25, 1980. The flight was carried out at altitudes of 15 to 25 m, and airspeeds of 0 to 50 km/h. The sky was overcast on the date of the survey, with the ceiling estimated at 900 m. There was no precipitation during the survey, and light was sufficient for the purpose of the reconnaissance. The winds were calm during this survey. The efficiency of the count was estimated to be 95 percent in the side channels and shallow regions of the river, where visibility was excellent. The estimated efficiency of enumerating chum salmon in the main channel was 50 percent, due to the depth.

The results of the chum salmon count are presented on Table 9. The locations at which the salmon were enumerated are illustrated on Figure 10. A total of 2750 salmon were counted, of which 2327 were living and 423 were carcasses. Virtually all fish were observed spawning in side channels in the region of the river surveyed. The first fish observed were near the mouth of Quill Creek in Kluane River; no chum salmon were observed upstream of this location during 1980. The pipeline route does not cross Kluane River, but traverses several tributaries which enter this river near these spawning areas.

4.2.2 Duke River

The Duke River was flown on October 25, 1980, from the river mouth to the Alaska Highway bridge, under the same conditions described for Kluane River (Section 4.2.1). The river runs in many braided channels, which are generally small and shallow at this time of year. Water clarity was good, and the efficiency of the survey was judged to be 100 percent.

No chum salmon were observed in the Duke River during the reconnaissance.

TABLE 9

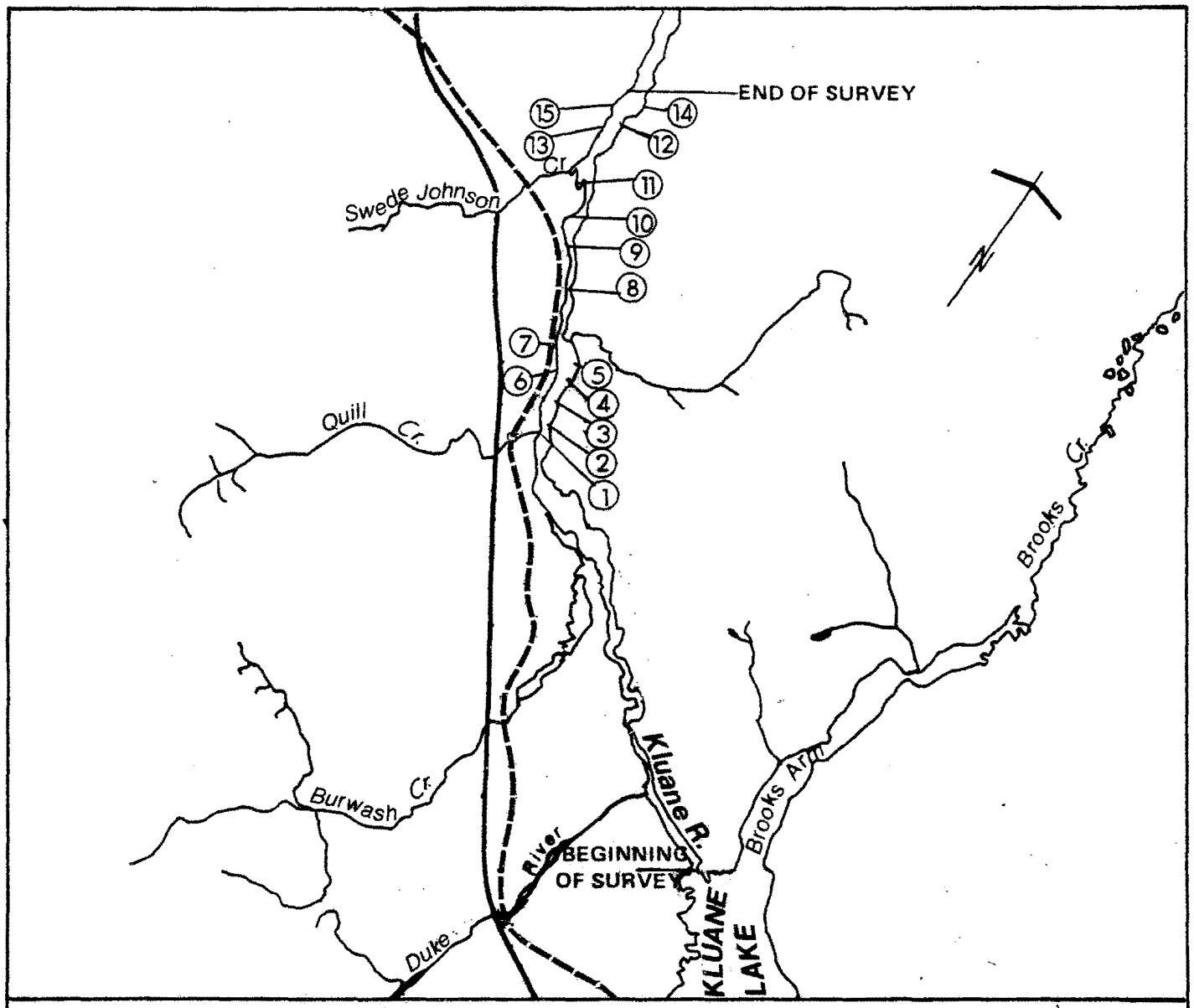
RESULTS OF THE AERIAL RECONNAISSANCE FOR
CHUM SALMON SPAWNERS, KLUANE RIVER, OCTOBER 25, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	31	1	32
2	1		1
3	85	12	97
4	1		1
5	55	1	56
6	19		19
7	64	6	70
8	40	8	48
9	61	3	64
10	18	3	21
11	262	75	337
12	1623	306	1929
13		3	3
14		1	1
15	67	4	71
TOTAL	2327	423	2750

TABLE 10

RESULTS OF THE AERIAL RECONNAISSANCE FOR
CHUM SALMON SPAWNERS, KOIDERN RIVER, OCTOBER 25, 1980

Map Location	Number of Fish Observed		
	Live	Dead	Total
1	8		8
2	2		2
3	14		14
4	2		2
5	1		1
TOTAL	27		27



Locations Of Chum Salmon Enumerated In Kluane River, October 25, 1980

Alaska Highway

Pipeline Route

① Enumeration Site

0 5 10 15 Km

Figure 10

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

4.2.3 Koidern River

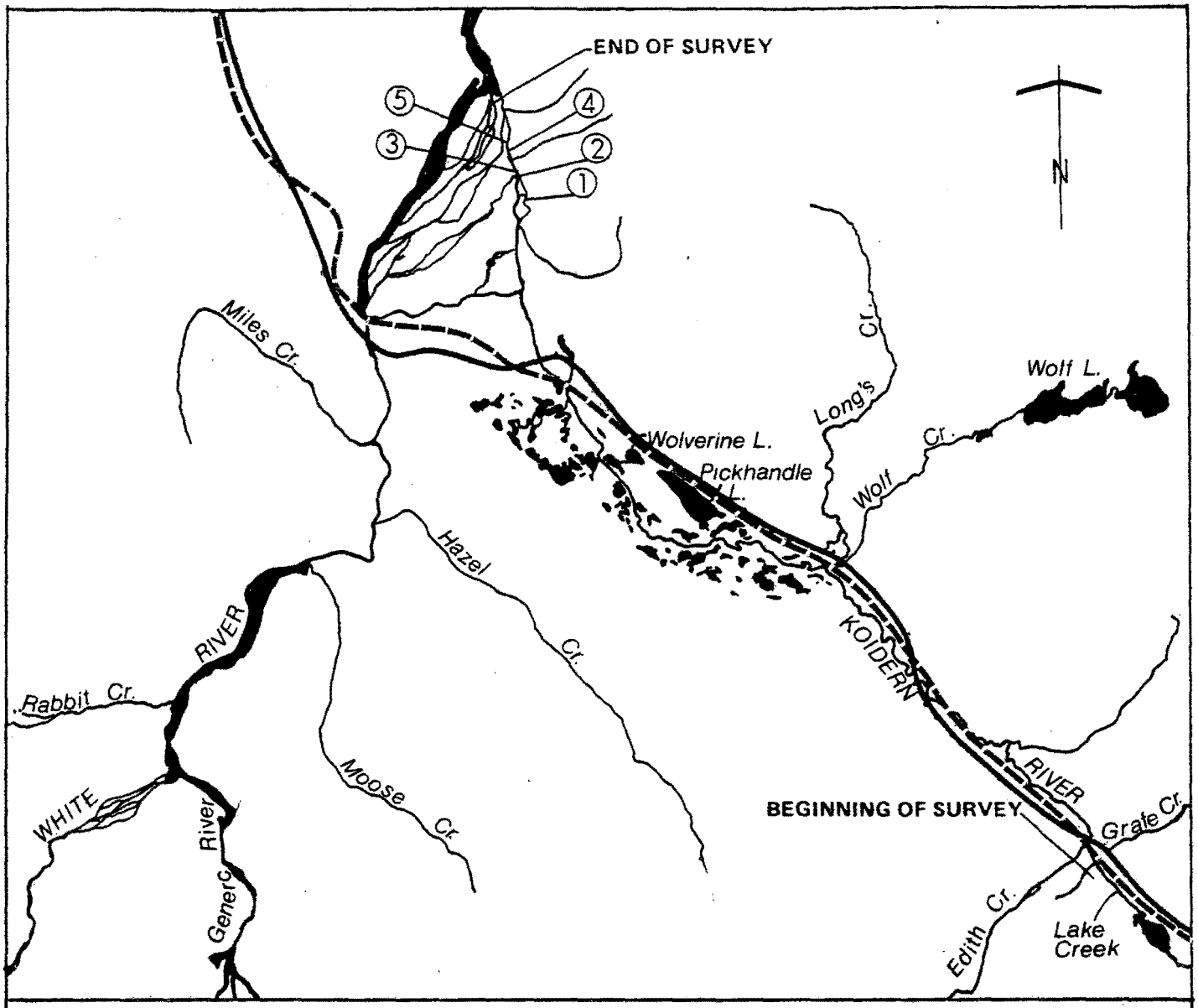
The Koidern River was surveyed from 200 m above the confluence of Edith and Lake creeks, along the entire length of the river, to its mouth at White River. A small tributary of Lake Creek, which was observed to support spawning chum salmon in 1979, was also surveyed from its origin to its confluence with Lake Creek. The survey was conducted on October 25, 1980. Climatic conditions were identical to those described in Section 4.2.1. The river was flown at altitudes of 15 to 25 m, at airspeeds of 0 to 50 km/h. The efficiency of the count was estimated to be 100 percent in open-water regions of the river. The river meanders extensively through the Pickhandle Lake complex, and in two areas runs through small lakes which were ice-covered during the survey.

The results of the Koidern River reconnaissance are presented on Table 10 and Figure 11. The only chum salmon observed were recorded near the river mouth. A total of 27 chum salmon were counted, and all fish were living. Eight fish were spawning in a spring entering the Koidern (map location 1). Sixteen others were noted spawning in the mainstem Koidern at the confluence with the White River floodplain. The remaining three were enumerated on the White River floodplain, at a point below the entry of a small channel of the White. The White River was following the west bank of the floodplain during 1980; very little discharge was present on the east side.

The pipeline route crosses Koidern River in three locations. The lowest pipeline crossing is located approximately 8 km upstream of the spawning area observed in 1980.

4.2.4 White River

A reconnaissance of the confluences of Miles, Hazel and Moose creeks with the White River was conducted on October 25, 1980 (Figure 11).



Locations Of Chum Salmon Enumerated In Koidern River, October 25, 1980

——— Alaska Highway

——— Pipeline Route

① ——— Enumeration Site

Figure 11

ENVIRONMENTAL MANAGEMENT ASSOCIATES 1980

A local resident had reported observing chum salmon at the mouth of Miles Creek several years ago (Tom Bradley, pers. comm.). No chum salmon were observed in these areas during the aerial survey.

Miles Creek was discharging, and exhibited a substrate composed primarily of boulder with some cobble. This habitat did not appear to be suitable for use by spawning chum salmon. Hazel Creek was also discharging, but was largely filled with anchor ice on October 25. The creek mouth at the White River did exhibit areas of fine gravel, but no fish were observed in this locale. Moose Creek was dry, with no ice cover, indicating discharge had ceased prior to the onset of the cold weather.

4.2.5 Christmas Creek

Christmas Creek was also surveyed on October 25, from the creek mouth at Christmas Bay in Kluane Lake to a point 8 km upstream. No chum salmon were observed in this creek during the aerial reconnaissance.

5.0 DISCUSSION

The construction, operation and abandonment of the Alaska Highway gas pipeline have the potential for adversely affecting salmon stocks in Yukon Territory. Potential impacts that may result in mortality of incubating eggs or alevins may be classified as direct, while activities associated with rendering spawning areas unsuitable for use by salmon may be grouped as indirect.

Foothills has incorporated mitigative measures during protection planning for construction of the pipeline, in order to alleviate potential direct and indirect impacts on salmon stocks in southern Yukon Territory. These include the identification of periods for instream construction activity which do not conflict with salmon reproductive cycles, and the relocation of pipeline crossing sites so as to avoid construction in a salmon spawning area. The first mitigative measure applies to all watercourses where salmon spawn downstream of the crossing. An example of the second mitigative measure is the relocation downstream of the previous pipeline crossing on Morley River, as a result of both geotechnical and fisheries concerns.

In order to provide baseline data for the numbers of spawning salmon in areas within the influence of the pipeline, a program was initiated in 1980 to enumerate salmon spawning locations and the number of spawners using these areas in watercourses within the influence of the proposed pipeline. Several years of preconstruction information are desirable for this purpose, as inherent variation in the number of spawners returning each year, and the locations of spawning areas utilized complicates determination of any impact on these stocks. In the following text, each watercourse surveyed during 1980 will be discussed in the context of what was observed and what has previously been described for these spawning locations. Information presented from Department of Fisheries and Oceans, Whitehorse, is largely taken from the Fisheries Service annual report on salmon and spawning grounds (Form 381), and in many cases the salmon counts reported are the results of professional judgement and not those of actual counts. This fact should be kept in mind when interpreting this information.

It should be noted that salmon spawning areas do not exist at every location where salmon were identified; in general, salmon spawning areas were identified only where congregations of fish were observed.

5.1 CHINOOK SALMON

The results of monitoring the numbers of chinook salmon passing through the fishway at Whitehorse Rapids Dam provide an indication of yearly relative abundance of spawners in the upper Yukon River system. These data, as taken from Brown et al. (1976) and from Fisheries and Marine Service files, Whitehorse, indicate that during 1980 the largest number of chinook salmon ascended the fishway since the ladder was constructed in 1959 (Table 11). Hence the results reported here are representative of a very good year for chinook salmon returns. The daily census for the enumeration of fish passing through the fishway during 1980 is presented on Table 12.

5.1.1 Takhini River

During the reconnaissance of the Takhini River, a total of 170 chinook salmon were counted. The Department of Fisheries and Oceans conducted a survey of the river by boat from the confluence of Mendenhall River upstream to the outlet of Kusawa Lake on August 30, ten days later than our aerial survey (Table 13). On that date, 173 spawners were counted. The efficiency of this boat survey was estimated to be 15 to 20 percent. In light of the comparable results obtained between the helicopter and boat survey, the efficiency of the boat survey appears to be underestimated. However, in analyzing the results of the count at the Whitehorse Rapids fishway, 15 percent of the total run ascended the ladder between August 20 and 30. On the basis of these results, a greater number of chinook salmon were likely present in the Takhini River on August 30, 1980, than at the time of the aerial survey. The results of some previous surveys, conducted by Department of Fisheries and Oceans, are presented on Table 14 to provide historical data for chinook salmon spawning in the Takhini River.

TABLE 11

TOTAL COUNT OF CHINOOK SALMON BY YEAR
AT THE WHITEHORSE RAPIDS FISHWAY

Year	Total	
1959	1054	
1960	660	
1961	1068	
1962	1500	(estimated)
1963	483	
1964	587	(estimated)
1965	903	
1966	563	
1967	533	
1968	414	
1969	334	
1970	625	
1971	856	
1972	392	
1973	224	
1974	273	
1975	313	
1976	121	
1977	277	
1978	725	
1979	1184	
1980	1236	

Source: Department of Fisheries
and Oceans, Whitehorse

TABLE 12

RESULTS OF FISH LADDER COUNTS FOR
CHINOOK SALMON, YUKON RIVER, JULY 22 TO SEPTEMBER 5, 1980

Date	Sex		
	Female	Male	Total
July 22		1	1
23			
24			
25	1	1	2
26	2	3	5
27		1	1
28		2	2
29	2	3	5
30		1	1
31	7	4	11
August 1	12	10	22
2	6	7	13
3		7	7
4	40	22	62
5	36	33	69
6	24	30	54
7	17	17	34
8	51	50	101
9	15	13	28
10	18	12	30
11	26	28	54
12	30	30	60
13	38	38	76
14	24	25	49
15	30	48	78
16	18	33	51
17	*	*	94
18	32	37	69
19	*	*	55
20	35	13	48
21	34	12	46
22	19	8	27
23	1	5	6
24	12	7	19
25	4	5	9
26	3	3	6
27	7	4	11
28	2	2	4
29	2	2	4
30	2	2	4
31	2	2	4
September 1	1	3	4
2	1		1
3		1	1
4			
5			
TOTAL	557	530	1236

*Incomplete Data

Source: Department of Fisheries and Oceans, Whitehorse

TABLE 13

RESULTS OF A BOAT SURVEY FOR ENUMERATION OF CHINOOK SALMON SPAWNERS, TAKHINI RIVER, CONDUCTED BY DEPARTMENT OF FISHERIES AND OCEANS, AUGUST 30, 1980

Section	Number of Fish Counted		
	Live	Dead	Total
Mendenhall River to Kusawa Lake	138	35	173

Source: Department of Fisheries and Oceans, Whitehorse

TABLE 14

CHINOOK SALMON COUNTS IN THE TAKHINI RIVER BY YEAR

Year	Chinook Salmon Enumerated
1963	100-200
1966	50
1967	1-50
1968	1-50
1969	1-50
1970	50-100
1972	17
1975	165
1976	6
1977	88

Source: Department of Fisheries and Oceans, Whitehorse

5.1.2 Ibex River

Ten chinook salmon were counted in the lower reaches of Ibex River on August 20, 1980. Records indicate that the only other documentation of this species in the Ibex were two individuals observed in 1977, at the confluence of Arkell Creek and the Ibex (Beak Consultants Limited 1977b). Correspondence in the lake and stream file, Department of Fisheries and Oceans, Whitehorse dated October 17, 1962 states that the Ibex River did support a small run of chinook salmon when the Ibex River drained Fish Lake and Jackson Lakes. The existing drainage pattern has been altered in this region, with these lakes now entering the Yukon River via Jackson Creek.

5.1.3 Yukon River

Only one chinook salmon was observed in the Yukon River during the reconnaissance of August 20, 1980. No chinook salmon spawning areas are anticipated to exist in the reach of the river upstream of the Whitehorse Rapids dam. A spawning area was reported to be 'indicated' below Lewis Dam, but the possibility that reservoir flooding of this region has resulted in the loss of such a spawning area is presented in Brown et al. (1976). There are no reports in the literature or in the Fisheries and Marine Service files documenting spawning in this region of the Yukon River. The chinook salmon observed during the survey presented here appeared to be migrating upstream.

5.1.4 M'Clintock River and Michie Creek

No chinook salmon spawning is anticipated to occur in the region of M'Clintock River, downstream of the Michie Creek confluence. The habitat in this reach of the river is unsuitable for this purpose. The 535 chinook salmon enumerated in Michie Creek, at the estimated efficiency of 50 percent, compares favorably with the 1041 salmon which had passed through the fish ladder at Whitehorse by August 19, 1980. An aerial survey conducted by

Department of Fisheries and Oceans on August 18, 1980 resulted in the observation of 321 salmon in this region of the creek (Table 15). Michie Creek is thought to be the major spawning area utilized by chinook salmon passing through the Whitehorse Rapids Dam fishway (Department of Fisheries and Oceans information pamphlet, Appendix I).

5.1.5 Teslin River

The results of the aerial reconnaissance of the Teslin River do not provide sound information on the numbers of chinook salmon in this river, due to the depth of the watercourse. The survey did furnish information on the location of major spawning areas, although the data are not suitable for identifying potential mainstem spawners. A survey conducted by Foothills Pipe Lines (South Yukon) Ltd. under the direction of E. Baddaloo, involved the use of divers and SCUBA gear in August, 1980. This investigation documented the location of spawning areas and number of spawners using these areas downstream of the pipeline crossing on the Teslin River. The report on this investigation is presented in Appendix II. Aerial surveys have been conducted sporadically on the Teslin River in the past. The results of these surveys are presented in Table 16. The range in enumeration of spawners is no doubt due to the difficulties of enumeration in this large, deep river. In addition to providing spawning habitat for chinook salmon, this river is also used as a migration route by this species to attain spawning areas in tributaries of Teslin Lake.

5.1.6 Morley River

Chinook salmon were observed spawning both upstream and downstream of the proposed pipeline crossing on Morley River. The total number of chinook salmon enumerated downstream of Morley Lake, 262, indicates this was a relatively good run in relation to counts conducted in previous years (Table 17).

TABLE 15

RESULTS OF DEPARTMENT OF FISHERIES AND OCEANS/
ALASKA FISH AND GAME DEPARTMENT
AERIAL RECONNAISSANCE FOR CHINOOK SALMON
SPAWNERS, YUKON TERRITORY, AUGUST 18, 1980

River	Section	Chinook Salmon Enumerated		
		Live	Dead	Total
Michie Creek		321		321
Smart River				
Swift River	From Swan Lake to Smart River Mouth	165	1	166
TOTAL		486	1	487

Source: Department of Fisheries and Oceans, Whitehorse

TABLE 16

CHINOOK SALMON COUNTS IN
THE TESLIN RIVER BY YEAR

Year	Source	Enumeration	Part of System Counted
1958	1	302	Lower 50 km of River
1959	1	26	Roaring Bull Rapids to 23 km Downstream
1963	2	26	Entire River
1966	2	2000-3000	Entire River
1967	2	2000-5000	Entire River
1968	2	5000-10000	Entire River
1969	2	5000-10000	Entire River
1970	2	5000-10000	Entire River
1972	1	208	Teslin Lake Outlet to 150 km Downstream
1972	2	1000-2000	Entire River

Sources: 1 Northern British Columbia and Yukon Division, 1973
2 Department of Fisheries and Oceans, Whitehorse

TABLE 17

CHINOOK SALMON COUNTS IN
THE MORLEY RIVER BY YEAR

Year	Source	Enumeration	Part of System Counted
1966	1	400	Entire River
1967	1	300-500	Entire River
1968	1	100-300	Entire River
1970	1	100-300	Entire River
1970	2	51	Below Canyon
1971	1	1-50	Entire River
1971	2	50	Entire River
1972	1	30	Entire River
1972	2	29	Entire River
1972	3	72	Morley Lake to Teslin Lake

Sources: 1 Department of Fisheries and Oceans, Whitehorse
2 Northern British Columbia and Yukon Division, 1973
3 Beak Consultants Limited, 1977b

TABLE 18

CHINOOK SALMON COUNTS IN
THE SWIFT RIVER BY YEAR

Year	Source	Enumeration	Part of System Counted
1966	1	200	Entire River
1967	1	100-300	Entire River
1968	1	50-100	Entire River
1969	1	0	Entire River
1971	1	100-300	Entire River
1971	2	250	Outlet of Swan Lake
1972	1	15	Entire River
1972	2	15	Entire River
1977	3	3	Swan Lake to River Mouth

Sources: 1 Department of Fisheries and Oceans, Whitehorse
2 Northern British Columbia and Yukon Division, 1973
3 Beak Consultants Limited, 1977b

It should be kept in mind while analyzing Table 17 that the 262 fish counted in 1980 include only that region of the river from Morley Lake to Teslin Lake.

5.1.7 Swift River

Major chinook salmon spawning areas in Swift River during 1980 were identified at the outlets of Swan and Swift lakes, and approximately 5 km upstream of the mouth of the river. The latter spawning area has not been described in the literature. A total of 420 chinook salmon were enumerated during the survey, which is likely the most salmon ever counted in this river. Other information on salmon counts in Swift River are presented in Table 18. Personnel of the Alaska Fish and Game Department and Department of Fisheries and Oceans observed 165 salmon at the outlet of Swan Lake in 1980 (Table 15).

5.1.8 Smart River

Chinook salmon were not documented in Smart River until very recently, as the first sighting of this species was at the outlet of Cabin Lake in 1977 (Department of Fisheries and Oceans, Whitehorse, lake and stream file). This prevents presentation of comparative data for previous surveys. The river was flown on August 18, 1980 by personnel of the Alaska Fish and Game Department and Department of Fisheries and Oceans, but no fish were recorded during that survey (Table 15).

5.1.9 McNaughton Creek

The results of the investigation reported here are the first documentation of chinook salmon spawning activity in McNaughton Creek. Walker (1976) identifies McNaughton Creek as a stream with a spawning

population of salmon on a range map, but no further published or unpublished information could be found which documents this activity. The migration that chinook salmon undergo to reach this area may well be the longest recorded distance travelled by this species during a spawning migration.

5.2 CHUM SALMON

The collection of life history information on chum salmon in Yukon Territory has not received as much attention as chinook salmon, as this species is not as important to commercial, domestic or sport fisheries. Chum salmon do not ascend the fish ladder at Whitehorse Rapids Dam, thus information which may be used in comparisons of annual relative abundance are not available. Chum salmon appear to follow a four-year cycle in the upper Yukon River drainage, with 1971, 1975 and 1979 being years of high returns.

5.2.1 Kluane River

The results of the chum salmon survey conducted on October 25 were the enumeration of 2750 salmon. The results of other salmon counts are presented on Tables 19 and 20, to assist in providing some comparative information. The area surveyed (index area) for the 1977 survey in Table 19, and for the 1980 surveys presented in Table 20 are identical to the index area examined in the Kluane River during this study.

5.2.2 Duke River

The only report of chum salmon in the Duke River was that of a single carcass noted on the river bank downstream of the Alaska Highway bridge in 1976 (Beak Consultants Limited 1977a). Investigations during 1977, 1978, 1979 and 1980 have failed to identify spawners in this river. It is anticipated that chum salmon do not use this watercourse for spawning. However,

TABLE 19

CHUM SALMON COUNTS IN
THE KLUANE RIVER BY YEAR

Year	Source	Chum Salmon Enumeration
1966	1	2000
1967	1	2000-5000
1968	1	2000-5000
1969	1	2000-5000
1970	1	1000-2000
1971	1	2000-5000
1972	1	100-300
1973	1	2000-3000
1974	1	200-300
1975	1	200
1976	1	20
1977	2	3555

Sources: 1 Department of Fisheries and Oceans, Whitehorse
2 Beak Consultants Limited, 1977b

TABLE 20

CHUM SALMON ENUMERATED BY
DEPARTMENT OF FISHERIES AND OCEANS,
KLUANE RIVER, 1980

Date	Method of Enumeration	Count (c) or Estimate (e)
September 22	On Foot	5000 (e)
October 17	Aerial	3000 (c)
November 10	Aerial	960 (c)

Source: B. Ionson, Fishery Officer, Pers. Comm.

this species does occasionally spawn in Kluane River at the mouth of Duke River, approximately 7 km downstream of the proposed pipeline crossing on the Duke (Beak Consultants Limited 1977b).

5.2.3 Koidern River

The results of the 1980 chum salmon reconnaissance are interesting in that no spawners were located in previously documented spawning areas; however, new spawning areas were identified near the mouth of the Koidern River, and on the White River floodplain. The spawners utilizing the White River floodplain should be considered Koidern River stock, as the majority of the discharge in the spawning channels was from the Koidern.

5.2.4 White River

No chum salmon spawners have been identified in the upper White River since the initiation of fisheries research in 1976 for the Alaska Highway gas pipeline project. No other documented reports of chum salmon exist for this region. The use of the upper part of the river by chum salmon, if any at all, must be very sporadic.

5.2.5 Christmas Creek

The aerial reconnaissance of Christmas Creek did not result in the enumeration of chum salmon in this watercourse. One dead ripe male, which had not spawned, was noted on a gravel bar at the mouth of the creek on October 5, 1980. This survey of the creek was conducted on foot. Other surveys of Christmas Creek which were carried out on foot on October 8, 24 and 27 did not result in the enumeration of any other chum salmon in this watercourse. Actual utilization of Christmas Creek by spawning chum salmon has not been documented to date.

6.0 CONCLUSIONS

Chinook salmon were enumerated in the Takhini, Ibex, Yukon, Teslin, Morley, Swift and Smart rivers, and Michie and McNaughton creeks during 1980. No chinook salmon were observed in M'Clintock River between Marsh Lake and the confluence of Michie Creek. Only one chinook was observed in the Yukon River, in the region between the Lewis Dam and the confluence with Takhini River.

No chinook salmon spawning activity was observed in the regions immediately downstream of the proposed pipeline crossings on the Yukon, M'Clintock, Smart or Swift rivers, or McNaughton Creek. Spawning areas do exist in downstream regions of crossings on the Ibex, Teslin and Morley rivers. Spawning does occur in the mouth regions of tributaries to the Swift River which are crossed by the pipeline route. A group of four chinook salmon were observed 2.8 km downstream of the proposed pipeline crossing on the Takhini River; however, these fish appeared to be migrating upstream rather than spawning in this locale.

Previously undocumented chinook salmon spawning areas in the Smart and Swift rivers, and McNaughton Creek were observed during the program reported here.

Chum salmon spawning was documented in Kluane and Koidern rivers during 1980. No chum salmon were observed in the White River upstream of the proposed pipeline crossing on that watercourse, or in Christmas Creek during the aerial survey reported here. No chum salmon were observed upstream of the mouth of Burwash Creek in Kluane River during 1980, nor were any observed in the upper reaches of the Koidern River. New chum salmon spawning areas were documented at the mouth of Koidern River during this investigation.

7.0 ACKNOWLEDGEMENTS

The assistance of Mr. Earle Baddaloo of Foothills Pipe Lines (Yukon) Ltd. during the aerial surveys is greatly appreciated. The staff of Department of Fisheries and Oceans in the Yukon Territory, in particular Messrs. G. Zealand, S. Johnson and B. Ionson were very helpful in providing results of past and present surveys of salmon in the study areas. Mr. K. Powley and Mr. M. Weber of Environmental Management Associates staff assisted in the collection of data in the field, and Mrs. K. Thornber did an excellent job of typing the manuscript.

8.0 LITERATURE CITED

Beak Consultants Limited. 1977a. A preliminary inventory of fish resources in southern Yukon Territory, 1976. Report prepared for Foothills Pipe Lines (Yukon) Ltd., Calgary, Alberta. 13+ pp.

Beak Consultants Limited. 1977b. A survey of fall spawning fish species in waterbodies within the influence of the proposed Alaska Highway Pipeline in Yukon Territory, 1977. Report prepared for Foothills Pipe Lines (Yukon) Ltd., Calgary, Alberta. 40+ pp.

Boland, J. 1973. The Yukon fishery resource: Its existing role and its future potential. Department of the Environment, Fisheries and Marine Service, Report NOB/ECON 1. 73 pp.

Brown, R.F., M.S. Elson and L.W. Steigenberger. 1976. Catalogue of aquatic resources of the upper Yukon River drainage (Whitehorse area). Environment Canada, Fisheries and Marine Service, Report PAC/T-76-4. 148 pp.

Environmental Management Associates. 1980. Fishery resource investigations along the Alaska Highway gas pipeline in southern Yukon Territory, 1980. Report prepared for Foothills Pipe Lines (South Yukon) Ltd., Calgary, Alberta. In Prep.

Northern British Columbia and Yukon Division. 1973. Catalogue of fish and stream resources of the Teslin watershed. Tech. Rept., Fish. Mar. Serv., Dept. of Environ., Pacific Region. PAC/T-73-13. 47 pp.

Sinclair, W.F. and O. Sweitzer. 1973. The economic value of the Yukon sport fishery. Department of the Environment, Fisheries and Marine Service, Report NOB/ECON 2-73. 91 pp.

Walker, C.E. 1976. Studies on the freshwater and anadromous fishes of the Yukon River within Canada. Department of the Environment, Fisheries and Marine Service, Report PAC/T-76-7. 99 pp.

APPENDIX I

YUKON RIVER AND MAJOR TRIBUTARIES

Information Pamphlet

Prepared by:

DEPARTMENT OF FISHERIES AND OCEANS

Yukon River and Major Tributaries
Chinook Salmon

In their ocean environment, chinook salmon are silvery in color. As the fish approach sexual maturity and enter the fresh water of the Yukon River, their bodies progressively darken to a deep red color. The males develop a pronounced hook to the upper jaw, and females tend to be slightly deeper through the body.

Chinook salmon of the Yukon River average 20 pounds in weight, although larger fish of 60-70 pounds have been taken in the commercial and Indian food fisheries. Very few fish over 40 pounds pass through the fishway.

Upon entering fresh water, adult salmon cease feeding. On their upstream migration, these fish use stored energy reserves. By the completion of spawning all energy reserves have been depleted; fins and tail have been worn down; scale have been gradually reabsorbed; fungus patches are noticeable on the bodies and death occurs.

Spawning occurs in August at Michie Creek with the female selecting the spawning site, usually in a riffle area of suitable-mixed gravel. A depression is dug by the female turning on her side and beating against the stream bottom. Usually more than one male fish will accompany the female during construction of the redd. When the redd is complete, the female lowers her anal fin into it. The dominant male fish, after continually chasing away lesser males, comes alongside the female and quivers. Both eggs and sperm are shed simultaneously. The fertilized eggs lodge between and beneath the gravel and rock of the redd. After spawning the female digs upstream of the redd, helping to cover the eggs. Each female may dig several redds, laying up to 8000 eggs, and spawn with several males. The female remains in the vicinity of the redd for about a week until she becomes too weak to hold her position in the stream and is carried downstream by the current.

Although chinook salmon can be readily observed in the acts of digging redds and guarding them after the eggs are laid, the actual spawning act is seldom witnessed. Inside the large red-orange eggs a new generation of salmon begin to develop. By January, the half inch long alevins with large attached yolk sacs have emerged from the eggs. Several months later when the nourishment of the yolk sac has been used up, the young fry work their way upward through the streambed gravel and begin to feed on plankton and other drifting food.

In the Yukon, the fry will remain for two years in fresh water. They have large vertical bars, called "parr marks" along their body sides. These two year old salmon, now called smolts, will begin their downstream migration through Whitehorse to the Bering Sea.

Female chinook from this system usually spend4-5 years at sea and return to the Yukon River in their 6th or 7th year. Males mature earlier and usually spend 2-3 years at sea.

Chinook salmon in the Yukon River are currently being harvested in a commercial and domestic fishery in the Dawson area. Gillnets and fishwheels are used to capture the salmon. Indian people use traditional netting areas along the river to net salmon and smoke-dry them at their fishcamps.

Whitehorse Rapids Dam Fishway

When the Whitehorse Rapids dam was built in 1958, the fish facility was designed to permit upstream-moving fish to pass the dam. Since June, 1959, six species of fish have been observed in the viewing chamber - chinook salmon, Arctic grayling, lake trout, longnose sucker, round whitefish and rainbow trout. At least six other species are found in Schwatka Lake, above the dam, but have not been seen using the fishway. These include humpback whitefish, broad whitefish, least cisco, northern pike, burbot and slimy sculpin.

Ladder Description

A concrete barrier angled upstream leads the fish to the fishway entrance pool, a 10x13 foot recess in the downstream end. The fishway is 6 feet wide, 6 feet deep, approximately 1200 feet long and has a vertical rise of 55 feet. The centre section of 700 feet is level while the two end sections are on a 1:10 floor slope. These sloping sections have four-foot high timber partitions spaced ten feet apart. Each timber baffle has a 1 x 1½ foot opening along opposite bottom corners, allowing fish to move upstream into each succeedingly high pool. The holding chamber in the level centre section has two large viewing windows to allow the public to view the fish, especially the large salmon.

Biological Sampling

Chinook salmon are counted and the sex of each fish determined. Some biological sampling is usually done on 10-30% of the run. This includes measuring lengths and taking scales for age determination. Fish are then released unharmed to continue their upstream spawning migration.

Daily counts of adult chinook salmon have been made annually since the fishway installation, with two exceptions (1962, 1964). In the first four years the run varied from 660 to 1500 with an average of 1070 fish. From that time to the present the abundance of chinooks at Whitehorse has decreased and now is in the range of 200-400 fish. The 1976 count of 121 was the lowest ever recorded.

Life Cycle of Chinook Salmon

Although there are five species of Pacific salmon, only two (chinook and chum) are known to migrate past Dawson City and only chinooks pass through Whitehorse. By late May, adult chinook salmon have left their salt-water environment in the North Pacific and Bering Sea and entered the muddy waters of the mighty Yukon River. The first fish reach Dawson City around July 1st and arrive at the Whitehorse Rapids fishway about August 1st, after travelling nearly 2000 miles. After passing through the fishway, the salmon must continue an additional 100 miles to Michie Creek, where they spawn.

APPENDIX II

HABITAT EVALUATION, SPAWNING LOCATION AND SPAWNER ENUMERATION OF CHINOOK SALMON WITHIN A 12 KM SECTION OF TESLIN RIVER

Prepared by:

FOOTHILLS PIPE LINES (SOUTH YUKON) LTD.

OCTOBER 1980

LIST OF FIGURES

LIST OF TABLES

HABITAT EVALUATION, SPAWNING LOCATION AND SPAWNER ENUMERATION OF CHINOOK SALMON WITHIN A 12 KM SECTION OF TESLIN RIVER

INTRODUCTION

The section of the Alaska Highway Gas pipeline through southern Yukon traverses six drainage systems. Four of these basins, containing the White, Takhini, Upper Yukon and Teslin Rivers are components of the larger Yukon River system which drains into the Bering Sea. The remaining two watersheds include the Liard, a part of the MacKenzie River system which flows into the Beaufort Sea and the Alsek basin which empties into the Gulf of Alaska.

Chinook salmon (Oncorhynchus tshawytscha) occur in both the Yukon and Alsek River drainages (McPhail and Lindsey, 1970). The journey to their spawning grounds impels this species to travel thousands of miles into the interior of the Yukon Territory making some of these migration routes the longest in the world to be travelled by Salmonidae. One such run of importance is the movement of salmon up the Yukon River through the Teslin River south into Teslin Lake then to various other watercourses and finally into the areas of their birthplace.

Chinook salmon are the most important commercially fished species in Yukon Territory. Since they are taken only during spawning migrations, subsistence fishermen are not totally dependent upon this salmon; however, at specific locations substantial quantities of salmon are netted and dried by native people, and comprise a significant portion of their subsistence fishing catch during late summer and/or fall.

The Alaska Highway gas pipeline crosses the Teslin River approximately three kilometres upstream from Johnsons Crossing (Figure 1). It is possible that pipeline construction activities scheduled for summer of 1983 may affect chinook salmon habitats, spawning activities and migration. Although the Teslin River has always been known to harbour salmon, neither an analysis of the habitat downstream from Teslin Lake, nor spawner enumeration had ever been done previous to this study. The exact location of spawning areas in the section of the river specified on Figure 1 had also not been identified. A thorough investigation of the area was required to provide the Environmental Services Department of Foothills Pipe Lines (Yukon) Ltd. with first-hand information of chinook salmon activities in order to determine if impacts might in fact occur and to allow proper planning of pipeline activities through the Teslin River in order that impacts may be minimized.

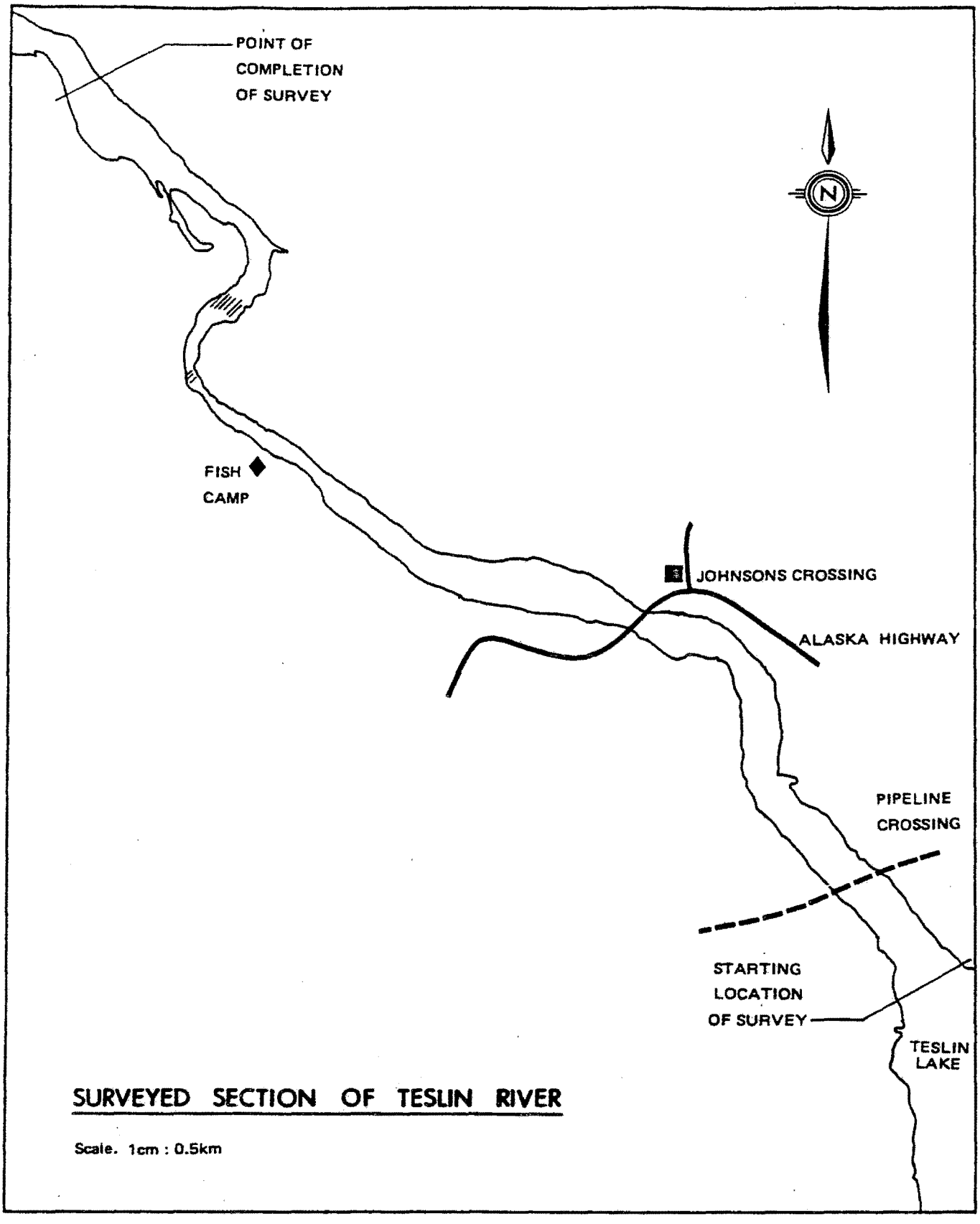


FIGURE 1. The section of the Teslin River surveyed for the purpose of obtaining information on stream substrate, numbers of spawning salmon and areas used for spawning by salmon.

SCOPE

Figure 1 shows the area of the Teslin River that was investigated on August 28, 1980. The section of the river covered extended from the outlet of the Teslin Lake to a point approximately 12 kilometres downstream. It took 12 hours to complete the survey. The following information was obtained.

1. A complete description of substrates and overall depth profile;

2. An enumeration of salmon observed; and

3. The location and numbers of congregation of salmon.

METHODS

A Mark I Zodiac was used to conduct the investigation and to transport equipment and personnel to various locations on the river. Records of findings were also made from within this craft.

The river bottom consisted of two sides, each sloping gradually towards a deeper trench which was located approximatley along the centre of the watercourse. Two divers were carried to the outlet of Teslin Lake and deposited on either side of the river. Each side of the watercourse was examined from shore to the trench of the river in a zig-zag fashion. The trench area was also surveyed periodically. The divers collected information on habitat types, substrates, overall depth profile, and salmon location. When any congregation of chinook salmon was observed, the area was again surveyed by allowing the divers to drift with the current along parallel lines over the section of the riverbed being utilized. This was repeated until the entire area was covered. All information was recorded by the diving tender from the Zodiac.

Stations were chosen at the convenience of the individual who was recording the data. On certain occasions it was also dependent upon actual changes in substrate.

RESULTS

Habitat Description

The river bottom was comprised mainly of silt, sand, and gravel mixtures on either side of a deep main channel which appeared rocky at various locations. The substrate composition on either side of the

trench did not change substantially between Stations 1 and 15 (Table 1); the trench increased in width at certain locations but maintained its rocky appearance. Weed beds occupied most of the shore line and back-waters within this area (Table 1). Figure 2 shows the location of stations described in Table 1 along the investigated section of the Teslin River.

At Station 15, an alteration in the substrate material was recorded. Fewer weed beds were observed and more granular substrate was recorded. The gravel beds appeared to be silty and in some areas sparse aquatic vegetation was observed in the gravel.

The substrate material downstream from Station 16 consisted entirely of gravel. Numerous salmon were also recorded in the area. Similar habitats were observed at Stations 17 and 18; spawning fish were also plentiful in these areas. The entire area was noted as Spawning Area 1 (Figure 3).

At Station 19 a change in the substrate material was again observed. The area consisted of a rocky bottom covered intermittently with very large boulders. This area was referred to as rapids (Figure 1 and 3). No salmon was observed.

Substrate material with no silt, similar to that downstream from Station 16, started at the bottom of the rapids; this was labelled as the beginning of Station 20.

TABLE 1 DESCRIPTION OF EACH STATION AS IDENTIFIED ON FIGURE 2 ALONG THE SURVEYED SECTION OF THE TESLIN RIVER.

Stations	West Side of Trench	Trench	East Side of Trench
1	Sand, gravel and silt mixture; small gravel bar in area; weed bed starts from shore and continues towards centre.	About 9 m deep; possibly rocky sides.	Sand, gravel and silt mixture forming substrate material; extremely weedy from shore toward centre of river.
2	Sand, gravel and silt mixture forming substrate; weed bed extending towards channel area.	About 9 m deep; possibly rocky sides; one face very steep, other falls off quickly.	Weeds from eastern shore towards centre. Silty bottom mixed with sand and gravel.
3	Weed bed close to shore; substrate composed of sand, gravel and silt mixture.	Shale wall on one side - other side gradual and rocky; about 9 m deep; rugged rocky bottom.	Weed bed extending from shore towards the centre channel; substrate - silt, sand and gravel mixture.
4	Substrate composed of silt sand and gravel mixture intermingled by weed beds.	Channel shows possibly volcanic rock - possibly erosion due to currents about 8 m deep.	Weed beds from shore inwards; poor habitat, very silty bottom.
5	Start of a small gravel bar - not very clean; weed beds intermittently.	Channel closer to eastern shore.	Weeds on eastern side of channel throughout whole of area. Poor substrate material - silt; eastern side drops off quickly.
6	Continuation of gravel bar - not very clean; weed beds intermittently; poor habitat.	Channel closer to east shore; 9 m deep.	Thick weed beds from shore towards centre; poor substrate material.
7	Gravel bar from shore - not very clean; weed beds intermittently; poor habitat.	Channel closer to east shore and about 9 m deep; rocky.	Thick weed beds from shore towards centre; poor substrate material.

TABLE 1. (page 2)

Stations	West Side of Trench	Trench	East Side of Trench
8	Gravel bar still on western shore - very silty; weed beds in various locations.	Channel closer to east shore and about 9 m deep; rocky.	Weeds from western shore to edge of trench - poor substrate habitat.
9	Thick weed beds covering whole area; silt, sand and gravel combination forming substrate.	Channel closer to east shore and about 9 m deep.	Thick weeds; silt, sand and gravel combination forming bottom.
10	Thick weed beds covering whole area; silt, sand and gravel combination forming substrate.	Channel closer to east shore and about 9 m deep.	Thick weeds; silt, sand and gravel combination forming bottom.
11	Thick weed beds covering whole area; silt, sand and gravel combination forming substrate.	Channel becoming more central and about 9 m deep.	Thick weeds; silt, sand and gravel forming bottom substrate.
12	Whole channel of river narrowed slightly. Weed beds on western side of channel but deeper.	Trench in central area of river about 8 m deep.	Thick weed beds in silt, gravel and sand substrate.
13	River maintaining a narrower channel. Weed beds extending throughout the western side.	Trench maintaining central location; about 8 m deep.	Thick weed beds growing in silt, gravel and sandy substrate.
14	Channel again narrows slightly; thick weed beds on western side of river.	Trench in centre of river; rocky sides and trench slightly wider approximately 9 m deep.	Weed beds located in silt, gravel and sand substrate.
15	Indian fishing camp on west bank; gravel substrate; better habitat than that observed at previous location - composed of gravel covered with a bit of silt.	Trench widens and looses its definite boundaries as previously described.	Weed beds located in silt, gravel and sand substrate; More gravel and less sand observed.

TABLE 1. (page 3)

Stations	West Side of Trench	Trench	East Side of Trench
16	Remarkable change noted in habitat. Clean gravel, numerous salmon spawning at all depths.	No deep trench area - clean granular material to a depth of about 6 m - numerous salmon spawning at all depths.	Habitat change noted. Start of clean gravel beds - no weeds observed along side of channels. - crystal clear water. - numerous salmon spawning at all depths.
17	Numerous salmon spawning. Substrate comprised of clean gravel - vary in depth from 1.2 - 6 m.	No central channel. Deeper in central area. Salmon observed at 6 m deep.	Numerous salmon spawning. Substrate comprised of clean gravel - vary in depth from 1.2 - 6 m.
18	Salmon spawning, excellent habitat; clean gravel.	Spawning salmon observed; good habitat. Grandular material.	Numerous salmon spawning. Excellent substrate material.
19	Habitat change noted. Rocky bottom and large cobble stone - no salmon noted - rapids observed through this area.	Centre channel slightly deeper. No salmon.	Habitat change noted. Rocky bottom and large cobble stones - no salmon activity - rapids observed through this area.
20	Habitat change recorded. Clean granular habitat; numerous spawning salmon variable depth 1.2 - 6 m.	No defined channel. Salmon spawning throughout area. Clean granular material.	Habitat change noted. Clean granular material habitat; numerous salmon spawning variable depth 1.2 - 6 m.
21	Granular substrate mixed with fine material; less salmon spawning	Channel back to centre of river. Not very defined, but deeper.	Less salmon spawning; finer material observed mixed with granular substrate.

TABLE 1. (page 4)

Stations	West Side of Trench	Trench	East Side of Trench
22	Substantial amounts of fine material noted in gravel beds only few salmon noted (4).	Channel in central area.	Substantial amounts of fine material noted in gravel beds only few salmon noted (2).
23	Granular substrate containing large quantities of fine material; no salmon recorded.	Channel in central area - no rock noted.	Granular substrate containing large amounts of fine material; no salmon recorded.
24	Granular substrate containing large quantities of fine material; no salmon noted.	Channel in central area - no rock noted.	Granular substrate containing large quantities of fine material; - no salmon noted.
25	Silt and large quantities of fine sand mixed with gravel; a bit of weed recorded.	Channel in central area - no rock noted.	Silt and large quantities of fine sand mixed with gravel; a bit of weed noted.

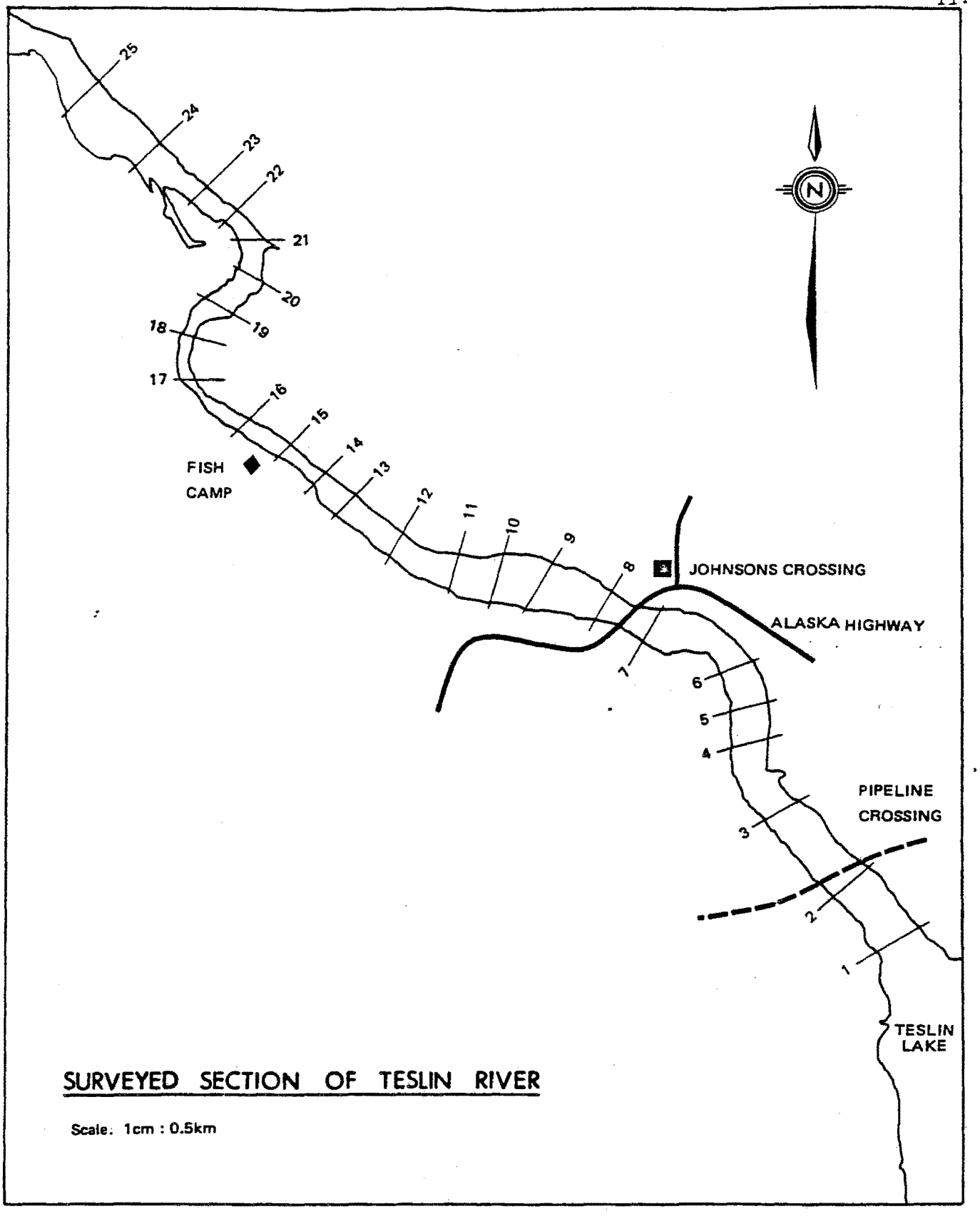


FIGURE 2. The location of the stations described in the table 1 along the surveyed section of the Teslin River north of Teslin Lake.

Numerous chinook salmon were recorded spawning in this location. This area was labelled Spawning Area 2 (Figure 3). Although substrate of a granular nature was noted at Station 21, the number of spawning salmon decreased. An analysis of the bottom material revealed sand intermingled with gravel.

From Station 22 onwards the quantity of fine material increased to the amount of larger granular substrate. Few salmon (a total of six) were recorded at Station 22.

No salmon were seen at Stations 23 and 24.

Station 25 revealed large quantities of fine material mixed with silt and gravel. Small weed beds were also observed on either side of the channel. No rock was found in the main channel. No salmon were recorded.

Salmon Enumeration

The location of both live and dead salmon recorded along the surveyed section of the Teslin River has been shown on Figure 3. Table 2 exhibits the number of salmon relative to the stations described and located on Table 1 and Figure 2, respectively.

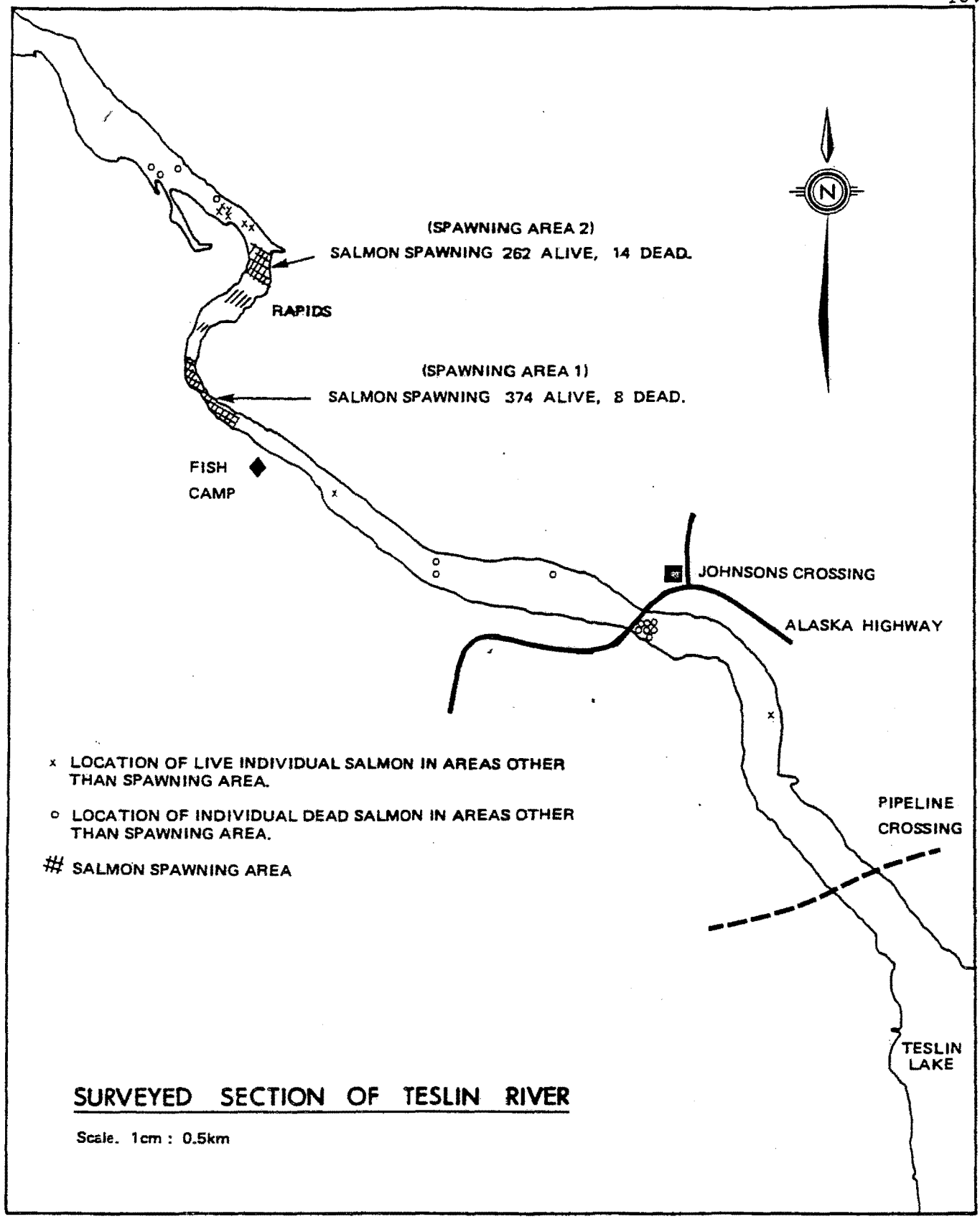


FIGURE 3. Location of salmon along the Teslin River from Teslin outlet.

TABLE 2 SALMON SPAWNER ENUMERATION BETWEEN ESTABLISHED STATIONS ALONG THE SURVEYED SECTION OF THE TESLIN RIVER

STATION	LIVE SALMON	DEAD SALMON	DISTANCE FROM CROSSING (km)
1	-	-	0.80
2	-	-	0.15
3	-	-	0.80
4	1	-	1.55
5	-	-	1.90
6	-	-	2.30
7		7	3.25
8	-	-	3.75
9	-	1	4.45
10	-	-	4.85
11	-	2	5.25
12	-	-	5.90
13	1	-	6.55
14	-	-	6.95
15	-	-	7.45
16	-	-	7.95
17	374	8	8.75
18	-	-	9.25
19	-	-	9.65
20	262	14	10.05
21	-	-	10.40
22	6	1	10.70
23	-	3	11.05
24	-	-	11.60
25	-	-	12.35
TOTAL	644	36	

A total of 644 live and 36 dead salmon were recorded during the survey. No large congregation of chinook salmon was observed in any other section of the river 12 kilometres north of Teslin Lake apart from the locations designated as Spawning Areas 1 and 2 (Figure 3).

A total of seven dead salmon were recorded at Station 7 which was situated within proximity of the dock area under the Teslin bridge. The only other locations within the surveyed area, where substantial numbers of carcasses were observed were at Spawning Area 1 (Stations 16, 17 and 18) and Spawning Area 2 (Stations 20 and 21).

Large Congregation

During the time of survey it would be safe to assume that if any congregation of salmon was observed within the surveyed area, they would have been spawning. A total of 374 live salmon and 8 carcasses were recorded at Station 16, 17 and 18 (Figure 2), while at Stations 20 and 21, 262 live and 14 dead salmon were observed. Working on the above assumption, Stations 16, 17 and 18 were labelled as Spawning Area I and Stations 20 and 21 as Spawning Area 2 (Figure 3).

It is possible that salmon were also using the area located at Station 22. A total of six salmon were observed at this location.

AREA COVERED

Within the surveyed 12 kilometres of the river, approximately 75 percent of the riverbed was covered by the divers. However, in areas where congregations of salmon were observed coverage could have been as high as 90 percent.

CONCLUSION

It would appear from the data obtained during the study that for chinook salmon, the substrate material (consisting of a mixture of silt and gravel or silt only) observed between Station 1 and Station 15 was not suitable for use during spawning. Instead, the areas (Stations 16, 17, 18, 20 and 21) used by the species for redds consisted of well graded gravel with little or no fines. Substrate containing a mixture of poorly graded gravel and fines (Station 23 and 24) was also disregarded by the spawning fish.

Depth of water did not seem to be an important factor for spawning chinook salmon. Spawning activities were observed as deep as six metres and in certain shallower areas, spawning activities were carried out in as little as 1.2 metres of water. In all cases however, eggs were deposited in areas where a substantial flow of water would be maintained throughout the winter period.

It is very likely that the main trench of the river is used for migration activities. Two live salmon were observed in areas other than the spawning grounds, and in both instances they were swimming upstream in the trench area, possibly to other natal watercourses. Such a conclusion was drawn after these two areas (Stations 4 and 13) were thoroughly searched for possible spawning habitats and/or any congregation of fish.

The seven dead salmon counted at Station 7 could have been deposited at the bridge (Figure 3) by individuals using the area as a dock for fishing boats. This was further substantiated by the quantity of heads and internal organs found in the area. Small numbers of dead salmon were also recorded at the two identified spawning areas, however, large quantitites were not observed. It is possible that individual carcasses could have drifted downstream and may have accumulated at other locations along the river. Several dead salmon were observed approximately 15 kilometres upstream from Roaring Bull Rapids last year (Allan Jacobs, personal communications). Roaring Bull Rapids is situated approximately 115 kilometres downstream from Johnsons Crossing.

REFERENCES

McPhail, J.D. and C.C. Lindsey, 1970. Freshwater fishes northwestern Canada and Alaska Fish.Res. Bd. Canada Bull.173: 381 p.p.

Jacobs, A. 1980. personal communication. Dead salmon were observed last year during a hunting trip down the Teslin River.