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Chinook Salmon Assessment and Restoration/Enhancement Options for Selected Tributaries of the Teslin River, 1997

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in association with
Laberge Environmental Services
and
Research Northwest

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1.0 INTRODUCTION

The Teslin River, located in south central Yukon and northern British Columbia is a major headwater tributary of the Yukon River. A total of 15 first order, 16 second order, 6 third order, and 2 fourth order tributary streams of the Teslin River mainstem served as the focus of the study (Figure 1). The study area lies within the traditional territory of the Teslin First Nation and has been a traditional location of salmon harvesting.

The Teslin River's proximity to population centers (Whitehorse and Teslin), relatively easy access, and recreational potential make it a good candidate for restoration/enhancement work that includes community involvement. Prior to this report, detailed information on the utilization of tributary streams by chinook salmon was lacking for much of the Teslin River. Spawning populations in some tributaries were undocumented, and other tributaries that once supported chinook salmon populations no longer appeared to do so.

The purpose of this study was to provide the background information required for (a) restoring habitat and wild stocks; (b) enhancing habitat; (c) enhancing wild stock, and (d) effective management of existing stocks. Documenting salmon utilization and restoration/enhancement potential of these tributaries will play an important role in influencing future land use decisions that might negatively impact these creeks.

The primary focus of this study was on tributaries of the Teslin River large enough to support spawning chinook salmon. These tributaries received detailed investigations including assessing the extent of adult salmon utilization, the potential availability of spawning habitat, and the utilization by rearing chinook salmon fry.

The extent to which chinook salmon utilized smaller tributaries for rearing or spawning was previously unknown within the study area. These tributaries were given cursory investigations to determine the extent of, or potential for, salmon utilization.

The Teslin Tlingit Council (TTC) has been developing an Integrated Resource Management Plan. This study will provide fisheries baseline data to aid in the development of that plan. Some work will be required to integrate this information to that program.

The specific objectives of this proposal were as follows:

- Conduct detailed investigations of tributaries to the Teslin River between Teslin Lake and Swift River to determine current and historical chinook salmon utilization.
- Conduct physical investigations of the tributaries to determine their potential as candidates for restoration/enhancement work.
- Prepare a report that would outline restoration/enhancement options for this portion of the Teslin River.
- Solicit support from local communities and other interested parties for possible future restoration/enhancement work resulting from the findings of these studies.
- Generate background data that could be used towards development of a regional plan for managing chinook salmon in the Yukon River drainage.

White Mountain Environmental Consulting (WMEC) conducted the fisheries investigations and coordinated this project. Lebarge Environmental Services (LES)

conducted the water quality/quantity and benthic assessments, and Research Northwest conducted the background research. Each partner completed analysis of data they collected and the compilation of this report was completed by WMEC and LES.

Funding for this study was provided by the Yukon River Panel Restoration and Enhancement Fund under the U.S./Canada Interim Agreement of the Pacific Salmon Treaty.

2.0 STUDY AREA

The Teslin River drains an area of approximately 31,078 square kilometers (12,000 square miles) in south central Yukon and northern British Columbia, Canada. Teslin Lake, 126 kilometers (78 miles) long and averaging 3.2 km (2 miles) wide and with an average depth of 59 meters (194 feet), is the dominant water body in the drainage and is one of the principle headwaters of the Yukon River (Fisheries & Marine Services,1973). Teslin Lake has been designated as a high quality water for the purposes of fisheries management. From Teslin Lake, the Teslin River flows to its confluence with the Yukon River at Hootalinqua, a distance of 189 km (117 miles).

The river is a popular canoe route and supports both a sports and First Nation food fishery. The study area is a section of river approximately 55 km (34 mi) long between Teslin Lake and the Swift River, and falls within the traditional territory of the Teslin Tlingit First Nation. A small community exists in the vicinity of Johnsons Crossing, and there are a few cabins scattered along the river in the study area . The Alaska Highway crosses the Teslin River at Johnsons Crossing about 136 km (85 mi) south-east of Whitehorse. Otherwise, access into the study area is restricted to aircraft and boats.

The study area lies within the Lake Laberge Ecoregion of south-central Yukon. This ecoregion is characterized by a cold continental climate modified slightly by marine influences from the Gulf of Alaska; however the coastal moderation is often realized more at higher elevations than on valley floors.

The ecoregion is in the scattered discontinuous permafrost region, however thermal analysis and drilling indicate that permafrost is more prevalent than first thought and commonly occurs on north aspects in fine textured lacustrine soils. (Oswald and Brown, 1978). Slumping occurs with some regularity throughout the study area and often results in the deposition of sediments into the river system. A large active slump near Henry Island was the most dramatic slump in the study area .

Boreal forest predominates at lower elevations and alpine tundra at higher elevations. Willow and alder are common along creek banks with poplar, aspen, white and black spruce and lodgepole pine comprising the dominant tree species.

The primary tributaries of the Teslin River located within the study area are as follows: Swift River, Hundred Mile Creek, Dave Creek, Wilson Creek, Squanga Creek, Muskrat Creek, and Meadow Creek. A total of 33 smaller (secondary) tributaries to the Teslin River are located within the study area.

Sixteen species of fish have been identified in the Teslin drainage. These include: lake whitefish (humpback)(*Coregonus clupeaformis*), broad whitefish (*C. nasus*), least cisco (*C. sardinella*), round whitefish (*Prosopium cylindraceum*), inconnu (*Stenodus leucichthys*),Arctic grayling (*Thymallus arcticus*), lake trout (*Salvelinus namaycush*), chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*), longnose sucker (*Catostomus catostomus*), northern pike (*Esox lucius*), burbot (*Lota lota*),slimy sculpin (*Cottus cognatus*), lake chub (*Couesis plumbeus*), pygmy whitefish (*Prosopium coulteri*) and Arctic lamprey (*Lampreta japonica)* (Fisheries & Marine Services,1973). Bull trout (*Salvelinus confluences)* / Dolly Varden (*Salvelinus malma*) complex have been reported in headwater areas adjacent to the Liard River drainage.

3.0 STUDY METHODS

3.1 Background Information

Collection of background information was initiated prior to starting field investigations and consisted of conducting interviews and researching existing information. Interviews with First Nations and knowledgeable individuals were conducted to gain information on historical and current salmon utilization of the area. Possible conflicts with existing or potential uses of land or water within the drainage basin were identified. Any concerns or suggestions regarding restoration and enhancement expressed by First Nations or interested community groups were noted. Efforts were made to solicit support for the implementation of future restoration/enhancement plans that might arise from the findings of this study.

A search for any existing fisheries or waters data from all sources was compiled. Background information and archival research has been presented in Appendix 1.

3.2 Planning

Pre-field orientation consisted of map and air photo reviews and a reconnaissance of the study area conducted on June 12, 1997 to gain an overview of the study area and aid in determining field logistics.

3.3 Field investigations

Field investigations consisted of the following three components: 1) water quality and quantity assessments, including Benthics, 2) fisheries assessments and 3) helicopter assisted spawning surveys.

3.3.1Water assessments

Basic hydrological information was obtained for each of the streams surveyed to assess the seasonal variation and water quality parameters. Air photographs and topographic maps were interpreted to identify basin and stream characteristics such as drainage area, stream gradient variation and median elevation. During the fisheries assessments, one reach near the outlet of each stream was selected for a detailed survey. This survey consisted of accurate instantaneous discharge measurements and surveying of the channel geometry using a surveyor's level and stadia rod. The field measurements were used to compute the discharge represented by the ordinary high water mark using Manning's Equation. In addition, the D.I.A.N.D. Design Flood Estimating Guidelines were used to estimate the expected Mean Annual Flood for each stream. These estimates of average high water events, when combined with the spot flow measurements made in July and August, and the low flow observations made in March, provide a basic snapshot of the seasonal stream flow variation in the tributaries.

Water Quality

On each visit, water samples were collected in clean new plastic bottles and analyzed for physical parameters, nutrients, anions and metals, by Quanta Trace Laboratories in Burnaby, B.C. Collection and analysis were based on methods in "Standard Methods for the Examination of Water and Wastewater, 15th Edition" published

by the American Public Health Association. Conductivity, pH, temperature and dissolved oxygen was measured in the field using Orion instruments.

Water Quantity

Discharge measurements were made using either velocity-area or salt dilution method depending on ice conditions. Stream geometry was surveyed in the field and used in an indirect estimate of historic flood flows. All necessary field measurements were made to allow for standard stream descriptions found in the DFO/MOE "Stream Survey Field Guide".

Benthic Sampling

Benthic invertebrates were collected in triplicate at each reach to determine the abundance and types of benthos available as fish food. Collections were made with a Surber Sampler (area = 0.02929m²) which had a 300 micron mesh, on August 21 and 22, 1997. Where possible, samples were collected from an undisturbed, fast flowing, gravel strewn riffle habitat at each of the reaches. The bed materials within the frame of the Surber Sampler were cleaned and washed by hand, with the fast flowing current carrying the disturbed bottom fauna and detritus into the collection bag. The level of effort for each sample and at each site was comparable. The captured invertebrates and detritus were placed in one liter nalgene bottles, preserved with 10% formalin, and shipped to an entomologist for sorting, identification and enumeration.

Analysis of the benthic invertebrate samples was conducted by Charles J. Low, Ph.D., an invertebrate biologist in Victoria, BC. All Samples were washed through two screens with mesh sizes 1 millimeter and 180 microns. All of the organisms retained by the coarse screen were counted and identified, whereas the organisms on the 180 micron screen were sub-sampled as necessary. A Folsom plankton splitter was used for the sub-sampling . The majority of the benthos were identified to the genus level.

Winter Low Flow Survey

The presence and extent of over wintering habitat in the seven surveyed streams was considered to be an important component in the overall project objectives. The late winter low flow conditions affect both available over wintering habitat for juvenile chinook salmon as well as certain restoration and enhancement options. The late winter low flow survey was conducted on March 9 and 10, 1998.

The parameters limiting over wintering capability of streams were measured on the basis of sampling near points that were flagged in August as good potential micro habitats for over wintering fish. Observations of steam flow and ice cover conditions were made in the lower reaches of all streams. The low flow survey included revisiting previously flagged deep pools at each of the tributaries and examining water quality and quantity. Efforts were made to qualitatively assess the status of the benthic community.

Access to the study area and stream locations was by snowmobile. In situ measurements of dissolved oxygen were made with a YSI dissolved oxygen meter. Conductivity and temperature were measured with an Orion instruments conductivity

meter. Sampling holes were drilled with a 6" ice auger, or opened with an ice chisel depending on ice thickness. Water samples were collected using standard sampling technique, and shipped to Norwest Laboratories for analysis of extractable metals, physical parameters and major ions.

Flow was measured using slug injection, simply estimated where a measurement was not possible, or using area/velocity where there was open water. The slug injection method of stream flow measurement is described by Kite in the Journal of Glaciology, Vol. 40, No. 134, 1994. This method involves injecting a slug of sodium chloride into the stream and recording the resultant rise in conductivity downstream and computing stream flow based on the conservation of mass.

Samples of substrate were collected by simply scooping some material from the bottom of the drilled hole through the ice or from an open lead if available. The substrate was initially frozen, then preserved with formalin and Bengal rose stain to identify the presence and species of macro invertebrates.

3.3.2 Fisheries Assessments

Timing

Fisheries assessments covering the entire study area were conducted between July 4-10, and July 16-20. Follow up investigations were conducted on August 26 and 27. Aerial surveys of all the primary tributaries and the Teslin River within the study area, were conducted on August 21 and 22, 1997.

Additional sampling was conducted at Squanga Creek on June 12, July 18, and on October 3, 1997. A reconnaissance visit of Squanga Creek to count salmon carcasses was conducted on August 22.

Habitat/Reach Descriptions

Homogenous sections of stream were delineated on a reach basis. Each reach was then given a site name and a general description form completed for each reach.

Each of these sites was assessed and described in terms of its physical parameters and aquatic habitat including average depth, average width, substrate, flow characteristics (pool, riffle, glide), available instream and overhead cover amounts, channel and bank characteristics, and surrounding forest type. Temperatures were recorded using a digital thermometer. Water velocities were estimated using the "floating object" method during the fisheries investigations and were later confirmed with price meter readings taken during water quality/quantity assessments.

Sampling Methods

Several non destructive methods were used to capture fish. Each sample method has biases and therefore a variety of methods were used to ensure accurate assessments of fish present. The limitations of each capture method are discussed later in this report.

Physical investigations in the outlet areas adjacent to the Teslin River consisted of evaluating salmon habitat in a total of 41 tributaries (of the Teslin River). The tributaries investigated were also assessed for the presence of chinook salmon fry, with the aid of Gee type minnow traps where practical. The 7 larger tributaries were given a more detailed investigation which included habitat evaluation and minnow trapping for a distance of up to 2 km from the Teslin River. Habitat mapping of the main tributaries was completed on a reach by reach basis and photographic documentation made. Seine netting and/or electro-fishing were conducted on the main tributaries, where conditions warranted, to get a better understanding of the abundance and utilization of salmon fry and to denote other species of fish present. Visual surveys, conducted from the ground, were made of all watercourses with the aid of polarized glasses.

Minnow traps (Gee type, ¼" mesh) were used to determine the presence of chinook salmon fry. Traps were baited with salmon roe suspended in the trap in a perforated plastic bag and left overnight. Traps were placed in a variety of habitat types and were set following DFO's protocol for the baiting of G-type minnow traps. The range in size and species of fish that a Gee trap will capture are limited but have been shown to be highly effective for, and specific to, Yukon River chinook salmon fry (Hunka and Shuler, 1988, and Moody 1993). Effort extended for minnow trapping was expressed as number of fish caught per hour (effort was made to have traps set for as close to a 24 hr period as possible).

Electrofishing was conducted using a Smith-Root type 11A battery powered, backpack type unit. The operator of the electrofisher was accompanied by a person to net and record stunned fish. Electrofishing was particularly effective in capturing smaller fish and in areas where fish could be corralled or cornered. Effort extended by electrofishing was expressed in seconds of shocking time.

Seine nets were pulled at suitable sites using a 7 m x 1.5m, 1/8' inch oval weave mesh pole seine. Seining was restricted to depths of 1.5 meters or less and to sites with a suitable landing area. Effort extended by seining was expressed in square meters of area seined.

Fish captured were handled delicately to allow for live release after sampling, anesthetics were not used. All fish captured or observed were identified and recorded. A sub sample of captured fish were sampled for fork length (+/- 1mm) and round weight (+/- 0.1 g). Weights were taken using a digital scale.

Spawning surveys.

Aerial surveys of all the primary tributaries and the Teslin River within the study area were conducted on August 21 and 22, 1997 and were timed to coincide with the peak of the chinook salmon spawn. As part of this survey minnow traps were set on a portion of Swift River not previously sampled to help determine the extent of upstream movement of chinook fry in this river, and to determine if a beaver dam on the Swift was acting as a

barrier to upstream movement of salmon fry. The aerial survey was conducted from a 206 Jet B Long Ranger Helicopter. Three observers counted salmon.

3.4 Data Analysis

3.4.1 Fisheries Data

Length frequency histograms based on a 5mm length interval were calculated for chinook salmon fry, for each of the primary tributaries.

Relative condition factor (K) was calculated for salmon fry from each of the primary tributaries using the formula: $K = W^* 10^5 / L^3$.

where W = round weight in grams

L = fork length in millimeters

Condition factor (K) was calculated for fish from different tributaries captured on the same day.

Catch per unit of effort was calculated for each capture method. Effort extended by Gee trapping was expressed in number of hours the trap was set. Effort expended by seining was expressed in square meters of area seined. Effort expended by electrofishing was expressed in seconds of shocking time.

Weight at length and logarithmic comparisons were calculated for salmon fry captured on each of the primary tributaries.

3.4.2. Water Quality

The water quality data was examined and compared to the Canadian Council of Resources and Environment Ministers guidelines for the protection of freshwater aquatic life.

3.4.3 Water Quantity

An indirect and approximate measurement of the flow corresponding to the ordinary high water mark was made using Manning's Equation. The Mean Annual Flood was calculated using the DIAND Flood Estimating Guidelines. In addition to these high water calculations, low flow conditions were also investigated. Combined with the stream flow measured during July and August, the measurements indicate the preliminary seasonal stream flow variation in the tributaries surveyed.

3.4.4 Benthic Invertebrates

The number of organisms of the triplicate data for each reach were summed to give a total abundance value for that site. Diversity was calculated per reach by enumerating all the taxonomic groups identified from species to phylum.

The benthos data was further analyzed by determining the composition of the community at each reach. The community was divided into the major taxonomic groups, usually orders, and the percentage of each determined. Any group which formed 25% or more of the community was classified as dominant.

4.0 RESULTS AND DISCUSSION

4.1 Traditional Knowledge

The traditional knowledge survey component of this study confirmed that First Nation harvesters have historically utilized chinook salmon within the study area. Reports of First Nation harvesters gaffing spawning chinook in the short section of Squanga Creek between the falls and its confluence with the Teslin River (SQ2), implies that this creek once supported a larger run than was observed during this study. Spawning salmon have been observed "trying to go up Swift River" and a carcass has been observed 200 meters below Swift Lake, upstream of where a beaver dam now obstructs salmon migration. All the areas where spawning chinook were noted during the fisheries component of this study, were identified by at least one of the people interviewed. While the traditional knowledge survey was accurate at identifying salmon spawning locations, juvenile rearing areas were not noted. An increase in sport fishing was noted with "heavy fishing beginning 10 to 15 years ago." The spawning area located approximately 2 miles downstream of the bridge at Johnsons Crossing was noted as being particularly heavily fished.

4.2 Fisheries Assessments

During the course of the fisheries investigations, a total of 338 minnow traps were set, 22 electro-fishing runs were conducted, and 37 seines were pulled. One gillnet was set on Squanga Creek. Results showed chinook salmon fry utilization occurred to some degree in all the primary tributaries investigated and in 12 of the 28 unnamed (secondary) tributaries investigated (Figure 1 and Tables 1,2,&3).

The following tributaries had the highest concentrations of chinook fry: Swift River, the lower reaches of Hundred Mile Creek, Meadow Creek, Dave Creek and Squanga Creek. Muskrat Creek also supported significant numbers of chinook fry. Wilson Creek had very low salmon fry utilization. The highest concentrations of salmon fry were captured when seining pools, often associated with breached beaver dams or instream woody debris.

Mean weights, lengths and the relative condition factor (K) for chinook fry from each of the main tributaries are presented in a combined format (Table 4). Condition factor (K) is a measure of the "plumpness" of the fish with higher values indicating a more plump fish. The mean lengths and weights rose consistently as the study progressed; a fact attributable to fish growth. The weight at length logarithmic comparison for chinook fry captured from each of the primary tributaries has been presented in Table 5. Chinook fry captured on the same day in August, showed a range in mean K from 0.95 in Meadow Creek to 1.12 in Squanga Creek.

Site descriptions were made from data collected during waters and fisheries field investigations by reach, for all the tributaries investigated. The complete descriptions have been presented in the following Appendixes: Appendix 2- Tributary Descriptions,

Appendix 3- Water Data Sheets including results of representative detailed reach surveys, Appendix 4- Water Quality Analytical Results, and Appendix 5- Benthic Invertebrates. Summary descriptions of each of the primary tributaries have been presented below.

4.3 Water Quality and Hydrology

All of the water quality analytical data for each sampling period have been presented in Appendix 4. Water samples taken in July and August found the overall surface water quality had very low concentrations of metals and the majority of nutrients. Many parameters were below the method of detection limit in each of the data sets. In general, water quality was within recommended guidelines for freshwater aquatic life.

Water samples were collected from the seven primary tributaries on March 9 and 10, 1998. No anomalies were noted. Sulphate concentrations showed a significant increase in the March samples and nitrate and nitrite were present in most samples whereas they were undetected during the summer sampling. Most metals were again below the method detection limits. The majority of the detected metals were constituents of hardness, which along with alkalinity and conductivity, were elevated compared to the summer sample sets. This is to be expected as elements in the water column would be concentrated during base flow conditions of late winter. Two metals slightly exceeded their respective CCREM guidelines for the protection of aquatic life; lead in Meadow Creek and selenium in Hundred Mile and Muskrat Creeks.

Streamflow variation for the tributaries was expected to be consistent with that of gauged streams of comparable drainage basin characteristics in the region. Peak flow in each of the streams is likely to occur on average in late May or June. The magnitude of this annual average flood has been estimated for each of the tributaries. High water events have caused significant changes in stream morphology in each of the streams as evidenced by breached beaver dams and arrangement of large woody debris and large substrate. After the peak flow period, streamflow recedes, at first sharply, and then more gradually throughout the open water season until minimum flow is reached around mid March. Occasional high water events due to intense rainfall are expected in each of the streams, but these are likely attenuated by swamp and lake storage in the upper reaches of most of the tributaries. Each of the tributaries appear on average to supply adequate depth of water throughout the spawning season with the possible exception of the lowest reach of Hundred Mile Creek. Rearing habitat availability at the confluence of the tributaries with the Teslin River decreased with the dropping water level in the Teslin throughout July and August.

Winter low flow surveys found water present at all of the streams, but over wintering habitat varied from excellent to very poor. A more detailed discussion of over wintering conditions is presented below.

4.4 Stream Descriptions

4.4.1 Swift River

The headwaters of the Swift River lie to the east of the Teslin River in the Big Salmon mountain range. The Swift is 32 kilometers long and drains Swift Lake which is located approximately 13 kilometers upstream of the Teslin River The basin drainage area is approximately 256 km^2. The main stem of the river originates at about 880m ASL (above sea level) and flows north west until it joins the outlet of Swift Lake to flow south, then due west to join the Teslin River at 60°48.75'N / 133°51.40'W (6742050m N, 561200m E). Swift Lake in turn is fed by Rosy Lake. The average channel slope begins at 0.4 to 0.5% and increases downstream of Swift Lake to 0.9 to 1.2% slope. Areas of locally reduced slope result in more complex habitats. The median basin elevation is approximately 900m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 18.4m^3 / sec which compares to a Mean Annual Flood of 18.6m^3 / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variation will be attenuated by the Rosy and Swift Lake system. Measured streamflow dropped from 3.38 to 1.86 m^3 / sec from July to August. Average mean monthly flow in August is expected to be about 2 m^3 / sec corresponding to an average riffle depth of 0.3 meters.

Swift River waters were moderately hard, slightly alkaline, and almost colourless in both sample sets. Suspended solids and turbidity were low and the water was very clear. Nutrients and metals harmful to aquatic organisms were all below the limits of detection. Swift River had the highest concentration of Sulphates of the seven tributaries sampled at 13 mg/L in the summer and 44 mg/L in the winter. This is in the normal range for surface waters.
Results are included in the Water Data Sheets in appendix 4.

Of the seven sites sampled for benthic invertebrates, the benthos community at Swift River was the most abundant and diverse (Table 6, Figure 16). Diptera was the dominant taxa at this site, forming 59.1% of the population. There was also good representation from other orders of aquatic insects (Ephemeroptera and Plecoptera). The substrate was composed mainly of gravel providing a preferred habitat for aquatic insects.

The late winter survey investigated the lower two reaches of the Swift River. A robust flow was observed and measured at 0.53 m^3/sec. The water was generally flowing freely under ice with little evidence of aufice formation (aufice is used herein to mean the local terms "overflow, or "glacier" ice conditions). Sampling was achieved through a skim of new ice in recently open leads. Over wintering conditions were excellent and extensive in the reaches observed. The deep pools marked in August had ample depth. Snow cover was approximately 400 mm with 2 - 30 cm of ice.

The only significant human development feature in the basin is an old winter access road which cuts along the North West flowing upper mainstem as it heads to a mineral exploration area on Red Mountain.

The predominant forest in the Swift River basin composed primarily of spruce with willow, alder and some poplar in riparian areas.

The Swift River was sampled for fish on July 4 and 5, 1997 and was divided into 5 distinct reaches (Figure 2).

The Swift River was found to be the most productive stream relative to salmon within the study area. The Swift River supports a spawning population of chinook (a total of 69 were counted during aerial surveys) and large numbers of rearing salmon fry. Substrates are composed of small boulder, cobble and gravel with extensive riffle areas. Pools become more common moving upstream, while instream woody debris and undercut banks provide fish cover in all reaches. Excellent fish habitats exist in the river for its entire length.

Chinook salmon fry were captured and observed throughout the Swift River with the exception of the reaches upstream of the beaver dam located at 60°48.45'N / 133°48.42'W. This dam acted as a barrier to the upstream migration of spawning adult salmon. Good spawning and rearing habitat for salmon exists upstream of this dam. Historical references report salmon carcasses being observed at the outlet of Swift Lake.

Length frequency histograms indicate that over-wintering may occur in the Swift River; the 70-80 mm range and the 90 mm range both correspond to sizes of fish aged 1+ years by Moody in Coucher Creek (1993)(Figure 9). The modal length for chinook salmon fry captured in the Swift River in July was 45mm.

The following fish were recorded in Swift River: chinook salmon (adults and fry abundant), Arctic grayling, slimy sculpin, longnose sucker, lake chub and burbot.

4.4.2 Hundred Mile Creek

Hundred Mile Creek has it's headwaters in the Big Salmon Range at approximately 1,500m ASL. The drainage basin area is approximately 116 square kilometers with a median elevation of about 900m ASL. The creek begins in three steep tributaries averaging 4 - 5% slope, and decreases to an average of 1% slope in the main stem until it joins the Teslin River at 60°43.77'N 133°41.39'W (571550mE 6733400mN). The mouth of the creek flows through an alluvial fan and delta complex which extends well into the Teslin River at low water.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 8.8m^3 / sec. This compares to the Mean Annual Flood of 9.5 m^3/sec derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Measured

streamflow dropped from 0.65 to 0.42 m^3 / sec from July to August. Average mean monthly flow for August is expected to be about 0.6 m^3 / sec corresponding to an average riffle depth of 0.2 meters.

Hundred Mile Creek waters were moderately soft, slightly Alkaline, and almost colourless in both sample sets. Suspended solids and tubidity were low and the water was very clear. Nutrients were very low with all but phosphorus below the limit of detection. Metals harmful to aquatic organisms were all near or below the limits of detection,with the exception of selenium which was detected in March. Results are included in the Water Data Sheet, Appendix 4.

The benthos community at Hundred Mile Creek was the second most abundant and diverse, with a population of 1078 and a diversity of 47 different taxonomic groups (Table 6, Figure 16). Dipterans were also dominant here forming 74.7% of the population. Other aquatic insect orders were present in significant numbers.

The late winter survey investigated the lower two reaches of Hundred Mile Creek, almost to the first Beaver Dam. Extremely thick layers of aufice were observed, and the total ice thickness at one of the deep pool sampling sites was over 5 feet with all of the flow confined to the subsurface. A recently open lead in the delta complex at the mouth of the creek was sampled. The stream flow here was approximated at less than 4 Litres/sec. Over winter conditions were determined to be adequate but extremely limited in scope. Adequate habitat appears confined to the delta complex and perhaps behind beaver dams upstream. Snow cover was approximately 450 mm with >1.2 m. of ice.

Hundred Mile Creek was sampled for fish on July 7 and 8 and was divided into 4 distinct reaches (Figure 3).

Hundred Mile Creek enters the Teslin River from the east. The lower reaches flow as braided shallow channels over a wide gravel apron that extends into the Teslin River. A 2.5 meter high beaver dam located approximately 380 meters upstream of the Teslin River acts as a barrier to chinook salmon fry movement. Good habitat for rearing fry exists both above and below this beaver dam. Relatively large numbers of salmon fry were captured below this dam but no salmon fry were captured above it. Upstream of this beaver dam there is abundant evidence of recent and historic beaver activity. Spawning chinook salmon were observed utilizing the gravel bar at the mouth of Hundred Mile Creek in the Teslin River. It is possible the shallow depth of the creek over the gravel apron at the outlet prevented adult salmon from moving into the creek as none were observed in the creek itself. The vicinity of spawning salmon near the mouth of this creek implies it is potentially important rearing habitat for salmon fry.

Good length distribution of juvenile chinook salmon was found on this creek possibly representing 2 year classes (Figure 10). The modal length for chinook salmon fry captured in Hundred Mile Creek in July was 50mm.

The following fish were recorded in Hundred Mile Creek: chinook salmon fry (abundant), Arctic grayling and slimy sculpin.

4.4.3 Dave Creek

Dave Creek has it's headwaters in Gunsight and Brewer Lakes at the foot of the Big Salmon Range. The drainage basin area is approximately 70 square kilometers. The main stem of the creek originates at about 930m ASL at the outlet of Gunsight Lake. The upper tributaries and start of the main stem average 3 to 4% slope. The lower reaches down to the mouth decrease in slope to an average of just under 1%. The median elevation of the basin is approximately 700m ASL. Dave creek enters the Teslin River from the east at 60°41.19'N / 133°38.36'W (174400mE 6728600m N).

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 3.4m³ / sec which is considerably less than the Mean Annual Flood of 5.3m³ / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow will be attenuated by the lake system. Measured streamflow dropped from 0.5 to 0.28 m³ / sec from July to August. Average mean monthly flow for August is expected to be about 0.4 m³ / sec corresponding to an average riffle depth of 0.09 meters.

Dave Creek waters were moderately hard, slightly alkaline, and almost colourless in both sample sets. Suspended solids and turbidity were low and the water was very clear. Except for orthophasphate in the August sample, nutrients were all below the limit of detection. Most metals harmful to aquatic organisms were below the limits of detection. Results are included in the Water Data Sheet, Appendix 4.

The benthic community at Dave Creek had a population of 497 individuals representing 37 different taxonomic groups (Table 6, Figure 16). Diptera was the dominant order forming 67.2% of the community. Stoneflies (Plecoptera) were also present in high numbers (22.5%).

Winter low flow surveys found the lower reaches of Dave Creek heavily affected by aufice, with the majority of flow reporting to the Teslin River through a channel south of the main channel within the delta complex. This channel was dry in the summer. A deep pool site 200 meters from the mouth was drilled and found to have 90 cm of mostly aufice ice cover confining turbid water under pressure with negligible flow. The water seemed to be confined to a muddy substrate. A second hole was drilled further downstream and was found to have 75 cm of aufice with 25 cm of water under pressure beneath. The flow was negligible. The over wintering habitat in Dave Creek appears poor and not extensive due to aufice formation and changing channels. Snow cover was approximately 250 mm with 75 - 100cm of ice.

Dave Creek was sampled for fish on July 8 and 9, and was divided into 3 distinct reaches (Figure 4).

The lower reach of Dave Creek at the Teslin River flows as a silt bottomed glide. Fish cover was limited in these lower reaches. Further upstream velocities increased and pool/riffle development became more prevalent. Gravel/cobble substrates were found in riffle areas. Evidence of historic and recent beaver activity was extensive throughout the reaches investigated. These beaver dams have a significant effect on the stream substrates. Typically, silted substrates were found within the first 50 meters upstream of each beaver dam then approximately 20 meters of sorted gravel offering good potential grayling spawning. Clean gravel/cobble substrates were found immediately below breached beaver dams, typically with a deep pool immediately below the point of breaching. The creek does provide some good habitats for juvenile chinook, although these are limited.

This Creek had a narrow range in length classes for juvenile chinook, although it may indicate 2 year classes (Figure 11). The modal length for chinook salmon fry captured in Dave Creek in July was 55mm.

The following fish were recorded in Dave Creek: chinook salmon fry (common to abundant), Arctic grayling, slimy sculpin, longnose sucker, burbot and round whitefish.

4.4.4 Wilson Creek

Wilson Creek is composed of two main tributaries, one draining Beaver Lake (770m ASL) in a westerly direction at an average slope of 1.3%, and the other draining the Big Salmon Range in a south westerly direction at an average slope of 4 - 5% until it nears the Teslin and diminishes to 1.5% slope. The creek averages 0.8% slope in the last two kilometers of it's length, and joins the Teslin at 60°36.40'N / 133°29.90'W (58730m E/6712900m N), immediately upstream of Henry Island. The basin drainage area is approximately 85km^2. The median basin elevation is approximately 800m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 4.7m^3 / sec which is considerably less than the Mean Annual Flood of 6.4m^3 / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow will be attenuated by the lake system. Measured streamflow dropped from 0.77 to 0.51 m^3 / sec from July to August. Average mean monthly flow for August is expected to be about 0.7 m^3 / sec corresponding to an average riffle depth of 0.07 meters.

Wilson Creek waters were moderately soft, slightly alkaline, and slightly grey in colour in both sample sets. Suspended solids and turbidity were moderate, giving the water a cloudy appearance. Orthophosphate was present throughout the sampling period. nitrate was deteceted during the winter sampling. There were low metals concentrations throughout, although copper, aluminium and iron exceeded the aquatic guidelines set for moderately soft waters, during the summer. All guidelines were met during the winter sampling. Results are included in the Water Data Sheet, Appendix 4.

The benthic community at Wilson Creek had a relatively low population, 317 individuals, but was quite diverse with 39 different taxonomic groups identified (Table 6, Figure 16). The orders Plecoptera and Ephemeroptera (Mayflies) dominated this site forming 48.7% and 30.3% of the community respectively. Compared to the other creeks, Dipterans were poorly represented, forming 14% of the community. Considering the substrate at this site (80% silty sand), it is interesting to observe such a high representation of aquatic insects here.

Late winter flow surveys were conducted at Wilson creek at a deep pool about 150m from the mouth. This site had 50 cm of ice over 16 cm of water under pressure. There was no aufice present. There does not appear to be a continuos channel between the deep pool sample site and the mouth, as the flow is sometimes confined entirely to the substrate. Over wintering habitat appears poor and is very limited in scope. Snow cover was approximately 400 mm with 75 cm of clear ice.

Wilson Creek was sampled for fish on July 16 and 17 and was divided into 5 distinct reaches (Figure 5).

During the time of investigations, the creek flow was turbid. The lower reach flowed as a glide with silt substrates. Moving upstream, pool/riffles increase, and cover becomes more abundant. The confluence of the 2 major tributaries occurs approximately 1.4 km upstream of the Teslin River. The south fork was clear while the north fork was turbid. The north fork cuts into a clay bank in 2 places within 150 meters of the confluence; active slumping causes the turbidity. Both forks support rearing chinook salmon fry, but higher numbers of fry were recorded in the south fork.

The size range of chinook from Wilson Creek were narrow, only encompassing a 15 mm range (Figure 12). The modal length for chinook salmon fry captured in Wilson Creek in July was 65mm.

The following fish were recorded in Wilson Creek: chinook salmon fry (uncommon), longnose sucker and slimy sculpin.

4.4.5 Muskrat Creek

Muskrat Creek collects headwaters in Muskrat Lake within the Big Salmon Range. The basin drainage area is approximately 97 km^2. The main stem of the creek originates at about 1280m ASL and flows north west and then south west at an average slope of 3.5% until it flows into marshy lowlands of the Teslin River valley. A southerly tributary flows from Surprise Lake and joins the main stem about 1km from the mouth. The lower reaches average 1.2% slope. Muskrat Creek enters the Teslin River from the east at 60°32.71'N/ 133°24.65'. The median basin elevation is approximately 900m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 10.1m^3 / sec which is considerably more than the Mean

Annual Flood of 7.3m³ / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variation will be attenuated by the lakes and swampland in the system, making the comparatively high OHWM flow seem excessive. However, there were many signs of active channel changes due to flooding. Measured streamflow dropped from 0.57 to 0.45 m³ / sec from July to August. Average mean monthly flow for August is expected to be about 0.6 m³ / sec corresponding to an average riffle depth of 0.13 meters.

Muskrat Creek waters were soft, near neutral, and almost colourless in both sample sets. Suspended solids and turbidity were low and the water was very clear. A minute amount of orthophosphate was detected, otherwise nutrients were all below the limit of detection. Metals harmful to aquatic organisms were all below the limits of detection. Selenium was detected in the March samples exceeding guidelines for the protection of aquatic life. Results are included in the Water Data Sheet, Appendix 4.

The benthic community at Muskrat Creek had a population of 518 individuals, and a diversity of 45 different taxonomic groups. The orders Diptera and Ephemeroptera both were dominant forming 36.3% and 28% of the population respectively. There was also good representation from Plecoptera which comprised 23% of the community (Table 6, Figure 16).

Late winter flow surveys were conducted on the lower three reaches of Muskrat Creek. Extremely thick aufice was observed for 350 m upstream of the mouth. Two recently open leads were found upstream of that point where the creek is more channelled and a beaver dam impedes flow further upstream. Stream flow was measured at 0.11 m^3/sec. The sample site was a recently open lead with a thin layer of new ice. Good over wintering habitat exists in Muskrat Creek in the second reach upstream. Snow cover was approximately 450 mm with 40 cm of clear to thick aufice.

Muskrat Creek was sampled for fish on July 18 and 19 and was divided into 5 distinct reaches (Figure 6).

The outlet enters the Teslin River in a large, shallow bay adjacent to the main flow. The lower reach of Muskrat Creek flows through an open meadow as a glide with a silt substrate. Further upstream the creek develops a more defined pool/riffle ratio with some gravel in riffle areas. Deep pools occur at stream bends and in association with spruce deadfall. Signs of recent and historic beaver activity exist with the most recent being a large, 2 meter high beaver dam built beside an old log bridge located approximately 615 meters upstream of the Teslin River (photo 1). Chinook salmon fry were recorded upstream of this dam indicating that the beaver dam/log bridge had not been an absolute barrier to juvenile chinook in the recent past. Fish cover is plentiful in the upper reaches of this creek, most often in the form of large organic debris.

Juvenile chinook salmon in Muskrat Creek had an uneven length class distribution with smaller length classes being more heavily represented (Figure 13). The modal length for chinook salmon fry captured in Muskrat Creek in July was 55-60mm.

The following fish were recorded in Muskrat Creek; chinook salmon fry (common), round whitefish, Arctic grayling, northern pike, lake chub and slimy sculpin.

4.4.6 Meadow Creek

Meadow Creek has its headwaters in the Big Salmon Range along the South Canol Road. The drainage basin area is approximately 112 square kilometers. The main stem of the creek originates at about 1200m ASL. The start of the main stem averages 3% slope until it crosses the Canol Road, then diminishes to 2-5% slope, and finally 0.8-1.5% slope in the last 5 km. The creek joins the Teslin at 60°30.74'N/ 133°21'36"W (590400m E 6709450m N). The median elevation of the basin is about 900m ASL.

The Canol road occupies the creek valley in the upper half of the basin. The old Johnsons Crossing dump and staging area for the removal of equipment from the Canol project is along the Canol Road in the Meadow Creek basin. There are residences near the mouth of the creek and at the Canol road crossing.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 9.5m³ / sec which is somewhat higher than the Mean Annual Flood of 8.3 m³ / sec derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Measured streamflow dropped from 1.22 to 0.66 m³ / sec from July to August. Average mean monthly flow for August is expected to be about 0.9 m³ / sec corresponding to an average riffle depth of 0.12 meters.

Meadow Creek waters were soft, slightly alkaline, and almost colourless in both sample sets. Suspended solids and turbidity were low and the water was very clear. Except for orthophosphate in both samples, nutrients were all below the limit of detection. Metals harmful to aquatic organisms were generally below the limits of detection, but there were low levels found in the July sample. In July, aluminium exceeded the recommended level for aquatic organisms, as did lead in the March sample. Results are included in the Water Data Sheet, Appendix 4.

The benthic population at Meadow Creek was extremely low with only 8 individuals but very diverse, as all 8 were different taxa. Diptera was the dominant order forming 62.5% of the population (5 individuals) (Table 6, Figure 16). The substrate at this site was mostly a thick sand and silt layer with very little gravels present. The substrate appeared to be fairly mobile in this lower reach. Several recently (since July 10) constructed beaver dams were upstream of the sample site.

Late winter flow surveys were conducted on Meadow Creek at the upper end of reach three. A robust flow was measured at 0.09 m³/sec. Ice cover varies from open leads to 30 cm of clear ice. No aufice was observed. The sample site was an open lead

with a thin layer of new ice. Over wintering habitat appeared excellent and extensive within the first three reaches. Snow cover was approximately 500 mm with 30 cm of clear to open ice.

Meadow Creek was sampled for fish on July 19 and 20 and was divided into 4 distinct reaches (Figure 7).

The lower reach of Meadow Creek at the Teslin River flows as a silt bottomed glide. Fish cover was limited in these lower reaches. Further upstream velocity increased and pool/riffle development became more prevalent. Evidence of recent and historic beaver activity was common in the mid reaches and large numbers of salmon fry were captured in pools associated with breached beaver dams (photo 2). Spawning adult salmon utilize the Teslin River upstream, downstream and close to the mouth of Meadow Creek, making this creek potentially important rearing habitat.

Meadow Creek had a wide distribution of size ranges for chinook fry captured with a modal length of 55 mm (Figure 14).

The following fish were recorded in Meadow Creek; chinook salmon fry (abundant), Arctic grayling (fry), lake chub, burbot and slimy sculpin.

4.4.7 Squanga Creek

Squanga Creek is composed of two main tributaries, Seaforth Creek and Squanga Lake with a combined drainage basin area of approximately 900 km^2. Seaforth Creek originates in a lake about 920m ASL. The other tributary drains Squanga Lake with the 2 tributaries joining near Squanga Lake. The creek enters the Teslin River at 60°32.50'N / 133°25.90'W (586300mE 6712800m N). The median elevation of the basin is approximately 700m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 20 m^3/sec. A Mean Annual Flood of over 50 m^3 / sec. was derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variations will be attenuated by the lake systems. Measured streamflow dropped from 2.07 to 1.22 m^3 / sec from July to August. Average mean monthly flow for August is expected to be about 0.9 m^3 / sec corresponding to an average riffle depth of 0.15 meters.

Squanga Creek waters were hard, slightly alkaline, and almost colourless in both sample sets. Suspended solids were moderate in July, causing a cloudy appearance. In August and March, suspended solids and turbidity were low and the water was very clear. Squanga Creek had the hardest water of the seven tributaries surveyed and consequently the highest alkalinity, specific conductance, and concentrations of cations. With the exception of zinc in July, tin in August, and vanadium in March, metals harmful to aquatic organisms were all below the limits of detection. Results are included in the Water Data Sheet, Appendix 4.

The benthic community at Squanga Creek had a population of 317, and a diversity of 42 different taxonomic groups. Dipterans (64.8%) formed the majority of the community (Table 6, Figure 16).

Winter flow surveys were conducted on the two lower reaches of Squanga Creek. The lowest reach, consisting of the embayment at the confluence with the Teslin River was entirely covered in a thick layer of aufice. The second reach upstream was flowing open with very little ice cover as far as 100 metres upstream. The flow was estimated using surface velocity/area at 1.4 m^3/sec. Sampling was done at the same site as for water quality and benthics in August. Over wintering habitat was excellent in the reach observed. Snow cover was approximately 450 mm with open water to thick aufice.

Squanga Creek was sampled for fish on June 12, July 17 and 18 , August 22 and October 3 and 4. The creek was divided into 5 distinct reaches (Figure 8).

Squanga Creek has a series of cataracts near its mouth averaging 14% slope. The creek has been investigated for hydro potential by government and private interests. Squanga Creek enters the Teslin River from the west via a long narrow bay. Upstream of the bay the creek flows over a gravel/cobble glide (chinook salmon spawn area). The creek then enters a series of rapids flowing from a steep canyon. The lower portion of these rapids provide excellent rearing habitat for significant numbers of salmon. A series of at least 6 waterfalls occur within the canyon and are a barrier to the upstream migration chinook fry (photo 3). The head of the canyon is a narrow notch in the bedrock forming a 4 meter high waterfall. Within the next 8 meters downstream, the creek drops a further 3 meters. Upstream of the canyon, the creek flows to Squanga Lake as a slow glide with the occasional riffle in a mostly open flood plain.

Juvenile chinook salmon in Squanga Creek had good length distributions with strong classes of larger fish and a modal length of 60 mm (Figure 15).

The following fish were recorded in Squanga Creek: chinook salmon (adults uncommon, and fry abundant), Arctic grayling, burbot, lake whitefish, northern pike, longnose sucker and slimy sculpin.

4.5 Spawning Surveys

Aerial surveys to observe and document spawning chinook salmon in the study area were conducted on August 21 and 22, 1997. Each of the main tributaries and the Teslin River between Swift River and the outlet of Teslin Lake were surveyed.

The Swift River had the largest number of spawning chinook of any of the tributaries. Five adult chinook were observed immediately downstream of the outlet of the Swift in the Teslin River. These fish may have been spawning at this location or were moving into the Swift River. Four salmon were observed moving into the Swift River from the Teslin. In the Swift River, 25 and 36 salmon were counted on August 21 and 22

respectively. Salmon in the Swift River, other than those at the mouth were all at least 1 km from the Teslin River and were spread out between 60° 48.43'N/ 133°50.34'W and 60° 48.45'N/ 133°48.42'W, a distance of approximately 2 km. The upstream limit of salmon observed during 1997 coincided with a large beaver dam which appears to be a barrier to upstream migration of this species at the flows prevailing.

Squanga Creek was the only other tributary where spawning chinook were observed. One live salmon was observed in the creek within 200 meters of the outlet bay of Squanga Creek on August 22, 1997. Ground surveys 2 days later identified 4 carcasses and what appeared to be 2 redds. Based on historical references and habitat assessments, Squanga Creek is likely currently under utilized by spawning salmon.

In the Teslin River spawning chinook were observed at several locations. A number (>100) were observed at the edge of the alluvial fan at the outlet of Hundred Mile Creek. An aggregation of >40 were observed between Muskrat and Meadow Creeks at 60°31.25'N / 133°22.30'W, and 8 salmon were observed at the up-stream side of Henry Island.

The largest aggregation of salmon in the Teslin River were observed above and adjacent to Meadow Creek. This site was spread through a rapids/riffle area and further upstream covering a reach over 2 km long. An accurate count of these fish was not possible due to the fish being in deeper water and the slightly turbid conditions. These same factors likely inhibited the survey crew from denoting other spawning salmon in the Teslin River.

4.6 General Comments

Water levels in the Teslin River mainstem dropped rapidly during the July portion of the fieldwork with an average drop of 1 cm every 8 hours recorded. This steady drop stopped during prolonged rainfall events. The fluctuating water level results in a dynamic condition relative to habitat availability. Habitats available and utilized at some times of the year would not be available at others. This was particularly evident at the outlet (mouth) areas of the tributary creeks where large gravel bars became exposed later in the summer (photo 4). Dropping water levels resulted in the stranding of some chinook fry caught in side pools in the Swift River. These pools eventually dried up, with the fry presumably perishing.

Definite changes in the habitat utilized by chinook fry were noted during the investigation. Many of the changes can be related to the drop in water levels which reduced the availability of certain habitats. As the fry grew their ability to hold in higher velocity water appeared to increase. Moving into higher velocity waters would have the advantage of being able to escape fish predators such as northern pike and burbot, both of which were often caught in slower water adjacent to the habitats utilized by chinook fry.

Many of the tributaries investigated had multiple beaver dams and the influence of beaver activity on stream morphology and fish distribution was evident throughout most

of the study area. The implications of beaver activity is discussed more fully in the restoration options portion of this report.

Since fisheries investigations were directed only on the tributaries of the Teslin River, and not in the mainstem itself, it is beyond the scope of this study to estimate what percentage of chinook fry utilize the mainstem for rearing at any given time. Knowing this would help determine the relative importance of these tributaries to rearing chinook populations in the area. This in turn would help determine the validity of instream enhancement to improve chinook fry rearing habitat in these tributaries.

5.0 ENHANCEMENT OPTIONS

We have avoided making specific recommendations regarding options for restoration/enhancement and rather have chosen to outline options. The final decision on actions undertaken should be left to those charged with managing the resource. The decision as to the restoration options chosen will be influenced by such things as budget constraints and cultural concerns. Further studies planned in 1998 with regards to Traditional Knowledge should help denote methods and direction for future enhancement work. We have tried here to present some of the ecological overviews that should be considered prior to embarking on any restoration/enhancement strategy. Any restoration/enhancement projects should be evaluated on a site basis with specific management objectives outlined and the results monitored and evaluated. This document should be considered a working document that will evolve over time depending on the perspectives/agenda of the managers, and as our knowledge of the ecology of the area increases.

Habitat Management

The limited access to the study area (boat and aircraft) limits the cost effectiveness of many restoration/enhancement options. Most, if not all , of the drainages within the study area are in a virtually pristine state. For the most part, habitats are intact although fish and wildlife harvesting is ongoing. Salmon enhancement could be achieved by restoring historic runs or increasing habitat utilization through habitat modifications, for example, removing barriers at tributary mouths, beaver dams, or adding habitat features (i.e. cover).

Adequate land and watershed management should be considered an important component of any fisheries restoration/enhancement strategy. Encroachment in these watersheds by other land use activities such as forestry, mining, hydroelectric development, and agriculture will likely increase in the future. Critical habitats such as spawning sites and important fry rearing tributaries might be protected through the YTG protected areas strategy and/or the TTC management plan. The TTC are currently developing an integrated resource management plan. It is hoped that the recommendations and suggestions presented here will assist in the development of that program.

Squanga Creek currently has an ongoing investigation by a private interest to determine the suitability of the lower reaches for a micro hydro generating site. Any development on Squanga Creek should be undertaken in such a way as to avoid any negative impacts to the spawning and rearing salmon. There is potential that such a micro hydro site could be developed in a way that allows for stock enhancement of chinook salmon. Such enhancement options as the creation of spawning beds near the outlet of the tail race could provide a net benefit to the salmon population rather than a reduction of habitats.

Building instream cover structures to enhance fry rearing habitat, particularly in the lower reaches of the main tributaries should provide a positive impact on availability of rearing habitats. Hundred Mile Creek and Meadow Creek might be good candidates for fry rearing enhancement due to their proximity to spawning areas in the Teslin River. These creeks appear under utilized by salmon fry due to the abundance of beaver dam obstructions. Fry rearing enhancement might take the form of the removal of beaver dams and/or the building of instream structures to enhance cover. The relative importance of these tributaries to rearing salmon fry is not fully understood without knowing what percentage of chinook fry use the Teslin River to rear at any given time. Prior to implementing this type of enhancement work, a better understanding of the relative importance of the tributaries and mainstem for chinook fry rearing is important. It seems likely, based on the number of fry captured in these tributaries that these creeks provide critical habitat for rearing fry.

The most obvious impact noted on chinook rearing creeks within the study area was caused by beaver activities. Beaver activity has had a significant impact in determining the physical characteristics, and the distribution of chinook fry, in many of the creeks surveyed. What follows is a discussion of some of the considerations that should be taken into account prior to initiating any beaver management strategy.

Beaver and salmon have coexisted for thousands of years and evidence of beaver activity past and present was apparent throughout much of the study area. The inter-relationships between salmon and beaver is both complex and dynamic and beaver can have both positive and negative effects on salmon. It is therefore important to proceed cautiously when assessing the effects of beaver in any specific location. While some of the positive and negative effects of beaver on fish are discussed here, a more complete discussion on this subject is presented in the Department of Fisheries and Oceans *Guidelines for the Management of Beaver in Fish Bearing Streams in the Yukon & NBC Division.*

Beaver dams can prevent upstream access by returning spawning adults and/or instream movement of rearing fry. The life stage of chinook salmon most severely affected by dams are the juveniles that may migrate considerable distances upstream in unobstructed tributaries (DFO guidelines for beaver mgnt). Salmon migrate upstream in summer during a period of lower flows. Beaver dams present more of a barrier at this time than in the spring when the dams may be naturally breached or the volume of water great enough to allow upstream migration. This may vary year to year depending on water levels.

Not all the effects of beaver activity on salmon are negative. Some aspects of beaver utilization may provide positive impacts in terms of salmon rearing; therefore beaver control should be approached with some caution. Many of the choice pools found supporting rearing fry had been created when a beaver dam ruptured, scouring a deep pool in the stream bed. Beavers add to the woody debris found in creeks that often provides habitat for juvenile chinook salmon. Beaver ponds often provide habitat for other fish species. Beaver dams may maintain downstream flows during periods of drought.

Aerial surveys to count adult spawning chinook salmon found that a beaver dam on the Swift River at 60°48'45"N 133°48'42"W was a barrier to the upstream migration of adult salmon. Minnow trapping found no salmon fry upstream of this dam. Historical and traditional knowledge studies reported that salmon carcasses have been found at the outlet of Swift Lake, a considerable distance upstream of where the beaver dam now exists. Habitat assessments conducted during the aerial surveys confirmed that suitable chinook salmon spawning habitat exists upstream in the reach from the beaver dam to the outlet of Swift Lake. Forest cover is composed primarily of mature spruce and preferred beaver foods appears to be limited. This reduces the likelihood of beavers re-establishing quickly once they are removed from this area.
The beaver dam on Swift River is a good candidate for removal to allow for the upstream movement of adult spawning salmon, and increasing rearing habitat for fry.

Beaver dams on Hundred mile Creek and Meadow Creek were found to be restricting upstream movement of rearing chinook fry. While removing these dams would increase the habitat available to rearing salmon fry, the cost effectiveness of such a project is questionable as it seems likely that beaver would re-establish in these areas relatively soon. If the decision was to be made to remove these dams, there should be an accompanying beaver removal program and the creeks should be monitored over the longer term so that any new beaver or beaver dams could be dealt with as they present themselves.

Dam removal should be timed for the period after the chinook fry have emerged from the gravel and before eggs have been deposited downstream. The dam should be lowered to roughly 30% of its height and the breach should be wide enough so as not to constrict the stream. The breach should be located at the pre-existing channel.

The Department of Fisheries and Oceans *Guidelines for the Management of Beaver in Fish Bearing Streams in the Yukon & NBC Division,* provides a protocol that should be consulted prior to initiating field programs.

One option to reduce the numbers of beaver in a given watershed would be to encourage local trappers to remove them. Due to low prices for beaver pelts, a subsidy might be offered to make this more economically viable

The abundance of beaver in a given area is often associated with the successional stage of the forest. Forest fire often results in coniferous (spruce) forest being replaced by a deciduous (aspen/willow) forest, thus producing a habitat more favorable to beavers. Therefore the successional stage of the forest should be considered when implementing beaver control as it will determine the likelihood of success, and the cost effectiveness of such a program. For example, beaver control and dam removal will have a lower likelihood of success in an area of aspen/willow (preferred beaver food) than in an area of mature spruce forest as beaver are more likely to successfully re-establish where food is plentiful. Fire suppression in watersheds that support spawning salmon runs might be a viable tool to manage the successional stage of the forest in favor of the salmon. It should be noted that long term fire suppression has its own environmental effects and these should be considered.

It is important to assess the long-term likelihood of success for any beaver management plan. Beaver control should be accompanied with a monitoring program and

should follow the guidelines laid out in DFO's "Guidelines for the Management of Beaver in Fish Bearing Streams in the Yukon & NBC division".

Harvest Management

An accurate estimate of the spawning population within the study area is important to determine sustainable harvest levels. An enumeration weir may be of value in suitable locations to obtain an accurate count of adult salmon using a particular creek. Such a weir could be operated by TTC and might be moved to different locations or installed on one creek over a period of several years to provide an index of the fluctuating salmon numbers in the system. Weirs could not be installed where they might restrict navigation. Such a program must consider other enumeration techniques currently being practiced, and be designed and located so as to compliment existing information. Other options for estimating spawning populations might include carcass surveys, visual counts or a float survey.

It is important to estimate the sector harvest and effort by both sport and food fisheries. Fishing pressure has been increasing in the study area, with the spawning site located approximately 2 miles downstream of Johnsons Crossing being the focus of much angling effort. A creel survey would be useful to determine the extent of angling pressure and to inform fishermen of conservation concerns with regards to salmon. A number of carcasses of cleaned salmon were evident at the boat launch in Johnsons Crossing. Concern was expressed by members of the TTC that the carcasses were being dumped in the river near the water intake for people living in Johnsons Crossing. Personnel conducting the creel survey could inform fishermen of this and other conservation concerns. The creel survey could be implemented simply as the location is easily accessible. There is also good opportunities to tie this type of program to other studies that may provide some additional funding, such as scale collections and adipose fin collections. Estimates of the extent of the food fishery could be obtained through the implementation of a Native harvest calendar and/or by requiring food fishers to report catches.

A longer term strategy to manage harvest levels should be developed. This might include controlling or capping food fisheries licenses and/or controlling angler harvests through limiting sport angler days or locations (i.e. closures on weekdays, or over spawning locations).

Population Enhancement

Salmon numbers in the study area could be increased through direct population enhancement. Such enhancement could take several forms including relocation of stranded fry, predator reduction and spawn take / fry stocking program (incubation boxes or a centralized hatchery).

Chinook fry sometimes become stranded in side channels that become isolated from the main stem as water levels recede. These channels eventually dry up and the fry perish as occurred in areas of the Swift River. These fry are a good stock for transplant to

suitable stream areas above obstructions, in this case a beaver dam. This approach is relatively low tech and inexpensive, however the number of fry available (stranded) may be low.

Chinook fry stocking and other related methods of fry enhancement should be approached cautiously. Protocols to protect local genetic stocks and community acceptance of techniques to be used require further development. The protocols for direct manipulation (enhancement) of fry and rearing of eggs to the fry stage have not been succinctly developed in the Yukon. Development of such procedures in the Teslin drainage requires consultation with both the peoples of Teslin and the scientific community.

Discussions of several techniques including variations of incubation boxes, fry introduction and other restoration/enhancement techniques will be discussed with the community elders during a proposed traditional knowledge survey proposed for 1998. This should clarify the attitudes of the Elders regarding such restoration and enhancement options as fry stocking and incubation boxes, and therefore help denote methods and direction for future enhancement work. Further development of protocols by the D.F.O. need to be assessed and considered in conjunction with the knowledge gained through the traditional knowledge survey.

Based on historical references and habitat assessments, Squanga Creek is likely currently under utilized by spawning salmon and therefore a good candidate for restoration efforts. Other creeks (tributaries of the Teslin within the study area) may also provide opportunities for direct population enhancement. These creeks include; Meadow Creek, Hundred Mile Creek, Muskrat Creek and Dave Creek. Such enhancement might include installation of incubation boxes or stocking of fry from a centralized hatchery. Egg takes for this could be taken from salmon spawning in areas of the Teslin mainstem near the tributary to be enhanced/restored. Enhancement work in these locations should be accompanied with a beaver control/dam removal program and involve further cursory field work and evaluation.

Several species of fish and avian predators place heavy predation pressure on chinook fry and eggs. The majority of these species exist outside the parameters of management. However, northern pike, found in slower velocities at the mouth/bay areas at creek outlets are voracious predators on fry, a pike only fishing derby was suggested as a method to reduce pike predation.

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Photo 1.
Beaver activity was prevalent throughout much of the study area. This dam is located on Muskrat Creek in reach MK3.

Photo 2. Large numbers of chinook fry were often found in pools associated with breached beaver dams. This pool is located on Meadow Creek (MDW4).

Photo 3. Waterfall on Squanga Creek (SQ3). This waterfall acts as a barrier to upstream migration of fish.

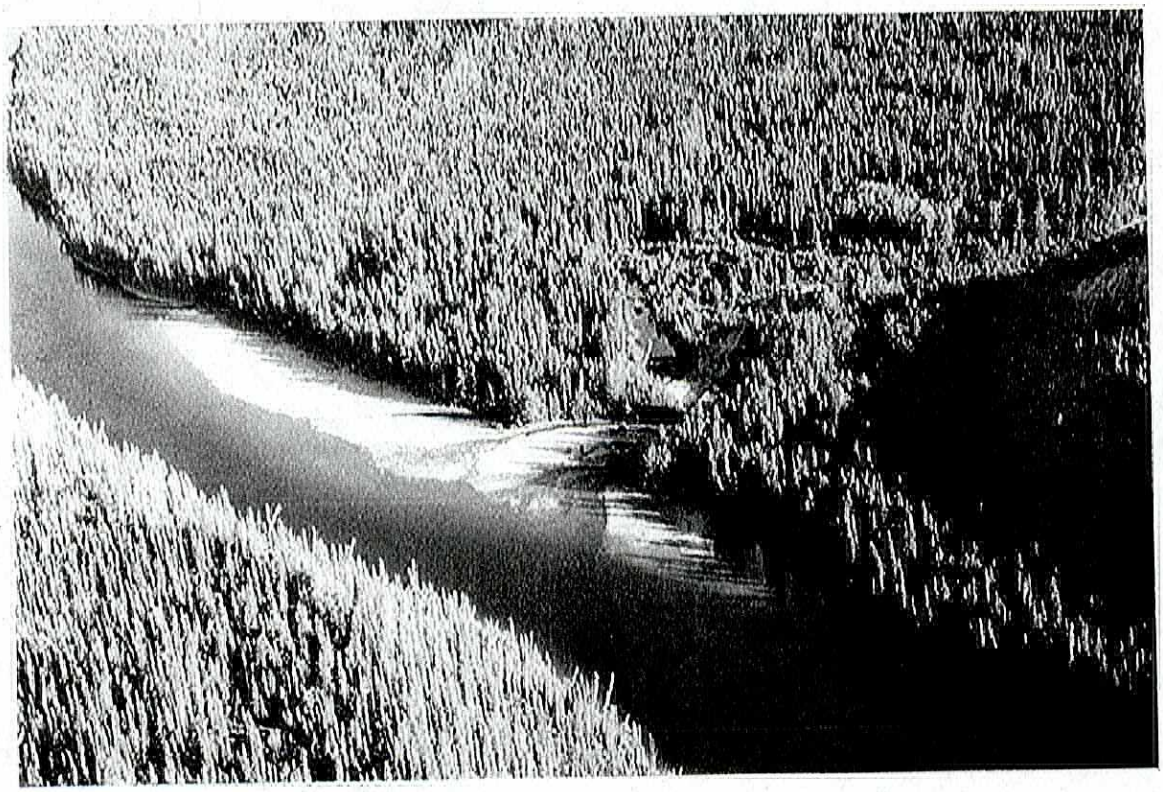

Photo 4. Aerial view of the confluence of Swift River and the Teslin River (SW1). Note the exposed gravel bar in late summer conditions.

Table 1.) Summary of Minnow Trap Results showing catch per unit of effort (# chinook/total effort) for chinook salmon (CH) on the Teslin River,Summer, 1997.

Creek	Site	# Traps set	Total effort (hrs)	# CH captured	CPUE (#fish/hr)	other species*
Swift River	SW1	5	106.35	6	0.06	LCB,BB,LNS,SS
	SW2	3	65.8	15	0.23	SS
	SW3	4	89.3	10	0.11	SS
	SW4	8	175.7	40	0.23	SS
	SW5	4	86.9	16	0.18	SS
totals		**24**	**524.05**	**87**	**0.17**	
Hundred Mile	H1	7	178	6	0.03	SS
	H2	4	100.65	10	0.10	SS
	H3	8	203.45	110	0.54	none
	H4	8	209.2	0	0.00	SS
totals		**27**	**691.3**	**126**	**0.18**	
Dave Creek	D1	4	94.6	5	0.05	SS
	D2	6	136.9	88	0.64	BB
	D3	15	307.9	31	0.10	SS
totals		**25**	**539.4**	**124**	**0.23**	
Wilson Creek	W1	4	96.3	0	0.00	none
	W2	4	96.4	0	0.00	LNS
	W3	8	189.2	2	0.01	SS
	W4	4	93	6	0.06	SS
	W5	4	92.3	1	0.01	SS
totals		**24**	**567.2**	**9**	**0.02**	
Squanga	SQT	11	161.25	32	0.20	none
	SQ1	8	199.3	0	0.00	NP
	SQ2	8	200.05	11	0.05	BB,NP
	SQ3	20	510.35	191	0.37	BB
	SQ4	7	157.56	0	0.00	SS,AG
	SQ5	7	121.95	0	0.00	NP
totals		**61**	**1350.46**	**234**	**0.17**	
Muskrat	MK1	3	70.2	2	0.03	NP
	MK2	2	46.8	7	0.15	NP
	MK3	8	186.5	46	0.25	NP
	MK4	6	138.7	47	0.34	none
	MK5	3	68.9	0	0.00	SS,LCB
totals		**22**	**511.1**	**102**	**0.20**	
Meadow Creek	MDW1	2	46.8	7	0.15	SS,LCB
	MDW2	3	71.95	85	1.18	SS,BB
	MDW3	14	324.4	223	0.69	SS
	MDW4	5	114.05	20	0.18	SS
totals		**24**	**557.2**	**335**	**0.60**	

* Species code: CH=chinook salmon, LCB=lake chub, SS= slimy sculpin, BB=burbot, LNS=longnose sucker, NP=northern pike, AG=Arctic grayling.

Table 1.) Summary of Minnow Trap Results continued.

Creek	Site	# Traps set	Total effort (hrs)	# CH captured	CPUE (#fish/hr)	other species*
unnamed 1	U1	3	58.5	2	0.03	SS
unnamed 2	U2	4	80.85	20	0.25	none
unnamed 3	U3	5	104.3	10	0.10	LCB
unnamed 4	U4	5	115.85	5	0.04	SS
unnamed 5	U5	9	205.77	32	0.16	SS
unnamed 6	U6	9	203.4	4	0.02	none
unnamed 7	U7	6	136.7	4	0.03	SS
unnamed 8	U8	5	112.2	36	0.32	none
unnamed 9	U9	5	112.8	3	0.03	SS
unnamed 10	U10	8	179.2	0	0.00	none
unnamed 11	U11	3	78.9	0	0.00	none
unnamed 12	U12	4	105.8	0	0.00	SS
unnamed 14	U14	3	73.1	0	0.00	none
unnamed 15	U15	3	75	0	0.00	none
unnamed 18	U18	3	62.1	0	0.00	none
unnamed 19	U19	5	107.5	0	0.00	SS
unnamed 20	U20	5	119.9	0	0.00	SS,NP
unnamed 21	U21	7	167.45	0	0.00	none
unnamed 22	U22	4	95	0	0.00	none

* species code: CH=chinook salmon, LCB=lake chub, SS= slimy sculpin, BB= burbot, LNS= longnose sucker, NP= northern pike, AG= Arctic grayling.

Table 1.) Summary of Minnow Trap Results continued.

Creek	Site	# Traps set	Total effort (hrs)	# CH captured	CPUE (#fish/hr)	other species*
unnamed 23	U23	3	71.55	0	0.00	none
unnamed 24	U24	2	48	0	0.00	none
unnamed 25	U25	5	118.85	0	0.00	none
unnamed 26	U26	5	117.8	1	0.01	NP
unnamed 27	U27	5	118.05	0	0.00	none
unnamed 28	U28	5	114.45	0	0.00	none
unnamed 29	U29	3	68.05	1	0.01	none
unnamed 30	U30	8	187.85	1	0.01	none
unnamed 31	U31	5	118.3	0	0.00	none

species code: CH=chinook salmon, LCB=lake chub, SS= slimy sculpin,BB= birbot, LNS= longnose sucker, NP= northern pike, AG= Arctic grayling

Table 2). Summary of Electro-fishing results showing catch per unit of effort (# chinook/total effort) for chinook salmon (CH) captured on tributaries of the Teslin River, July 1997.

Creek	Site	# ELS	Total effort (sec)	# CH	CPUE	Other species
Dave	D1	1	95	36	0.38	SS, LNS
	D2	2	465	6	0.01	SS
	D3	5	779	3	0.00	AG,RWF,SS
Hundred Mile	H1	1	89	70	0.79	none
	H2	1	155	0	0.00	SS
	H3	1	193	7	0.04	SS,AG
	H4	3	495	0	0.00	SS
Squanga	SQ2	1	160	0	0.00	none
	SQ3	1	326	16	0.05	SS,AG
	SQ5	1	305	0	0.00	SS,AG
Swift	SW1	4	124	*450+	n/a	SS,LNS
	SW2	1	80	*50+	n/a	SS

* estimate

Table 3). Summary of seine netting results showing catch per unit of effort (#chinook/total effort) for chinook salmon (CH) captured on tributaries to the Teslin River, July and August, 1997.

Creek	Date	Site	# seines	Total effort (m2)	#CH	CPUE	other species
Dave	Aug, 97	D1	3	137	17	0.12	SS,AG
	July, 97	D2	2	56	125	2.23	SS
	July, 97	D3	4	N/A	24	N/A	AG,SS,UI
Hundred Mile	July, 97	H1	1	63	1	0.02	SS
	Aug, 97	H2	1	35	534	15.26	AG
	July, 97	H2	2	74	31	0.42	none
	July, 97	H3	5	138	157	1.14	AG,SS
Meadow	July, 97	MDW3	2	N/A	0	N/A	SS
	Aug, 97	MDW3	1	30	364	12.13	AG
Muskrat	Aug, 97	MK1	1	90	10	0.11	none
	July, 97	MK2	1	49	0	0.00	RWF
	Aug, 97	MK3	1	72	102	1.42	none
	July, 97	MK3	1	49	59	1.20	AG,SS
	July, 97	MK4	1	28	125	4.46	none
	July, 97	MK5	6	158	1	0.01	AG,SS
Swift	July, 97	SW1	2	102	323	3.17	AG,SS
	Aug, 97	SW2	3	N/A	143	N/A	AG
	July, 97	SW3	2	105	119	1.13	none
	July, 97	SW4	3	60	653	10.88	SS
Squanga	Aug, 97	SQ2	2	148	65	0.44	NP,RWF,LNS
U21	July, 97	U21	1	49	0	0.00	BB,COR (sp.),NP,LC
U5	July, 97	U5	1	21	79	3.76	SS,COR (sp.)
Wilson	Aug,97	W2	6	368	9	0.02	SS
	July, 97	W3	3	115	17	0.15	SS

Species code: CH is chinook salmon, SS is slimy sculpin, AG is Arctic grayling, BB is burbot, NP is northern pike, COR (sp.) is whitefish species, RWF is round whitefish, LNS is longnose sucker.

Table 4). Biological data for chinook salmon fry captured in tributaries to the Teslin River, August 1997.

		Length (mm)		Weight (g)			
Site	N	mean length	Range	mean weight	Range	SD	mean K
Swift River	62	58.0	(44 - 82)	2.0	(1.0 - 5.4)	0.88	0.99
Hundred Mile Creek	40	70.4	(55 - 89)	3.6	(1.5 - 6.7)	0.89	1.01
Dave Creek	18	63.7	(53 - 76)	2.6	(1.7 - 4.1)	0.67	1.01
Wilson Creek	9	76.0	(60 - 97)	5.0	(2.0 - 10.6)	2.52	1.06
Squanga Creek	36	75.4	(60 - 89)	4.9	(2.7 - 8.6)	1.16	1.12
Muskrat Creek	31	74.7	(55 - 90)	4.3	(2.1 - 7.9)	1.46	1.01
Meadow Creek	29	77.9	(55 - 91)	4.6	(1.6 - 8.3)	1.29	0.95

Table 5). Weight at length relationships for chinook salmon fry captured in tributaries to the Teslin River, August 1997.

Site	N	slope (b)	RSQ	Y intercept (a)
Swift River	62	2.82	0.81	-4.69
Hundred Mile Creek	40	2.64	0.84	-4.34
Dave Creek	18	2.54	0.83	-4.16
Wilson Creek	9	3.29	0.99	-5.53
Squanga Creek	36	2.80	0.85	-4.58
Muskrat Creek	31	2.74	0.93	-4.52
Meadow Creek	29	2.96	0.94	-4.95

Table 6). Summary of the Physical Characteristics and Benthic Data for Upper Teslin River Tributaries, August, 1997.

SITE DESCRIPTION	DATE 1997	SUBSTRATE DESCRIPTION	WATER TEMP (°C)	D.O. (mg/L)	D.O. (%)	COND (uS/cm)	MEAN VELOCITY (m/s)	MEAN DEPTH (m)	FLOW (m^3/sec)	TOTAL ABUNDANCE	TAXONOMIC RICHNESS	DENSITY # of organisms per square metre	DOMINANT TAXA
Swift River	Aug 21	Surber gravels: 10 - 15 cm brown algae covering most rocks	13.2	11.6	119	231	0.61	0.23	1.859	1143	57	4101	Diptera
100 Mile Cr	Aug 21	Surber gravels: 5 - 10 cm otherwise mostly fines	8.6	12.7	121	193	0.28	0.12	0.419	1078	47	3868	Diptera
Dave Creek	Aug 21	Surber gravels: 8 - 13 cm	9.4	12.9	125	220	0.63	0.10	0.280	497	37	1783	Diptera
Wilson Creek	Aug 22	Surber gravels: 4 - 6 cm	9.7	12.5	121	180	0.73	0.10	0.508	317	39	1137	Plecoptera Ephemeroptera
Squanga Creek	Aug 22	Surber gravels: 5 - 10 cm main channel had cobbles >20 cm, filamentous green algae covering large rocks	11.7	9.6	98	270	0.63	0.22	1.224	437	42	1568	Diptera
Muskrat Creek	Aug 22	Surber gravels: 5 - 8 cm	9.6	10.1	97	120	0.55	0.13	0.451	518	45	1859	Diptera Ephemeroptera
Meadow Creek	Aug 22	Surber gravels: 5 - 8 cm otherwise mostly silt	9.4	11.2	110	100	0.38	0.11	0.658	8	8	29	Diptera

NOTE: Mean velocity and mean depth were calculated from measurements at the three Surber sites.

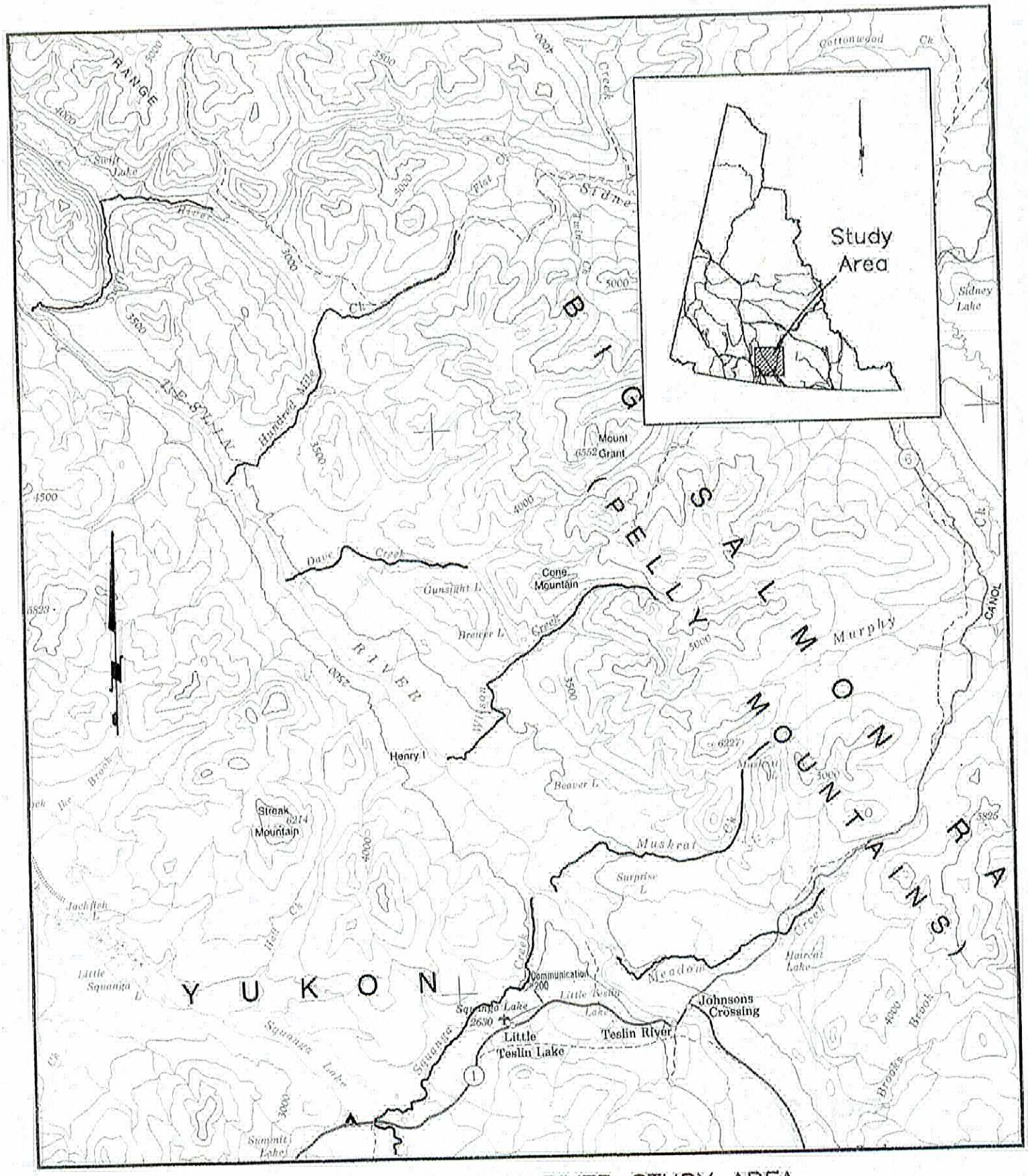

FIGURE 1 : TESLIN RIVER STUDY AREA

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

5 0 5 10 15 Km

SCALE 1:250,000

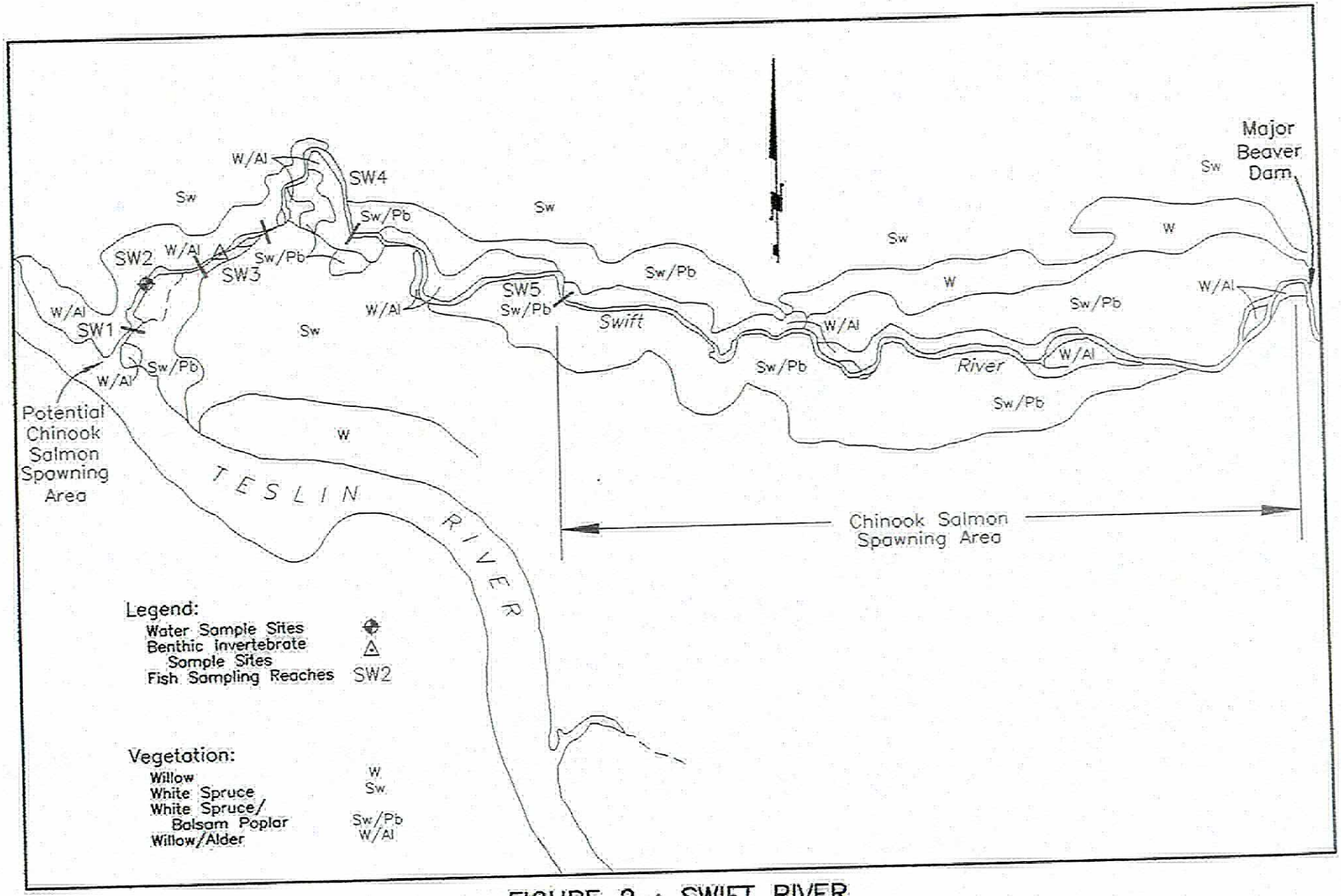

FIGURE 2 : SWIFT RIVER

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

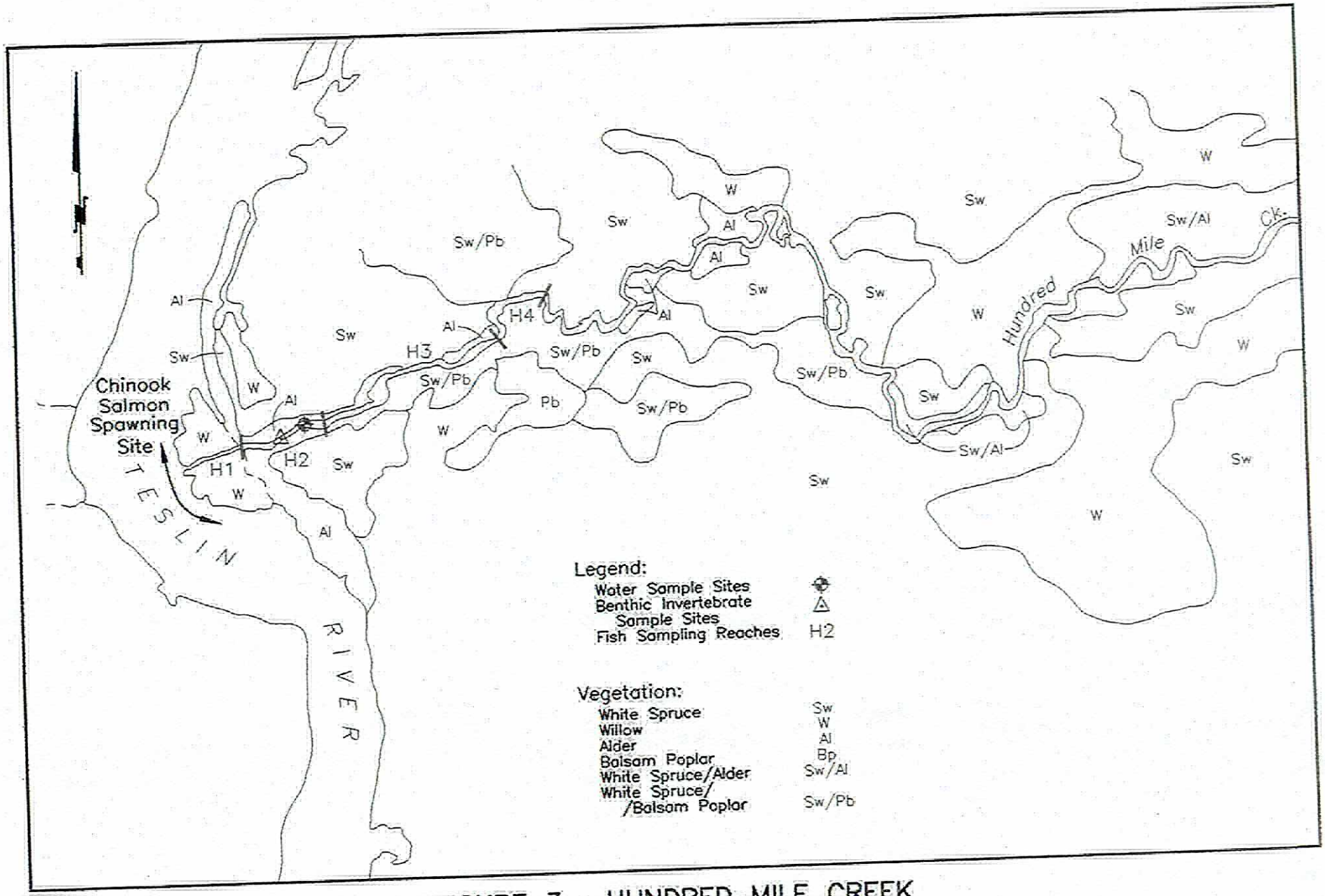

FIGURE 3 : HUNDRED MILE CREEK
TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

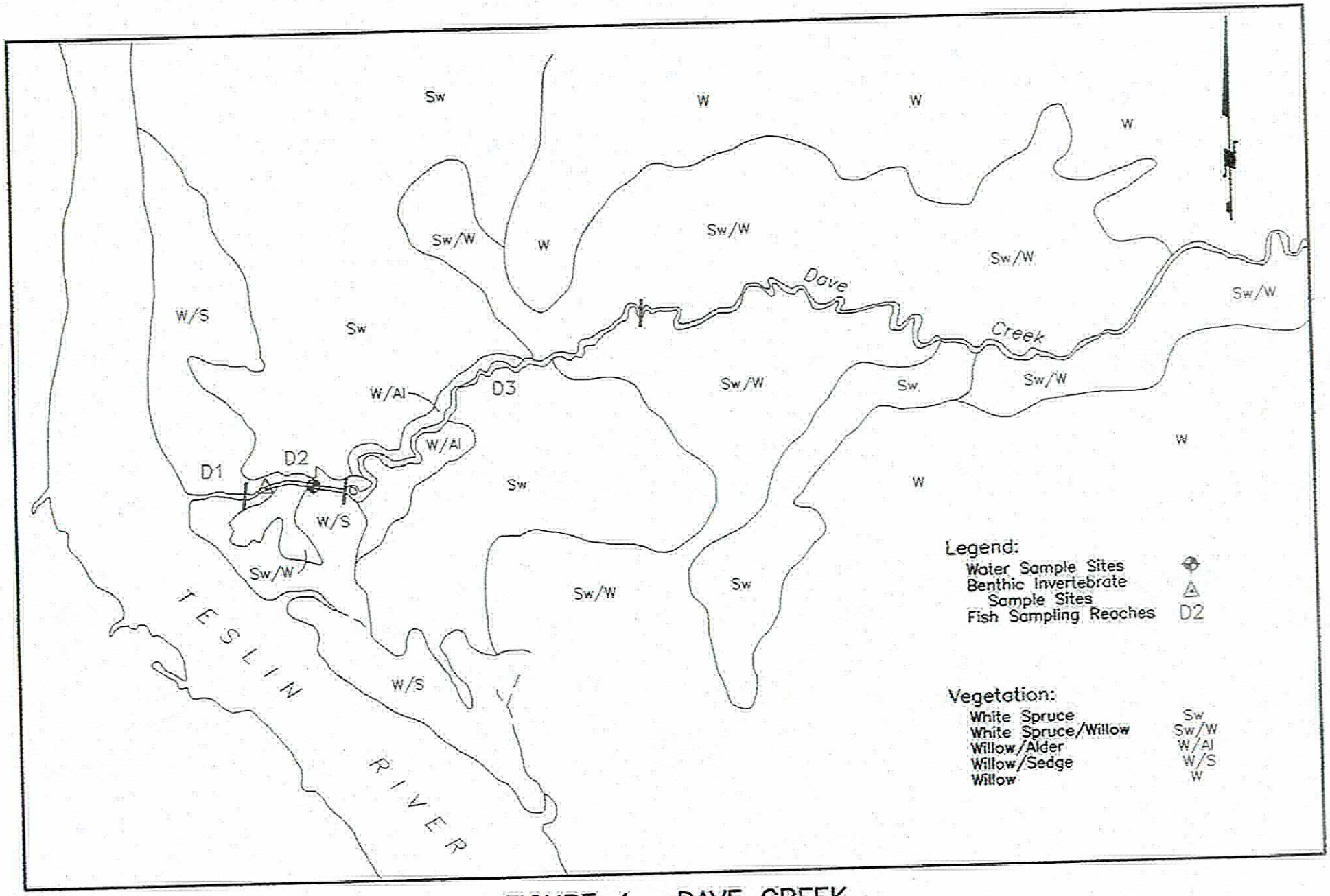

FIGURE 4 : DAVE CREEK

TESLIN RIVER TRIBUTARIES SALMON HABITAT
RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

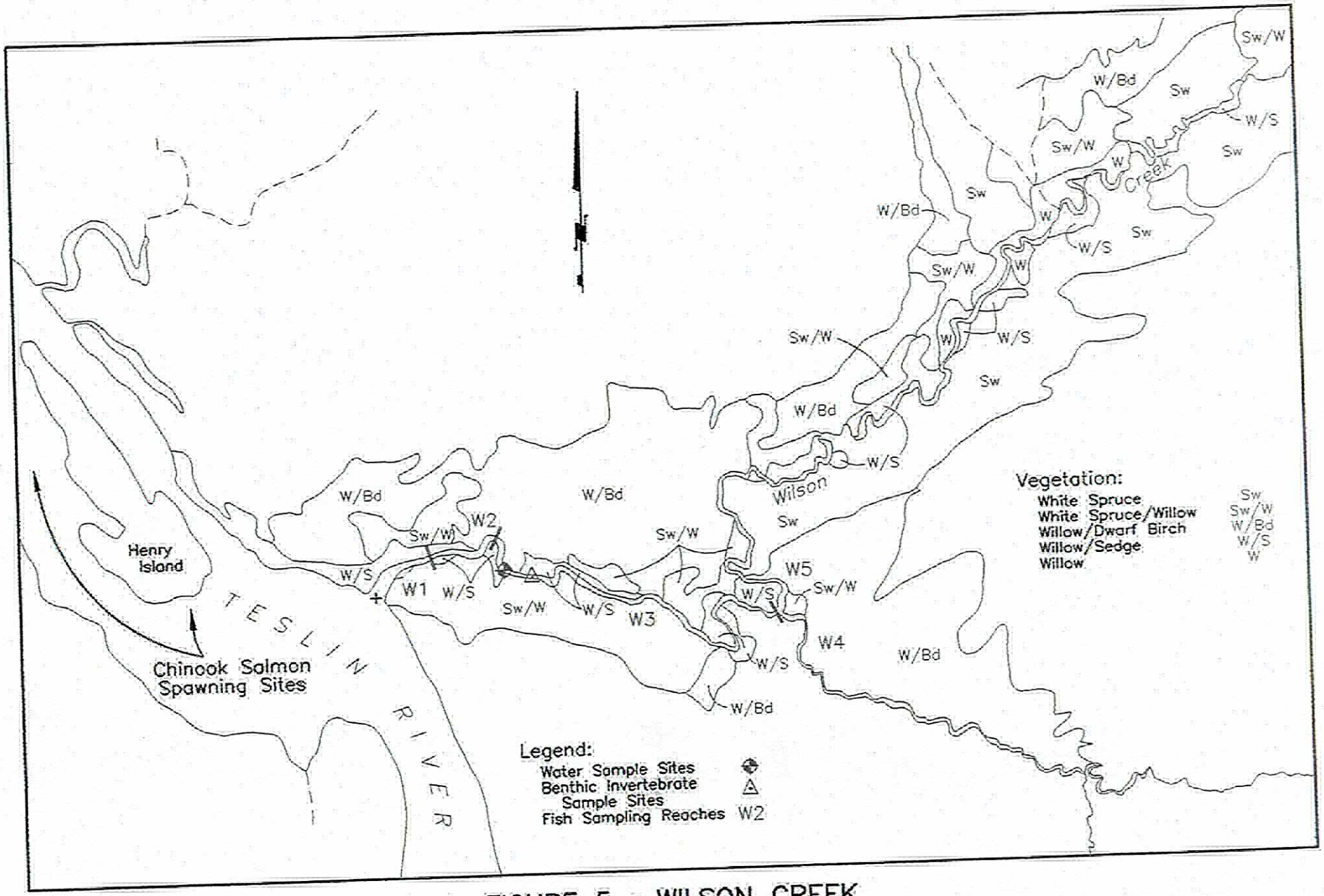

FIGURE 5 : WILSON CREEK

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

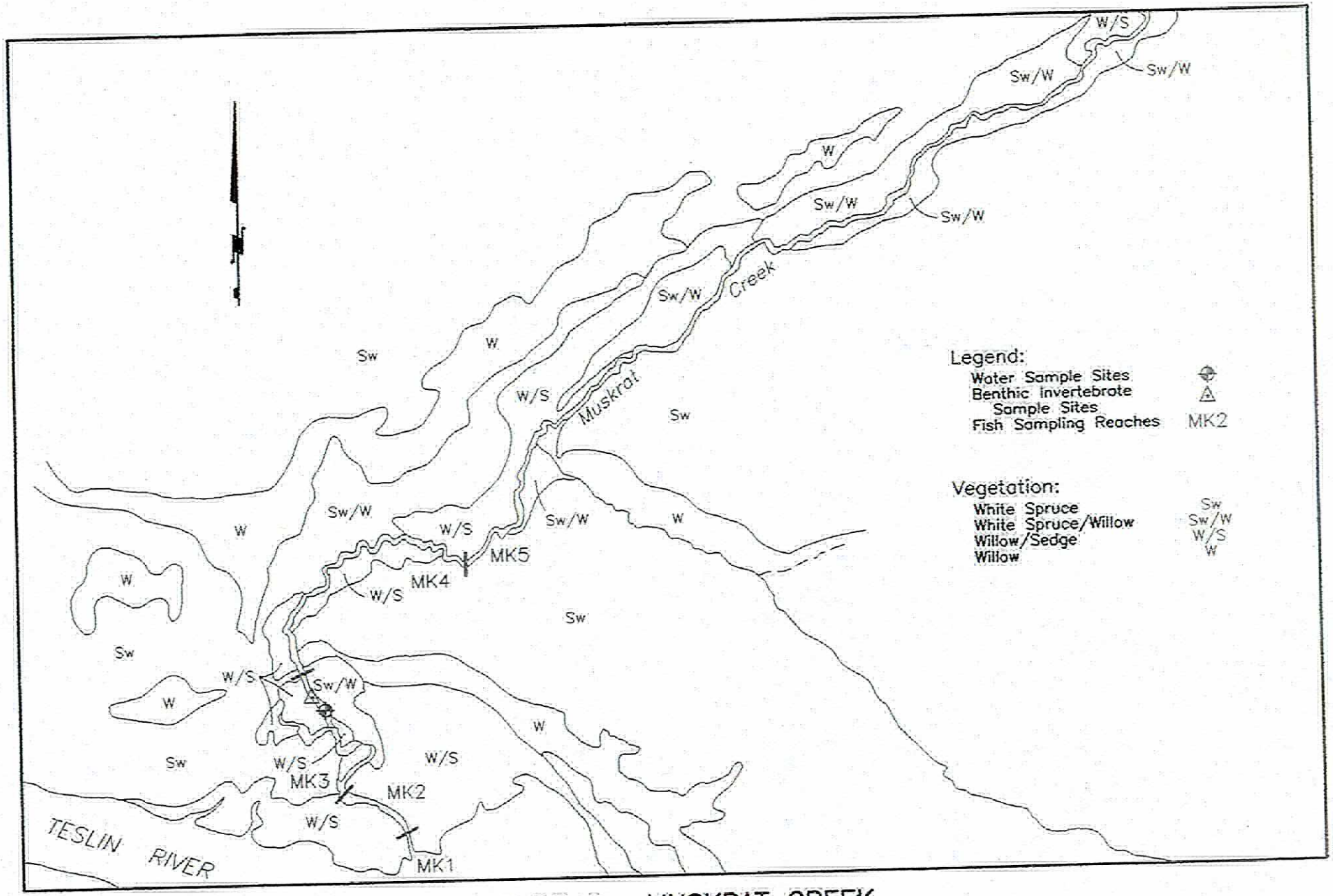

FIGURE 6 : MUSKRAT CREEK

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

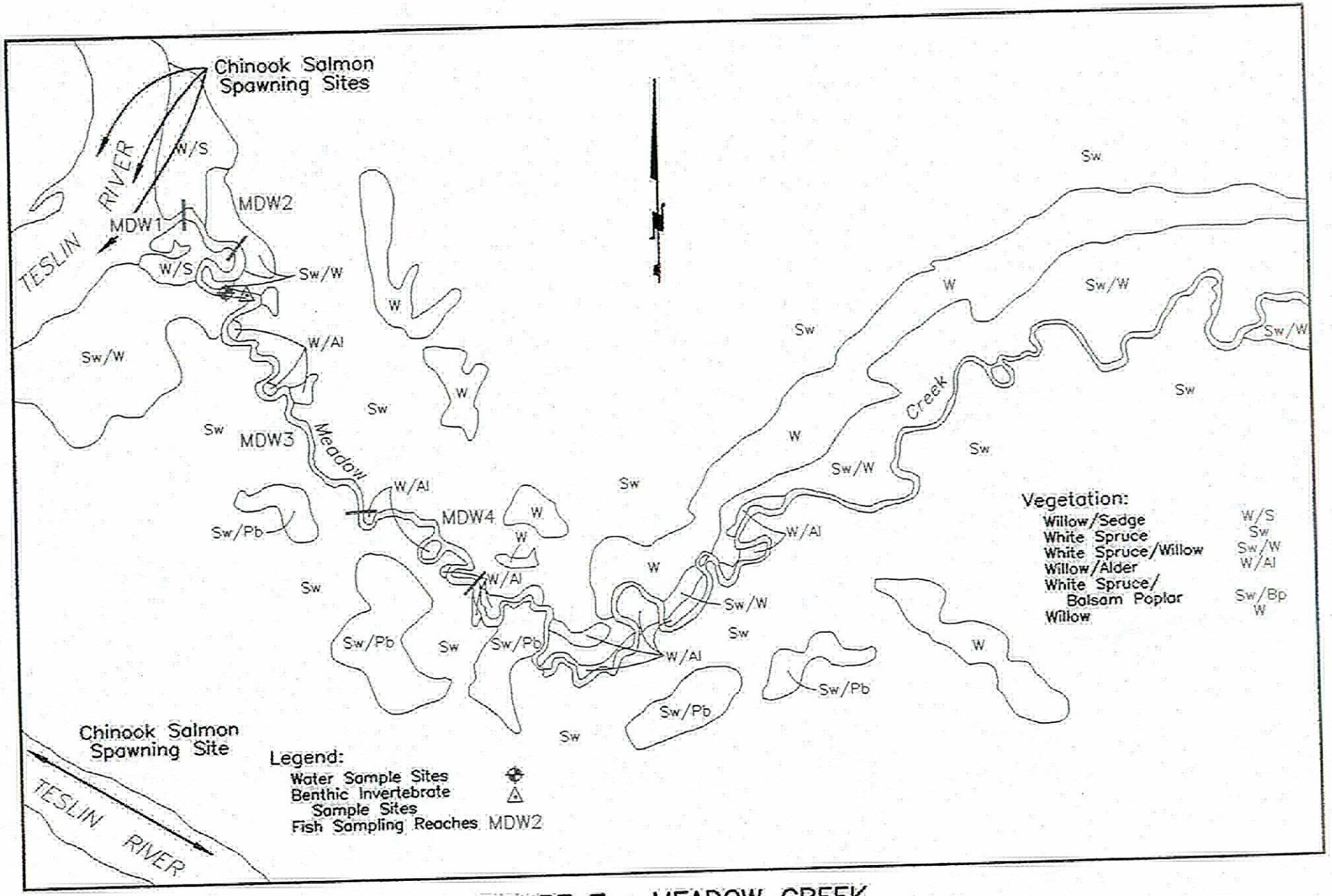

FIGURE 7 : MEADOW CREEK

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

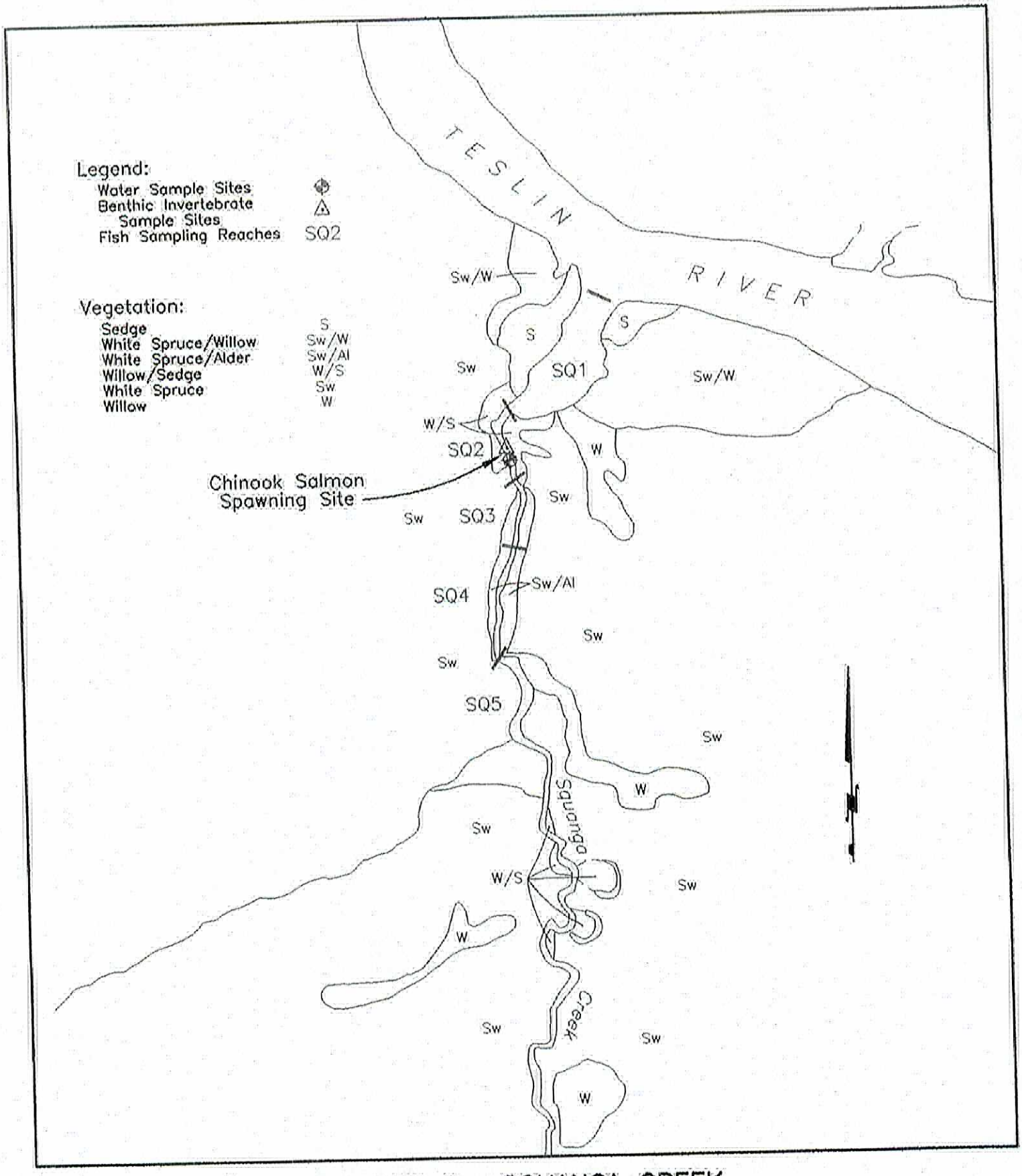

FIGURE 8 : SQUANGA CREEK

TESLIN RIVER TRIBUTARIES SALMON HABITAT RESTORATION and ENHANCEMENT STUDY

100 0 100 200 300 400 500m

SCALE 1:10,000

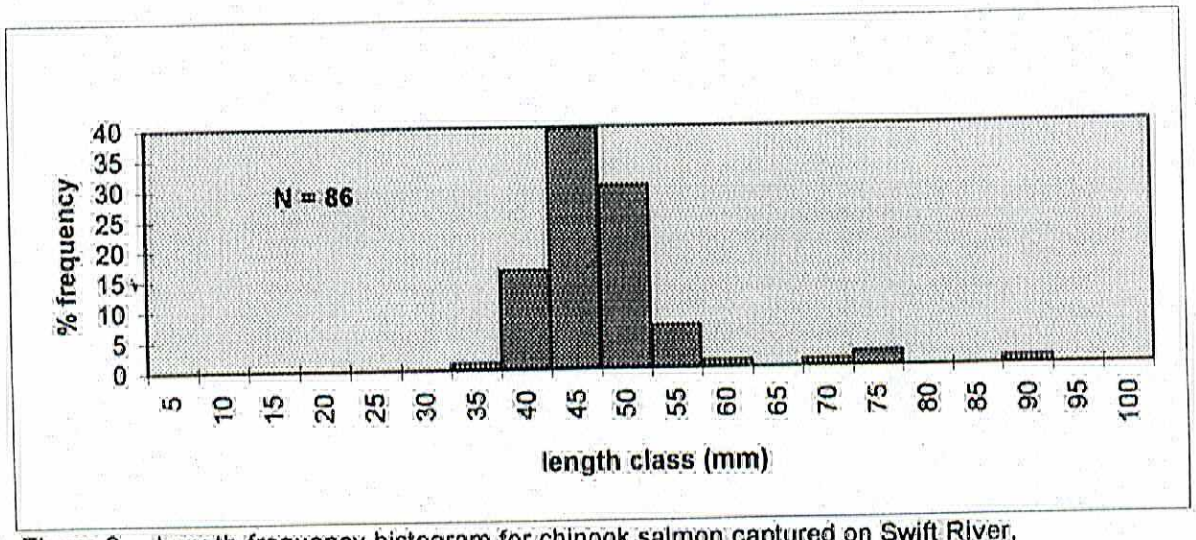

Figure 9. Length-frequency histogram for chinook salmon captured on Swift River, Yukon, July 4-5, 1997.

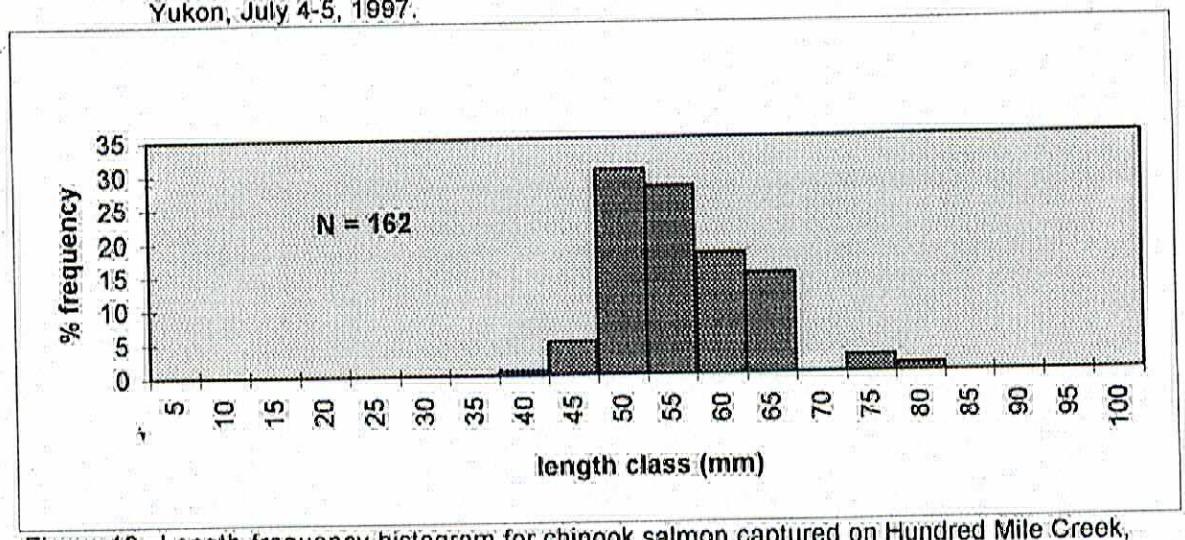

Figure 10. Length-frequency histogram for chinook salmon captured on Hundred Mile Creek, Yukon, July 7- 8, 1997.

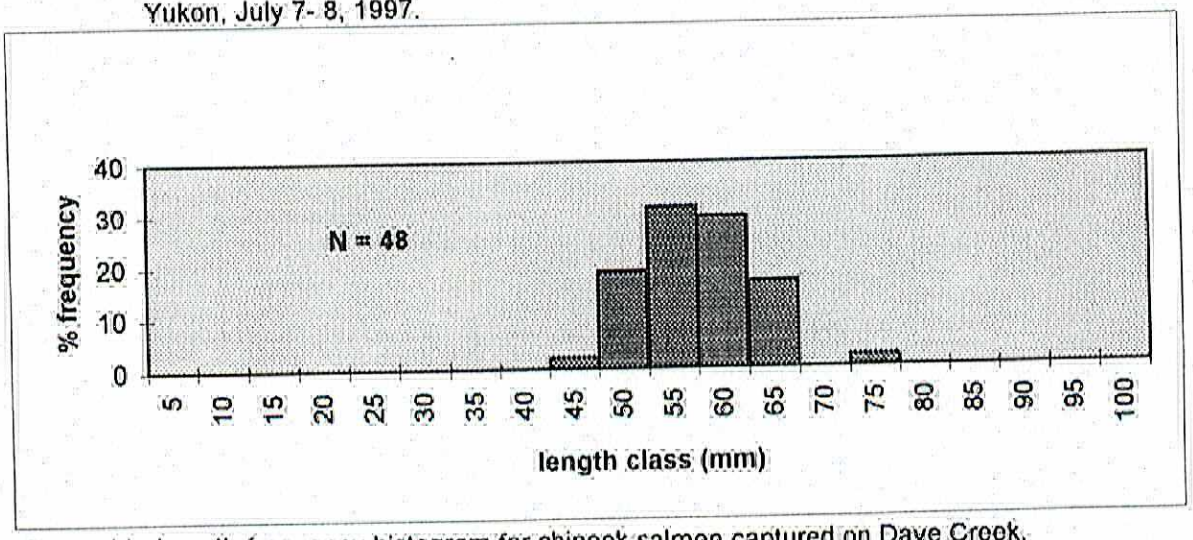

Figure 11. Length-frequency histogram for chinook salmon captured on Dave Creek, Yukon, July 8 - 9, 1997.

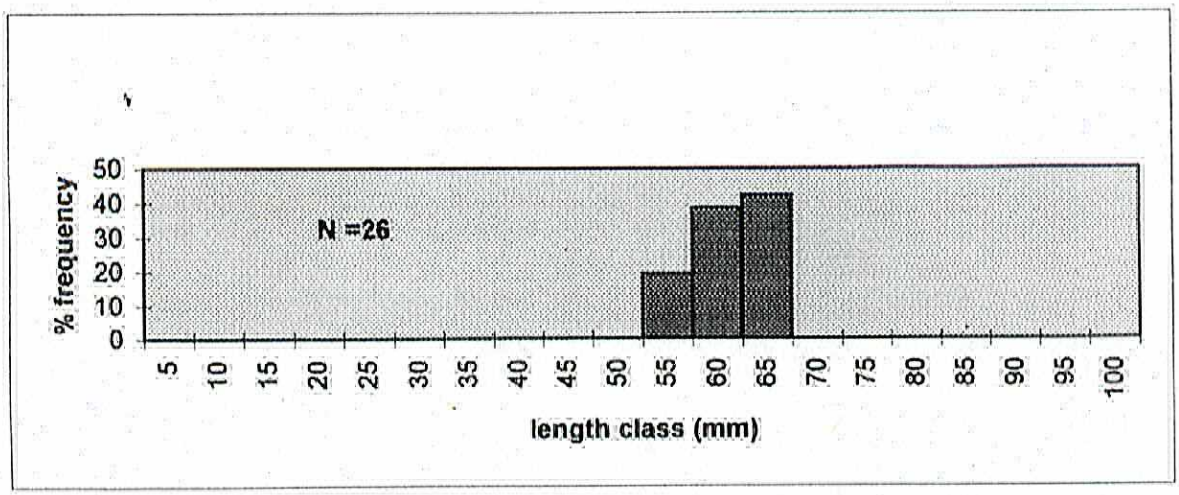

Figure 12. Length-frequency histogram for chinook salmon captured on Wilson Creek, Yukon, July 16-17, 1997.

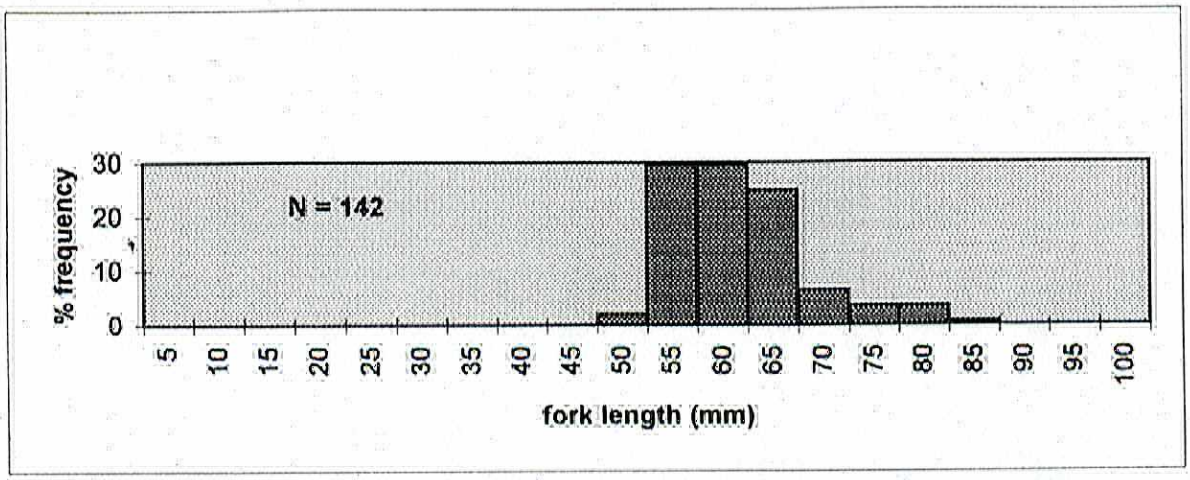

Figure 13. Length-frequency histogram for chinook salmon captured on Muskrat Creek, Yukon, July 18-19, 1997.

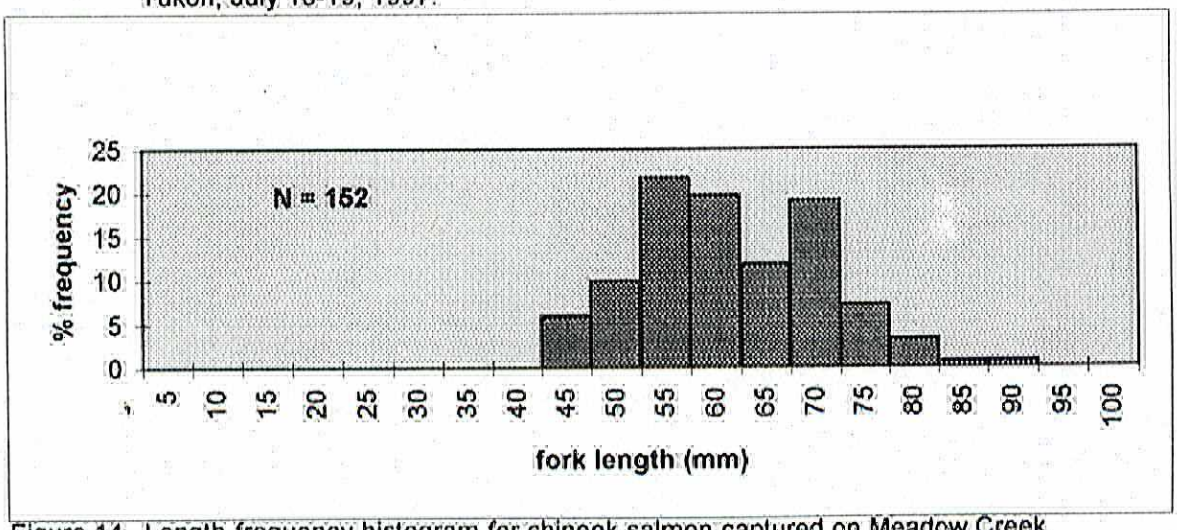

Figure 14. Length-frequency histogram for chinook salmon captured on Meadow Creek, Yukon, July 19-20, 1997.

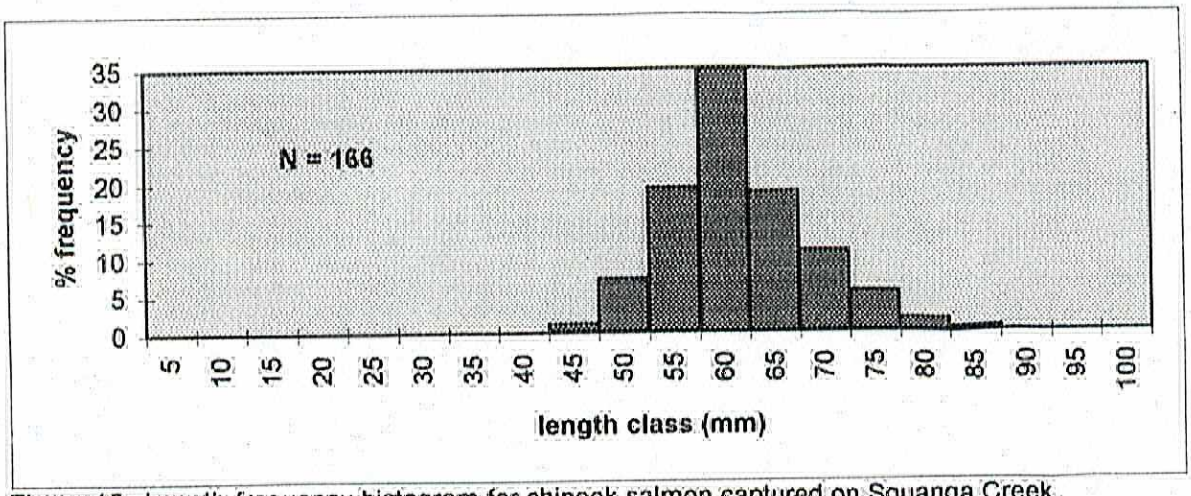

Figure 15. Length-frequency histogram for chinook salmon captured on Squanga Creek, Yukon, July 17-18, 1997.

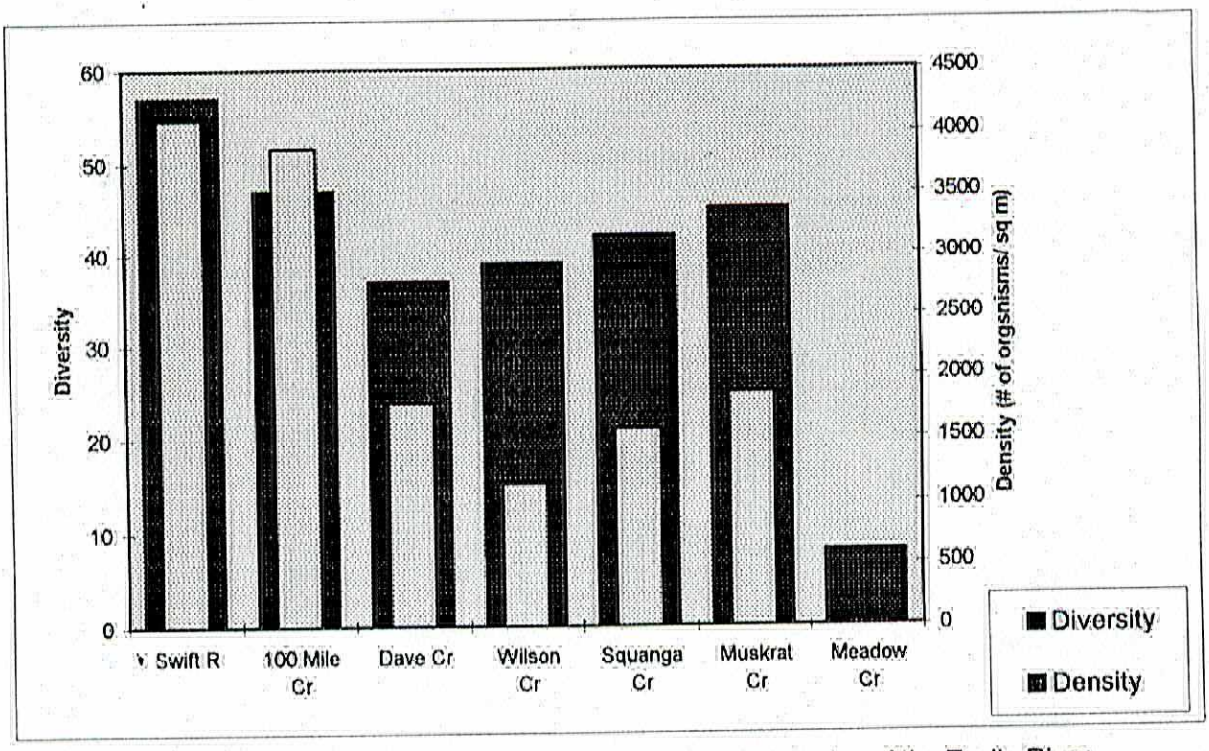

Figure 16. Density and diversity of benthic invertibrates on tributaries of the Teslin River, summer 1997.

APPENDIX 1:

BACKGROUND INFORMATION AND ARCHIVAL RESEARCH

Background Information & Archival Research

Early Accounts of Teslin River Area

The rare nineteenth and early twentieth-century written accounts of the Teslin Lake area are by individuals with an interest in only certain aspects of the country — geology, trade, wood supplies for steamers, access to the Klondike, the morality/spirituality of the First Nations people, etc. Noting their observations about the fish was not a priority.

Individual placer miners worked in the Teslin Lake area — most were on the Teslin River — during the 1880s and early 1890s. George M. Dawson, leader of the 1887 Yukon Expedition sponsored by the Geological and Natural History Survey of Canada, learned about the Teslin River from Tom Boswell and two other miners who had spent most of the summer on it: "They had found fine gold all along the Tes-lin-too and also on the Ni-sutlin-hi-ni. They worked in different places along the river and appear to have done fairly well."[1]

In 1895, a significant number of prospectors and traders from the coast moved to Teslin Lake and made it their base for various enterprises. The routes from the Stikine River and Taku River to the inland had been used by native people, Hudson Bay Company traders and surveyors for the Western Union Telegraph Company. Interest in the Teslin area steadily grew, and when people were seeking routes to the Klondike in 1897, the Canadian and British Columbia governments questioned the possibility of developing the Stikine-Teslin route, later known as the "All-Canadian Trail."

The Department of the Interior sent Arthur St. Cyr to the area in 1897 to investigate the viability of a wagon road and navigability of the Teslin River. The party explored the Teslin Lake area in June and returned to the area to go downriver in October 1897. Two and a half miles below the outlet of the Teslin River, St. Cyr noticed several houses built by miners in the previous year. He noted that "where [the river] runs close to the foot of the benches which impinge on the river, it has caused extensive land slides, leaving bare the face of the hills and forming high cut-banks of clay and gravel. These alternate with flats formed by the materials carried down stream during the season of high water."[2]

St. Cyr submitted a favourable report of the route, and plans were made to build a railroad along it. The Hudson's Bay Company established a post on Teslin Lake in 1898, and by the autumn, the trail had guided many prospectors up the Stikine River and over to Teslin Lake before the B.C. government withdrew its support for the railroad. Unfortunately, for the purposes of this report, personal accounts of Stikine-Teslin route have minimal information about the fish and wildlife of the Teslin Lake area.

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[1] Dawson, George M. Report on an Exploration in the Yukon District, N.W.T. and Adjacent Northern Portion of British Columbia 1887. Montreal: 1889, reprinted 1987, p. 156B.

[2] St. Cyr, Arthur. "Report of A. St. Cyr, D.L.S. Exploration of the Country between the Stikine River and the Mouth of the Teslin River," in Annual Report of the Department of the Interior for the year 1897. Ottawa: 1898, pp. 120-21.

The Population

In December 1898, the manager of the Hudson's Bay Company post in Teslin estimated that there were only about a dozen native people living by the post while others lived in the surrounding area.[3] In April 1900, he reported a total of 30.[4] These numbers do not, however, reflect the nomadic population of the area.

The non-native population was more transient at the turn of the century. Although some people passed through the area en route to either the Dawson gold fields or to Atlin, others remained to prospect and mine. R.G. McConnell of the Geological Survey of Canada travelled through the area in June 1898 and reported: "Fine gold is found in a number of bars and beaches along the Teslin [River], but as a rule in inconsiderable quantities."[5] Some work had been done, but he noted that the streams did not pass through particularly promising gold country.

A number of lease applications for dredging in the Teslin River were filed in the early 1900s. People could apply for one lease of up to 10 miles. A letter from the Assistant Gold Commissioner R. C. Miller (March 26, 1908) states that he has had applications for leases between the 10 and 20 mile mark from the mouth since 1899. In another letter to an applicant, he wrote that the entire stretch of river was leased except for a small section beginning 35 miles from the mouth up for five miles and another section beginning 50 miles from the mouth and up for five miles.[6] Although the federal government issued these leases, the archival records do not indicate what — if any — work was done. There are, however, remains of some dredging equipment at O'Brien's Bar on the lower part of the Teslin River.

By 1909, the Anglican church had established itself in Teslin, and in the following year, Tom Smith began hauling supplies in his launch from Whitehorse to set up a new trading post. In 1911, the Whitehorse-based firm of Taylor & Drury opened another post in Teslin, and the company's steamer, the *Thistle*, also delivered supplies to the prospectors along the Teslin River once a year. In a letter in 1920, Mr. W. Drury noted that there was a party of miners at Hundred Mile Landing.[7]

In 1940, Father Marcel Bobillier noted that Teslin residents consisted of two storekeepers (one of whom had a family), one RCMP officer and 175 native people.[8] In 1944, after the Alaska Highway was completed, there were 150 native people in Teslin.

The U.S. Army constructed the bridge across the Teslin River to support the Alaska Highway and the Canol Pipeline in 1942. The army engineers named their camp "Johnsons Crossing." Approximately 25 people — native and non-native — currently live at Johnson's Crossing during the summer months.

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[3] Mitcham, Allison Mitcham. Taku: The Heart of North America's Last Great Wilderness. Nova Scotia: 1993.

[4] McClellan, Catharine. My Old People Say: An Ethnographic Survey of Southern Yukon Territory. National Museums of Canada, Ottawa: 1975, p. 48, referring to L. W. Hall, "Journals for Teslin Post," at the HBC Archives, Winnipeg.

[5] McConnell, R.G. "Big Salmon River, Teslin River and Lake, Nisutlin River and route from Teslin Lake to Telegraph Creek," 1898, in Bostock, H.S., ed. Yukon Territory. Selected Field Reports of the Geological Survey of Canada, 1898-1933, Queen's Printer, Ottawa: 1956, pp. 11-17.

[6] Yukon Archives: Yukon Government Records, YRG 1, GOV 1959, series 5, Vol. 13, f. 739

[7] Yukon Archives: Yukon Government Records, YRG 1, GOV 1889, f. 12-3B 1920

[8] Bobillier, Marcel. Journal d'un Missionnaire au Yukon. 1939-1969. [Yukon Archives: October 2, 1940. MF #65, 88/46]

Fishing

Subsistence

Catharine McClellan did her anthropological fieldwork in the Teslin area in the late 1940s and early 1950s. "A few families drift net for salmon in the Teslin River just below Johnsons Crossing at the foot of the lake. Using gas lanterns to attract the fish, two boats will drift for about half a mile with a gill net strung between them. The boats usually make about four runs an evening. Some of the salmon caught are in good enough condition for human consumption, but many are fit only for dogs."[9]

McClellan was told about a number of other fishing sites along the tributaries to Teslin Lake (e.g. on the Nisutlin River), but she stated that: "...in spite of the number of old fish camps, the only place where the Teslin band of Inland Tlingit now seems to catch and dry salmon to any extent is at Johnsons Crossing, and most of the fish caught there seem to be primarily for the dogs. Other people apparently rely solely on lake fish, meat, and commercial feed for their dogs." People would usually feed the head and backbone to their dogs and, if the fish was in reasonable shape, keep the ribs and sides for their own use. "One woman said that she dried 100 to 300 salmon a summer for her dogs, and that these fish she might get as many as 10 weighing 45 or 50 pounds."[10]

In a 1954 report from the RCMP Teslin detachment, the constable described the First Nations fishery in the Teslin River as being primarily for individual use. Based on his interviews with a number of First Nations people, he reported: "Very little fishing is done by the Indians for commercial use as this usually starts trouble among them for some reason or other... It should be pointed out that construction work in the Teslin Area is gradually decreasing , and many of the Indians engaged in this type of work will be forced to return to fishing and trapping within a year. If this takes place, approximately 35 families of the Teslin Indian Reserve will have to depend upon fishing and trapping etc. for a living. In past years, each Indian family depended on catching one hundred to one hundred and twenty King salmon in the Fall of the year to be used as food for the winter months. King salmon and Whitefish are the main species of fish preferred by the Indians for consumption. Other types are caught, but are used mostly for feeding the dogs in winter."[11]

In 1955, the U.S. Fish and Wildlife Service initiated studies of the salmon resources in the Upper Yukon River watershed in order to predict the effects of proposed hydro-electric developments. Alaskan researchers and Canadian representatives travelled to Johnson's Crossing and Teslin to visit the First Nation fish camps and take fish samples, and they conducted aerial surveys. They observed that: "Prior to the construction of the Alaska Highway, the native populations living on or adjacent to this drainage were directly dependent upon the salmon resources for a substantial portion of their winter food supply. Today, the situation has changed somewhat, and many of the younger men are engaged in construction work and no longer devote time to the catching and processing of salmon. The use of gillnets for the catching of salmon is a recent innovation. Elderly natives state that, formerly, weir-type traps were installed across the streams for the purpose of catching salmon. This method apparently was very effective in capturing fish and it is conceivable that, in many streams where the installation reached from shore to shore, all of the ascending salmon were captured and the runs were exterminated."[12]

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[9] Ibid, p. 195.

[10] Ibid, p. 194.

[11] Gillespie, B.J. (Const.). "Re: Fisheries Act - Yukon Territory (Asst. to Dept. of Fisheries," Teslin Detachment, RCMP, November 5, 1954. [National Archives of Canada: DFO records, RG 23, Acc. 1990-91/236, Vol. 78, f. 721-4-27, Vol. 3.]

[12] U.S. Fish and Wildlife Service. United States Department of the Interior. Progress Report No. I: A Special Report on the Salmon Resources of the Upper Yukon River Basin (above Carmacks), Yukon Territory, Canada. Juneau, Alaska: April 1956, revised December 1957, p. 15.

Despite the reports of large salmon runs in the Teslin River, the aerial spawning ground surveys conducted between August 25 and 28, 1955, revealed few salmon in the drainage. The U.S. Fish and Wildlife report suggests three possible reasons: the native people believed that the salmon were late in arriving; the demand for food was so high before the construction of the Alaska Highway that many of the runs were completely destroyed through over-fishing; and thirdly, 1955 may have been a low year in the cycle.

First Nations people continue to fish for salmon in the Teslin River. Most salmon are caught from Johnson's Crossing down to Hundred Mile Creek. Within this stretch of river, most of the fishing is done in the two miles below the Teslin River bridge.

Domestic

It does not appear that the non-native prospectors, trappers and residents in the early part of the century took a significant amount of salmon or other fish from the Teslin River area. This conclusion is made for two reasons. Firstly, fishery inspectors' reports for the Yukon Territory between 1900 and 1918 state that Teslin Lake is fished mainly by First Nations people.[13] In one letter, the inspector reported on his 1906 trip through the territory and briefly described the Livingstone Creek and Hootalinqua (Teslin) River District: "Indians are the only fishermen here. Quite a number of miners here but they do no fishing."[14] Secondly, in a petition to the Commissioner of the Yukon in 1920 seeking a permit to kill game out of season for personal use, residents at Teslin Lake wrote: "We catch and use fish when procurable but fish are only to be obtained at certain places and at certain times, and furthermore fresh water fish are both difficult to handle and not suited as a sustained diet."[15]

Salmon may have been caught by fur farmers for their animals as it was standard practice to feed fish and game to the captive animals. Fur farming was a booming Yukon industry in the 1920s and 1930s, and at least three people were involved in fur farming (mink) at Teslin Lake — George Geddes, Annie Ida Young and Robert McCleery.[16] Joseph Crandle, who had been leasing 160 acres at Hundred Mile Landing on Teslin River since 1914, also operated a mink ranch.[17]

Commercial

No commercial fishing licenses are issued for the Teslin River. Records of licenses issued in the 1940s and 1950s show that people did fish commercially in the river at Johnson's Crossing, but the species of fish are not indicated.

Sport

According to First Nations' residents of Johnson's Crossing and Teslin, the number of people angling near the Teslin River bridge during the salmon spawning season has been steadily increasing over the last 10 to 15 years. One fisherman has counted up to 16 boats trolling back and forth on the river while a

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[13] The Fishery Inspector did not submit reports for every year from 1900 until the termination of this position, but the existing reports do list the number of fish taken by First Nations from Teslin Lake.

[14] Letter from Horace McKay, Fishery Inspector, Dawson, to R.W. Venning, Assistant Commissioner of Fisheries, Ottawa, October 12, 1906. [National Archives of Canada: DFO records, RG 23, vol. 328, f. 2801] It should be noted, however, that the fishery inspector was posted in Dawson, and because he was responsible for the entire territory, his knowledge of the situation in the southern end of the territory was limited.

[15] Letter to Hon. G. P. Patton Mackenzie, Commissioner, signed by 10 individuals, Teslin Lake, January 5, 1920. [Yukon Archives: Yukon Government Records, YRG 1, GOV 1884, f. 12-3B]

[16] Yukon Archives: YRG 1, GOV 1891 f. 12-6; GOV 1892, f. 12-8A & 12-8B

[17] It is unclear when he began his mink farm, but it was in operation in 1918. In 1924, Brewer left the territory and the entry was cancelled. [Yukon Archives: Yukon Government Records, YRG 1, GOV 1962, Series 5, Vol. 16, f. 930]

number of other people fished from the shore. There is a boat-ramp at Johnson's Crossing, and the owners of the restaurant/campground have a couple of boats and a fish-cleaning table available, and they give advice to people interested in fishing. Although most of the fishers are from Whitehorse, the owner hopes to expand the business over the years to provide fishing opportunities to tourists.[18]

Other Factors possibly affecting the fish

Small boats and steamers began plying the Teslin River at the turn of the century. However, the size and depth of the Teslin River limited the size of the boats. The steamer *Anglian*, built at Teslin Lake, travelled the river supplying the prospectors and residents of the area, but R.G. McConnell reported that the Teslin River was lower than usual in 1898, and by the end of August, the steamer could not make its way upstream past the shallow bars. As noted above, Taylor & Drury used a steamer to deliver supplies to its Teslin post and to people along Teslin River. The RCMP also had a launch that travelled the river to supply the Livingstone and Teslin detachments.

While the impact of the construction of the highway on the native people, their lifestyle and the wildlife in the Teslin area have been documented, the effects of the highway camps and personnel on the salmon fishery is not mentioned.[19] Fish would have been affected to some degree by the two bridges built by the U.S. Army — one over the Nisutlin River and one at Johnson's Crossing — and by the sternwheelers that barged fuel up the Teslin River to Teslin.

Documented Fishery Information

Local knowledge

Spawning areas along the Teslin River within the study area are identified on map.

Don Henry, Whitehorse & Johnsons Crossing, June 27, 1997.

- Last year he caught 20 or so fish. He is not a full-time fisherman, but he just goes out to catch a few.
- He saw salmon in both Swift River and Squanga Creek about three or four years ago.
- **Swift River:** He saw two salmon in a sandy place just up from the mouth. He also saw one carcass up by Swift Lake, about 200 yards below the lake (about 4 or 5 miles up the creek). He knows they go up there to spawn. It is quite jammed up the river and shallow at the mouth, but if there was a channel, more salmon would go through. The river should be opened up, but people should not fish there to let them spawn.
- **Squanga Creek**: He knows they go up the creek as far as the waterfalls. There is less water in Squanga Creek than Swift River. He saw one big salmon up the creek just below the waterfalls. He suggests dumping sand in Squanga for spawning.
- **Hundred Mile Creek**: He has never seen them up the creek.
- there is a creek crossing the Canol Road about 1.5 miles up that comes out in the Teslin about two miles below Johnsons Crossing where he has never seen salmon in it, but he think it would support salmon.
- **Deadman Creek**: salmon go up this creek. He has never seen them but old Jim Smarch told him that he saw dead ones up it.

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[18] Personal communication, September 25, 1997.

[19] Including: Coates, Ken S. Best Left as Indians: Native-White Relations in the Yukon Territory, 1840-1973. McGill-Queen's University Press, Montreal: 1993.

Pansy Allen, Johnsons Crossing. June 26, 1997.

- **Squanga Creek:** Her mom used to go a little way up Squanga Creek to gaff. The water is not too deep — about knee-high.
- **Hundred Mile Creek:** She doesn't go up the creek but there are salmon at the mouth.
- **Brooks Brook:** Her sister used to see little fish there before the water trucks put in the screen to pump water.
- In the last two years, the salmon run at Johnson's Crossing has been better than usual. They came at the end of July and stayed to the end of August — the longest runs she can ever remember. She caught 23 salmon last year.

Bert Goodevin, Teslin. June 26, 1997.

- **Meadow Creek:** It might be cleaned up now, but it may be a possible future site. It had been dammed and there is more sediment in the spring.
- **Squanga Creek:** People have said the salmon used to go up, but the creek gets steep and they would reach the waterfalls and would not be able to get up.
- **Wilson Creek:** He has never heard of salmon being there.
- **Hundred Mile Creek:** There are good numbers at the mouth. The creek comes to a fan, but there is no real channel for the fish to go up. There are lots of salmon at the mouth.
- **Dave Creek:** There is about the same volume of water as Hundred Mile Creek, but not as many fish at the mouth.
- **Swift River:** He has seen them trying to go up Swift River. He has not been up this river for several years. There is quite a bit of water. There is a gravel bar below Swift River where he has seen them floating around. They spawn at islands just past Swift River.
- There is a lot of catch-and-release fishing around Johnson's Crossing and at the head of the river. There are more fishermen at the foot of the lake. The current lodge-owners seem to be promoting fishing more.

Jim Smarch, Teslin, June 26, 1997.

- Children used to watch the salmon spawning from the bank, but now there are many rod fishermen drifting over the spawning areas above Meadow Creek. One day, he saw 16 boats at one time — "so many you could cross the river on them" — not including the people fishing from the shore. The fish have moved away, and he wonders where too. He wonders if they are above the bridge. This heavy fishing began 10 or 15 years ago. He is opposed to people fishing and catching the spawning salmon. The locals usually fish in the evening when the beds and spawners would be disturbed less;
- Just above Meadow Creek, there is an island where they spawn;
- They spawn just above Henry's Island. When coming toward the island from above, you go around a bend and see lots of spawners. There is a kind of slough there. He doesn't know if there are any below that on the north side;
- from Meadow Creek all the way down, there are clay flats in the creeks. He doubts if the salmon go up those creeks.
- **Squanga Creek:** He doesn't know if the salmon can still go up the creek. They used to go up.
- When the fish spawn, they will stay on the downstream side of a creek where the gravel has come down;
- Beaver dams should be taken out in the fall. They are easier to pop out then, or, if it has to be done in the spring, it should be done in high water.
- **Other:** he has seen salmon above the Canol Road crossing on Sidney Creek and in the Cottonwood in the bend by the Canol Road; at the reef at the Fox Creek outlet into Teslin Lake.

Marge and Orville Smith, Teslin, June 26, 1997.

- Over the past 20 years, they have been fishing more on the lake and stay within the first three miles of the river. When they go to Johnson's Crossing, they fish under the bridge. In the past few years, they have stayed in the lake.
- There is good spawning area about half a mile down from Johnson's Crossing. There are now a lot of people trolling who go back and forth about 300 yards hoping to catch or snag the salmon. This really disturbs the fish because they are trying to prepare their beds.
- **Mary River:** Orville thinks he remembers people saying the salmon used to go up there.
- **Squanga Creek:** Marge has seen a lot of dead ones in the backwaters in Squanga Creek below the falls.
- Lots of salmon go up the **Nisutlin and Morley rivers**, and they go up the Wolf River to Wolf Lake and beyond.
- The chum come in late fall.
- People used to feed the heads and backbones of the salmon to the dogs, and they would eat the rest.
- The Teslin and Johnson's Crossing people really just go as far as Hundred Mile Creek to fish for salmon. The Ross River people would come across and go down the river from there. The people from Carmacks come up the Teslin a little ways from the mouth.

Winnie Read, Johnsons Crossing, June 23, 1997.

- The salmon would go to any of the little outlets and creeks where there is enough water and gravel. They will go where there are gravel bars and back eddies. There is gravel all the way down to Hundred Mile Creek.
- **Dave Creek:** this is at the end of her trapline. She has seen dead salmon at the mouth.
- **Twelve Mile Creek:** Her mother saw a dead salmon up this creek. The water must have been high that year.
- On right-hand side below her home (east side of Teslin River), where the water is calm, deep and muddy, there is a back eddy by the point where the salmon spawn.
- She has seen dead salmon right in the main river at **Hundred Mile Creek** and at the big bend by **Mary River**.
- **Swift River:** There is a beaver dam there. She does not go past this creek.
- She thinks that a good time to see where the fish are is in the fall when the salmon are dying and drifting.
- Most of the big salmon are just below the point past her house (across from the restaurant/campground). She has seen lots of white heads and tails. She sees small ones in August all the way down the river to Hundred Mile Creek. Whether or not people see them up the creeks is another question. She doesn't know. The salmon are mostly in the main river. Other than Swift River, the creeks are not deep.
- She sees lots of activity and redness in the water at the point past Johnson's Crossing. She sees lots of drifting fish in the first part of September. One year in September, she found a 40-lb., dead salmon in a creek above Dave Creek. It looked fresh but was dead.

Scientific studies

The earliest survey of the fish resources in Teslin Lake and its tributaries was conducted in 1944.[20] In response to the growing interest in commercial fishing opportunities in Teslin Lake and other lakes adjacent to the new Alaska Highway, Clemens et al. investigated all types of fish and noted that two species of Pacific salmon reach the lake in late summer and early autumn to spawn in the tributary streams of the lake.[21]

To understand the impact on salmon of a number of proposed large-scale hydro projects in the late 1940s and 1950s, the Canadian and American governments needed basic information about the fisheries in the upper Yukon River. One of the developments proposed in 1953 by Ventures Limited and its subsidiary companies involved diverting water from Teslin River to Marsh Lake via Mary River, Michie Creek and McClintock River. Beginning in 1954, the Department of Fisheries and its Alaskan counterparts carried out investigations in the upper Yukon River, including the Teslin River. The Department of Fisheries asked for information from the police detachments and sent biologists to the area, while the Alaskan Department of Fish and Game conducted aerial surveys and field investigations.

In 1958, the Department of Fisheries relieved the RCMP of the responsibility of enforcing the fisheries regulations in the territory by creating the position of fishery officer in Whitehorse. The new officer filed a number of reports of his observations beginning in 1959.

In 1973, biologists conducted a study for the Fisheries and Marine Service that focused on the Teslin watershed. Based on the limited number of aerial surveys conducted since 1959, fisheries staff estimated the total run in the Teslin system at 3,700 to 8,600 fish annually of which 2,000-5,000 spawn in the Teslin River.[22]

In the mid-1970s, there were a number of fishery investigations in the Johnson's Crossing area at the proposed Foothills gas pipeline crossing.

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[20] Clemens, W.A., R.V. Boughton, J.A. Rattenbury. A Limnological Study of Teslin Lake,Canada. Management Publication No. 12 of the British Columbia Fish and Wildlife Branch, 1968.

[21] When the Saskatoon Tannery Company submitted a proposal to supply personnel on the Alaska Highway all the way to Fairbanks by fishing on Teslin and Swan lakes and all tributaries to these lakes (Sept. 10, 1943), R. A. Gibsen responded that the fisheries would be depleted. He insisted on full protection of the interests of the Indians in the Teslin Lake area and stated that William A. Johnston was already commercially fishing there. It is highly unlikely, however, that these fishermen were interested in the salmon; whitefish and trout were the fish of preference. [Yukon Archives: Yukon Government Records, YRG 1, GOV 1904, f. 28798]

[22] Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973, p. 2.

Summary of information about the salmon and the fishery[23]

Teslin River

	Observations	Source
1902	Observations in September: "Another band of Indians, belonging to Big Salmon and Hootalinqua, were hunting and fishing on the upper reaches of the Hootalinqua River... Pike and grayling are very plentiful in the Hootalinqua, the former being caught by net, and the latter taking the fly. Lake trout were easily caught in Lake Teslin by trolling, some fine specimens being obtained. A fair number of salmon were seen, but these fish were not fit to eat so far from salt water but they make good dog feed."	"Report of Corporal Acland of the Livingstone Creek Detachment," Oct. 7, 1902, in the Report of the North-west Mounted Police, 1902. Ottawa: 1903.
1954	"At present there are approximately 15 Indians fishing the Teslin River in that area within ten miles of Teslin Lake. The number of King Salmon taken from the aforementioned area this year is approximatley 400. The average weight of these fish is 17 pounds... The run of King Salmon in the Teslin River Area is said to be very good and the only reason for limited fishing at this time, is the employment provided the Indians by Construction Projects in this area at present. The Run of King Salmon is from the last week of July to the first week of September, and the spawning period is the last three weeks of the run near the mouth of the Teslin River. There are two known heavy spawning areas near the mouth of the Teslin River, one is two miles north of the Johnson's Crossing Bridge, and the other is eight miles North of the Bridge. Fishing is usually carried on during the spawning period... It appears that most of the fishing done by the Indians, is near the mouth of the Teslin River, that is for King Salmon. As far as can be ascertained Chum (Dog) salmon are not found in either the Teslin River or the Morley River. The Indians claim that this type of salmon is not found in this area."	Gillespie, E.J. (Const.). "Re: Fisheries Act - Yukon Territory (Asst. to Dept. of Fisheries)," Teslin Detachment, RCMP, November 5, 1954. [National Archives of Canada: DFO records, RG 23, Acc. 1990-91/230, vol. 78, f. 721-4-27, vol. 3]
	"The Teslin River from its mouth to Teslin Lake appears to be one of the principal spawning areas for chum salmon in the Yukon system above Dawson City... Spring Salmon are known to spawn in the Teslin River and tributaries of Teslin Lake (Morley and McNaughton Rivers etc.) These are exploited by an Indian Fishery at Johnsons Crossing (outlet of Teslin Lake) as well as by the commercial fishery downstream."	Report prepared by Department of Fisheries, Vancouver: "Additional Comments on Effect of Yukon-Taku Development on Fisheries, prepared as a result of Inspection of Area by Fisheries Personnel, July, 1954." [National Archives of Canada: DFO records, RG 23, Acc. 80-81/260, vol. 1226, f. 726-11-7 (1)]

[23] Most of the information is quoted directly from the source and was not edited.

1955	Field trip to native fish camps below Johnson's Crossing. "Three native families were fishing for king salmon in the Teslin River, about three miles below the highway bridge at Johnson's Crossing. More than 300 king salmon were taken here during the last two weeks in August. These fish were also captured by gillnets which were drifted with the current during the night. It was the general opinion of these people that the run this year was very poor but that the condition of the fish appeared better than in previous years. Without exception all the natives reported that the salmon were late in arriving on the spawning grounds... Length-weight frequencies, sex and scale samples were taken from 49 specimens. Of this sample 40% were males and 60% were females. Average weight was 19.5 pounds and the average length was 32.2 inches. (Measurements were made with steel tape from center of eye to fork of the tail along the contour of the body). Maximum and minimum weights recorded were 33.0 pounds and 7.5 pounds respectively, while the maximum and minimum lengths were 40.3 and 26.7 inches... Of the [scale] samples collected, 25% were age 5_2 having a length range of 26.0 inches to 36.0 inches, while 69% were age 6_2 and fell within the length range of 31.0 to 41.0 inches. Only 6% of the sample were age 7_2 which fell within the legnth range of 36.0 to 40.0 inches." [pp. 11-13] "Early historical records obtained through interviews with local residents who have lived in the area for a considerable number of years indicate that king salmon were widely distributed throughout this basin. These reports indicate that king salmon were present in varying abundance in most of the major tributaries. The reliability of these data is somewhat questionable; however, they represent the only known historical records currently available. As such, they provide some indication of the early distribution and abundance of salmon in this watershed." [pp. 14-15] "On the basis of the information obtained, it may be stated that the Teslin watershed presently supports king salmon runs of greater magnitude than does the main stem of theYukon above the confluence of the Takhini River. The large tributary streams of the Teslin River possess a far greater potential for the spawning and rearing of king salmon than do the tributaries of the main stem of the Yukon above the confluence of the Takhini River." [p. 17-18]	U.S. Fish and Wildlife Service. United States Department of the Interior. Progress Report No. I: A Special Report on the Salmon Resources of the Upper Yukon River Basin (above Carmacks), Yukon Territory, Canada. Juneau, Alaska: April 1956, revised December 1957.
1958	04/09/58: Chinook — 2 live, 300 dead — top 32 miles of Teslin River. [p. 37]	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973.
1959	"1959 — salmon arrived Aug. 25."	Log entry. [DFO, Whitehorse: FISS Support Files]
	"Aug. 28 — Flight — Teslin River is 25 miles below LaBerge flows into Yukon R. Gravel bars begin around Boswell River downstream."	Log entry. [DFO, Whitehorse: FISS Support Files]

1959	31/08/59: Chinook — 2 live, 24 dead — from Roaring bull Rapids to 14 mi. downstream.	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973.
	"Oct. 7, 1959 — Flight — No salmon observed."	Log entry. [DFO, Whitehorse: FISS Support Files]
	Information provided by "Mr. Johnny E. Jackson (Indian) commercial licence holder on Teslin Lake. March 9th, 1959": "In regards to Salmon in the Teslin River and tributaries. He tell me that Spring salmon arrive in the Teslin River about July 25th. and he says that are all through by Aug. 31st. It has been the practise of these Indians to set drift nets at a point just below the outlet of Teslin Lake and drift the nets down stream between two boats for a couple of miles. This is done during the dark hours. He says that they take 500 to 600 fish to the family. With about four familys [sic] fishing. Salmon spawn in the Morley River; Nisutlin River; Jennings R. in B.C. Bo Mi Creek in B.C. other smaller streams in B.C. and Yukon. They also spawn along the Teslin River to the junction of the Teslin with the Yukon River at Hootalinqua. Chum Salmon spawn from Sept. to October and there are quite a few spawn on Big Eddy above the junction of the Boswell River. Indians call it Dog Salmon Slough. He informs me that Pinks spawn here in July and Aug. Just where in the Teslin River I'm not sure though. He may be calling some other fish by this name."	Letter from W. K. Elliott, Fishery Officer, April 7, 1959. [DFO, Whitehorse: FISS Support Files]
	"At the Outlet of Teslin lake or at Johnson Crossing there is quite an extensive Indian Fishery for Spring Salmon. In six nights of drifting down the river with a net strung between two boats three families took 750 Spring Salmon. These were in excellent condition and would average about 20 lbs. each. From here down some 50 miles there were areas of good gravel and ideal water conditions but no sign of spring salmon was seen until Roaring Bull Rapids, which is actually only swifter moving water. For the next 14 miles some 24 dead and 2 live springs were counted. From there to Masons Landing 1 more dead was observed. From Open Creek and above the water was clear but at Millar Creek the river had picked sand up and the water was cloudy indicating sand rather than gravel bottom. The good gravel bars began around Boswell River downstream. Indians inform me that near Boswell River there is a place which they call Dog Salmon Slough but our inspection Oct. 7th did not show any spawning salmon although Chums were known to be there at that time. The river from Masons Ldg. down stream has not been examined as yet."	Report from W. K. Elliott, Fishery Officer, Jan. 21, 1960. [DFO, Whitehorse: FISS Support Files]
	"It is very difficult to Estimate numbers however Indians and fishermen report a very good run of Spring salmon. Three Indian familys [sic] took 750 Springs in 6 nights of drifting down the river just below Johnsons Crossing. The fish were apparently of very good size and in good condition seeing that they had travelled something over 2,000 miles... Am also told that they spawn below Johnsons Crossing, but did not observe any."	Letter from W.K. Elliott to the Area Director of Fisheries, Vancouver, Jan. 7, 1960. [National Archives of Canada: DFO records, RG 23, vol. 523, f. 711-3-24 (1)]

1960	Teslin River: "Aug. 31, 1960 — FL #6 — water was silty. On Aug. 26 Rogerson observed salmon — est. 30, - 35,000."	Log entry. [DFO, Whitehorse: FISS Support Files]
	"1960 Indian fishery took est 845 Kings taken in two nights of nets. This system has been covered once by air once by boat and 2 other part trips were also made. There are 3 main Spawning areas on the Teslin with the biggest being below St. Marys River second largest just below Boswell River and third approx 2 miles below J.C. Fish spawn also in the series of small Lakes and just about the full length of the system. The water is very cloudy and it was hard to see fish that were not on the [spawning] grounds. Est total run would be 20-25000 Kings. The Chum Salmon also use this River and cover about two thirds of the Spawning Area coming up as far as St Marys River. Est Total Chum Run 10,000."	Log entry. [DFO, Whitehorse: FISS Support Files]
1961	"Est. 10,000-15,000 Kings, 10,000-15,000 Dogs." [for the Teslin River - no exact location given]	Log entry. [DFO, Whitehorse: FISS Support Files]
	Estimated King salmon escapement on the Teslin River: 12,000 in 1961 and 10,000 in 1962. Approximate number of King Salmon taken at Johnson's Crossing in 1961 was 1,500.	"Yukon River Basin - Canada Estimated Total Population of King Salmon 1961and 1962." [National Archives of Canada: DFO records, RG23, vol. 111, f. 726-11-7, vol. 15]
	Teslin River: 12,000 Kings, 11,500 Chum.	"Spawning Report." [Handwritten table of statistics — DFO, Whitehorse: FISS Support Files, file "Spawning Report 1961-62 from Fisheries Research Board Oct. 61-May 62"]
1962	Indian Food Supply catch estimate for Johnsons Crossing: 1,000 Kings.	Letter from W.K. Elliott, Fishery Officer, to G. Watson, Bureau of Commercial Fisheries, Juneau, Dec. 11, 1962. [DFO, Whitehorse: FISS Support Files, file "Guardian Dawson F-S-6-6591"]

1962	"The furthest upstream that Chum Salmon to my knowledge spawn is the Teslin River near the outlet of Teslin Lake, which I estimate at 425 miles above Dawson City. As of this date Chum Salmon are just beginning to spawn, the weather being quite mild lately."	Letter from W.K. Elliott, Fishery Officer, to Gordon W. Watson, Bureau of Commercial fisheries, Juneau, Alaska, October 18, 1962. [DFO, Whitehorse: FISS Support Files]
	"At Teslin at the outlet of Teslin Lake the Indians drift for the salmon at night and am not sure just how many nets are used in this operation." Information in this letter obtained from RCMP, forestry and Dept. of Indian Affairs officers and local priests.	Letter from W.K. Elliott to Ronald Regnort, Alaska Dept. of Fish & Game, Feb. 15, 1963. [DFO, Whitehorse: FISS Support Files, file "USA State Tagging-1961-62"]
1963	Aug. 29 — FL #10. "From about 3 miles below Roaring Bull Rapids to Marys River, the river was silty from the slide at Mary's River 2 years ago. In this area 24 dead and 2 live King Salmon were counted. About 1 mile below 100 Mile River (Cabin on East Bank) was a fairly large spawning area, with an estimated 150-200 Kings spawning at this time. On the spawning area below Johnson's Crossing nothing was observed, although reliable reports indicated the area had many Salmon. This could have been possible because of light conditions. Further to the estimate on the 100 Mile Area 63 dead were counted and 94 live. I would estimate a total run spawning in the Teslin River at approximately 1000 King Salmon."	Letter from W.K. Elliott to Area Director, Vancouver, August 30 1963. [DFO, Whitehorse: FISS Support Files]
	"Sept. 11, 1963, FL #11 — on the spawning area (100 mile), 15 live + 55 dead Kings obs."	Log entry. [DFO, Whitehorse: FISS Support Files]
1964	"Teslin R. was fished by 4 indians for the present season. An approximate total of 180 spring salmon were netted; this is in average of 45 salmon per person, much lower than an average year. The indians maintained that there was a noticeable lack of female fish, e.g. few egg-bearers. Local fishing guide believes that in time there will probably be no indian fishery on this river. Interest in fishing manifest in older indian women. The younger indians regard it with only lukewarm interest. The indians fishing the river are: Johnny Joe, Annie Geddes, Kate Henry, Mary Jackson."	[handwritten report probably by T. Duncan], Sept. 8, 1964. [DFO, Whitehorse: FISS Support Files, file "16-5 Statistics. Indian Food Supply Catch"]
1965	Subsistence Fishery for Teslin R. (Johnson's Crossing): 1 driftnet, 450 Kings, no chums. Number of families in contributing to catch: 3 families, 200 on band list. Estimates of king salmon based on ground survey: Teslin River = fairly heavy; counts impossible.	Letter from J.A. Summers, District Protection Officer, to R.I. Regnart, Alaska Dept. of Fish and Game, 1965 (no exact date). [National Archives of Canada, Pacific Region: Department of Indian Affairs records, RG 10, Acc. V89-90/101, box 27, f. 801/20-2, vol. 5]

1968	"Teslin River: Main river not surveyed as a result of last year's studies which indicated that main river stocks are late spawners (late August) and this river is almost completely unsurveyable due to the depth and the dark brownish stain to water. At Johnson's Crossing, Les Allen, a sports fishing guide, believes that this year's run is larger than that of 1967 — this based on his observation of more 'jumpers' this year. One family fishing near Johnson's Crossing have taken 20 kings thus far (16 males; 4 females). They also have seen more 'jumpers'' or signs of king salmon this year."	"Yukon Territory Spawning Surveys, August 17-20, 1968." State of Alaska, Department of Fish and Game, March 4, 1969. [DFO, Whitehorse: FISS Support Files]
1969	Aerial survey, August 16: "Teslin River, Main River: Roaring Bull Rapids to Teslin Lake. As reported in previous surveys, the river is characterized by dark-stained water and depth. Runoff from recent rains added to water discoloration. Summers pointed out the main spawning area located in relatively shallow water with a visible bottom. No redds, spawning fish or carcasses were seen. Previous surveys indicated that the main river stocks are late spawners (late August). A set gill net, approximately two miles above Johnson's Crossing, contained no fish. Very few salmon were observed on fish racks at a fishing camp in the immediate area. (8/16)"	"Yukon Territory Spawning Surveys, August 14-17, 1969." State of Alaska, Department of Fish and Game, August 21, 1969. [DFO, Whitehorse: FISS Support Files]
1970	Alaska Department of Fish and Game conducted a special king salmon sampling project in 1970. Aerial survey (Aug. 20) results include the Teslin River: "Surveyed from Hundred Mile Creek to Johnson Crossing and observed no salmon. As I previous years, this stream is too deep and turbid for counting in most places." Report states that the surveys were done under overcast conditions. They were done due to a smaller than average king run in 1970.	Report of the Alaska, Dept. of Fish and Game, Jan. 22, 1971. [DFO, Whitehorse: FISS Support Files]
1971	25/08/71: Chinook — "fish observed near Johnsons Crossing."	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973.
1972	04/09/72: Chinook — 12 live, 196 dead. Miller Creek (22 miles from mouth) to Teslin L. outlet	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973.
	Fork length measurements of juvenile chinook salmon are 49-67, modal 45 mm. "Major chinook spawning areas appear to exist one mile below Johnsons Crossing and within 5 miles of Boswell R. Data on spawning for other species is lacking. Subsistence and recreational fisheries for chinook are condducted. drift gill nets account for most of the food fishery catch, while trolling accounts for the remainder, trolling is also used in the recreational fishery. Estimated annual catch is 200-500 fish."	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973. [p. 37]
1973	"A limited number of aerial surveys have been conducted since 1959... The total [chinook] run in the Teslin system is estimated to be 3,700-8,600 fish annually. Relatively good numbers spawn in the Teslin River (2,000-5,000)..."	Environment Canada. Fisheries and Marine Service. Catalogue of Fish and Stream Resources of the Teslin Watershed. PAC/T-73-13. 1973. [p.2]

1974	Total chinook catch in 1974: in Teslin River — commercial (13); subsistence (20). Catch of chinook salmon with gillnet: Johnsons Crossing — 2 males tagged; 1 tagged female; 51 untagged. No chum.	Brock, Dennis N. Distribution and Abundance of Chinook (Oncorhynchus tshawytscha) and Chum (Oncorhynchus keta) Salmon in the Upper Yukon River System in 1974, as Determined by a Tagging Program. PAC/T-76-3. 1976. [p. 27]
1977	Local residents said that chinook salmon parr migrate down the river during the middle of June. "The primary use of this region of the Teslin River would appear to be that of a migration route, both by grayling and chinook salmon parr, in the spring and early summer."	Foothills Pipe Lines. A Spring Inventory of the Fishery Resource Along the Proposed Alaska Highway Pipeline in Yukon Territory, 1977. Calgary: August 1977.
	No salmon reported the summer inventory (July 17 and 22).	Foothills Pipe Lines. A Summer Inventory of the Fishery Resource Along the Proposed Alaska Highway Pipeline in Yukon Territory, 1977. Calgary: November 1977.
	"The Teslin River was investigated on August 23, 25, 27, September 4 and 7, 1977. Local residents reported that chinook salmon began moving into the region near the outlet of Teslin Lake about August 8, 1977. No sampling was done in this area but many chinooks which had been caught by domestic fishermen were examined. These fishermen reported that the 1977 chinook salmon spawning run was greater than in previous years and that approximately 600 salmon were harvested. An aerial survey of this region of the Teslin River revealed that numerous chinook salmon were present in this area. Major spawning grounds are present 1.6 km below Johnson's Crossing (Department of Environment 1973), approximately 2.5 km downstream of the proposed crossing site. No chinook salmon were observed at the proposed crossing and the substrate in that region did not appear suitable for spawning. Chinooks migrated past this site into Teslin Lake, to reach spawning areas in the Upper Teslin Drainage."	Foothills Pipe Lines. A Survey of Fall Spawning Fish Species in Waterbodies within the Influence of the Proposed Alaska Highway Pipeline in Yukon Territory, 1977. Calgary: December 1977. [pp. 13-14]

1978	July 23, 1978. Sampling Teslin River at km. 1345.8 — "A salmon carcass was collected during beach seining."	Northern Natural Resource Services Ltd. A Compilation of Fisheries Data from Waterbodies Adjacent to the Alaska Highway from Kilometer 1008 to Kilometer 1635. 1978. [p. 310]
1982	Of 46 chinook migrating to tributaries of the Yukon River, 7 entered Teslin sub-basin, two tracked to spawning areas in mainstem Teslin River. One spawned 4 km below Johnsons Crossing between Aug. 20 and 27, and by Aug. 31, it had drifted downstream. The other fish spawned after Aug. 26, date and location unknown. Peak spawning occurred during third week of August. Chinook carcasses and abandoned redds observed Aug. 31 during aerial survey. Five discrete mainstem spawning areas identified in mainstem portions of the river.	Milligan, P.A. et al. The Distribution and Abundance of Chinook Salmon (Oncorhynchus tshawytscha) in the Upper Yukon River Basin as Determined by a Radio-Tagging and Spaghetti Tagging Program: 1982-1983. August 1985.

Squanga Creek

1976	Site about 1.5 miles from road and Squanga Lake. Temp @ 7 degrees; water clear: "pools are excellent rearing areas"; "excellent spawning gravel"; river quite high in algae content." "About 400 yards upstream from the confluence with the Teslin River is a water fall which is definitely impassable by salmon."	Report by Jim Mitchell, September 28, 1976 re: proposed Foothills pipeline crossing. [DFO, Whitehorse: FISS Support Files]
1977	June 15, 1977 — upstream of road; set traps; gravel comp %51-250 mm. Current speed 1.5 knots. Depth estimate 18 inches; Water temp. 3 degrees celsius. No catch. June 24, 1977 — By road (upstream); gravel comp. % 2 -50 mm; current speed 1 knot; depth 18 inches; water temp 3 degrees celsius. Water level dropped about 6 inches. No catch. "The creek would be almost impossible for fish travel because (1) Water very cold; (2) Water very shallow (20 feet wide) (inches deep); (3) Water travels through swampy brush and lacks a defined river bed (wandering)."	"Seine and Trap Net Data Sheet; Yukon Pipeline Study." [DFO, Whitehorse: FISS Support Files]
1977	Squanga Lake - ascent of fish from Teslin River is blocked by falls with a drop of at least 180 feet (55 m) in the lower quarter miles of Squanga Creek.	Northern Natural Resource Services. Collection of Fisheries Information from Water Bodies Along the Proposed Alaska Highway Gas Pipeline Route to July 15, 1977. July 1977, p. 229.

Current Land Use

- *agriculture* — none.
- *First Nations land claims*
  - Teslin Tlingit Council — The TTC has settled its land claim. The First Nation's lands include one R-block east of Hundred Mile Creek and several smaller site-specific lands along the Teslin River within the study area.
  - Carcross/Tagish First Nation — the First Nation's traditional area reaches the mouth of Squanga River. It has not made its final land selections but has made a site-specific claim bordering Squanga Creek near the Squanga Lake airstrip.
- *mining* — all mining claims have lapsed (summer 1997) with the exception of one quartz mining area at the head of Evelyn Creek. It extends to the headwaters of Wilson Creek and a tributary to Dave Creek.
- *outfitting* — none.
- *trapping* — three traplines fall within the study area.

APPENDIX 2:

TRIBUTARY DESCRIPTIONS

APPENDIX #2

Tributary Descriptions

The stream descriptions presented here are based on investigations conducted primarily between July 4-16, with re-evaluations conducted during August and October, 1997. The physical conditions (and therefore fish habitats) of each watercourse are dynamic and are subject to change depending on water levels, ongoing beaver activity, etc. The reaches have been described in ascending order moving upstream from the mouth of each watercourse at the Teslin River.

The extent of chinook salmon utilization of each reach has been simplified to subjective descriptions. These descriptions consist of the following categories; 1) absent, 2) uncommon, 3) common and 4) abundant. Absent indicates no chinook fry were recorded; uncommon indicates chinook fry were present but not commonly caught or observed; common indicates significant numbers of fry were observed and recorded with all capture techniques and abundant indicates chinook fry were readily observed and easily caught with at least one of the following criteria being met; minnow trap catch per unit of effort (CPUE) > 0.20 fry per hour, electro-fishing CPUE > 0.50 fry per second of shocking time and/or seine CPUE > 1 chinook per meter ^{2}. A more precise evaluation of utilization is presented in the catch records in the Results section of this report.

Dave Creek

Summary: Dave Creek has its headwaters in Gunsight and Brewer Lakes at the foot of the Big Salmon Range. The drainage basin area is approximately 70 square kilometers. This is a third order stream. The main stem of the creek originates at about 930m ASL (above sea level) at the outlet of Gunsight Lake. The upper tributaries and start of the main stem average 3 to 4% slope. The lower reaches down to the mouth decrease in slope to an average of just under 1%. The median elevation of the basin is approximately 700m ASL. Dave creek enters the Teslin River from the east at 60°41.19'N / 133°38.36'W (174400mE 6728600m N).

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 3.4m^3 / sec which is considerably less than the Mean Annual Flood of 5.3m^3 / sec. Derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variation will be attenuated by the lake system.

The lower reach of Dave Creek at the Teslin River flows as a silt bottomed glide. Fish cover was limited in these lower reaches. Further upstream, velocities increased and pool/riffle development became more prevalent. Gravel/cobble substrates were found in riffle areas. Evidence of historic and recent beaver activity was extensive throughout the reaches investigated. These beaver dams have a significant effect on the stream substrates. Typically, silted substrates were found within the first 50 meters upstream of each beaver dam, then approximately 20 meters of finer sorted gravel often offering good potential grayling spawning habitat. Clean gravel/cobble substrates were found immediately below breached beaver dams, typically with a deep pool immediately below the point of breaching. The creek does provide some good fish habitats although these are limited.

Fish species recorded in Dave Creek include: chinook salmon fry (common to abundant), Arctic grayling, slimy sculpin, longnose sucker, burbot and round whitefish.

D1 This reach extends from the Teslin River upstream for 80 meters. The creek flows as a glide throughout this reach with the average depth being 0.4 meters and the average width 4 meters. Substrates are sand and silt. The creek banks are deeply cut and rise to 1 meter above the creek. Stream side vegetation is primarily willow and sedge meadow. Some overhead cover exists (20%) in the form of overhanging willow.

Fish species recorded in this reach include: chinook salmon fry (common), slimy sculpin and longnose sucker.

D2 This reach extends from the end of reach D1 to a breached beaver dam 220 meters upstream. The average depth is 0.3 meters and the average width 4.5 meters. Water velocity increases relative to reach D1 and riffles begin to appear (pool/riffle ratio = 3:1). Pools typically entered long glides before the next riffle. Substrates consist of clean gravel and cobble in flow areas with siltation in low velocity areas. Banks are typically undercut on one side with the opposing bank a point bar. Stream side vegetation consists primarily of willow and spruce. Cover (30%) is primarily in the form of undercut banks and overhanging vegetation.

A detailed reach survey was completed in reach **D2.** See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (abundant), slimy sculpin and burbot.

D3 This reach extends upstream of the breached beaver dam located at 60°41.35'N 133°37. 58'W. The average depth is 0.2 meters and average width 5.0 meters. Stream banks are gentle with willow and alder being the dominant stream side vegetation. Overhead cover is reduced relative to reach D2, and instream cover consists primarily of old sticks and beaver dams. Recent and historic beaver activity was prevalent throughout this reach. The area immediately upstream of the breached beaver dam at the start of this reach shows heavy siltation; otherwise the substrates were primarily gravel (60%), sand/silt (30%),cobble (5%) and organic (5%).

Fish species recorded in this reach include: chinook salmon (common), slimy sculpin, Arctic grayling and round whitefish.

Hundred Mile Creek

Summary: Hundred Mile Creek has it's headwaters in the Big Salmon Range at approximately 1,500m ASL. The drainage basin area is approximately 116 square kilometers with a median elevation of about 900m ASL. This is a third order stream. The creek begins in three steep tributaries averaging 4 - 5% slope, and decreases to an average of 1% slope in the main stem until it joins the Teslin River at 60°43.77'N 133°41. 39'W (571550mE 6733400mN). The mouth of the creek flows through an alluvial fan and delta complex which extends well into the Teslin River at low water.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 8.8m³/ sec. This compares to the Mean Annual Flood of 9.5 m³/sec derived from the D.I.A.N.D. Design Flood Estimating Guidelines.

Hundred Mile Creek enters the Teslin River from the east. The lower reaches flow as braided shallow channels over a wide gravel apron that extends into the Teslin River. A 2.5 meter high beaver dam located approximately 380 meters upstream of the Teslin River was found to be a barrier to chinook salmon fry movement. Good habitat for rearing fry exists both above and below this beaver dam. Relatively large numbers of salmon fry were captured below this dam but no salmon fry were captured above it. Upstream of this beaver dam shows abundant evidence of recent and historic beaver activity. Spawning chinook salmon were observed utilizing the gravel bar at the mouth of Hundred Mile Creek in the Teslin River. The shallow gravel apron at the outlet appeared to prevent adult salmon from moving into the creek and no adult salmon were observed in the creek itself. The presence of spawning salmon in the vicinity of the mouth of this creek implies it is potentially important rearing habitat for salmon fry.

Fish species recorded in Hundred mile Creek include: chinook salmon fry (abundant), Arctic grayling and slimy sculpin.

H1 This reach extends from the Teslin River upstream for 100 meters across a wide gravel apron. This reach was extended to over 200 meters by the end of August due to decreasing water levels in the Teslin River. The average depth of this reach is 0.3 meters and the average width 4 meters. The creek braids with a total of four channels (2 main channels) and flows primarily as a riffle in straight narrow channels with a few small pools. Substrates are cobble (60%) and gravel (40%) overlain by silt. Stream banks are low with sedge and willow vegetation. Overhead cover was limited to a few clumps of willow at the top of the reach. Good fish cover occurred only at the very top of the reach in the small pools .

Fish species recorded in this reach include: chinook salmon fry (uncommon), Arctic grayling (fry) and slimy sculpin.

H2 This reach extends from the top of reach H1 upstream for 150 meters. The average depth of this reach is 0.2 meters and the average width 7 meters. The channel shows good pool riffle development, ratio = 2:1, with few eddies, in a 20 meter wide flood plain. Substrates consist of gravel and cobble overlain by silt. Banks are typically undercut on one side with the opposing bank a point bar. Stream side vegetation is primarily willow and poplar. Overhead cover is plentiful (40%) while some undercut banks occur.

A detailed reach survey was completed in reach **H2**. See water Data Sheets, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (abundant) and slimy sculpin.

H3 This reach extends from the end of reach H2 upstream for 380 meters. The stream channel becomes narrower and more confining, resulting in increased velocities. Substrates consist of gravel and cobble with silting in areas of lower velocity. The average depth is 0.35 meters and the average width 4.5 meters. Banks rise abruptly on both sides,

with some undercut areas. Stream side vegetation is primarily alder, willow and poplar. A deep pool (1.7 meters deep) formed as a result of a breached beaver dam located 310 meters upstream of the start of this reach was found to support adult grayling and round whitefish and may provide over-wintering habitat. Overhead cover is plentiful (40%) and instream cover comes primarily in the form of undercut banks. The channel has an even pool riffle development, ratio = 1:1. A beaver dam, approximately 2.5 meters high, separates this reach from reach H4. This dam represented a barrier to fish passage at the time of these investigations.

Fish species recorded in this reach include: chinook salmon fry (abundant), adult and sub-adult Arctic grayling, adult round whitefish, and slimy sculpin.

H4 This reach extends upstream from the beaver dam at the top of reach H3 for 115 meters. The average depth of this reach is 1.5 meters and the average width 25 meters. Velocity of the creek is near zero as the creek has become a beaver pond. The beaver dam has flooded the original channel and surrounding forest. Substrates are entirely silt. The surrounding vegetation is primarily spruce with some poplar. There is a series of old beaver dams in this reach.

Fish species recorded in this reach were: slimy sculpin.

Meadow Creek

Summary: Meadow Creek has its headwaters in the Big Salmon Range along the South Canol Road. The drainage basin area is approximately 112 square kilometers. This is a third order stream. The main stem of the creek originates at about 1200m ASL. The start of the main stem averages 3% slope until it crosses the Canol Road, then diminishes to 2-5% slope, and finally 0.8-1.5% slope in the last 5 km. The creek joins the Teslin at 60°30.74'N / 133°21.36'W (590400m E 6709450m N). The median elevation of the basin is about 900m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 9.5 m^3 / sec which is somewhat higher than the Mean Annual Flood of 8.3 m^3/sec derived from the D.I.A.N.D. Design Flood Estimating Guidelines.

The Canol road occupies the creek valley in the upper half of the basin. The old Johnsons Crossing dump and staging area for the removal of equipment from the Canol project is along the Canol Road in the Meadow Creek basin. There are residences near the mouth of the creek and at the Canol road crossing.

The lower reach of Meadow Creek at the Teslin River flows as a silt bottomed glide. Fish cover was limited in these lower reaches. Further upstream, velocity increased and pool/riffle development became more prevalent. Evidence of recent and historic beaver activity was common in the mid reaches, and large numbers of salmon fry were found in pools associated with breached beaver dams (photo 2). Spawning adult salmon utilize the Teslin River upstream and downstream of the mouth of Meadow Creek, making this creek potentially important rearing habitat.

Fish species recorded in Meadow Creek include: chinook salmon fry (abundant), Arctic grayling (fry), lake chub, burbot and slimy sculpin.

MDW1: In this reach the creek flows as a meandering glide in an open bay 25 meters by 50 meters in area; this reach was flooded by the Teslin River in June. The average depth of this reach is 0.35 meters and the average width 25 meters. Velocities are low and substrates entirely silt/sand. What little cover there is (5%) takes the form of overhanging willow/sedge vegetation. The banks are well defined with willow and sedge vegetation.

Fish species recorded in this reach include: chinook salmon fry (common), slimy sculpin and lake chub.

MDW2 This reach starts 60 meters from the Teslin River at a point where the creek constricts. The creek flows as a riffle in a wide flat channel with half the creek bed exposed. Substrates consist of gravel and cobble with some sand and silt. Small side channels occur on the exposed south side and a small pond created by a small beaver dam exists on the north side. The average width is 7 meters and the average depth 0.3 meters. Water velocities are somewhat higher than in MDW1. The surrounding area in this reach is a wide flat flood plain and stream side vegetation is willow, sedge and equisetum. There was very little overhead or subsurface cover for fish.

A detailed reach survey was completed in reach **MDW2.** See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (common), slimy sculpin, and burbot.

MDW3 This reach starts 170 meters upstream of the Teslin River. This reach showed somewhat higher velocities than in the lower reaches and a more developed pool/riffle ratio (pool/riffle = 3:1). Many of the deeper pools were associated with several old breached beaver dams within this reach. One beaver dam at the top of the reach was reconstructed and acting as a barrier late in August. The substrates were primarily sand or gravel with extensive sorting by size in riffle areas. The channel was often braided in gravel areas. The average depth of the creek in this reach was 0.15 meters and the average width 3 meters. Stream side vegetation consisted of willow, alder and spruce. This reach showed an increase in overhead cover (15%) over lower reaches with spruce sweepers and 2 log jams associated with sweepers. Large numbers of chinook and grayling fry were concentrated in pools associated with breached beaver dams particularly later in the summer. Several potential grayling spawning sites were observed.

Fish species recorded in this reach include: chinook salmon fry (abundant), Arctic grayling fry, and slimy sculpin.

MDW4 This reach starts 1170 meters upstream of the Teslin River at a recent beaver dam and continues for another 600 meters. Beaver activity, both recent and historic, was evident throughout this reach (photo 2). The average depth was 0.35 meters and the average width 6.0 meters, with a pool to riffle ratio of 1:1. The surrounding spruce forest has been killed by flooding caused by the beaver dam leaving virtually no stream side vegetation and reducing overhead cover (10%) to dead spruce sweepers. The substrates are silt/sand immediately above the beaver dam for 100 meters before turning to sorted sand and gravel. The stream banks are abrupt and the channel appears newly cut. A

significantly large log jam created by sweepers along a new channel exists at the top of the reach.

Fish species recorded in this reach include: chinook salmon fry (common) and slimy sculpin.

Muskrat Creek

Summary: Muskrat Creek collects headwaters in Muskrat Lake within the Big Salmon Range. The basin drainage area is approximately 97 km^2. This is a third order stream. The main stem of the creek originates at about 1280m ASL and flows north west and then south west at an average slope of 3.5% until it flows into marshy lowlands of the Teslin River valley. A southerly tributary flows through Surprise Lake and joins the main stem about 1km from the mouth. The lower reaches average 1.2% slope. The median basin elevation is approximately 900m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 10.1m^3/ sec which is considerably more than the Mean Annual Flood of 7.3m^3/ sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variation will be attenuated by the lakes and swampland in the system, making the comparatively high OHWM flow seem excessive. There were however, many signs of active channel changes due to flooding. It is possible that the high OHWM flow could have resulted from a sudden breach of an upstream beaver dam.

Muskrat Creek enters the Teslin River from the east at 60°32.71'N/ 133°24.65'W. The outlet enters the Teslin River in a large, shallow bay adjacent to the main flow. The lower reach of Muskrat Creek flows through an open meadow as a glide with a silt substrate. Further upstream, the creek develops a more defined pool/riffle ratio with some gravel in riffle areas. Deep pools occur at stream bends and in association with spruce deadfall. Signs of recent and historic beaver activity exist with the most recent a large, 2 meter high beaver dam built beside an old log bridge located approximately 615 meters upstream of the Teslin River (photo1). Chinook salmon fry were recorded upstream of this dam indicating that the beaver dam/log bridge had not been a total barrier to fish, or did not exist, in the recent past Fish cover is plentiful in the upper reaches of this creek most often in the form of root wads and sweepers.

Fish species recorded in Muskrat Creek include: chinook salmon fry (common), round whitefish, Arctic grayling, northern pike, lake chub and slimy sculpin.

MK1 This reach extends from the outlet at the Teslin River upstream for 80 meters to the first bend in the creek. In this reach, the stream flows as a glide through a wetland area in a defined channel. During high water, flooded sedge meadows extended as much as 60 meters from the main channel. The average depth is 0.3 meters and the average width 8 meters. Water velocities are low and substrates consist entirely of silt/sand. Abrupt mud banks rise 0.5 meters above the water. Bank vegetation is sedge, equisetum and willow, providing little overhead cover (5%).

Fish species recorded in this reach include: chinook salmon fry (uncommon) and northern pike.

MK2 This reach extends from the upstream end of MK1 for approximately 100 meters. The average depth of this reach is 0.15 meters and the average width 5 meters. Water velocities increase in this reach relative to reach MK1 and riffles become more common (pool/riffle ratio =1/5). Substrates consist primarily of sand/silt with some gravel and cobble in riffle areas. Stream banks rise abruptly 1 meter above water level on one side with the other being a point of deposition. Little overhead cover exists and instream cover consists of cut banks.

Fish species recorded in this reach include: chinook salmon fry (common), northern pike, and round whitefish.

MK3 This reach starts at the first deep pool approximately 180 meters upstream of the Teslin River. The reach has an average depth of 0.25 meters and average width of 6 meters. Water velocities increase in this reach relative to lower reaches. Substrates include sand, gravel, cobble and organic debris. The pool/riffle ratio is 1:1 with deep pools associated with creek bends and spruce sweepers. The stream is confined with abrupt banks rising 2 meters above the water. Stream side vegetation consists primarily of spruce, willow and alder, with sedges at the banks. Overhead cover (10%) takes the form of spruce deadfall and overhanging vegetation. Recent and historic beaver activities are in evidence.

A detailed reach survey was completed in reach **MK3.** See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (abundant), northern pike, Arctic grayling and slimy sculpin.

MK4 This reach extends from an old beaver dam located approximately 615 meters upstream of the Teslin river for 200 meters to an old log bridge with a beaver dam built against it. The beaver dam, approximately 2 meters high, has been built directly upstream of the log bridge. This dam appeared to be a barrier to fish passage at the time of investigation. This reach has an average depth of 0.4 meters and average width of 4 meters. The substrates consist of cobble (40%) and gravel (30%) with sand (20%) and organic debris (10%) in lower velocity areas. The pool/riffle ratio was even at 1:1. Stream banks were abrupt with willow, alder and spruce vegetation. This reach had many old trees (instream), root wads, overhanging vegetation and breached beaver dams providing excellent cover instream and overhead (40%) for fish.

Fish species recorded in this reach include: chinook salmon fry (abundant).

MK5 This reach extends upstream from the beaver dam/log bridge at the top of MK4. Extensive flooding has occurred immediately upstream of the beaver dam, creating a pond with a maximum width of 45 meters that extends upstream for almost 130 meters. Two active bank slumps introduce sand and some silts. Several log jams have occurred in association with these slumps. This reach has an average depth of 0.25 meters and average width of 3.0 meters. The substrates consist of silt and organic debris deposited behind the beaver dam. Extensive overhead cover (<50%) in the form of willow, alder and spruce, combined with extensive instream structure creates excellent fish habitats.

Fish species recorded in this reach include: chinook salmon fry (abundant), Arctic grayling, slimy sculpin and lake chub.

Squanga Creek

Summary: Squanga Creek is composed of two main tributaries Seaforth Creek and Squanga Lake, with a combined drainage basin area of approximately 90 km². Seaforth Creek originates in a lake about 920m ASL. The other tributary drains Squanga Lake with the 2 tributaries joining near Squanga Lake. This is a third order stream. The creek enters the Teslin River at 60°32.50'N / 133°25.90'W (586300mE 6712800m N). The median elevation of the basin is approximately 700m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 20.0m³ / sec. The Mean Annual Flood is 50 m³ / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variations will be attenuated by the lake systems.

Squanga Creek has a series of cataracts near its mouth averaging 14% slope. The creek has been investigated for hydro potential by the government and private interests. Squanga Creek enters the Teslin River from the west via a long narrow bay. Upstream of the bay, the creek flows over a gravel/cobble glide (chinook salmon spawning area). The creek then enters a series of rapids flowing from a steep canyon. The lower portion of these rapids provide excellent rearing habitat for significant numbers of salmon fry. A series of at least 6 waterfalls occur within the canyon and were shown to be a barrier to the upstream migration chinook fry (photo 3). The head of the canyon is a narrow notch in the bedrock where water directly falls 4 meters, then 8 meters downstream drops another 3 meters. From above the notch to Squanga Lake, the creek flows as a slow glide with the occasional riffle in a mostly open flood plain.

Fish species recorded in Squanga Creek include: chinook salmon (adults uncommon, and fry abundant), Arctic grayling, burbot, lake whitefish, northern pike, longnose sucker and slimy sculpin.

SQ1: This reach flows as an oval shaped bay that spans approximately 450 meters from the Teslin River to the first riffle. The bay averages 180 meters in width. The south side of the bay is a high clay cliff and the north side a willow meadow. The clay cliffs on the south side show signs of recent erosion. Local knowledge suggests the slump occurred within the last 25 years. The reach has a primarily silt/sand bottom with patches of cobble in a slightly deeper channel visible during low water. Fish cover in this reach exists in the form of instream woody debris and aquatic vegetation. The bay area has a sluggish velocity.

Fish species recorded in this reach include: chinook salmon fry (uncommon), northern pike, and longnose sucker.

SQ2: This reach extends from the upstream end of SQ1 for approximately 200 meters to the start of the canyon (SQ3). The upstream end of this reach marks the Teslin River high water mark. During high water, the reach flows as a wide gentle glide averaging 9 meters in width and 0.4 meters deep with confined banks up to 1.8 meters high. Later in summer, as water levels drop, this reach becomes a riffle confined to a 5 meter wide channel. Bank

vegetation is primarily willow or sedge meadow. Substrates consist of clean gravel/cobble. Cover exists in the form of occasional undercut banks and willow overhang.

A detailed reach survey was completed in reach **SQ2.** See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon (fry common, adults uncommon), burbot, northern pike, long nose sucker and round whitefish. Chinook salmon were observed spawning in Squanga Creek at the very top of this reach.

SQ3: This reach extends from the start of rapids at a canyon outlet upstream for 225 meters to the first waterfall. This waterfall has a 5 meter drop at a 45% grade, and was determined to represent a barrier to upstream movement of chinook fry (photo 3). This reach averages 7 meters in width and 0.4 meters deep with boulder banks giving way to high rock cliffs on both banks moving upstream. Bank vegetation is spruce, mosses, alder and birch. Ample cover for fish results from large boulders and some undercut banks. Velocities are high to very high with much eddying. Substrates consist primarily of boulder with some cobble.

Fish species recorded in this reach include: chinook salmon fry (abundant), burbot and slimy sculpin.

SQ4: This reach starts at the above mentioned waterfall and includes the remainder of the canyon area. The creek within this reach has confining, high bedrock cliffs on both sides with a series of steep drops creating rapids and waterfalls. Several of these drops represent barriers to the upstream movement of fish; at least 9 falls greater than 3 meters in height occur. The reach has an average depth of 0.6 meters and an average width of 4.0 meters. Substrates consist of bedrock overlain by large boulders and cobble.

Fish species recorded in this reach include: Arctic grayling juveniles (likely washed down from above the canyon), and slimy sculpin.

SQ5: This reach starts above the canyon and continues to Squanga Lake. In this reach, the creek flows as a slow gentle glide with an average depth of 1.25 meters and an average width of 7 meters. The channel has well defined stable banks rising to 2 meters for the first 300 meters from the notch, then enters a wide flood plain (<100 meters) that continues to Squanga Lake. Stream side vegetation is composed of spruce and sedges; grassy banks, often flooded, occur commonly and gravel bottomed riffles are rare. Beaver activities are in evidence; the only recent dams exist close to the lake. Cover takes the form of ample aquatic vegetation and overhanging spruce.

Fish species recorded in this reach include: lake whitefish, northern pike and Arctic grayling.

Wilson Creek

Summary: Wilson Creek is composed of two main tributaries; one draining Beaver Lake (770m ASL) in a westerly direction at an average slope of 1.3%, and the other draining the Big Salmon Range in a south westerly direction at an average slope of 4 - 5% until it nears the Teslin and diminishes to 1.5% slope. The creek averages 0.8% slope in

the last two kilometers of its length, and joins the Teslin at 60°36.40'N / 133°29.90'W (58730m E 6712900m N). The basin drainage area is approximately 85km². This is a fourth order stream. The median basin elevation is approximately 800m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 4.7m³ / sec, which is considerably less than the Mean Annual Flood of 6.4m³ / sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines.

Wilson Creek enters the Teslin River immediately upstream of Henry island. During the time of investigations, the creek flowed turbid. The lower reach flowed as a glide with silt substrates. Moving upstream, pool/riffles increase and cover becomes more abundant. The confluence of the 2 major tributaries occurs approximately 1.4 km upstream of the Teslin River. The south fork flows clear while the north fork flows turbid. The north fork cuts into a clay bank in 2 places within 150 meters of the confluence where active slumping causes the turbidity. Both forks were found to support rearing chinook salmon fry, however more fry were recorded in the south fork.

Fish species recorded in Wilson Creek include: chinook salmon fry (uncommon), longnose sucker and slimy sculpin.

W1 This reach extends from the outlet at the Teslin River upstream for 220 meters. The channel is incised into unconsolidated silty materials. The reach has an average depth of 0.75 meters and average width of 7.0 meters. Water velocities are relatively low and substrates composed entirely of silt. The water was turbid relative to the Teslin River. Stream side vegetation is primarily equisetum, sedge and willow, with overhead cover relatively sparse (15%), and composed of the occasional spruce sweeper and willow overhang.

No fish were recorded in this reach.

W2 This reach extends from the upstream end of W1 for approximately 150 meters. The creek in this reach has the occasional gravel riffle. The reach has an average depth of 0.4 meters and average width of 4 meters. The stream channel is incised into silt banks rising 1-2 meters above the creek. Substrates consist of silt covered gravel/cobble (70%) with clean gravel/cobble in areas of higher water velocities. Stream side vegetation is composed of willow, spruce and sedges. Limited overhead cover exists in the form of overhanging willow. Turbidity provides subsurface cover.

A detailed reach survey was completed in reach **W2.** See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (uncommon), slimy sculpin and longnose sucker.

W3 This reach extends from the top of W2, upstream for approximately 860 meters to the confluence of the two tributaries. The reach has an average depth of 0.7 meters and an average width of 4 meters. Pool/riffle ratio is 10:1. Substrates consist of gravel/cobble with heavy siltation in low velocity areas. Stream side vegetation is composed of spruce willow, and alder. A series of old breached beaver dams occurs throughout this reach. Overhead cover (5-10%)is limited.

Fish species recorded in this reach include: chinook salmon fry (uncommon) and slimy sculpin.

W4 This reach comprises the south fork of Wilson Creek. This tributary has clear water, an average depth of 0.3 meters and an average width of 2 meters. Substrates consist of sand and fine gravel. Stream side vegetation is willow, spruce and grasses. Abundant overhead cover (35%) exists in the form of willow, alders and spruce sweepers. The creek has many small tight meanders and a pool/riffle ratio of 1:1.

Fish species recorded in this reach include: chinook salmon fry (common) and slimy sculpin.

W5 This reach comprises the north fork of Wilson Creek. The water is turbid in this fork due to the 2 exposed and actively slumping clay banks that occur within 150 meters of the confluence. The creek has an average depth of 0.2 meters and an average width of 4.0 meters. Substrates consist of gravel overlain by heavy siltation. Stream side vegetation is willow alder and grass but overhead cover is limited (15%). Evidence of recent and historic beaver activity exists. At 280 meters upstream of the confluence, the creek enters a dense stand of mature spruce in a 3 meter wide confined channel with 50% overhead cover of willows.

Fish species recorded in this reach include: chinook salmon fry (uncommon) and slimy sculpin.

Swift River

The headwaters of the Swift River lie to the east of the Teslin River in the Big Salmon mountain range. The Swift is 32 kilometers long and drains Swift Lake located approximately 13 kilometers upstream of the Teslin River. The basin drainage area covers approximately 256 km^2. This is a fourth order stream. The main stem of the river originates at about 880m ASL and flows North West until it joins the outlet of Swift Lake to flow south, then due west to join the Teslin River at 60°48.75'N / 133°51.40'W (6742050m N, 561200m E). Swift Lake in turn is fed by Rosy Lake. The channel slope begins at 0.4 to 0.5% and increases downstream of Swift Lake to 0.9 to 1.2% slope. The median basin elevation is approximately 900m ASL.

The calculated flow at the Ordinary High Water Mark (OHWM) using Mannings Equation and field surveys was 18.4m^3/ sec which compares to a Mean Annual Flood of 18.6m^3/ sec. derived from the D.I.A.N.D. Design Flood Estimating Guidelines. Stream flow variation will be attenuated by the Rosy and Swift Lake system.

The only significant human development feature in the basin is an old winter access road which cuts along the north west flowing upper mainstem, then heads to a mineral exploration area on Red Mountain.

The Swift River was found to be the most productive tributary relative to salmon within the study area. The Swift River supports a spawning population of chinook (a total of 69 were counted during aerial surveys), as well as large numbers of rearing salmon fry. The river consistently has substrates of small boulder, cobble and gravel, with extensive

riffle areas. Pools become more common moving upstream, while instream woody debris and undercut banks provide fish cover in all reaches. Excellent fish habitats exist in the River for it's entire length.

The surrounding forest is composed primarily of spruce with willow, alder and some poplar in riparian areas.

Chinook salmon fry were captured and observed throughout the Swift River with the exception of the reaches upstream of the beaver dam located at 60°48.45'N / 133°48.42'W. This dam was also acting as a barrier to the upstream migration of spawning adult salmon. Good spawning and rearing habitat for salmon exists upstream of this dam. Historical references do report salmon carcasses being observed at the outlet of Swift Lake.

Fish species recorded in Swift River include: chinook salmon (adults and fry abundant), Arctic grayling, slimy sculpin, longnose sucker, lake chub and burbot.

SW1 This reach composes the outlet of the Swift River at its confluence with the Teslin River, and consists of a gravel apron that extends into the river and sweeps downstream (photo 4). The reach is composed of 2 channels, the north channel being entirely riffle and the south with a pool to riffle ratio of 1:1. The river flows at relatively high velocities over primarily gravel/cobble substrates. As water levels subsided, the channels became more braided with the north channel taking the majority of the flow. The banks rise abruptly to 1 meter high with the south bank undercut and unstable. The north channel provides good instream and overhead cover in the form of instream woody debris, overhanging vegetation and undercut banks. The south channel flows over the gravel apron in a narrow and fast channel with an average depth of 0.1 meter Stream side vegetation is composed of poplar, willow, alder and spruce.

Fish species recorded in this reach include: chinook salmon fry (abundant), burbot, lake chub, slimy sculpin, and longnose sucker.

SW2 This reach starts 80 meters upstream of the Teslin River and continues further upstream for 250 meters. The average depth of the river in this reach is 0.4 meters and the average width is 4 meters. This reach is primarily riffle with some exposed gravel bars, a pool to riffle ratio of 1:10, and some small side channels. A small pond formed by an old meander scroll lies on the north side of the reach; a small dam built by beavers backs water into the pond. Substrates consist of roughly equal proportions of cobble gravel and sand. Banks rise abruptly to an average of 0.3 meters above the water on the north bank; the south bank is exposed gravel bar. The reach has an average depth of 0.6 meters and an average width of 4.0 meters with a maximum width of 8 meters. Stream side vegetation is primarily willow and alder with some spruce and poplar. This reach provides cover in the form of instream woody debris, overhanging vegetation, eddies and undercut banks. Large numbers of chinook fry were recorded throughout this reach and some were found stranded in side channels as water levels dropped.

A detailed reach survey was completed in reach **SW2**. See Water Data Sheet, Appendix 3.

Fish species recorded in this reach include: chinook salmon fry (abundant) and slimy sculpin.

SW3 This reach starts approximately 330 meters upstream of the Teslin River and continues upstream for 150 meters flowing in a northwest direction with high clay cliffs along the south bank. The reach has an average depth of 0.4 meters and an average width of 7.0 meters. This reach flows primarily as a braided riffle with only one pool of any size. Substrates consist primarily of cobble (40%) and gravel (40%) with some boulders (10%) and sand (10%). Cover is provided by undercut banks and occasional boulders. Stream side vegetation is composed of poplar, alder and willow with some grassy areas and a prlmarily mature spruce forest adjacent. Stream banks are abrupt and often undercut. A deep pool at the confluence of a small side channel at the upstream end of this reach may offer potential over wintering habitat.

Fish species recorded in this reach include chinook salmon fry (abundant) and slimy sculpin.

SW4 This reach starts at the top of SW3 and continues upstream for 675 meters through a relatively flat valley bottom that does not confine the river. A large log jam 250 meters into the reach creates several large pools and braids the channel, creating 2 main channels and one smaller side channel that converge at the bottom of the reach. The reach has an average depth of 0.35 meters and an average width of 8.5 meters. Pools become more common with pool/riffle ratio of 1:4. Substrates consist of sorted gravel, cobble and sand. Banks are typically abrupt on one side with the opposing bank a gravel point bar. Stream side vegetation is composed of alder, large poplar and mature spruce; sedges cover point bars, with the surrounding forest an extensive stand of mature spruce. There is evidence of historic and recent beaver activity.

Fish species recorded in this reach include chinook salmon fry (abundant) and slimy sculpin.

SW5 This reach starts at the top of SW4 and continues upstream for 900 meters, a point approximately 2 km upstream of the Teslin River. The reach has an average depth of 0.4 meters and an average width of 7.0 meters. The valley begins to constrict creating a channel with numerous long and relatively straight riffle stretches, with good pools occurring only near corners. Substrates consist evenly of boulder, cobble and sorted gravel with some sand. Banks are typically abrupt on one side with the opposing bank a gravel point bar. Stream side vegetation is composed of alder and spruce with sedge on the point bars. Above this reach, the river continues much the same but becoming increasingly more confined.

Fish species recorded in this reach include chinook salmon fry (abundant) and slimy sculpin.

Unnamed tributary #1

This creek flows in a generally north east direction and enters the Teslin River from the west at 60°47.74'N/133°49.61'W. This is a third order stream. The creek is approximately 7 kilometers long, with a head water lake located approximately 3.5 kilometers upstream of the creek mouth. The creek has an average depth near the outlet area of 0.3 meters and an average width of 2 meters. Stream side vegetation is composed

primarily of alder. Overhead cover (75%) is alder. Substrates consist of cobbles (40%), boulders (30%), and sand (30%) with a pool riffle ratio of 1:1.

Fish species recorded in this tributary include chinook salmon fry (uncommon) and slimy sculpin.

Unnamed tributary #2

This creek flows in a northerly direction and enters the Teslin River from the west at 60°46.61'N/133°46.87'W. This is a first order stream. The creek is approximately 2.5 kilometers long. The creek has an average depth near the outlet area of 1 meter and an average width of 6 meters. Stream side vegetation is composed primarily of willow with some poplar and spruce. Willow provides 30% overhead cover. Substrates consist of silt.

Fish species recorded in this tributary were chinook salmon fry (abundant).

Unnamed tributary #3

This creek flows in a northerly direction to enter the Teslin River from the west at 60°46.75'N/133°46.26'W. This is a second order stream. The creek is approximately 4.5 kilometers long. The creek has an average depth near the outlet area of 0.8 meters and an average width of 3 meters. Stream side vegetation is composed primarily of willow and grass. Overhead cover (30%) comes from overhanging willow and some instream cover from woody debris. Substrates consist of organic debris near the mouth with cobble further upstream.

Fish species recorded in this tributary include chinook salmon fry (common) and lake chub.

Unnamed tributary #4

This creek flows south from it's headwater lake in the Big Salmon Range to enter the Teslin River from the east at 60°46.06'N/133°44.26'W. This is a first order stream. The creek is approximately 4.5 kilometers long with an average depth near the outlet area of 1.5 meters and an average width of 1 meter. Stream side vegetation is composed primarily of willow sedge and equisetum. Within 20 meters of the mouth, the creek becomes 100% willow covered. Substrates consist entirely of silt. A 2 meter high beaver dam located 40 meters upstream of the Teslin River likely impedes upstream fish migration.

Fish species recorded in this tributary include chinook salmon fry and slimy sculpin.

Unnamed tributary #5

This creek flows south from it's headwaters in the Big Salmon Range to enter the east side of the Teslin River at 60°45.66'N/133°43.01'W. This is a first order stream. The creek is approximately 5 kilometers long with an average depth of 0.6 meters and an average width of 1.5 meters near the outlet. Stream side vegetation is composed primarily of willow and sedge. Within 80 meters of the mouth, the creek becomes 100% willow covered. Substrates consist of organic debris and silt.

Fish species recorded in this tributary include chinook salmon fry (common), slimy sculpin and unidentified coregonid (whitefish) species (fry).

Unnamed tributary #6
This creek flows north and enters the Teslin River from the west at 60°45.39'N/133°43.24'W. This is a second order stream. The creek is approximately 8.5 kilometers long with an average depth of 0.5 meters and an average width of 4 meters, near the outlet area. A small bay exists at the creek outlet to the Teslin River, extending 120 meters with an average width of 13 meters. The bay flows as a sluggish glide while the creek has a pool:riffle ratio of 1:1, with most riffles created by submerged vegetation. Stream side vegetation is composed primarily of willow and sedge, with some poplar. Substrates consist of heavily silted gravel. An occupied beaver lodge exists near the mouth of this creek.

Fish species recorded in this tributary were chinook salmon fry (uncommon).

Unnamed tributary #7
This creek flows south-west from the Big Salmon Range to enter the Teslin River from the east at 60°45.12'N/133°42.38'W. This is a second order stream. The creek is approximately 3.75 kilometers long with an average depth of 0.15 meters and an average width of 2.5 meters near the outlet area. Stream side vegetation is composed primarily of willow with some alder. Substrates consist of gravel (60%), cobbles (20%), and silt (20%). The creek has 75% willow cover and abundant instream woody debris.

Fish species recorded in this tributary include chinook salmon fry (uncommon) and slimy sculpin.

Unnamed tributary #8
This creek flows in a north-east direction to enter the Teslin River from the west at 60°45.08'N/133°42.61'W. This is a second order stream. The creek is approximately 2.5 kilometers long with an average depth of 0.25 meters and an average width of 1 meter near the outlet area. Stream side vegetation is composed primarily of willow with low and gentle moss banks, which becomes willow choked within 200 meters of the Teslin River. Substrates consist of silt/sand with some cobble.

Fish species recorded in this tributary were chinook salmon fry (abundant). Northern pike and adult grayling were observed in the outlet area.

Unnamed tributary #9
This creek flows in a north-east direction to enter the Teslin River from the west at 60°43.61'N/133°41.19W. This is a second order stream. The creek is approximately 7.25 kilometers long and has an average depth of 0.15 meters and an average width of 4 meters near the outlet area. Stream side vegetation is composed primarily of willow and alder. Substrates consist of silt/sand covered cobble. The mouth area forms a small bay (25m x 30m) at the Teslin River.

Fish species recorded in this tributary include: chinook salmon fry (uncommon) and slimy sculpin.

Unnamed tributary #10
This creek flows generally north-east to enter the Teslin River from the west at 60°42.65'N / 133°40.37'W. This is a first order stream. The creek is approximately 2

kilometers long. An inlet/flooded channel leads from the creek mouth to the Teslin River proper. This inlet/flooded channel flows in an "L" shape for approximately 500 meters, with an average width of 30 meters and an average depth of 1.2 meters. The creek at the outlet area has an average depth of 0.5 meters with an average width of 3 meters. Stream side vegetation is composed primarily of sedge, willow and aspen. Substrates consist of deep silt/mud. The lower reaches of the creek flow as a meandering glide through a sedge meadow.

No fish were recorded in this tributary.

Unnamed tributary #11

This creek flows north-west from a small lake for 2.5 kilometers before turning south-west to enter Teslin River from the east at 60°42.82'N/133°39.60'W. This is a first order stream. The creek is approximately 4.5 kilometers long, small and flows turbid. The creek's channel flows through tangled willow/alder (100% overhead cover) in a shifting channel over silt substrates. Near the outlet, the creek has an average depth of 0.1 meters and an average width of 0.3 meters. Stream side vegetation is composed primarily of willow and alder. The creek empties into a small bay (10 m wide x 35 m) off the Teslin River.

No fish were recorded in this tributary.

Unnamed tributary #12

This creek flows in a north-east direction to enter the Teslin River from the west at 60°42.37'N/133°39.38'W. This is a second order stream. The creek is approximately 8.5 kilometers long. The creek has an average depth, near the outlet area, of 0.25 meters and an average width of 2.5 meters. Stream side vegetation is composed primarily of willow and sedge, with 60% cover by overhead willow within 60 meters of its mouth. Substrates consist of silt covered gravel/cobble. The creek has a pool:riffle ratio of 2:1 and some areas of high velocities. The creek water was turbid at the time of investigations. A bay area (25m x 100m) exists where the creek enters the Teslin River.

Fish species recorded in this tributary; slimy sculpin. Chinook salmon fry were observed in the bay area at the creek mouth.

Unnamed tributary #14

This creek flows in a north-east direction to enter the Teslin River from the west at 60°41.35'N/133°38.83'W. This is a first order stream. The creek is approximately 3 kilometers long with an average depth near the outlet area of 0.2 meters and an average width of 0.8 meters. This is a small, turbid creek with silt substrates. Stream side vegetation is composed primarily of sedge and willow. The creek becomes 100% willow covered within 60 meters of it's mouth.

No fish were recorded in this tributary.

Unnamed tributary #15

This creek flows in a north-east direction to enter the Teslin River from the west at 60°40.84'N/133°38.14'W. This is a first order stream. The creek is approximately 3 kilometers long with an average depth near the outlet area of 0.25 meters and an average

width of 1 meter. Stream side vegetation is composed primarily of sedge and willow, Within 75 meters upstream of the mouth, the creek has 100% willow cover. The creek is turbid and flows in a newly cut channel over recently deposited silt. The creek enters the Teslin River via a bay 80 meters long by 45 meters wide.

No fish were recorded in this tributary.

Unnamed tributary #16

This creek flows south-west from a headwater lake for 2.5 kilometers before turning north-west for 1.5 kilometers to enter the Teslin River from the east at 60°40.49'N/133°36.82'W. This is a first order stream. The creek is approximately 4 kilometers long and enters the Teslin via a small bay. The creek has an average depth near the outlet area of 0.1 meter and an average width of 0.3 meters. The creek flows through an open willow meadow, is turbid and carries a high sediment load over silt substrates.

No fish were recorded in this tributary.

Unnamed tributary #17

This creek flows in a generally north-east direction to enter the Teslin River from the west at 60°39.82'N/133°36.79'W. This is a first order stream. The creek is approximately 5.25 kilometers long and has an average depth near the outlet area of 0.1 meters and an average width of 0.2 meters. The stream flows through an open willow draw with adjacent sedge meadows. The water was very turbid and newly deposited silt to 0.5 meters deep was evident. Substrates consist entirely of silt.

No fish were recorded in this tributary.

Unnamed tributary #18

This creek flows in a generally south-west direction to enter the Teslin River from the east via a small bay at 60°39.63'N/133°35.88'W. This is a second order stream. The creek is approximately 3.5 kilometers long with an average depth near the outlet area of 0.1 meters and an average width of 0.3 meters. The creek flows as a riffle through a gentle grassy flood plain with silt substrates and evidence of historic beaver activity. Stream side vegetation is composed primarily of sedge.

No fish were recorded in this tributary.

Unnamed tributary #19

This creek flows in a generally north-east direction to enter the Teslin River from the west at 60°39.45N/133°36.06W. This is a second order stream. The creek is approximately 3 kilometers long with an average depth near the outlet area of 0.1 meters and an average width of 5 meters. A 120 meter long by 6 meter wide flooded bay forms the outlet area of this creek. Stream side vegetation is composed primarily of willow with 80-100% overhead cover. Substrates consist of silt covered cobble/gravel washed clean only in the occasional place. The creek was carrying a heavy sediment load and the stream channel was shifting over the deposited sediments.

Fish species recorded in this tributary were slimy sculpin.

Unnamed tributary #20

This creek flows in a generally south-west direction to enter the Teslin River from the east at 60°38.44'N/133°32.91'W. This is a second order stream. The creek forks approximately 1.5 kilometers upstream of its mouth and each of these forks are approximately 2 kilometers long. The creek enters the Teslin via a long narrow bay, 120 meters long and 30 meters wide. The creek has an average depth near the outlet area of 0.4 meters and an average width of 0.5 meters. Stream side vegetation is composed primarily of sedge. Substrates consist of heavily silted cobbles. Within 30 meters of the creek mouth, the creek is 100% covered by spruce deadfall.

Fish species recorded in this tributary include northern pike and slimy sculpin.

Unnamed tributary #21

This creek flows in a generally north-east direction to enter the Teslin River from the west at 60°37.91'N/133°33.08'W. This is a second order stream. The creek is approximately 5.75 kilometers long and enters the Teslin via a narrow bay. The narrow bay consists of a 60 meter long flood reach from the Teslin, then a 50 meter long glide before becoming confined with an average depth of 0.3 meters and an average width of <1 meter. Stream side vegetation is composed primarily of willow. The creek is 60% willow covered and has some instream spruce deadfall; willow cover increases to 80% in the confined channel area. Substrates consist of gravel (90%) and cobble (10%). While the lower reaches of the creek flow as a gentle glide, riffle areas develop within 50 meters of the creeks becoming confined.

Fish species recorded in this tributary include burbot, northern pike, and several species of unidentified coregonid believed to be broad whitefish, lake whitefish fry and least cisco.

Unnamed tributary #22

This creek flows in a north-west direction from a small headwater lake to enter the Teslin River from the east at 60°37.64'N/133°32.73'W. This is a first order stream. The creek is approximately 2.75 kilometers long and enters the Teslin via a long bay 240 meters long that is 20 meters wide at the Teslin, and narrows to 2 meters at the top of the Teslin River flood line. Above the bay, the creek has an average depth of 0.1 meters and an average width of 0.5 meters that flows in an incised channel through silts and organic materials over 1 meter thick. Substrates consist of deep silts and organic materials over heavily silted cobbles. Cobbles are visible only in areas of higher velocities. Stream side vegetation is composed primarily of sedge, willow and equisetum, with the creek becoming 100% willow covered within 80 meters of the constriction. The creek water was turbid with velocities >1 meter/ second and a pool to riffle ratio of 2:1.

No fish were recorded in this tributary.

Unnamed tributary #23

This creek flows west to enter the Teslin River from the east at 60°37.23'N/133°31.28'W. This is a first order stream. The creek flows into the Teslin via a 1.3 kilometer long bay that averages a width of 12 meters. The creek is approximately 2 kilometers long and small with an average depth of 0.2 meters and an average width of 0.2 meters. Stream

side vegetation is composed primarily of aquatic grasses, willow and moss, and within 150 meters of the bay area, becomes a willow filled draw. Substrates consist entirely of silt, and the water flows turbid.

Fish species recorded in this tributary were adult northern pike in the bay area.

Unnamed tributary #24

This creek flows generally north-east from two small headwater lakes to enter the Teslin River from the west via a small shallow bay at 60°36.61'N/133°31.50'W. This is a first order stream. The creek is approximately 3.5 kilometers long with an average depth of 0.15 meters and an average width of 3.5 meters near the outlet area. Stream side vegetation is composed primarily of willow, alder and spruce, and the creek becomes completely covered by willows 30 meters upstream of the outlet. Substrates consist of silted gravel. An active cut bank 300 meters upstream of the outlet introduces silts and increases turbidity. Evidence of historic beaver activity exists. The pool/riffle ratio was 8:1.

No fish were recorded in this tributary. Arctic grayling juveniles, lake trout juveniles and numerous unidentified whitefish fry were observed in the adjacent bay.

Unnamed tributary #25

This creek flows east to enter the Teslin River from the west at 60°36.03'N/133°30.29'W. This is a second order stream. The creek is approximately 6.5 kilometers long. The average depth near the outlet area is 0.05meters and the average width is 1 meter. Stream side vegetation is composed primarily of willow and sedge, the outlet area is comprised strictly of sedges with willows increasing moving upstream to become 100% willow covered within 85 meters of the outlet. The pool/riffle ratio was 2:1 in an incised channel with substrates consisting primarily of silt with patches of washed cobble/gravel. The water in this creek was cold relative to other creeks investigated at 4.7°C.

No fish were recorded in this tributary. Chinook fry and unidentified whitefish fry were observed at the outlet to the Teslin River.

Unnamed tributary #26

This creek flows in a generally north-east direction to enter the Teslin River from the west at 60°35.09'N/133°28.87'W. This is a first order stream. The creek is approximately 7.5 kilometers long with an average depth of 0.15 meters and an average width of 1.5 meters near the outlet area. The creek channel is incised cut into unconsolidated silts and has abrupt banks Stream side vegetation is composed primarily of willow, sedges and equisetum. The creek is 40% willow covered near the outlet and becomes 100% willow covered within 110 meters . Substrates consist of silt covered cobble with clean cobble in higher velocity areas. Pool/riffle ratio in the creek was 2:1.

Fish species recorded in this tributary include: chinook salmon fry (uncommon), grayling juveniles and northern pike.

Unnamed tributary #27

This creek flows east to enter the Teslin River from the west via a 200 meter long bay at 60°34.20'N, 133°27.02'W. This is a second order stream. The creek is approximately

6.5 kilometers long with an average depth of 0.08 meters and an average width of 3.5 meters near the outlet. Stream side vegetation is composed primarily of sedge and willow. Very little overhead cover exists in the first 75 meters but increases to 100% willow cover 250 meters upstream of the outlet. The creek is mostly a shallow glide and riffle with very few pools. Substrates consist of silt covered cobbles with some sand. The creek banks are stable and provide very little fish habitat.

No fish were recorded in this tributary.

Unnamed tributary #28

This creek flows in a generally south-west direction to enter the Teslin River from the east at 60°34.01'N/133°25.40'W. This is a second order stream. The creek is approximately 3 kilometers long and enters the Teslin via a long bay more than 400 meters long confined by high clay cliffs on both sides. The creek has an average depth of 0.1 meters and an average width of 0.3 meters near the outlet area. Stream side vegetation is composed primarily of willow and sedge with little overhead cover for the first 60 meters, then becomes 100% willow covered. Substrates consist of silt.

No fish were recorded in this tributary. Adult northern pike were abundant in the adjacent bay.

Unnamed tributary #29

This creek flows north, then east to enter the Teslin River from the west at 60°33.75'N / 133°26.50'W. This is a second order stream. The creek is approximately 3 kilometers long and has a long narrow inlet (450m x 20m) leading from the Teslin River to the creek mouth. This inlet has abundant aquatic vegetation and supports high numbers of adult northern pike. The creek flows as a gentle glide with the average depth being 0.5 meters and the average width 1 meter. Stream side vegetation is composed primarily of sedge and equisetum. Substrates consist entirely of silt.

Fish species recorded in this tributary include chinook salmon fry (uncommon) and northern pike.

Unnamed tributary #30

This creek flows generally north to enter Teslin River from the west immediately upstream of the Alaska highway bridge at Johnsons Crossing at 60°29.25'N / 133°18.00'W and enters the Teslin through a long slow channel 180 meters long. This is a second order stream. The creek is approximately 13 kilometers long. The outlet channel flows as a deep ,slow glide with the average depth >2 meters and an average width of 4 meters; maximum width is 12 meters. Stream side vegetation is composed primarily of willow and sedge with stable, well vegetated banks. Within 180 meters from the Teslin River the creek narrows to 2.5 meters wide and becomes 50 % willow covered with an increase in instream woody debris and adjacent spruce. After approximately 290 meters upstream of the outlet, the creek narrows to 1 meter width and 0.5 meters depth, and becomes 100% willow covered. Substrates consist of silt covered gravel. An active fish camp is situated at the outlet bay.

Fish species recorded in this tributary include: chinook salmon fry (uncommon), Arctic grayling (adults and fry) and adult round whitefish.

Unnamed tributary #31

This creek flows in a south-west direction to enter Teslin River from the east at 133°28.50'N / 133°16.50'W. This is a first order stream. This creek is the first creek to enter the Teslin River downstream of the outlet from Teslin Lake. The creek is approximately 3 kilometers long with an average width of 0.3 meters and an average depth of 0.2 meters. Stream side vegetation is composed primarily of willow and spruce with very little overhead cover for the first 65 meters, then becoming 100% willow covered within 120 meters upstream of the Teslin. Substrates consist of silt over submerged willows, and the channel is incised.

No fish were recorded in this tributary.

Unnamed tributary #33

This creek flows generally south-west and enters Teslin Lake immediately upstream of the outlet to Teslin Lake on the east side at 60°27.74'N / 133°14.81'W. This is a second order stream. The creek is approximately 2.25 kilometers long. The average depth near the outlet area is 0.05 meters and the average width is 0.3 meters. Stream side vegetation is composed primarily of sedge and willow. Substrates are silt. The creek water was turbid and the creek flows from a willow thicket (100% cover) in a newly cut channel. The creek does not provide suitable fish habitats nor inland access from the lake.

No fish were recorded in this tributary.

APPENDIX 3:

WATER DATA SHEETS

WILSON CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH W2

CHANNEL CHARACTERISTICS:

Average Channel Width:	15m	Gradient 0.70%	Surveyed length 115m
Average Wetted Width:	6.2m(July),	5.9m(August)	
Average Riffle / Run Depths:		0.10 / 0.30m(July)	0.08 / 0.20m(August)
Average Velocity in Riffles / Run:		0.8m/sec	0.4m/sec
% Pool, Riffle, Run:	0 %Pool	10%Riffle	90%Glide

Side Channels: <5%, none connected in surveyed reach

Debris: <5% in Area, 90%stable, L.O.D.

Cover: 5 - 10%, stable L.O.D., instream vegetation, turbidity

Crown Closure: <10%, overhanging willow

Riparian Vegetation: Consists of an overstory of white spruce (*Picea glauca*) and a shrub layer of willow (*Salix* spp.). see Appendix 6 for a list of other riparian vegetation.

Aspect: flows south west to the Teslin River

BED MATERIAL: moderately compacted small gravels overlain by silty sand

Fines	80%,	silty sand
Gravels	20%,	mostly small, D_{50} 15mm
Larges	none	
Bedrock	none	
D_{90}	2 cm	

STREAM BANKS: frequently confined, average height 2m, very fine sand and silt, moderate slopes

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
09/07/97	0.77	0.44	0.28
21/08/97	0.51	0.37	0.22

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
4.7 m^3/sec using Manning's Equation (Derived Mean Annual Flood 6.6m^3/sec)
LATE WINTER LOW FLOW CONDITIONS: Unable to measure flow. Goes into substrate intermittently. Not much aufice.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
08/07/97	8.03	11.5	151	8.5	10.1
22/08/97	8.2	9.7	180	5	12.5
09/03/98		0.5	216	3	4.8

DAVE CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH D2

CHANNEL CHARACTERISTICS:

Average Channel Width:	10m	Gradient 0.96%	Surveyed length 192m
Average Wetted Width:	7.0m(July),	6.5m(August)	
Average Riffle / Run Depths:		0.10 / 0.20m(July)	0.10 / 0.15m(August)
Average Velocity in Riffles / Runs:		0.7m/sec	0.4m/sec
% Pool, Riffle, Run :	10 % Pool	30% Riffle	60% Run

Side Channels: <5%, none connected in surveyed reach
Debris: 5 - 15% in Area, 80%stable, old breached Beaver dams
Cover: 30%, overhanging willow, undercut
Crown Closure: 20%, overhanging willow
Riparian Vegetation: Consists of an overstory of white spruce (*Picea glauca*) and a shrub layer dominated by alder (*Alnus* sp) and willow (*Salix* spp.). see appendix 6 for a list of other riparian species.
Aspect: flows west to the Teslin River

BED MATERIAL: moderately compacted sandy gravels overlain by sandy silt

Fines	50%,	fine silty sand
Gravels	40%,	mostly small, D_{50} 20mm
Larges	10%,	half small, D_{50} 75mm
Bedrock	none	
D_{90}	8 cm	

STREAM BANKS: unconfined, average height 1.2m, silty sand, near vertical slopes.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
08/07/97	0.50	0.36	0.20
21/08/97	0.28	0.29	0.15

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
3.5 m^3/sec using Manning's Equation (Derived Mean Annual Flood 5.3m^3/sec)
LATE WINTER LOW FLOW CONDITIONS: Extreme aufice, channel changed.
Unable to measure flow, negligible velocity.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
08/07/97	7.73	10.9	193	1	9.6
21/08/97	8.2	9.4	220	1	12.8
09/03/98		0.5	226	2	5.5

HUNDRED MILE CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH H2

CHANNEL CHARACTERISTICS:

Average Channel Width:	20m	Gradient 1.1%	Surveyed length 165m
Average Wetted Width:	6.0m(July),	5.0m(August)	
Average Riffle / Run Depths:		0.30 / 0.15m(July)	0.20 / 0.10m(August)
Average Velocity in Riflles / Run:		0.7m/sec	0.5m/sec
% Pool, Riffle, Run:	10 % Pool	20% Riffle	70% Run

Side Channels: <5%, none connected in surveyed reach

Debris: 5 - 15% in Area, 80%stable, L.O.D.

Cover: 60%, predominantly overhanging veg. / sedge, some undercut.

Crown Closure: 40%, overhanging willow.

Riparian Vegetation: Consists of a mature closed overstory canopy of white spruce (*Picea glauca*) and balsam poplar (*Populus balsafimera*) with an understory dominated by a thick shrub layer primarily alder (*Alnus* sp.). see appendix 6 for a list of other riparian species.

Aspect: flows west to the Teslin River

BED MATERIAL: moderately compacted small gravels and cobbles

Fines	15%, all sand
Gravels	50%, mostly small, D_{50} 20mm
Larges	35%, mostly small
Bedrock	none
D_{90}	10 cm

STREAM BANKS: Frequently confined, average height 1.2m, silty sand, moderate slopes.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
08/07/97	0.65	0.54	0.21
21/08/97	0.42	0.43	0.19

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
8.8 m^3/sec using Manning's Equation
LATE WINTER LOW FLOW CONDITIONS: Extreme aufice. Less than .004m^3/sec.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
08/07/97	7.81	10.3	162	1.5	10.2
21/08/97	8	8.6	193.4	<1	12.7
10/03/98		1.8	225	2	7.8

MEADOW CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH MDW2

CHANNEL CHARACTERISTICS:

Average Channel Width:	15m	Gradient 0.85%	Surveyed length 120m
Average Wetted Width:	9.0m(July),	7.0m(August)	
Average Riffle / Run Depths:		0.15 / 0.35m(July)	0.10 / 0.28m(August)
Average Velocity in Riffles / Run:		1.0m/sec	0.5m/sec
% Pool, Riffle, Run:	10 %Pool	20%Riffle	70%Glide

Side Channels: <5%, none connected in surveyed reach

Debris: 5 - 15% in Area, 80%stable, old breached Beaver dams, L.O.D.

Cover: 5 - 10%, undercut, stable L.O.D.

Crown Closure: <10%, overhanging willow

Riparian Vegetation: Consists of an overstory of white spruce *(Picea glauca)* and balsam poplar *(Populus balsamifera)*. The shrub layr is dominated by willow *(Silex* spp.) and alder *(Alnus* sp.). See appendix 6 for list of other riparian species.

Aspect: flows south to the Teslin River

BED MATERIAL: moderately compacted sandy gravels, lower end of reach is all sands

Fines	50%,	fine silty sand
Gravels	50%,	mostly small, D_{50} 15mm
Larges	none	
Bedrock	none	
D_{90}	2.5 cm	

STREAM BANKS: sometimes confined, average height 1.5m, silty sand, very steep.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
10/07/97	1.22	0.45	0.28
22/08/97	0.66	0.38	0.23

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
9.5 m^3/sec using Manning's Equation (Derived Mean Annual Flood 8.2m^3/sec)
LATE WINTER LOW FLOW CONDITIONS: Measured 0.09m^3/sec. Aufice first two reaches, improves upstream.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
10/07/97	7.43	9.3	79.5	<1	9.8
22/08/97	8.1	9.4	100	2	11.2
10/03/98		0.3	160.3	2	8.5

MUSKRAT CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH MK3

CHANNEL CHARACTERISTICS:

Average Channel Width	20m	Gradient 1.2%	Surveyed length 142m
Average Wetted Width	5.0m(July),	4.8m(August)	
Average Riffle / Run Depths:		0.15 / 0.25m(July)	0.11 / 0.20m(August)
Average Velocity in Riffles / Runs:		0.7m/sec	0.45/sec
% Pool, Riffle, Run:	20 % Pool	20% Riffle	60% Run

Side Channels: <5%, none connected in surveyed reach

Debris: >25% in Area, 90%stable, L.O.D. and old breached beaver dams

Cover: 10%, overhanging bank vegetation and stable L.O.D.

Crown Closure: <5%, overhanging willow

Riparian Vegetation: Consists of an overstory of white spruce (*Picea glauca*) and a shrub layer of primarily willow (*Silex* spp.). see appendix 6 for a list of other riparian vegetation.

Aspect : flows west to the Teslin River

BED MATERIAL: moderately compacted small gravels overlain by silty sand

Fines	25%,	all sand
Gravels	70%,	mostly small, D_{50} 20mm
Larges	<5%,	mostly small,
Bedrock	none	
D_{90}	6 cm	

STREAM BANKS: sometimes confined, average height 1.8m, sandy silt, steep slopes.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
09/07/97	0.57	0.46	0.23
22/08/97	0.45	0.39	0.21

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
10.1 m^3/sec using Manning's Equation (Derived Mean Annual Flood 7.3m3/sec)

LATE WINTER LOW FLOW CONDITIONS: Measured flow 0.11m^3/sec March 10,1998. Etreme aufice first 350m, gives way to unconfined flow under 5 - 30 cm clear ice upstream.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
09/07/97	7.9	9.9	100.8	0.6	9.9
21/08/97	7.6	9.6	120	4	10.1
10/03/98		0.3	185.1	2	8.2

SQUANGA CREEK - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH SQ2

CHANNEL CHARACTERISTICS:

Average Channel Width:	25m	Gradient 1.2%	Surveyed length 98m
Average Wetted Width:	10.0m(July),	7.5m(August)	
Average Riffle / Run Depths:		0.20 / 0.30m(July)	0.13 / 0.25m(August)
Average Velocity in Riffles / Runs:		2.0m/sec	1.0m/sec
% Pool, Riffle, Run:	5 % Pool	20% Riffle	75% Run

Side Channels: <5%, none connected in surveyed reach
Debris: none
Cover: <10%, undercut, overhanging veg.
Crown Closure: <5%, overhanging willow
Riparian Vegetation: Consists of an overstory of open canopy white spruce (*Picea glauca*). The shrub layer is mostly willow (*Salix* spp.). See appendix 6 for a list of other riparian vegetation.
Aspect: flows north to the Teslin River

BED MATERIAL: loosly compacted gravels, cobbles

Fines	10%,	coarse sand
Gravels	30%,	mostly large
Larges	60%,	mostly large sizes
Bedrock	none	
D_{90}	20 cm	

STREAM BANKS: frequently confined, average height 1.5m, gravelly sand, steep slopes.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
09/07/97	2.07	0.80	0.29
21/08/97	1.22	0.62	0.23

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
6.0 m^3/sec using Manning's Equation (Derived Mean Annual Flood 6.8m^3/sec)
LATE WINTER LOW FLOW CONDITIONS: SQ2 open water. Flow 1.4 m^3/sec.Thick aufice in SQ1

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (°C)	Specific Conductance (uS/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
09/07/97	8.28	16.1	259	1	9.3
22/08/97	8.3	11.7	270	2	9.6
10/03/97		0.4	271	2	8.9

SWIFT RIVER - WATER DATA SHEET

RESULTS OF DETAILED REACH SURVEY, REACH SW2

CHANNEL CHARACTERISTICS:

Average Channel Width:	30m	Gradient 0.98%	Surveyed length 350m
Average Wetted Width:	9.0m(July),	8.0m(August)	
Average Riffle / Run Depths:		0.30 / 0.50m(July)	0.25 / 0.40m(August)
Average Velocity in Riffles / Runs:		1.7m/sec	0.7m/sec
% Pool, Riffle, Run:	5 % Pool	70% Riffle	25% Run

Side Channels: <5%, none connected in surveyed reach
Debris: 5 - 15% in Area, 80%stable, L.O.D.
Cover: 20%, overhanging veg., L.O.D., undercut.
Crown Closure: <10%, overhanging willow
Riparian Vegetation: Consists of an overstory of white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*). The shrub layer is dominated by alder (*Alnus* sp.) and willow (*Silex* spp.). see appendix 6 for a list of other riparian vegetation.
Aspect: flows west to the Teslin River

BED MATERIAL: loosly compacted small gravels and cobbles

Fines	5%,	all sand
Gravels	40%,	mostly small, D_{50} 20mm
Larges	55%,	half small, D_{50} 75mm
Bedrock	none	
D_{90}	18 cm	

STREAM BANKS: unconfined in a flood plain, average height 1m, silty sand, gentle slopes.

STREAM FLOW CHARACTERISTICS MEASURED IN FIELD:

Date	Discharge (m^3/sec)	Average Velocity (m/sec)	Average Depth (m)
08/07/97	3.38	0.75	0.48
21/08/97	1.86	0.51	0.38

INDIRECT MEASUREMENT OF ORDINARY HIGH WATER MARK FLOOD:
18.4 m^3/sec using Manning's Equation (Derived Mean Annual Flood 18.6m3/sec)
LATE WINTER LOW FLOW CONDITIONS: Measured 0.53m^3/sec.,unconfined flow, ice varies from open leads to 30 cm clear ice. 40 cm snow cover.

WATER QUALITY IN SITU SURVEY RESULTS

date	pH	Temp (^{0}C)	Specific Conductance (*u*S/cm)	Turbidity (N.T.U.)	Dissolved Oxygen (mg/L)
08/07/97	7.87	15.1	209	0.3	9
21/08/97	7.09	13.2	231	<1	11.6
10/03/98		0.5	257	1	7.8

APPENDIX 4:

WATER QUALITY ANALYTICAL RESULTS

WATER QUALITY - TESLIN RIVER TRIBS - JULY 1997

Identification	Date	Fraction	Lab Ref #	total alk.	pH	turbidity	NFR	nitrate N	nitrite N	sulfate	ammonia	nitrite N	ortho Phosphate
Dave Cr	08-Jul-97		832-001	79	8.1	1	4	< 0.05	< 0.1	8.7	< 0.05	< 0.003	0.005
Meadow Ck	10-Jul-97		832-002	30	7.1	1	< 1.	< 0.2	< 1.	4	< 0.05	< 0.003	0.006
Muskrat Ck	09-Jul-97		832-003	68	7.9	0.6	1	< 0.05	< 0.05	5.3	< 0.05	< 0.003	< 0.005
Swift Ck	08-Jul-97	Duplicate	832-004A	81	8.2	0.3	< 1.	< 0.05	< 0.05	12.5	< 0.05	< 0.003	< 0.005
Swift Ck	08-Jul-97	Duplicate	832-004B										
Teslin Riv	10-Jul-97		832-005	58	7.9	0.2	< 1.	< 0.05	< 0.05	8.4	< 0.05	< 0.003	0.006
100 Mile Ck	10-Jul-97		832-006	79	8	1.5	6	< 0.05	< 0.05	10	< 0.05	< 0.003	0.005
Wilson Ck	09-Jul-97		832-007	69	7.9	8.5	22	< 0.05	< 0.05	6	< 0.05	< 0.003	< 0.005
Squanga Cr	09-Jul-97		832-008	117	8.3	1	22	< 0.05	< 0.05	8.6	< 0.05	< 0.003	0.005
BLANK			832-009										

		Extractable Metals											
Identification	total hard	aluminum	antimony	arsenic	barium	beryllium	bismuth	boron	cadmium	calcium	chromium	cobalt	copper
Dave Cr	94.4	0.05	< 0.02	< 0.02	0.0425	< 0.0002	< 0.02	< 0.01	< 0.0005	27.8	< 0.001	< 0.001	0.003
Meadow Ck	38.8	0.13	< 0.02	< 0.02	0.0207	< 0.0002	< 0.02	< 0.01	< 0.0005	11	< 0.001	< 0.001	0.002
Muskrat Ck	48.2	0.05	< 0.02	< 0.02	0.0212	< 0.0002	< 0.02	< 0.01	< 0.0005	14.6	< 0.001	< 0.001	< 0.002
Swift Ck	105	0.02	< 0.02	< 0.02	0.066	< 0.0002	< 0.02	< 0.01	< 0.0005	28.2	< 0.001	< 0.001	< 0.002
Swift Ck	104	0.02	< 0.02	< 0.02	0.0649	< 0.0002	< 0.02	< 0.01	< 0.0005	27.7	< 0.001	< 0.001	< 0.002
Teslin Riv	65	0.02	< 0.02	< 0.02	0.0307	< 0.0002	< 0.02	< 0.01	< 0.0005	18.1	< 0.001	< 0.001	< 0.002
100 Mile Ck	79.3	0.07	< 0.02	< 0.02	0.0394	< 0.0002	< 0.02	< 0.01	< 0.0005	21.8	< 0.001	< 0.001	0.002
Wilson Ck	77.5	0.36	< 0.02	< 0.02	0.0453	< 0.0002	< 0.02	< 0.01	< 0.0005	21	< 0.001	< 0.001	0.005
Squanga Cr	129	0.04	< 0.02	< 0.02	0.0874	< 0.0002	< 0.02	< 0.01	< 0.0005	34.4	< 0.001	< 0.001	< 0.002
BLANK	0.06	< 0.01	< 0.02	< 0.02	< 0.0006	< 0.0002	< 0.02	< 0.01	< 0.0005	0.02	< 0.001	< 0.001	< 0.002

WATER QUALITY - TESLIN RIVER TRIBS - JULY 1997

Identification	Extractable Metals iron	lead	lithium	magnesium	manganese	molybdenum	nickel	phosphorus	potassium	selenium	silicon	silver
Dave Cr	0.11	< 0.005	< 0.002	5.96	0.019	< 0.005	< 0.002	< 0.06	1	< 0.02	3.54	< 0.001
Meadow Ck	0.248	< 0.005	< 0.002	2.46	0.0153	< 0.005	< 0.002	< 0.06	0.9	< 0.02	4.55	< 0.001
Muskrat Ck	0.122	< 0.005	< 0.002	2.73	0.0156	< 0.005	< 0.002	< 0.06	0.6	< 0.02	4.26	< 0.001
Swift Ck	0.061	< 0.005	< 0.002	8.45	0.0049	< 0.005	< 0.002	< 0.06	1	< 0.02	2.65	< 0.001
Swift Ck	0.1	< 0.005	< 0.002	8.3	0.0052	< 0.005	< 0.002	< 0.06	1	< 0.02	2.59	< 0.001
Teslin Riv	0.062	< 0.005	< 0.002	4.73	0.0042	< 0.005	< 0.002	< 0.06	0.8	< 0.02	3.03	< 0.001
100 Mile Ck	0.188	< 0.005	< 0.002	5.84	0.0144	< 0.005	< 0.002	< 0.06	1.1	0.03	3.89	< 0.001
Wilson Ck	0.667	< 0.005	< 0.002	5.27	0.0425	< 0.005	< 0.002	0.06	0.8	< 0.02	4.35	< 0.001
Squanga Cr	0.128	< 0.005	< 0.002	10.4	0.0366	< 0.005	< 0.002	< 0.06	0.8	< 0.02	3.78	< 0.001
BLANK	0.008	< 0.005	< 0.002	< 0.01	0.0007	< 0.005	< 0.002	< 0.06	< 0.2	< 0.02	< 0.06	< 0.001

Identification	Extractable Metals sodium	strontium	sulfur	thallium	thorium	tin	titanium	uranium	vanadium	zinc	zirconium
Dave Cr	1.85	0.123	2.9	< 0.003	< 0.005	< 0.005	0.002	< 0.06	0.003	0.007	< 0.001
Meadow Ck	1.58	0.043	1.1	< 0.003	< 0.005	< 0.005	0.007	< 0.06	< 0.002	0.01	< 0.001
Muskrat Ck	1.61	0.057	1.7	< 0.003	< 0.005	< 0.005	0.002	0.06	< 0.002	0.009	< 0.001
Swift Ck	1.37	0.143	3.8	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.003	0.009	0.001
Swift Ck	1.33	0.137	3.8	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.002	0.007	< 0.001
Teslin Riv	1.46	0.067	2.7	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	0.009	< 0.001
100 Mile Ck	1.72	0.115	3.1	< 0.003	< 0.005	< 0.005	0.002	< 0.06	0.002	0.01	< 0.001
Wilson Ck	2.06	0.09	2	< 0.003	< 0.005	< 0.005	0.02	< 0.06	< 0.002	0.01	< 0.001
Squanga Cr	3.28	0.171	2.7	< 0.003	< 0.005	< 0.005	0.002	< 0.06	0.003	0.008	< 0.001
BLANK	< 0.06	< 0.005	< 0.1	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	0.013	< 0.001

WATER QUALITY - TESLIN RIVER TRIBS - AUGUST 1997

Identification	Date	Lab Ref #	hydroxide	carbonate	bicarb.	total alk	conduct.	pH	turbidity	NFR	nitrate N
Swift Creek	21-Aug-97	1117-001	< 5.	< 5.	130	130	230	8.3	< 1.	< 5.	< 0.05
100 Mile Creek	21-Aug-97	1117-002	< 5.	< 5.	105	105	190	8.2	< 1.	< 5.	< 0.05
Dave Creek	21-Aug-97	1117-003	< 5.	< 5.	110	110	210	8.2	1	< 5.	< 0.05
Wilson Creek	22-Aug-97	1117-004	< 5.	< 5.	111	111	165	8.2	5	< 5.	< 0.05
Squanga Creek	22-Aug-97	1117-005	< 5.	< 5.	164	164	260	8.3	2	< 5.	< 0.05
Muskrat Creek	22-Aug-97	1117-006A	< 5.	< 5.	55	55	98	7.6	4	< 5.	< 0.05
Muskrat Creek	22-Aug-97 duplicate	1117-006B									
Meadow Creek	22-Aug-97	1117-007	< 5.	< 5.	72	72	115	8.1	2	< 5.	< 0.05

	sulfate	ammonia	ortho phosphate	total hard	Extractable Metals aluminum	antimony	arsenic	barium	beryllium	bismuth	boron	cadmium
Swift Creek	13	0.05	< 0.005	116	< 0.01	< 0.02	< 0.02	0.0718	< 0.0002	< 0.02	0.01	< 0.0005
100 Mile Creek	11	0.05	< 0.005	94.3	< 0.01	< 0.02	< 0.02	0.0437	< 0.0002	< 0.02	< 0.01	< 0.0005
Dave Creek	8.7	0.05	< 0.005	102	< 0.01	< 0.02	< 0.02	0.0446	0.0003	< 0.02	< 0.01	< 0.0005
Wilson Creek	6.9	0.05	0.015	84.2	0.02	< 0.02	< 0.02	0.0386	< 0.0002	< 0.02	< 0.01	< 0.0005
Squanga Creek	8.4	< 0.05	0.006	135	< 0.01	< 0.02	< 0.02	0.0869	0.0005	< 0.02	< 0.01	< 0.0005
Muskrat Creek	6	< 0.05	< 0.005	54.8	< 0.01	< 0.02	< 0.02	0.0232	< 0.0002	< 0.02	< 0.01	< 0.0005
Muskrat Creek				56.2	< 0.01	< 0.02	< 0.02	0.0237	< 0.0002	< 0.02	< 0.01	< 0.0005
Meadow Creek	3.6	< 0.05	0.006	45.6	0.01	< 0.02	< 0.02	0.0209	< 0.0002	< 0.02	< 0.01	< 0.0005

WATER QUALITY - TESLIN RIVER TRIBS - AUGUST 1997

	chromium	cobalt	copper	iron	lead	lithium	magnesium	manganese	molybdenum	nickel	phosphoru	potassium
Swift Creek	< 0.001	< 0.001	< 0.002	0.012	< 0.005	< 0.002	9.31	0.0032	< 0.005	< 0.002	0.07	0.6
100 Mile Creek	< 0.001	< 0.001	< 0.002	0.026	< 0.005	< 0.002	6.96	0.0047	< 0.005	< 0.002	0.06	0.7
Dave Creek	< 0.001	< 0.001	< 0.002	0.032	< 0.005	< 0.002	6.29	0.0047	< 0.005	< 0.002	< 0.06	0.7
Wilson Creek	< 0.001	< 0.001	< 0.002	0.07	< 0.005	< 0.002	6.06	0.0082	< 0.005	< 0.002	0.06	0.6
Squanga Creek	< 0.001	< 0.001	< 0.002	0.042	< 0.005	< 0.002	11.1	0.0114	< 0.005	< 0.002	0.08	0.7
Muskrat Creek	< 0.001	< 0.001	< 0.002	0.057	< 0.005	< 0.002	3.18	0.0052	< 0.005	< 0.002	< 0.06	0.6
Muskrat Creek	< 0.001	< 0.001	< 0.002	0.059	< 0.005	< 0.002	3.26	0.0072	< 0.005	< 0.002	< 0.06	0.5
Meadow Creek	< 0.001	< 0.001	< 0.002	0.06	< 0.005	< 0.002	2.95	0.0059	< 0.005	< 0.002	< 0.06	0.7

	silicon	silver	sodium	strontium	sulfur	thallium	thorium	tin	titanium	uranium	vanadium	zinc
Swift Creek	2.53	< 0.001	1.49	0.163	4.4	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.003	< 0.001
100 Mile Creek	4.2	< 0.001	1.96	0.152	3.5	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	< 0.001
Dave Creek	3.63	< 0.001	2.02	0.138	2.9	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	< 0.001
Wilson Creek	3.91	< 0.001	2.38	0.11	2.3	< 0.003	< 0.005	< 0.005	0.001	< 0.06	< 0.002	< 0.001
Squanga Creek	4.22	< 0.001	3.46	0.19	2.8	< 0.003	< 0.005	0.007	< 0.001	< 0.06	0.003	< 0.001
Muskrat Creek	4.42	< 0.001	1.91	0.068	2	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	< 0.001
Muskrat Creek	4.49	< 0.001	2	0.069	2	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	< 0.001
Meadow Creek	4.9	< 0.001	1.75	0.055	1.2	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	< 0.002	< 0.001

WATER QUALITY - TESLIN RIVER TRIBS - MARCH 1998

	iron	lead	lithium	magnesium	manganese	molybdenum	nickel	phosphorus	potassium	selenium	silicon
Swift Creek	0.031	< 0.005	< 0.002	12.6	0.0025	< 0.005	< 0.002	< 0.06	1	< 0.02	3.36
100 Mile Creek	0.037	< 0.005	< 0.002	9.81	0.0026	< 0.005	< 0.002	< 0.06	1	0.04	4.15
Dave Creek	0.037	< 0.005	< 0.002	9.26	0.0184	< 0.005	< 0.002	< 0.06	1.2	< 0.02	4.72
Wilson Creek	0.134	< 0.005	< 0.002	9.07	0.0373	< 0.005	< 0.002	< 0.06	1.2	< 0.02	4.91
Squanga Creek	0.057	< 0.005	< 0.002	12.8	0.0138	< 0.005	< 0.002	< 0.06	1.4	< 0.02	5.11
Muskrat Creek	0.035	< 0.005	< 0.002	8.01	0.021	< 0.005	< 0.002	< 0.06	1.3	0.04	5.65
Meadow Creek	0.073	0.006	< 0.002	6.38	0.0669	< 0.005	< 0.002	< 0.06	0.8	< 0.02	6.12

	sodium	strontium	sulfur	thallium	thorium	tin	titanium	uranium	vanadium	zinc	zirconium
Swift Creek	1.84	0.19	5.7	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.003	0.001	< 0.001
100 Mile Creek	2.25	0.179	4.5	< 0.003	< 0.005	< 0.005	0.001	< 0.06	0.004	0.002	< 0.001
Dave Creek	2.78	0.174	4.9	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.005	0.003	< 0.001
Wilson Creek	2.97	0.145	3	< 0.003	< 0.005	< 0.005	0.003	< 0.06	0.003	0.002	< 0.001
Squanga Creek	3.57	0.167	3.1	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.004	< 0.001	< 0.001
Muskrat Creek	2.76	0.12	2.8	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.003	0.004	0.001
Meadow Creek	2.68	0.1	2.2	< 0.003	< 0.005	< 0.005	< 0.001	< 0.06	0.003	0.001	< 0.001

WATER QUALITY - TESLIN RIVER TRIBS - MARCH 1998

Identification	Date	Lab Ref #	total alk.	conduct.	turbidity	NFR	nitrate N	nitrite N	sulfate	ammonia	ortho phosphate	tota
Swift Creek	10-Mar-98	33687-4	146	295	1	< 5.	0.13	< 0.003	44	<0.05	0.009	
100 Mile Creek	10-Mar-98	33687-6	135	255	2	< 5.	0.15	< 0.003	42	<0.05	0.018	
Dave Creek	9-Mar-98	33687-2	127	290	2	< 5.	0.17	< 0.003	36	<0.05	0.008	
Wilson Creek	9-Mar-98	33687-3	141	225	3	< 5.	0.11	< 0.003	19	<0.05	0.01	
Squanga Creek	10-Mar-98	33687-5	135	290	2	< 5.	0.11	0.005	16	<0.05	0.017	
Muskrat Creek	10-Mar-98	33687-7	105	210	2	< 5.	0.11	< 0.003	12	<0.05	0.017	
Meadow Creek	10-Mar-98	33687-1	84	185	2	< 5.	0.08	0.003	21	<0.05	0.01	

	Extractable Metals aluminum	antimony	arsenic	barium	beryllium	bismuth	boron	cadmium	calcium	chromium	cobalt	co
Swift Creek	< 0.01	< 0.02	< 0.02	0.0786	< 0.0002	< 0.02	< 0.01	< 0.0005	38.5	< 0.001	< 0.001	
100 Mile Creek	0.03	< 0.02	< 0.02	0.0465	< 0.0002	< 0.02	< 0.01	< 0.0005	34.7	< 0.001	< 0.001	
Dave Creek	0.02	< 0.02	< 0.02	0.0495	< 0.0002	< 0.02	< 0.01	< 0.0005	43	< 0.001	< 0.001	
Wilson Creek	0.06	< 0.02	< 0.02	0.0449	< 0.0002	< 0.02	< 0.01	< 0.0005	32.6	< 0.001	< 0.001	
Squanga Creek	0.04	< 0.02	< 0.02	0.0952	< 0.0002	< 0.02	< 0.01	< 0.0005	37.4	< 0.001	< 0.001	<
Muskrat Creek	0.1	< 0.02	< 0.02	0.0372	< 0.0002	< 0.02	< 0.01	< 0.0005	29.3	< 0.001	< 0.001	
Meadow Creek	< 0.01	< 0.02	0.02	0.0321	< 0.0002	< 0.02	< 0.01	< 0.0005	25.8	< 0.001	< 0.001	<

BENTHIC INVERTEBRATES

Ameletus sp												
Family Baetidae												
Baetis sp	12	5	4	9	1	2	5	32	15			
Family Heptageniidae												
Cinygmula sp	20	10	6	16	11	1		3				
Epeorus (Iron) sp	3		4	1	1	2						
Heptagenia sp		1										
Rhithrogena sp	16	19	17	5	3	1		2				
Family Ephemerellidae											1	
Ephemerella doddsi	3	11	10	15	5	1						
Ephemerella flavilinea		1	1	6	1							
Ephemerella grandis		1										
Ephemerella sp			1	1				9	1			
Family Leptophlebiidae												
Paraleptophlebia sp								1	1			
Order Plecoptera												
Plecoptera Unid J												
Family Capniidae												
Capnia sp	7	2	13	53	8	3			5			
Family Perlidae												
Claasenia (sabulosa)								2				
Family Perlodidae												
Isoperla sp A (white stripe)												
Isoperla sp B (dark stripe)												
Skwala curvata (RWB)	1	2		8	4	1		1				
Skwala (paralella)	4	4	1		1	3						
Family Nemouridae												
Podmosta sp	40	11	9	23	2	1			1			
Pteronarcys sp J							2					
Zapada sp	10	2	3	9	4							
Family Taeniopterygidae											1	
Taenionema sp	2	3		3								
Family Chloroperlidae												
Sweltsa sp gp	2	1	2	7	3	2		1				
Order Trichoptera												
Trichoptera Unid J	1	1						3				
Family Hydropsychidae												
Arctopsyche sp	1	1		2								
Hydropsyche sp								6	2			
Family Brachycentridae												
Brachycentrus sp												
Micrasema sp												
Family Limnephilidae												
Dicosmoecus sp												
Ecclisomyia sp												
Family Glossosomatidae												
Glossosoma sp												
Family Hydroptilidae												
Hydroptila sp												
Family Rhyacophilidae												
Rhyacophila acropedes or vao							1					
Rhyacophila angelita	2						1					
Rhyacophila vocala												
Order Diptera												
Diptera Unid A				3	3	1						
Diptera Unid L	9	9	5	61	36	6						
Family Chironomidae												
Chironomidae A	1	4		1				1				1
Chironomidae P	4		2	28	19	5		38	5			
Chironomidae Unid J							1	6				
Sub-Family Orthocladiinae												
Cardiocladius sp	1	1		20	13	18		10				
Corynoneura sp					1			11				
Cricotopus sp	39	38	21	193	140	149	1	56	7	1		
Eukiefferiella sp	5	8	6	23	20		3	60	12			1
Euryhapsis sp			1	19	1	6						
Heleniella sp								1		1		
Rheocricotopus sp												
Synorthocladius sp		1		12	4	2						
Thienemanniella sp		1						1				
Sub-Family Chironomi								1				
Cyphomella sp				2								
Polypedilum (Polypedilum) sp							1					
Rheotanytarsus sp	1	1		4								
Stichtochironomus sp								1	1			
Sub-Family Diamesa												

unid = unidentified J = juvenile L = larvae P = pupae A = adult D = damaged

Family Ceratopogonidae						1	1									
Probezzia sp																
Family Empididae																
Chelifera sp					1					2						
Clinocera sp																
Weidemannia sp																
Family Psychodidae																
Pericoma sp			1							5						
Family Simuliidae																
Prosimulium sp L	10	1	1		2											
Prosimulium sp P		1	1													
Simulium sp	4		4			1				12	5		1			
Simulium sp P																
Family Tabanidae ? L					1	1										
Family Tipulidae																
Antocha sp			1						10	27	16					
Dicranota sp		1	1		1	2	1			2	1					
Hesperoconopa sp																
Hexatoma sp																
Order Coleoptera Unid A																
Carabidae L																
Curculionidae	1															
Staphylinidae																
Order Colembola																
Isotoma sp						1										
Order Homoptera																
Aphididae																
Order Hymenoptera Unid A							1									
Order Thysanoptera			1		1											
Class Arachnida																
Order Hydracarina																
Hydracarina Unid J					11	5										
Kawamuracarus sp		1			1	1										
Lebertia sp					1											
Neumannia sp																
Sperchon sp	1	1			13	11				1						
Unioncola sp																
Wandesia sp																
Class Crustacea																
Sub-Class Ostracoda																
Order Podocopa																
Candona sp					1		1			1						
Cypria sp							1			1						
Sub-Class Copepoda																
Order Eucopepoda																
Sub Order Cyclopoida		1			1											
PHYLUM MOLLUSCA																
Class Gastropoda																
Sub-Class Pulmonata																
Family Lymnaeidae dam																
PHYLUM ANNELIDA																
Class Oligochaeta																
Order Lumbriculida																
Family Lumbriculidae																
Kincaidiana hexatheca									1							
Lumbriculus sp	2	3														
Family Enchytraeidae	31	11	3			1			1	17	3					
Family Tubificidae	1					1			8	8						
Family Naididae																
Chaetogaster sp										1						
Nais (communis)																
PHYLUM NEMATODA	1	1	1			2				2					1	
Total abundance/sample	236	160	122	0	561	308	209	0	35	327	75	0	3	2	3	0
Total abundance/site	518				1078				437				8			

unid = unidentified J = juvenile L = larvae P = pupae A = adult D = damaged

Ameletus sp									
Family Baetidae									
Baetis sp	13	7	15	6	2	5	9	31	18
Family Heptageniidae									
Cinygmula sp	9	8	14				4	18	15
Epeorus (Iron) sp		1	3		1		1		
Heptagenia sp			1			1	1	1	
Rhithrogena sp	3	5	11	3	2		6	12	24
Family Ephemerellidae									
Ephemerella doddsi								2	2
Ephemerella flavilinea			1					1	1
Ephemerella grandis							1		
Ephemerella sp	3		1		1		1	2	
Family Leptophlebiidae									
Paraleptophlebia sp			1					2	6
Order Plecoptera									
Plecoptera Unid J									
Family Capniidae									
Capnia sp	18	6	32	17	24	12	2	14	6
Family Perlidae									
Claasenia (sabulosa)							3	7	2
Family Perlodidae									
Isoperla sp A (white stripe)	10	3	21	2	3			2	
Isoperla sp B (dark stripe)	2								
Skwala curvata (RWB)						1		1	
Skwala (paralella)		1		1	2			1	
Family Nemouridae									
Podmosta sp									
Ptoronarcys sp J									
Zapada sp	6	6	22	5	19	9	19	40	26
Family Taeniopterygidae									
Taenionema sp	11	5	9	4	8	1	1		
Family Chloroperlidae									
Sweltsa sp gp	1	1		1		3	2	8	5
Order Trichoptera									
Trichoptera Unid J									
Family Hydropsychidae									
Arctopsyche sp								9	10
Hydropsyche sp					1		2		
Family Brachycentridae									
Brachycentrus sp		1						2	
Micrasema sp							1		
Family Limnephilidae									
Dicosmoecus sp				1					
Ecclisomyia sp			2				1		
Family Glossosomatidae									
Glossosoma sp			3		2		1		
Family Hydroptilidae									
Hydroptilia sp								1	
Family Rhyacophilidae									
Rhyacophila acropedes or vao								1	
Rhyacophila angelita					1				
Rhyacophila vocala									
Order Diptera									
Diptera Unid A									
Diptera Unid L									
Family Chironomidae									
Chironomidae A		2							
Chironomidae P	2			8		4	7	17	21
Chironomidae Unid J	1	1	3	6		23	11	23	8
Sub-Family Orthocladiinae									
Cardiocladius sp	1			16	11	30		3	
Corynoneura sp									2
Cricotopus sp	3	1	9	65	21	67	82	186	64
Eukiefferiella sp	3	2	9	30	6	17	36	46	23
Euryhapsis sp				1	1			1	
Heleniella sp									
Rheocricotopus sp				5	2	2	25	37	14
Synorthocladius sp									
Thienemanniella sp	1							2	3
Sub-Family Chironomi									
Cyphomella sp						1			
Polypedilum (Polypedilum) sp									
Rheotanytarsus sp									
Stichtochironomus sp							1		
Sub-Family Diamesa									

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Probezzia sp	1								1		
Family Empididae											
Chelifera sp					1	1	1			7	1
Clinocera sp										1	
Weidemannia sp										1	
Family Psychodidae											
Pericoma sp		1					1		1	5	3
Family Simulidae											
Prosimulium sp L			1								
Prosimulium sp P											
Simulium sp			2		2	2			1		1
Simulium sp P						1					
Family Tabanidae ? L		1									
Family Tipulidae											
Antocha sp											
Dicranota sp			2		1	3	4		1		1
Hesperoconopa sp							1				
Hexatoma sp									2	1	
Order Coleoptera Unid A											
Carabidae L											
Curculionidae											
Staphylinidae											
Order Colembola											
Isotoma sp	1										
Order Homoptera											
Aphididae										1	
Order Hymenoptera Unid A		1							1		
Order Thysanoptera											
Class Arachnida											
Order Hydracarina											
Hydracarina Unid J	2	1			2		1			3	6
Kawamuracarus sp										1	
Lebertia sp											
Neumannia sp			2		1		1			18	1
Sperchon sp							4			6	2
Unioncola sp					5		5		1	65	20
Wandesia sp											1
Class Crustacea											
Sub-Class Ostracoda											
Order Podocopa											
Candona sp						1				1	12
Cypria sp	1										
Sub-Class Copepoda											
Order Eucopepoda											
Sub Order Cyclopeida											
PHYLUM MOLLUSCA											
Class Gastropoda											
Sub-Class Pulmonata											
Family Lymnaeidae dam			1								
PHYLUM ANNELIDA											
Class Oligochaeta											
Order Lumbriculida											
Family Lumbriculidae											
Kincaidiana hexatheca											
Lumbriculus sp											
Family Enchytraeidae		1			1						1
Family Tubificidae											
Family Naididae											
Chaetogaster sp											
Nais (communis)											
PHYLUM NEMATODA	3	1	1		2		2			4	
Total abundance/sample	95	56	166	0	186	115	196	0	247	592	304
Total abundance/site	317				497				1143		

unid = unidentified J = juvenile L = larvae P = pupae A = adult D = damaged