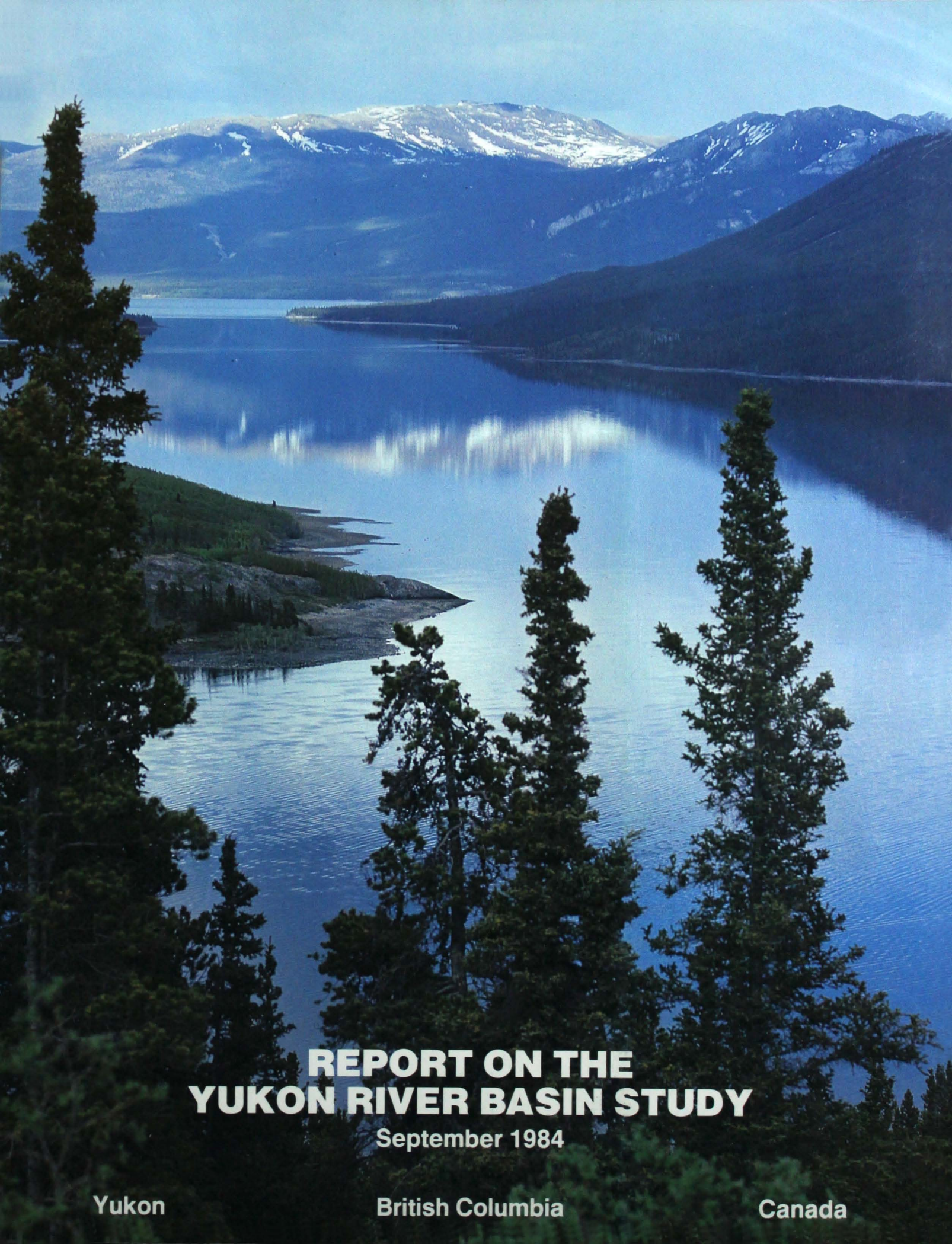


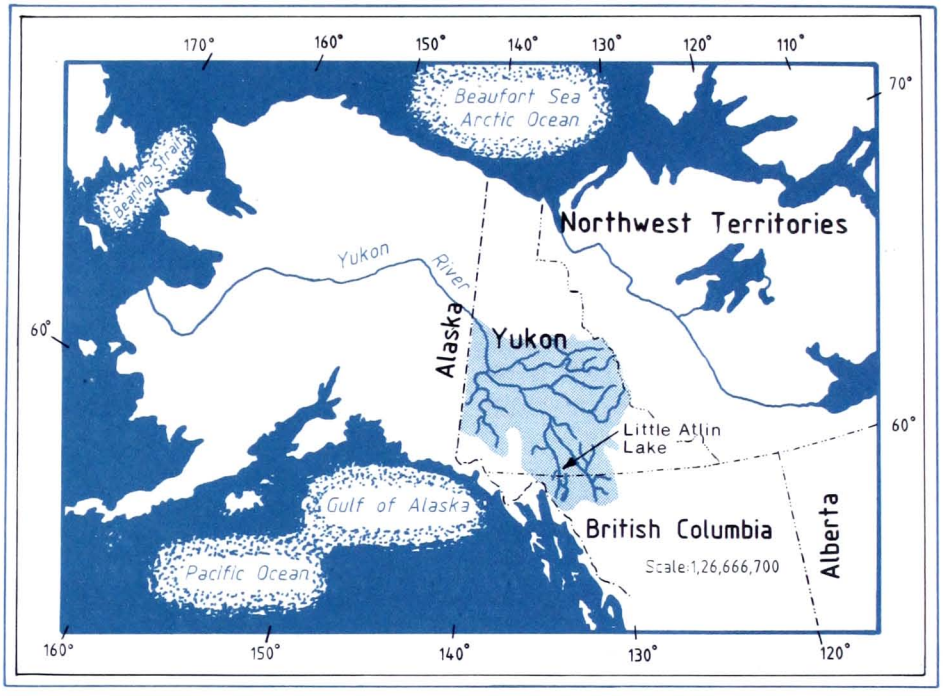
REPORT ON THE YUKON RIVER BASIN STUDY

September 1984

Yukon British Columbia Canada

Little Atlin Lake in the Yukon. Part of the Yukon River Headwater Lakes.

Photo courtesy of the Yukon Government.



REPORT ON THE YUKON RIVER BASIN STUDY

September 1984

Yukon **British Columbia** **Canada**

YUKON
RIVER BASIN COMMITTEE

BRITISH COLUMBIA	CANADA	YUKON
J.O'RIORDAN	E.M. CLARK (Chairman) M.J. MORISON	G.LIVINGSTON

September 30, 1984

The Honourable Suzanne Blais-Grenier
Minister of the Environment
Ottawa, Canada

The Honourable David Crombie
Minister of Indian Affairs and
Northern Development
Ottawa, Canada

The Honourable Anthony J. Brummet
Minister of Environment
Victoria, British Columbia

The Honourable Howard Tracey
Minister of Renewable Resources
Whitehorse, Yukon

Commissioner D. Bell
Whitehorse, Yukon

Dear Madame Minister, Messieurs Ministers, and Mr. Commissioner:

On November 24, 1980 the Governments of Canada, British Columbia and Yukon entered into An Agreement Respecting Studies and Planning of the Water Resources in the Yukon River Basin. The Agreement scheduled to terminate on December 30, 1983 was extended to September 30, 1984.

The Committee established under this Agreement has completed its assignment and is pleased to submit the Report on the Yukon River Basin Study. The report includes a recommendation for a formal agreement to continue the coordination of planning and management of the water resources of the Yukon River Basin started by this Agreement.

The Committee appreciates the support received during the study from the Governments and their respective agencies and from representatives of the public.

Respectfully submitted,

E.M. Clark
Regional Director
Inland Waters Directorate
Environment Canada

M.J. Morison
Director General
Northern Affairs Program
Indian and Northern Affairs Canada

J. O'Riordan
Director
Planning & Assessment Branch
Ministry of Environment
British Columbia

G.R. Livingston
Deputy Minister
Department of Renewable Resources
Yukon

EXECUTIVE SUMMARY

The Yukon Territory experienced a surge of resource development proposals in the late 1970's. Expectations were high for economic development and the resulting development proposals and investigations were creating a stir of excitement and intense speculation. It seemed apparent that a boom economy was again on the horizon. Amidst the increasing pressures for development, countervailing forces were striving to protect Yukon's environment, its heritage and wilderness resources and to gain proprietary rights.

As a result of these initiatives, residents and officials responsible for resource management expressed concern over potential water use conflicts in the Yukon River Basin. In response to these concerns the Governments of Canada, Yukon and British Columbia established the Yukon River Basin Preplanning Task Force to assess the potential for conflicts in water use. The Task Force found that there was an imbalance of information on proposed developments and their potential effects on the resource base. This imbalance of information created a situation where an evaluation of the result of choosing one course of action over another could not be made on a knowledgeable basis.

In response to the Task Force recommendations, an agreement was signed on behalf of the governments of Canada, British Columbia and Yukon on November 24, 1980. This report describes the analysis of the water and related resources of the Yukon River Basin. Work under the agreement was designed to increase our understanding of these resources and to undertake projects and programs that could lead to the formulation of a framework for water planning under which potential developments in the Basin could be evaluated.

The resources of the Yukon River Basin are of importance to all Canadians, and to the residents of the Basin in particular. The management challenges that have been identified and the resulting recommendations are based on an overview of the Basin and on results of nine main study programs. The programs dealt with the Basin as a whole and are described below:

A **hydrology program** was undertaken to improve the knowledge of the Basin's hydrology for water management purposes. A daily hydrologic flow model was developed and was used to simulate the effects of hydroelectric developments on downstream flows. An assessment of the Basin's hydrometric, meteorological and snowpack networks was completed and future needs were identified. A flood risk study described flooding and flood prone areas and studies were undertaken to improve understanding of the causes of flooding in the Basin, winter ice formation and break-up.

Little was known about the water quality of the Basin or the processes which influence it. A **water quality program** was initiated and 21 water quality stations on the Basin's major streams were established and monitored. Results were analyzed to establish a network and determine optimum future sampling needs. Also, a project was completed to determine why low oxygen concentrations are observed in some of the Basin's rivers during the period of ice cover.

A **fisheries program** improved information and knowledge on the Basin's fisheries resource so that the potential effects of water resource development could be evaluated. The number of salmon entering the Basin, their distribution within the major tributaries and the location of their spawning grounds were determined. Selected areas of potential conflicts between fisheries and placer mining were identified and inventories of fish habitat were completed. Productivity and species abundance of fish in a number of the Basin's lakes were examined. Laboratory and field work were undertaken to investigate the short-term effects of sediment on grayling. A creel census on a headwater lake was also carried out.

A **wildlife program** provided data and information on species most dependent on aquatic and riparian habitat. An inventory of

aquatic and furbearer populations was made and habitat mapped to identify sensitive areas. The wetland system of the Nisutlin Delta area of Teslin Lake was studied and components of the ecosystem critical for the fall staging of migratory waterfowl were identified and described. In addition, the identification and description of physical and biological characteristics of early open water areas used by waterfowl for spring staging was completed. Areas important to Canada geese and other waterfowl and riparian raptor nest sites were identified on selected rivers in the Basin. Finally, moose populations were identified in selected areas and late winter habitat characteristics were identified.

A **placer mining program** concentrated on examining the socio-economic and environmental aspects of water use in the placer industry. Information was developed on a history of the industry, a listing of placer operations and a description of the general legislation, regulations and mining practices. Information on placer mining was also gathered through the fisheries and socio-economic programs.

The **tourism, parks and recreational program** helped to identify the interrelationship between the water resource and its use for recreation and tourism. A physical description of the Basin's rivers and lakes was completed and the recreational capability of the Basin was evaluated.

An **energy program** was completed to provide an overall appraisal of energy supply and demand in the Basin. A demand study that described and compared different approaches for forecasting electrical energy requirements and a preliminary evaluation of hydroelectric energy supply options in the Basin were completed. Evaluations of the existing hydroelectric inventory and the cost of providing electricity through interconnections with British Columbia, Northwest Territories or Alaska grids were also undertaken.

The economic conditions in the Basin and current insitutional responsibilities for managing water and related resources were described by a **socio-economic program.** An input-output table for the Yukon economy was created to provide data on the interrelationship among sectors of the economy. As well, a method for updating and extending the economic information for Yukon was established and a model of the economy was developed which could be used to evaluate influences of many factors on the economy. The model was used to simulate growth in the Yukon economy between 1983 and 2003. An in-depth description and assessment of institutional arrangements in the Basin was also completed.

An **information exchange program** was undertaken that involved the public and other government agencies and promoted public awareness of the Yukon River Basin Study and provided an avenue for public feedback. A community tour was completed for introducing the Study at a series of public meetings. Meetings were held with interest groups and service clubs and a public display was created by a high school class. An Independent Review Group was formed to actively involve selected members of the public in the final phase of the Study. The Group provided comments on the overall Study, reviewed this committee report and prepared a report on its findings and conclusions.

Water is the one essential natural resource in the Yukon River Basin. The survival of every other renewable natural resource in the Basin depends on the availability of specified quantities of water with an established quality. This Study has identified several areas where there is, or may be, competition for the water resource. In order to make informed decisions as to the best use for water, the managers of the water resource must rely on information supplied by the users. Knowledge of fish and wildlife distribution and abundance, habitat requirements, the potential recreational use of a river or lake, and an area's importance to other water users such as placer mining are all required for planning water use. Of particular importance to the planning of water management in the Basin is the potential hydroelectric use. If the option for large-scale or even intermediate-sized projects is to be preserved, then the effects on other existing or potential water users must be evaluated. The transboundary effects of raising headwater lake levels for water storage must be examined, especially for its interjurisdictional aspects.

It is important that water management planning in the Basin be coordinated with other agencies whose plans include the use of water. Water planning cannot stand alone; it must be

undertaken in concert with other resource planning processes. In this way conservation or wise use of water and related resources can be achieved. Further developments within the Basin will compete for water and narrow the choices for future use, raising the potential for conflicts in water use. Effective management can best be assured through a formal agreement for planning and management of water among jurisdictions. The Yukon River Basin Committee therefore recommends that:

1. The governments of Canada, British Columbia and Yukon enter into a formal agreement that will establish a coordinating committee of agencies with water management responsibilities to complete the development of a framework for water resource planning and to coordinate ongoing planning and management activities.

2. Government agencies coordinate water and land use planning activities. Specifically, closer ties should be established to ensure proper management of shoreline development control, access to lakes and rivers, and developments on floodplains.

3. Ongoing activities for planning and management of water and related resources in the Basin should include public participation from their inception.

4. Appropriate jurisdictions review the various recommendations found within the Study reports and identify, for implementation, those which can contribute to water management.

5. The following water resource items receive priority consideration and that appropriate agencies:

a. establish water quantity stations required to provide baseline, site specific and small stream data;

b. establish a water quality network;

c. integrate the water quantity and water quality networks where practical;

d. evaluate the effect of the construction and operation of existing hydroelectric facilities on the water resource;

e. maintain and improve the daily flow model, particularly in terms of the White River contributions and headwater lakes elevations;

f. evaluate the status of groundwater use and quality, not included in the Study, with particular emphasis on drinking water supplies;

g. map floodplains and high water lake elevations and, where appropriate, establish land use controls;

h. continue examination of the cause of ice jam floods at Dawson to understand processes; and,

i. emphasize consideration of the effects of regulation on biological productivity in the current limnological research program on the headwater lakes.

SOMMAIRE

Vers la fin des années 1970, le Yukon enregistrait une vague de projets de mise en valeur des ressources, projets qui ont suscité beaucoup d'anticipations, d'intérêt et de spéculation. Une économie florissante semblait poindre, à nouveau, à l'horizon. Parallèlement aux pressions grandissantes en faveur du développement, d'autres forces recherchaient la protection de l'environnement et des ressources patrimoniales et sauvages du Yukon et la reconnaissance de droits de propriété.

Par suite de ces initiatives, les résidants et les représentants officiels responsables de la gestion des ressources ont donc exprimé leurs préoccupations relativement aux possibilités de conflits reliés à l'utilisation de l'eau dans le bassin hydrographique du Yukon. En réponse à ces préoccupations, les gouvernements du Canada, de la Colombie-Britannique et du Yukon ont créé le Groupe de travail de préplanification du bassin hydrographique du Yukon et l'ont chargé d'évaluer les possibilités de conflits reliés à l'utilisation de l'eau. Le Groupe de travail a constaté un déséquilibre au niveau de l'information concernant les projets d'aménagement des ressources et leurs incidences sur les ressources. Ce déséquilibre empêchait l'évaluation avisée des avantages relatifs des diverses options reliées à l'utilisation des ressources naturelles du bassin.

Dans le sillon des recommandations du Groupe de travail, un accord fut conclu le 24 novembre 1980 au nom des gouvernements du Canada, de la Colombie-Britannique et du Yukon. Le présent rapport fait l'analyse de l'eau et des ressources hydriques du bassin hydrographique du Yukon. Les travaux prévus par l'accord devaient améliorer l'état des connaissances sur ces ressources et permettre la réalisation de travaux et de programmes susceptibles de conduire à l'élaboration d'un cadre de planification qui permettrait d'évaluer les possibilités de mise en valeur du bassin.

Les ressources du bassin hydrographique du Yukon revêtent une grande importance pour tous les Canadiens, notamment pour les résidants du bassin. Les défis identifiés sur le plan de la gestion ou de l'aménagement et les recommandations formulées pour relever ces défis découlent d'une étude générale du bassin et sont fondés sur les résultats de neuf grands programmes d'étude, qui ont porté sur l'ensemble du bassin et dont voici une description:

Un **programme d'hydrologie** a été entrepris dans le but d'améliorer l'état des connaissances sur l'hydrologie du bassin à des fins d'aménagement de l'eau. Un modèle hydrologique de débit quotidien a été élaboré et a servi à simuler les effets de projets d'aménagement hydroélectrique sur les débits en aval. Une évaluation des réseaux hydrométriques, météorologiques et d'observation de la neige a été menée à terme et les besoins éventuels à ce chapitre ont été identifiés. Une étude des risques d'inondation a décrit les régions inondées ou susceptibles de l'être. Des études ont été entreprises pour améliorer les connaissances sur les causes des inondations dans le bassin, sur la formation des glaces et sur la débâcle.

On disposait de peu de renseignements sur la qualité de l'eau du bassin ou sur les processus qui l'influencent. Un **programme d'observation de la qualité de l'eau** a été entrepris et 21 stations de détermination de la qualité de l'eau ont été mises en place et surveillées, dans les principaux cours d'eau du bassin. Les résultats ont fait l'objet d'une analyse dans le but d'établir un réseau et de déterminer les exigences de l'échantillonnage éventuel. On a également mené à terme une étude visant à expliquer les faibles teneurs en oxygène observées dans certains cours d'eau du bassin, lorsque ceux-ci sont recouverts de glace.

Le **programme sur les pêches** a permis d'améliorer l'état des connaissances sur les ressources en poisson du bassin, en vue de permettre l'évaluation des incidences des projets d'aménagement de l'eau. Le nombre de saumons fréquentant le bassin, leur répartition entre les principaux tributaires ainsi que

l'emplacement des frayères ont été déterminés. Certaines régions susceptibles de faire l'objet de conflits d'utilisation, entre la pêche et l'exploitation de placer, ont été identifiées et des inventaires d'habitats de poisson ont été dressés. On a également étudié la productivité et l'abondance des espèces de poissons dans un certain nombre de lacs du bassin. Des travaux ont été entrepris tant en laboratoire que sur le terrain pour étudier les incidences à court terme des sédiments sur l'ombre. On a également fait une étude de rendement de la pêche dans un lac d'alimentation.

Un **programme sur la faune** a fourni des données et des renseignements sur les espèces qui dépendent le plus des habitats aquatiques et riverains. Un inventaire des populations d'animaux aquatiques et d'animaux à fourrure et une carte des habitats ont été dressés pour permettre l'identification des régions sensibles. On a étudié le réseau des terres humides de la région du delta de Nisutlin, du lac Teslin, et on a identifié et décrit les éléments de l'écosystème critiques pour la migration automnale de la faune aquatique. On a aussi achevé l'identification et la description des caractéristiques physiques et biologiques des eaux qui se libèrent des glaces tôt au printemps et qui sont utilisées par la faune aquatique, lors de la migration printanière. On a identifié sur certains cours d'eau du bassin les zones de nidification importantes pour la bernache du Canada et pour d'autres oiseaux aquatiques et rapaces riverains. Enfin, on a identifié dans certaines régions les populations d'orignaux ainsi que les caractéristiques des habitats utilisés à la fin de l'hiver.

Le **programme sur l'exploitation de placer** s'est attaché à examiner les dimensions socio-économiques et environnementales de l'utilisation de l'eau dans l'industrie de placer. On a obtenu des renseignements sur l'évolution de l'industrie, dressé une liste des exploitations de placer et établi une description des lois générales, des règlements et des pratiques d'exploitation minière. Des renseignements sur l'exploitation de placer ont également été recueillis dans le cadre des programmes sur les pêches et les questions socio-économiques.

Le **programme sur le tourisme, les parcs et les loisirs** a contribué à préciser les rapports entre l'eau et son utilisation à des fins de loisirs et de tourisme. Une description physique des cours d'eau et des lacs du bassin a été établie et on a évalué le potentiel récréatif du bassin.

Le **programme sur l'énergie** visait l'établissement d'une appréciation générale de l'offre et de la demande d'énergie dans le bassin. Une étude de la demande décrivant et comparant diverses méthodes de prévision des besoins en électricité, ainsi qu'une évaluation préliminaire des options d'approvisionnement hydroélectrique offertes par le bassin, ont été menées à terme. On a entrepris des évaluations de l'inventaire hydroélectrique existant et du coût de l'approvisionnement en électricité par interconnexion avec les réseaux de la Colombie-Britannique, des Territoires du Nord-Ouest et de l'Alaska.

Les conditions économiques dans le bassin et les responsabilités institutionnelles actuelles sur le plan de la gestion de l'eau et des ressources connexes ont été décrites grâce à un **programme sur les questions socio-économiques.** On a dressé un tableau des intrants-extrants de l'économie du Yukon afin de documenter les rapports entre divers secteurs de l'économie. On a également adopté une méthode pour mettre à jour et améliorer les renseignements économiques concernant le Yukon et élaboré un modèle de l'économie permettant d'évaluer les influences de plusieurs facteurs de l'économie. Ce modèle a servi à simuler la croissance de l'économie du Yukon entre 1983 et 2003. Une description et une évaluation détaillées des arrangements institutionnels dans le bassin ont également été faites.

Un **programme d'échange de renseignements** a également été entrepris avec le concours d'organismes publics et d'autres organismes gouvernementaux pour renseigner le public sur l'Etude et lui permettre d'exprimer ses réactions à ces travaux. Une tournée des agglomérations a été organisée pour présenter l'Etude, grâce à une série de réunions publiques. On a rencontré des groupes et des associations pour les renseigner

sur l'Etude et les étudiants d'une classe de niveau secondaire ont organisé une exposition publique sur ce sujet. Un Groupe d'examen indépendant a été formé pour permettre à certains porte-parole, choisis parmi le public, de participer activement à la dernière étape de l'Etude. Le Groupe a commenté l'ensemble de l'Etude, examiné le rapport du Comité et formulé ses constatations et ses conclusions sous forme de rapport écrit.

L'eau constitue la seule ressource naturelle essentielle du bassin hydrographique du Yukon. La survie de toutes les autres ressources naturelles renouvelables du bassin dépend de la disponibilité de masses spécifiques d'eau, de qualité déterminée. Cette Etude a identifié plusieurs régions dont les ressources en eau font l'objet ou sont susceptibles de faire l'objet d'une utilisation concurrentielle. Pour prendre des décisions éclairées sur la meilleure utilisation possible de l'eau, les responsables de la gestion de l'eau doivent s'appuyer sur les renseignements fournis par les usagers de l'eau. Pour prévoir l'utilisation de l'eau, il importe de disposer de renseignements sur l'abondance et la répartition du poisson et de la faune, sur les besoins en matière d'habitat, sur le potentiel récréatif d'une rivière ou d'un lac, et sur l'importance d'une région pour les autres usagers de l'eau, notamment pour ceux qui l'utilisent à des fins d'exploitation de placer. Le potentiel hydroélectrique revêt une importance particulière au niveau de la planification de la gestion de l'eau du bassin. Si l'on veut garder l'option offerte par les grands projets d'aménagement hydroélectrique, ou même par les projets d'envergure moyenne, il faudra en évaluer les répercussions sur les autres usagers de l'eau, tant actuels qu'éventuels. Il faudra étudier les incidences transfrontalières de l'élévation du niveau des lacs d'alimentation, dans un but de retenue, notamment les dimensions inter-juridictionnelles.

Il importe que la planification de la gestion de l'eau du bassin soit coordonnée avec les initiatives des autres organismes dont les projets comprennent l'utilisation de l'eau. La planification de l'eau ne peut se faire de façon isolée; elle doit s'intégrer à d'autres processus de planification de la mise en valeur des ressources, ce qui permettra d'assurer la conservation ou l'utilisation avisée de l'eau et des ressources connexes. Les aménagements éventuels, dans le bassin, accentueront la concurrence en matière d'utilisation de l'eau et réduiront l'éventail des choix possibles à cet égard, générant ainsi des possibilités de conflits. La conclusion d'un accord officiel de planification et de gestion de l'eau entre les diverses compétences facilitera la gestion efficace de l'eau. Le Comité formule donc les recommandations qui suivent:

1. Les gouvernements du Canada, de la Colombie-Britannique et du Yukon devraient conclure un accord officiel pour constituer un comité de coordination des organismes ayant des responsabilités en matière de gestion de l'eau, qui serait chargé de mener à terme l'élaboration d'un cadre de planification de l'eau et de coordonner les activités courantes de planification et de gestion.

2. Les organismes gouvernementaux devraient coordonner leurs activités de planification de l'utilisation de l'eau et du sol. Des liens plus étroits devraient notamment être établis pour assurer la gestion appropriée des mécanismes de régie de l'aménagement des berges, l'accès aux lacs et aux rivières ainsi que l'aménagement des plaines inondables.

3. Les activités courantes reliées à la planification et à la gestion de l'eau et des ressources connexes, dans le bassin, devraient prévoir la participation du public, dès le début des travaux.

4. Les administrations compétentes appropriées devraient étudier les diverses recommandations consignées dans les rapports de l'Etude et identifier à des fins d'application celles susceptibles de contribuer à la gestion de l'eau.

5. Les mesures suivantes concernant l'eau devraient être envisagées en premier et les organismes appropriés devraient:

a. mettre en place les stations de mesure de débit requises pour fournir des données de base, des données spécifiques sur des emplacements et des données sur de petits cours d'eau;

b. mettre en place un réseau de détermination de la qualité de l'eau;

c. lorsque la chose s'avère pratique, intégrer les réseaux de mesure et d'observation de la qualité de l'eau;

d. évaluer les incidences de la construction et de l'exploitation des installations hydro-électriques existantes sur l'eau;

e. tenir à jour et améliorer le modèle de débit quotidien, tout particulièrement en ce qui concerne l'apport de la rivière Blanche et le niveau des lacs d'alimentation;

f. apprécier l'utilisation et la qualité des eaux souterraines, non touchées par l'Etude, en accordant une importance particulière aux approvisionnements d'eau potable;

g. cartographier les plaines d'inondation et les niveaux de crue des lacs et, lorsque la chose s'avère appropriée, mettre en place des mécanismes pour régir l'utilisation du territoire;

h. poursuivre l'étude des inondations provoquées par les embâcles de glace, à Dawson, pour en expliquer le mécanisme;

i. étudier davantage les incidences de la régularisation sur la productivité biologique, dans le programme de recherche limnologique actuel sur les lacs d'alimentation.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I
INTRODUCTION

A. BACKGROUND

In the late 1970's the Yukon Territory was experiencing a wave of resource development proposals and investigations which created a stir of excitement and intense speculation. Expectations were high for economic development: increased mining production and potential were anticipated; rising gold prices were stimulating an expansion in placer mining; the proposed natural gas pipeline along the Alaska Highway was announced; and, new hydroelectric developments were anticipated to serve pipeline pumping stations, future mines and mineral smelters. It seemed apparent that a boom economy was again on the horizon. At the same time, concern was mounting for the protection of Yukon's pristine environment. Amidst the increasing pressures for development, countervailing forces were striving to protect heritage and wilderness resources and to gain proprietary rights.

All of these initiatives, either directly or indirectly, would affect the use of the water resource. As a result, residents and officials responsible for resource management expressed concern over potential water use conflicts in the Yukon River Basin. In response to these concerns the Governments of Canada, British Columbia and Yukon established the Yukon River Basin Preplanning Task Force to assess the potential for conflicts in water use, to determine the need for baseline data and, if appropriate, to prepare a rationale for a cost-shared intergovernmental Canada Water Act (CWA) study agreement.

The Preplanning Task Force found that there was an imbalance of information on proposed resource developments and their effects on the resource base. This imbalance created a situation where an evaluation of trade-offs between choosing one course of action over another with respect to the use of the Basin's natural resources could not be made on a knowledgeable basis. It was clear that irreversible water use decisions could be made that would preclude future options for water use. Such actions could interfere with the conservation, or wise use, of the Basin's water resource. Based on these conclusions the Task Force, in its report of September 1979, recommended that a three-year intergovernmental CWA planning study be undertaken.

In response to the Task Force recommendations, "An Agreement Respecting Studies and Planning of the Water Resources of the Yukon River Basin" was signed on behalf of the governments of Canada, British Columbia and Yukon on November 24, 1980 (Appendix 1). The objective of the Yukon River Basin Planning Study as specified in the Agreement was "to undertake jointly studies leading to the formulation of a planning framework under which potential development alternatives in the Basin may be evaluated."

B. THE PLANNING STUDY

As the Study began, it became apparent that the boom economy had not materialized. Immediate prospects for expanding economic development had subsided and pressures to resolve potential water use conflicts had abated. This economic lull presented an ideal opportunity for water resource planning — an opportunity to plan in a relatively undeveloped area before major water resource use conflicts arose.

The Yukon River Basin Committee directed that two types of studies be undertaken, which together would lead towards the development of a framework for planning. The first type was inventory studies designed to fill important gaps in baseline data. These fell into two categories. One category provided a broader geographical basis for resource inventory, such as assessing salmon migrations to each of the major sub-basins and sampling water quality at various locations. The other category improved understanding of physical, chemical and socio-economic processes, such as changes in dissolved oxygen under ice, ice break-up patterns and the development of an economic model for Yukon that would help predict demands for water and related resources.

The second type of studies considered specific interrelationships between water uses to gain a better understanding of potential conflicts in use and opportunities to resolve these. These studies were not designed to be comprehensive but to provide the Yukon River Basin Committee with insight to the competitive nature of some water uses and to more productive avenues for managing these during the development of a planning framework. Examples included the relationship between waterfowl productivity and changing water levels in the Nisutlin Delta, the effects of various concentrations of sediments on Arctic grayling and the development of a hydrologic model to assess changes in flows resulting from hydroelectric development proposals.

This information, covering baseline data, bio-physical and socio-economic processes and selected resource interactions, provides some of the ingredients for developing a framework for planning water management in the Basin. To this base must be added both a clear set of objectives for the various agencies that manage the water and related resources and criteria that measure their achievements. The Yukon River Basin Study has thus provided a unique opportunity to initiate this planning process.

1. The Agreement

The Agreement provided for the establishment of the Yukon River Basin Committee consisting of four members, one each appointed by the Minister of the Environment for Canada, the Minister of Indian Affairs and Northern Development for Canada, the Minister of Environment for British Columbia and the Commissioner of the Yukon Territory, on advice of the Government of Yukon. The Committee was chaired by the member from Environment Canada (Appendix 2). The Committee was responsible for the administration and conduct of the Study and for determining the manner in which funds allocated to the Study would be spent.

The Agreement stipulated that total funding would not exceed $2,200,000. It was further stipulated that the overall funding costs would be shared by the Parties in the following proportions:

Department of the Environment	50%	$1,100,000
Department of Indian Affairs and Northern Development	40%	880,000
Yukon	5%	110,000
British Columbia	5%	110,000

The Agreement called for a three year study to be completed with a final report on the study program for presentation to the Ministers by December 30, 1983. Subsequently, on the recommendation of the Committee, the participating Parties agreed to extend the time of the Agreement to September 30, 1984. Details on the expenditure of funds over the life of the Agreement are provided in Appendix 3.

2. Study Organization

To assist in carrying out the terms of the Agreement, the Committee appointed a Study Director and established a study office in Whitehorse, Yukon. Subsequently, support staff were hired to assist the Study Director.

To help identify data requirements and key physical, ecological and economic processes, the Committee established work groups for each of the eight program areas identified in the Preplanning Task Force Report: Hydrology; Water Quality; Fisheries; Wildlife; Placer Mining; Tourism, Parks and Recreation; Energy; and, Socio-Economic. The Committee appointed the chairperson and members of the work groups, drawing from the participating governments and corporations involved with the management and use of water and related resources (for list of work group participants see Appendix 2). Each work group was asked to review the Task Force recommendations and develop a specific work plan for its study area, monitor progress and evaluate results of projects and prepare a final program report. Project proposals which best met the objective of the Study were approved by Committee for funding. An annotated bibliography of all project reports is provided in Appendix 4.

In addition to the eight program areas, the Committee initiated an Information Exchange Program. The program had two basic objectives: first, to inform the public about the Study and to provide an opportunity for their participation; and second, to facilitate the exchange of information among the governments and agencies involved in the Study. An Independent Review Group provided the Committee with their perception of the strengths and weaknesses of various aspects of the Study (for list of members see Appendix 2). The Group also provided helpful suggestions in the preparation of the Committee's final recommendations. The review group's report is provided in Appendix 5.

C. STUDY AREA

The Yukon River Basin is the fifth largest in North America, both in land area and average discharge (Todd, 1970). The Yukon River rises in the north Coast Mountains of British Columbia within 30 kilometres of the Pacific Ocean and flows northward and westward for 3 018 kilometres draining the southern portion of Yukon and crossing the international boundary to continue through Alaska to the Bering Sea.

The study area for this report is the portion of the Basin in Canada that drains into the Yukon River upstream of the Yukon-Alaska boundary (Figure1). This area covers approximately 44 percent of the Yukon Territory and approximately 3 percent of British Columbia. The major sub-basins are Teslin, White, Pelly, Stewart and mainstem Yukon Rivers. Major headwater lakes include Kluane, Bennett, Marsh, Tagish, Atlin and Teslin Lakes.

The Porcupine River sub-basin is not included in the study area since it joins the Yukon River in Alaska. In addition, several small tributaries have drainage areas which straddle the international boundary before flowing into the Yukon River in Canada; except for the purpose of specific hydrology projects, the Alaskan portion of these sub-basins is not included in the study area.

D. REPORT OUTLINE

The report is assembled in five chapters. This introductory chapter deals with the background, objective, study area and organization of the Study. The next chapter provides an overview of the Basin's physiography, climate and vegetation and a description of physical aspects of the Yukon's water resource and two related resources — fish and wildlife; the strengths, limitations and unique aspects of these resources are identified. Chapter III provides an overview of opportunities for water use in the Basin. The Basin's history and demography are outlined and development opportunities for water and related resources in the Basin are discussed. Chapter IV discusses challenges to water resource management posed by potential conflicts in water uses and utilizes the information gathered during the Study to improve understanding of these conflicts. In the final chapter, the Committee presents its recommendations for future steps required to achieve the wise use of the Basin's water resource.

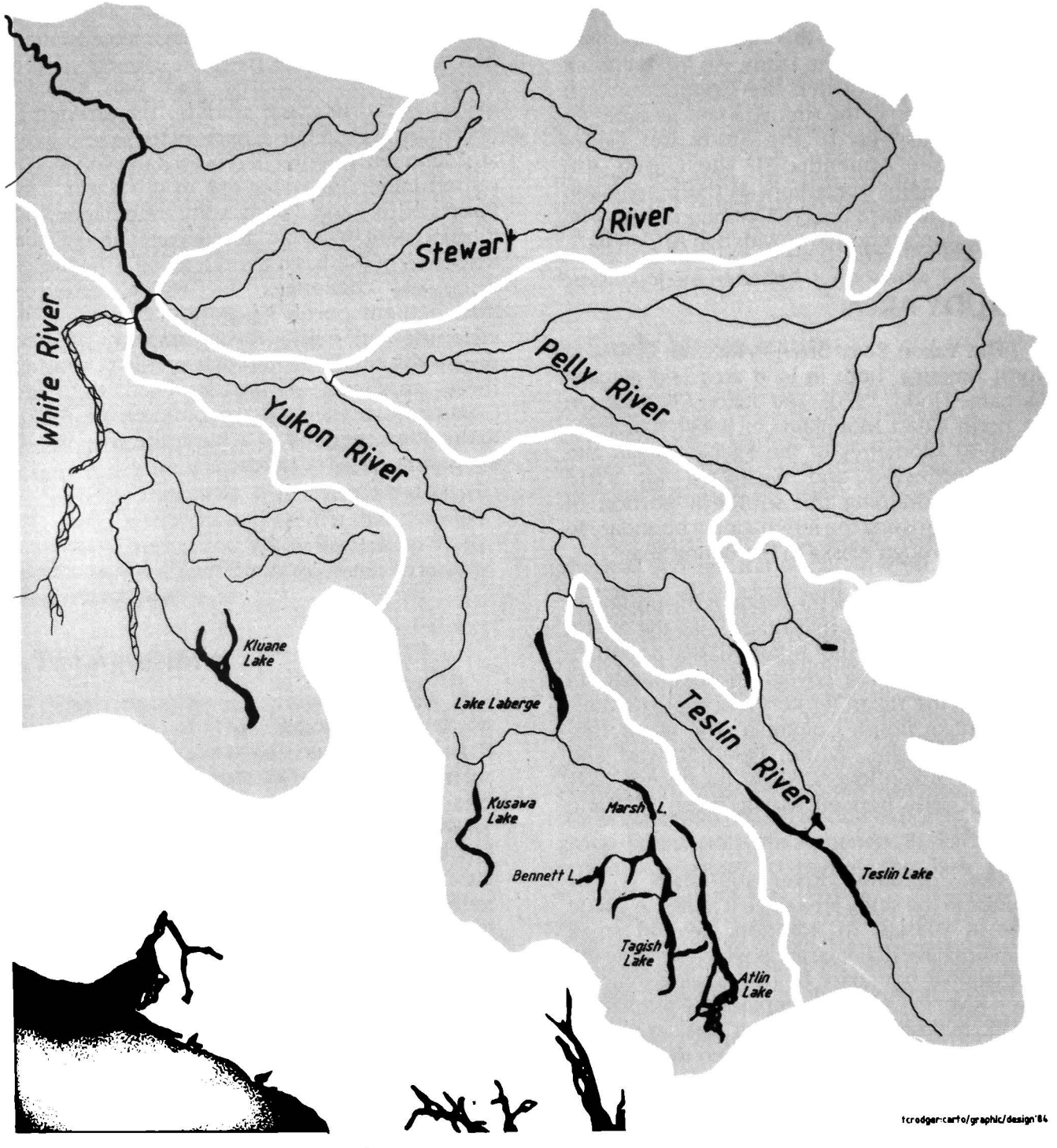


Figure 1: Yukon River Basin

CHAPTER II
WATER AND RELATED RESOURCES

An understanding of the physical characteristics of water, and of how fish and wildlife are dependent on the water resource, is a prerequisite to developing a planning framework for managing the Basin's water on a sustainable basis. The Preplanning Study identified deficiencies in data and information for a number of natural resources in the Basin; however, a priority was placed on obtaining data on fish and wildlife because of their direct use of the water resource. It was apparent that knowledge of species abundance and aquatic habitat use must be obtained before the effects of new developments on the water resource and its competing uses could be assessed. The Yukon River Basin Study has maintained this priority.

In spite of the improved state of knowledge resulting from the projects completed under this Study, the level of understanding of various fish and wildlife species and their relationship to water use still varies widely and, with few exceptions, has not proceeded much past the inventory level. Therefore, the significance of induced changes in the hydrologic processes and related impacts on the Basin's fish and wildlife resources remain uncertain. This uncertainty is the major contributing factor underlying fish and wildlife issues that arise from various proposed competing water uses. Current and potential water uses are further dealt with in Chapter III.

The following section provides a description of the physical aspects and hydrologic processes that characterize the Basin. An examination is made of fish and wildlife resources and their interaction with the water resource. Discussion is limited to those fish and wildlife species that were addressed during the Study, i.e., species of anadromous and freshwater fish and wildlife that are of greatest interest from both a water use and water management point of view. For each species, a description is provided and an assessment is offered of their present numbers and distribution. Following this review, physical and biological water-related processes and habitat requirements, important to fish and wildlife, are described.

A. PHYSICAL DESCRIPTION

1. The Yukon River Basin

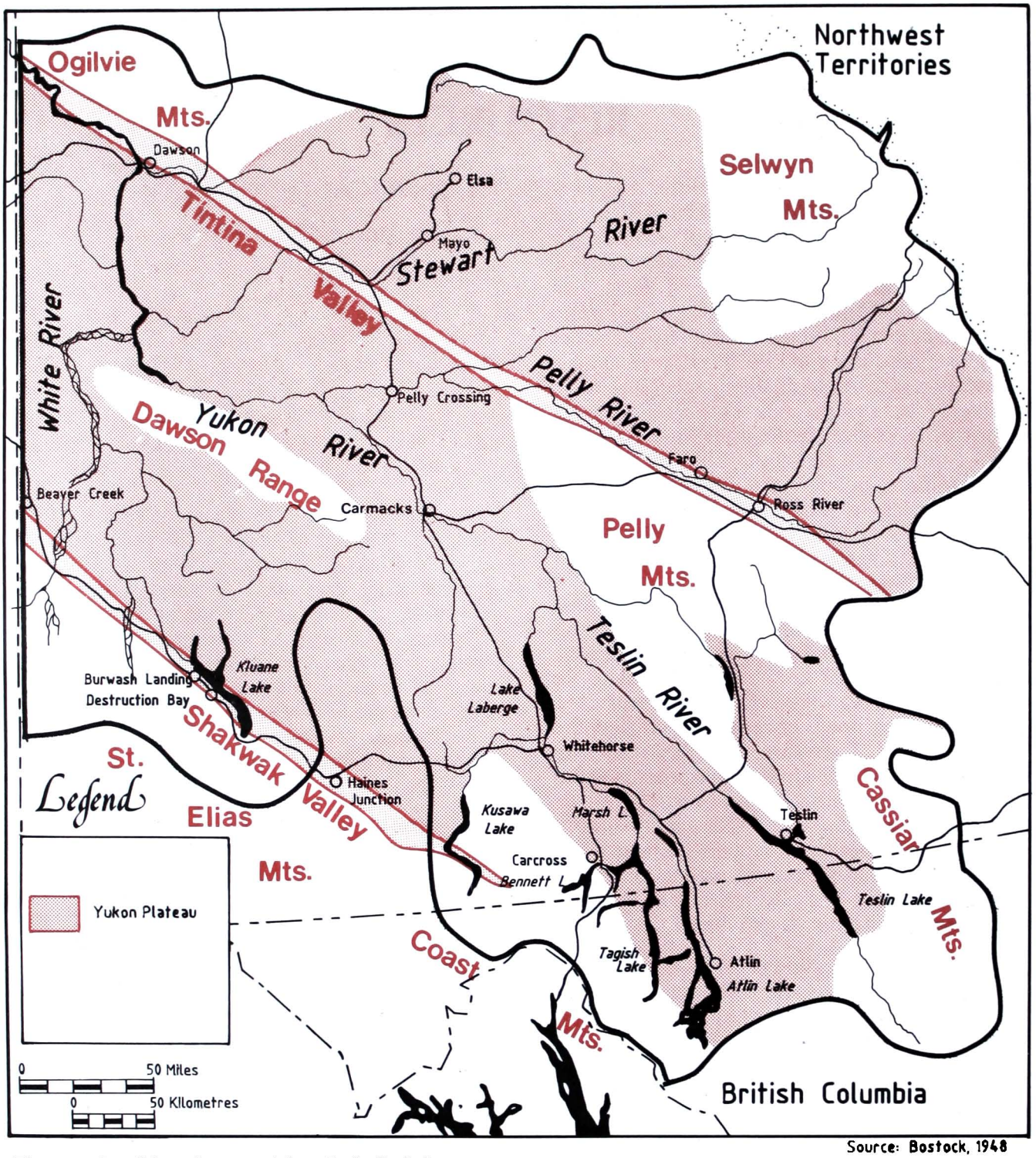
a. Physiography

The Yukon River Basin lies within the Western and Interior Systems of the Canadian Cordillera. In the Basin, the Western System is represented by the St. Elias and Coast Mountains in the west and south, and the Interior System by the Yukon Plateau and the Ogilvie and Selwyn Mountains to the north and east (Figure 2).

The plateau, covering most of the Basin, consists of large rolling hills with elevations over 1 500 metres and isolated mountains over 1 800 metres. In the previously glaciated portion of the Basin, there are conspicuous, wide upland depressions, spectacular deep narrow valleys and many long narrow lakes. Two major trench-like valleys run through the Basin in a northwest direction: the Shakwak Valley, adjacent to the St. Elias Mountains, and the Tintina Valley in the centre of the Basin.

b. Climate

The Basin has a subarctic continental climate which is characterized by large seasonal variation in temperature, low humidity and low precipitation. The St. Elias and Coast Mountains to the southwest of the Basin form an effective barrier against the moderating influences of moist Pacific air masses, although relatively warm Pacific air often intrudes through the mountain passes to influence the southern portions of the Basin. Mean annual temperatures range from near 0°C in the south to -7°C in the northern interior of the Basin. Monthly mean temperatures range from 12° to 16°C in July to -19° to -35°C in January. Table 1 illustrates temperature and precipitation characteristics of the Basin.



Source: Bostock, 1948

Figure 2: Physiographic Subdivisions

TABLE 1
CLIMATE

	Elev.(m)	Temp (°C) Annual	May-Sept.	Jan.	July	Precip. (mm) Annual	June-Aug.
Carcross	661	-1	9	-19	13	226	69
Teslin*	701	-1	10	-20	13	326	99
Whitehorse*	698	-1	11	-19	14	260	98
Ross River	698	-7	9	-35	13	253	102
Burwash	801	-5	8	-30	12	283	144
Carmacks	521	-5	10	-34	14	247	107
Beaver Creek	663	-7	9	-34	13	412	229
Mayo*	495	-4	11	-27	15	293	117
Dawson*	324	-5	11	-29	16	325	140

* Based on 25-year or more data
SOURCE: Oswald and Senyk, 1977

Precipitation is generally low, ranging from 225 to 425 millimetres over most of the Basin; however, there is great variation. Portions of the St. Elias and Coast Mountain regions have annual precipitation as high as 3 500 millimetres. The other mountainous areas surrounding the Basin have annual precipitation in the 500 to 700 millimetre range.

c. Vegetation

Boreal forest, consisting of stands of black and white spruce, lodgepole pine and some aspen, covers most of the Basin. Treeline elevations of 1 050 metres in the western and northern portions of the Basin and 1 500 metres in the south are characteristic (Oswald and Senyk, 1977). Shrubs are prevalent throughout the Basin; they occur as low growing species under much of the forested area, especially at mid to higher elevations, and they form a broad zone between forest and tundra in the northwestern part of the Basin.

Alpine tundra occurs in the Basin at high elevations. It is a treeless region where stunted shrubs, primarily shrub birch, willow and ericoids, give way to lichens, moss, forbs and prostrate shrubs at the highest elevations. The subalpine, occurring below the tundra, contains alpine fir in the southern part of the Basin and white spruce to the north.

2. The Sub-Basins

Table 2 shows drainage areas for the Basin and its major sub-basins: the Teslin, White, Pelly, Stewart, and mainstem Yukon Rivers. The sub-basins and major headwater lakes are shown in Figure1.

TABLE 2
BASIN AND SUB-BASIN AREAS

	Square Kilometres
Yukon River Basin Study Area	262 600
Yukon	238 300
British Columbia	24 300
Major Sub-Basins	
Pelly	50 200
Stewart	51 000
Teslin	36 500
White	38 100
Yukon Mainstem	86 800

a. Yukon River Mainstem

The Yukon River originates south and west of Whitehorse in the Coast Mountains of northern British Columbia. Marsh Lake, one of the numerous headwater lakes, is regulated by the Northern Canada Power Commission for hydroelectric generation downstream at the Whitehorse Rapids plant; this is the only regulation carried out on the mainstem river. From Marsh Lake, the Yukon River flows northwest before entering Lake Laberge. Below Lake Laberge, it is joined first by the Teslin River, then the Pelly River. Following the north side of the Dawson Range, the Yukon River runs through a narrow valley as far as the mouth of the White River. The Stewart River enters just downstream of the White River. From the White River to Dawson, the valley widens and the river follows a broad braided channel. Downstream of Dawson the river enters the Tintina Valley and continues on to Alaska.

Elevations in the mainstem basin range from a maximum of 2 700 metres in the Coast Mountains to a minimum of 268 metres at the Alaska border. Annual precipitation is about 300 millimetres along most of the river, although very high precipitation (up to 3 500 millimetres) occurs in the mountainous headwater regions.

b. Teslin River Basin

The Teslin River drains 36 500 square kilometres. Its headwaters drain the Stikine Plateau and the Cassiar Mountains of northern British Columbia. With an area of 357 square kilometres, Teslin Lake provides natural streamflow regulation. The Teslin River leaves the lake and flows in a straight northwesterly direction, joining the Yukon River downstream of Lake Laberge.

Elevations in the Basin range from 2 100 metres at its headwaters to 595 metres at the mouth. Annual precipitation ranges from 250 millimetres to 325 millimetres over the basin.

c. Pelly River Basin

The Pelly River drains an area of 50 200 square kilometres in the eastern portion of the Yukon River Basin. From its headwaters in the Selwyn Mountains, it enters the Tintina Trench which it follows for 250 kilometres before turning west to join the Yukon River.

Elevations range from 2 700 metres at its source to 435 metres at the mouth. Mean annual precipitation ranges from approximately 600 millimetres at the higher elevations to 290 millimetres at Fort Selkirk.

d. Stewart River Basin

The Stewart River, with a drainage area of 51 000 square kilometres, drains the northeastern portion of the Basin. Its headwaters drain the Selwyn Mountains. The river flows in a generally westerly direction to the Tintina Trench which it follows for a short distance before turning to the west once more, until it joins the Yukon River 90 kilometres upstream of Dawson.

Elevations in the basin range from 3 000 metres in the Selwyn Mountains to 356 metres at the mouth. Annual precipitation ranges from 600 millimetres to 300 millimetres.

e. White River Basin

The White River drains an area of 38 100 square kilometres in the southwestern Yukon portion of the Basin and 11 900 square kilometres of eastern Alaska. The headwaters are fed from extensive snow and ice fields in the St. Elias and Wrangell Mountains. Kluane Lake, with an area of 405 square kilometres, is located in the eastern headwaters in the Shakwak Valley. The White River and its main tributaries flow in a northerly direction to the west of the Dawson Range to join the Yukon River.

Elevations in this basin vary greatly, from the 5 230 metre Mount Lucania, highest peak in the Yukon River Basin, to 363 metres at the mouth. There are several other peaks of 3 000 to 4 000 metres in the St. Elias portion of the Basin and peaks of 1 800 to 2 100 metres in the interior ranges. Although mean annual precipitation is as high as 2 000 millimetres in parts of the St. Elias Mountains, only a portion of this is able to break through the mountain barrier. Annual precipitation ranges from 500 millimetres at the divide to 300 millimetres at the Basin's eastern boundary.

B. WATER

1. Water Quantity

a. Surface Runoff

The Yukon River at the Canada-United States border drains an area of 287 000 square kilometres, or about one-third of the total Yukon River drainage. This includes 24 400 square kilometres in Alaska that drains into the Canadian portion of the Basin. The mean annual runoff from this area is 2 334 cubic metres per second, the equivalent of 247 millimetres of depth over the Basin.

There is wide variability in runoff within the Basin, both in timing and areal distribution. Most of the Basin's runoff occurs between May and October with maximum flows in the spring or summer as a result of snow or glacier melt (Figure 3). Streams which drain the St. Elias and Coast Mountains experience a rapid rise in discharge during early summer due to snow melt at lower elevations, followed by the maximum discharge in late summer due to glacier melt at higher elevations. Streams draining the remainder of the Basin experience spring peaks due to snow melt. Low flows occur in March or April; all but the smallest streams maintain winter flows.

Figure 4 demonstrates the high contributions to runoff of the headwater areas, particularly the St. Elias, Coast and Selwyn Mountains; and the low contributions of portions of the Yukon Plateau, in the centre of the Basin. Mean annual runoff ranges from approximately 1 290 millimetres at Lindeman Creek in the Coast Mountains to 87 millimetres in the dry central portion of the Basin.

Table 3 and Figure 5 illustrate the relative contributions from the major tributaries of the Basin. Most of the flow in the Yukon River is contributed by the eastern tributaries and the White River; the central portion of the Basin, accounting for almost 30 percent of the total area, contributes very little. The upper Yukon River, although a relatively high yield area, is very small relative to the other tributaries and accounts for only ten percent of the total flow in the Basin.

The eight largest headwater lakes play an important hydrological role by storing summer inflows from the Coast and St. Elias Mountains and maintaining flows in the winter. The moderating effect on streamflow of these lakes is important to water users, such as fish, wildlife and hydroelectric development. The lakes also play an important role in influencing water quality, temperatures and sediment concentrations downstream.

b. Ice Regime

The Yukon River and its tributaries are generally ice covered from November through April. Freeze-up usually begins in late October, starting at the higher elevations of the tributaries and working its way down toward the mainstem river. At the same time, freeze-up on the mainstem proceeds in a general north to south direction. The freeze-up process occurs concurrently in several sections of the river, building up from a bridging point at the downstream end of each section. The time required for ice cover to form in the sections between bridging points varies; it may take from a few days to several weeks, depending upon air temperatures (Hydrology Report No. 4).

Large lakes in the Basin freeze over much more slowly than the rivers because of their large volume of relatively still, warm water. The large lakes remain partially open until late December or January. Lake outlets remain open throughout the winter, due mainly to the warmer water that is forced up from the lower levels of the lake. These open water areas form important waterfowl resting and staging areas during spring migrations.

Spring break-up in the Basin occurs generally during late April in the southern portion, and in early May in the portion between Lake Laberge and the international border. The cause of break-up appears to be a combination of warm, sunny weather and changing flows that flex and fracture the ice.

Surveys during break-up in 1982 and 1983 have shown that break-up on the Yukon River does not occur sequentially in the downstream direction as is normally expected in north-flowing rivers. The headwater portions of the river upstream of Lake Laberge clear first. Downstream of Lake Laberge, break-up occurs in the following general order:

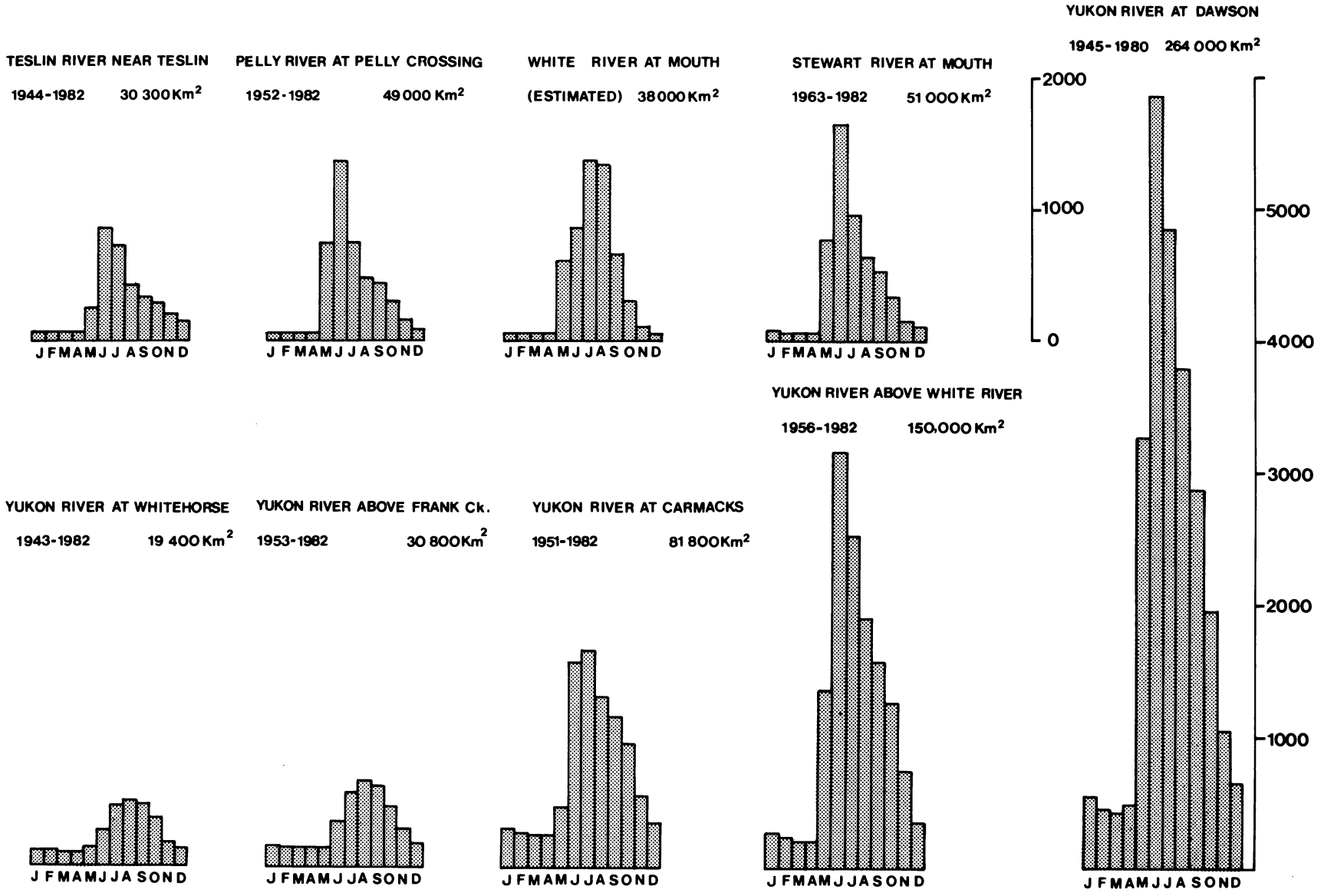
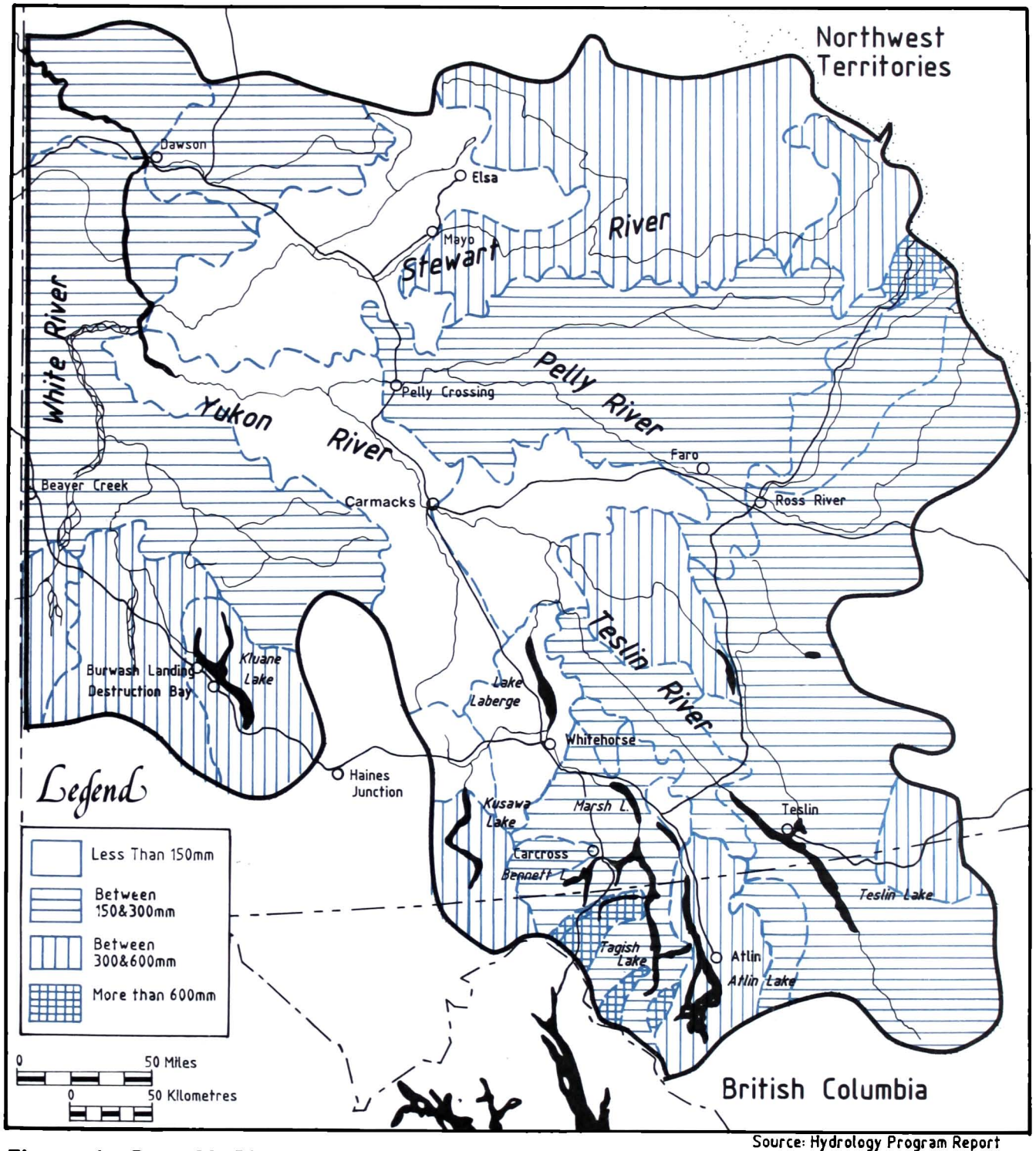


Figure 3: Mean Monthly Flow of Rivers (Cubic Metres Per Second)

Source: Canada, 1983



Source: Hydrology Program Report

Figure 4: Runoff Distribution

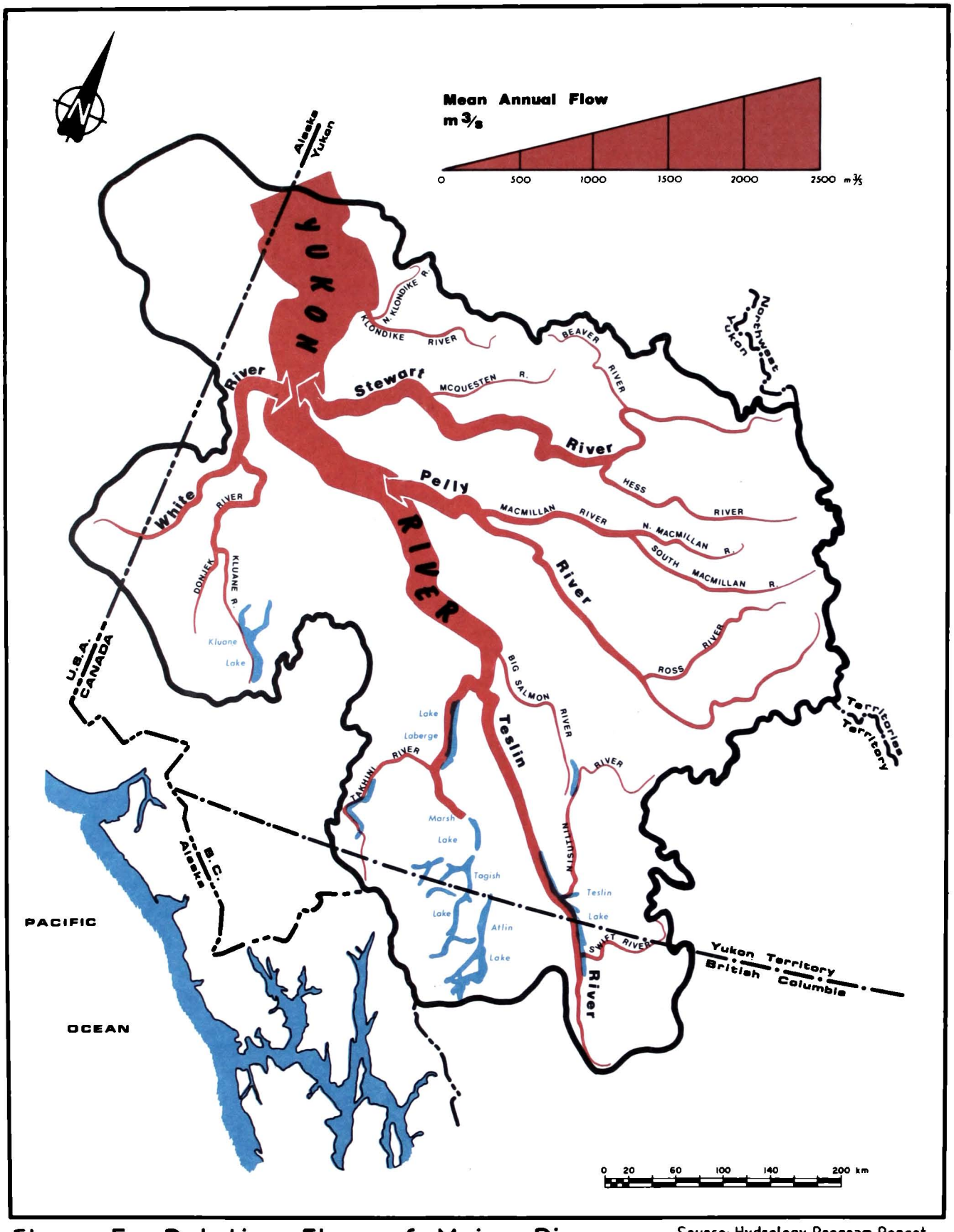


Figure 5 : Relative Flow of Major Rivers

Source: Hydrology Program Report

i. the reach between Lake Laberge and Carmacks
ii. the reach downstream of the mouth of the Klondike River at Dawson
iii. the reach between the White River and Dawson
iv. the reach between Carmacks and the Pelly River
v. the reach between the Pelly River and the White River

(Hydrology Report No. 4)

c. Flooding

Five different causes of flooding in the Basin have been identified: snow melt; ice jams; high intensity rainfall; lake flooding generally from high volume glacier melt; and, glacier outburst floods (jökulhlaups) where a glacier-dammed lake is suddenly released due to melting, lifting or movement of a glacier (Hydrology Report No. 1). The causes of floods most affecting communities in the Basin are ice jams, snow melt and lake flooding, in that order of importance.

The most severe ice jam floods occur during the break-up period and occur with little warning. Flooding usually occurs in surges, with several surges often accompanying one jam. This type of flooding is a major problem at Dawson and several small settlements along the Yukon River and its tributaries. Initial studies of this problem at Dawson have produced only a preliminary understanding of the cause and extent of the major ice jam floods. Ice jams also occur during freeze-up in a similar manner to break-up jams or by slush ice plugging narrow or shallow areas of river channels. In the Basin, these floods are not as large as break-up jams; however,

TABLE 3
FLOW CONTRIBUTIONS OF SUB-BASINS

Basin	Drainage Area (km^2)	Percent of Total Basin Flow	Mean[1] Annual Flow m^3/s(mm)	Percent of Total Area	Range of Mean Daily Discharge Recorded[1] $m^3/s/km^2$ max.	mean	min.
Total Basin (ie. at Border)	287 000[4]	100.0	2 334(257)	100.0	0.0540	0.0081	—
Stewart R.	51 000	17.8	454(281)	19.4	0.1100	0.0089	0.0007
Pelly R.[3]	49 000[3]	17.1	382(246)	16.4	0.0880	0.0078	0.0006
Teslin R.	36 500	12.7	331(286)	14.2	0.0510	0.0091	0.0014
White R.[2]	50 000[4]	17.4	766(483)	32.8	—	—	—
Yukon R. above Whitehorse	19 400	6.8	242(393)	10.4	0.0330	0.0125	0.0017
Miscellaneous mainstem tributaries	81 100	28.2	159(62)	6.8	—	—	—

NOTES: 1. Data for period of record near each tributary mouth
2. No records available for White River at mouth — data are estimated
3. Areas and records are for Pelly River at Pelly Crossing
4. Includes areas in Alaska draining into Canada

SOURCE: Hydrology Program Report

in some locations, such as Whitehorse, they are the most common type of floods.

Snow melt flooding during the spring freshet occurs on all the tributaries and on the mainstem Yukon River in years of heavy snowpacks and rapid melt. Water levels rise steadily over a period of several days or weeks until the peak is reached. Thus, a flood can be forecast to some extent and there is usually time to prepare. Such floods generally occur during late May or early June. This is the typical type of flood at Ross River and Mayo and occurs, as well as ice jam flooding, at Dawson, and at virtually all the floodplains along the large rivers of the Basin.

Lake flooding has been a problem in the Basin in the headwater lakes areas. Following high snowfall winters and rainy summers, lakes can overflow their banks; this normally occurs slowly and lasts for several weeks. Such flooding typically occurs in late summer in Marsh, Tagish and Bennett Lakes due to heavy glacial melt and high precipitation in the mountains.

Flooding due to heavy local rainfall occurs during the summer in the smaller tributaries. Such floods are associated with a great deal of erosion, landslides and debris. Glacier outburst flooding also occurs in the White River sub-basin. These floods are much like the rainfall flash floods as they develop very quickly, are of short duration and are most pronounced in the headwater regions.

Study results have identified areas along the Basin's rivers and lakes which are subject to flooding; however, the depth and extent of such flooding was not determined. Therefore, specific flood risk information is not available to future users.

2. Water Quality

Prior to the Study, water quality data was collected on a site-specific basis for assessment of environmental impacts, monitoring of pollution control measures, maintaining the quality of water supplies or locating mineral deposits. During the Study, a Basin-wide view of water quality was provided by sampling 21 sites for 37 variables for one year (Figure 6). This baseline data can be used to select ongoing monitoring stations and assist in the future establishment of water quality objectives for selected areas.

Preliminary assessment of the network data demonstrated seasonal changes in water quality. In winter, groundwater provides most of the river flow and results in relatively high ion concentrations. In early summer, runoff and flooding result in relatively high concentrations of suspended sediments and related variables. While water quality was found to vary between sites, indicating regional characteristics, ambient conditions are generally considered acceptable for drinking and domestic use (Water Quality Report No.1). Only in limited areas can the influence of human activities on aquatic systems be detected.

A one year basic data set from this 21 station network is now available for use. Statistical analysis of these data revealed that the optimum sampling frequency for most variables at most sites is greater than once per week. A need was identified for an initial water quality network of six stations sampled, due to practical limitations, on a weekly basis (Water Quality Program Report).

In the arctic and subarctic regions, dissolved oxygen concentrations become depressed under winter ice cover. A study of this phenomenon indicated that the initial depression of dissolved oxygen occurs much more rapidly than previously believed. The study also found that production of oxygen increases under the ice layer when the snow cover melts. Concentrations of dissolved oxygen may reach levels which restrict fish populations. Discharge of sewage or disturbance of streambeds during the fall and winter could accentuate the depression of dissolved oxygen and have harmful effects on biological communities (Water Quality Report No. 3).

Many aspects of the Basin's water quality remain to be considered. Asbestos has been detected in a few locations in the waters of the Basin, but health implications are not well understood. The presence of high levels of suspended sediments in Yukon has been noted, but the effects of sediment on water quality are not well known. The Basin contains some highly mineralized areas and the relationship between biota and their environment in these areas remains unknown. Many Yukon communities depend on groundwater as a source of drinking water; little is known about the quality of these supplies (Water Quality Program Report).

3. Monitoring Networks

Three networks are maintained in the Basin to document hydrologic processes: hydrometric, meteorological, and snow course networks (Hydrology Report No. 2). In addition, water quality and sediment data are also collected.

a. Hydrometric Data Network

A total of 77 hydrometric stations of various types are presently in operation within the Basin. The Water Survey of Canada (WSC) operates 55 stations which record water levels and provide daily discharges as the basic inventory of runoff (Figure 6). The Department of Indian Affairs and Northern Development (DIAND) operates 22 stations primarily for site-specific purposes on smaller streams. The WSC stations are distributed fairly uniformly over the Basin with a somewhat higher concentration in the southern portion. The DIAND stations are concentrated along the highways of the territory.

b. Meteorological Data Network

The meteorological data network in the Yukon is operated by the Atmospheric Environment Service of Environment Canada (AES) and is supplemented by DIAND. Recorded meteorologic data have many uses in the Basin: for weather forecasting, for aviation and other transportation services; and, for the management of natural resources with respect to planning, design and operation. Most activities dealing with the subarctic environment must give fundamental consideration to the available climatic records. Meteorologic data, particularly precipitation and temperature, are important in forecasting runoff.

c. Snow Course Networks

Snow melt is the primary source of streamflow in many areas. This is especially true of northern and high elevation regions such as the Yukon River Basin. It has been estimated that 60 to 70 percent of total precipitation is in the form of snowfall throughout much of the Basin. For this reason, it is important to understand the nature and distribution of snowfall and the mechanisms involved in the snow melt process in order that adequate estimates of streamflow may be derived.

To assess the long-term variation in snowpack characteristics, it is necessary to carry out annual snow surveys according to a consistent schedule. In western and northern North America, snow surveys are carried out simultaneously by different agencies at the beginning of each month, starting in February. In Yukon, surveys are carried out February 1, March 1, April 1, May 1, May 15 and June 1, if necessary. There are currently 37 snow course stations in the Basin operated by DIAND and the British Columbia Ministry of Environment.

d. Sediment Sampling

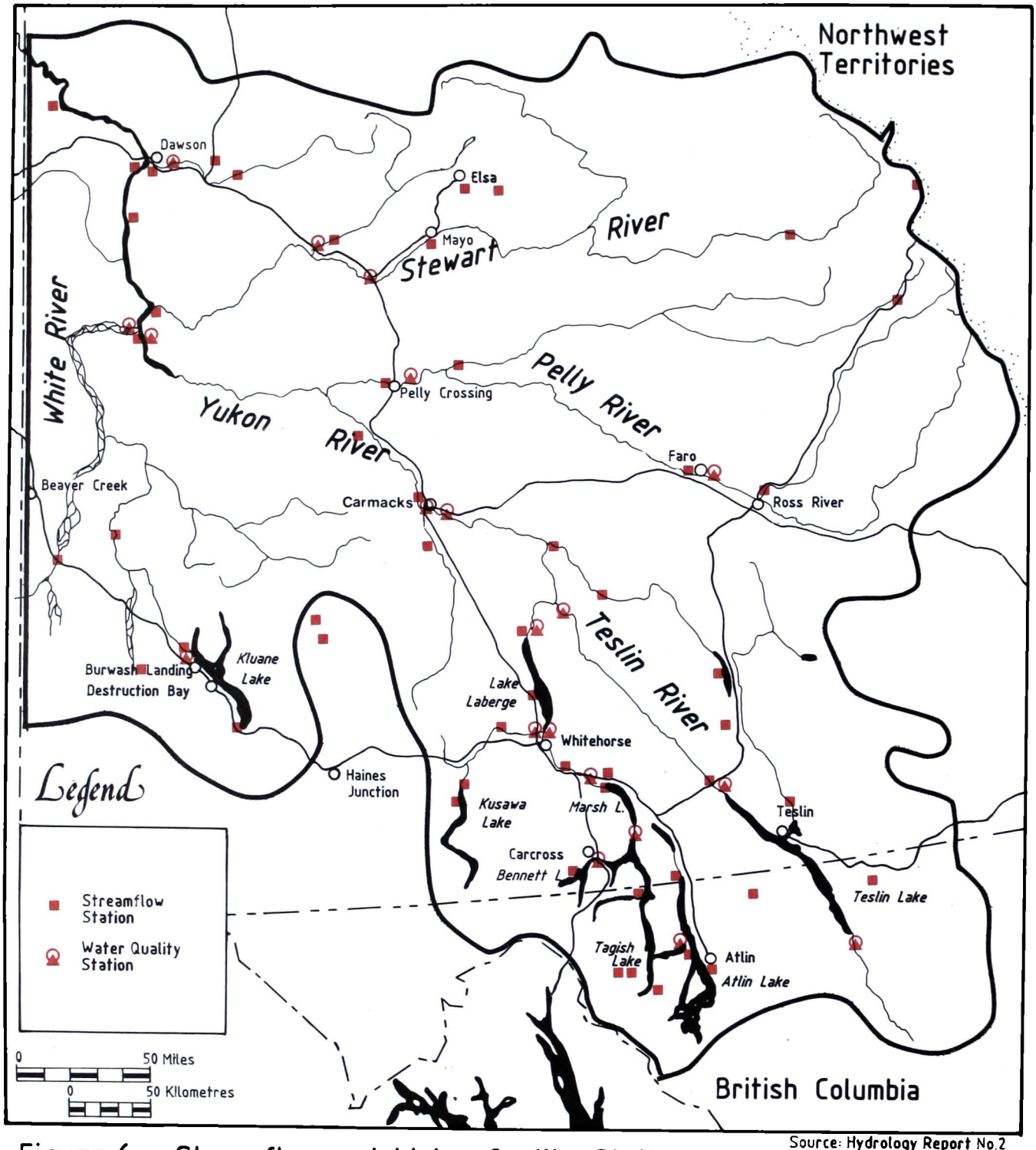
Sediment sampling has recently commenced in the Basin. The first stations, Pelly River at Pelly Crossing and Yukon River at Whitehorse, were established in 1970. Studies related to the proposed Alaska Highway pipeline led to the collection of suspended sediment data at a number of sites in 1977 and 1978. Suspended sediment data is now collected at four sites: Pelly River at Pelly Crossing; Yukon River above White River; White River at km 1 881 Alaska Highway; and, Stewart River at its mouth.

To date, the data collected are categorized as miscellaneous; samples are collected three to five times a year at each station. These types of data currently have limited use but do provide some information on general sediment concentrations in the Basin.

e. Network Review

The hydrometric, climatological and snow course networks were reviewed during the Study for adequacy of data for use in water resource management (Hydrology Program Report). Review of the hydrometric network identified a need for seven stations to provide baseline streamflow data for medium to large drainage areas; four stations to meet site-specific needs; and, a network of 12 stations for small streams.

There is a need for additional precipitation and temperature data from the climatological network in remote areas and at higher elevations. Similar needs were identified for the snow course networks notably in the Selwyn Mountains and headwater lakes area.



Source: Hydrology Report No.2

Figure 6: Streamflow and Water Quality Stations.

4. Daily Flow Model

As part of the Basin Study a daily flow model was developed for testing the hydrologic effects of major storage or diversion projects on the Yukon River system (Hydrology No. 3). The Basin model includes the major tributaries of the Yukon River from its headwaters south of Whitehorse to the international boundary. The White River is not included in the model because of the difficulty in obtaining discharge data.

The hydrologic model can simulate the effects of any proposed project on downstream flows and levels. It can also determine the natural flows and water levels that would have occurred if an existing development had not been in place. The model uses daily mean discharges at key points in the Basin to describe the natural flow regime. Once calibrated, the model can simulate any changed condition in the river. The simulated flows can be compared to the reference natural flows along the river system. River or lake elevations can also be simulated.

The model can be maintained, refined and updated as additional hydrometric data are collected. Data from the White River will permit calibration of the model for that sub-basin. Additional data on Tagish River and Tagish Lake would enable Marsh, Tagish and Bennett Lakes to be modelled as individual lakes instead of as one lake. The resulting improved ability to predict lake levels would help operation of present and future control structures and would aid in avoiding lake shore flooding.

C. FISHERIES

Twenty species of fish are known to be present in the Basin's lakes and streams, including 17 freshwater species and 3 anadromous species (Table 4). In addition, at least two unique or hybrid forms occur in the watershed: the broad whitefish found in the Pelly River-Tatlmain Lake region; and a large, spotted form of least cisco which is present in Quiet and Twin Lakes. Nine indigenous species are taken most often in the fisheries: chinook and chum salmon, lake trout, Arctic grayling, whitefish, pike, inconnu, burbot, and Dolly Varden char. All species, with the exception of sculpin, stickleback, lamprey and chub, are taken in the Indian food fishery. Two species, rainbow trout and coho salmon, have been introduced into pothole lakes in the Basin and contribute to the sport fishery.

TABLE 4

FISH SPECIES

Common Names	
Arctic lamprey	rainbow trout
inconnu	chinook salmon
humpback whitefish	chum salmon
broad whitefish	coho salmon
least cisco	northern pike
round whitefish	lake chub
pygmy whitefish	longnose sucker
Arctic grayling	burbot
lake trout	slimy sculpin
Dolly Varden char	threespine stickleback

SOURCE: Fisheries Program Report

From the viewpoint of fisheries management and, therefore, water management, the most important indigenous species include chinook and chum salmon, lake trout and Arctic grayling. The following section provides an overview of the distribution and abundance of these species. Following this review, physical and biological water and habitat aspects, important to fisheries, are described.

1. Major Fish Species: Distribution and Abundance

a. Chinook Salmon

The Yukon River chinook resource is composed of several genetically distinct stocks. The migration timing of discrete spawning stocks varies, depending on the ultimate destination of the fish within the system. The distribution and abundance of all salmon stocks in the Basin was determined by a radio-tagging and spaghetti-tagging program. Chinook salmon enter the mouth of the Yukon River from late May to early June, and appear in the Dawson area in late June or early July. At the Yukon mouth, Canadian-bound chinook are abundant early in the run,

while downriver stocks are more abundant later in the run. The chinook migration to headwater tributaries within the Canadian portion of the Yukon River drainage represents the longest salmon migration in North America (up to 3 000 kilometres). Migration rates vary from 17 to 57 kilometres per day, with an average for all stocks on the Yukon mainstem of 36 kilometres per day (Fisheries Report No. 5a).

Chinook spawning habitat in the Basin includes both large and small tributaries. Sixty-one spawning areas which each support 100 or more spawners have been identified within the Basin. Documented migration routes for chinook salmon are shown in Figure 7. Additional undocumented migration routes and spawning areas probably occur along the turbid Yukon River mainstem and in more remote reaches of some of the tributaries.

Spawning activity usually occurs between mid-August and mid-September, depending on the location within the Basin. Detailed knowledge regarding specific habitat requirements of spawning chinook is limited. In general, chinook utilize a wide variety of spawning habitat with optimum sites located in rivers containing coarse substrate. Spawners often select sites near lake outlets, although the primary criterion is adequate winter flow that maintains a suitable environment for egg incubation. Salmon fry emerge the following spring with the majority remaining in the Basin one to two years before seaward migration. Overwintering often occurs in deeper segments of the rivers or in lakes.

Although the relative importance of sub-basins for salmon production vary annually, a sub-basin ranking based on importance for chinook production was established based on 1982-1983 estimates:

i. Mid-Yukon mainstem (Teslin to Stewart River including Big Salmon, Little Salmon and Nordenskiold Rivers and Tatchum Creek)
ii. Teslin
iii. Pelly
iv. Stewart
v. Upper Yukon mainstem (upstream of Teslin River, including the Takhini River)
vi. White
vii. Lower Yukon mainstem (downstream of Stewart River including the Klondike River)

(Fisheries Report No. 5a)

In 1982 and 1983, the number of chinook returning to the Basin was estimated to be 36,600 and 47,700 respectively. Approximately 50 percent of the chinook salmon of the entire Yukon River system originate in the Basin.

b. Chum Salmon

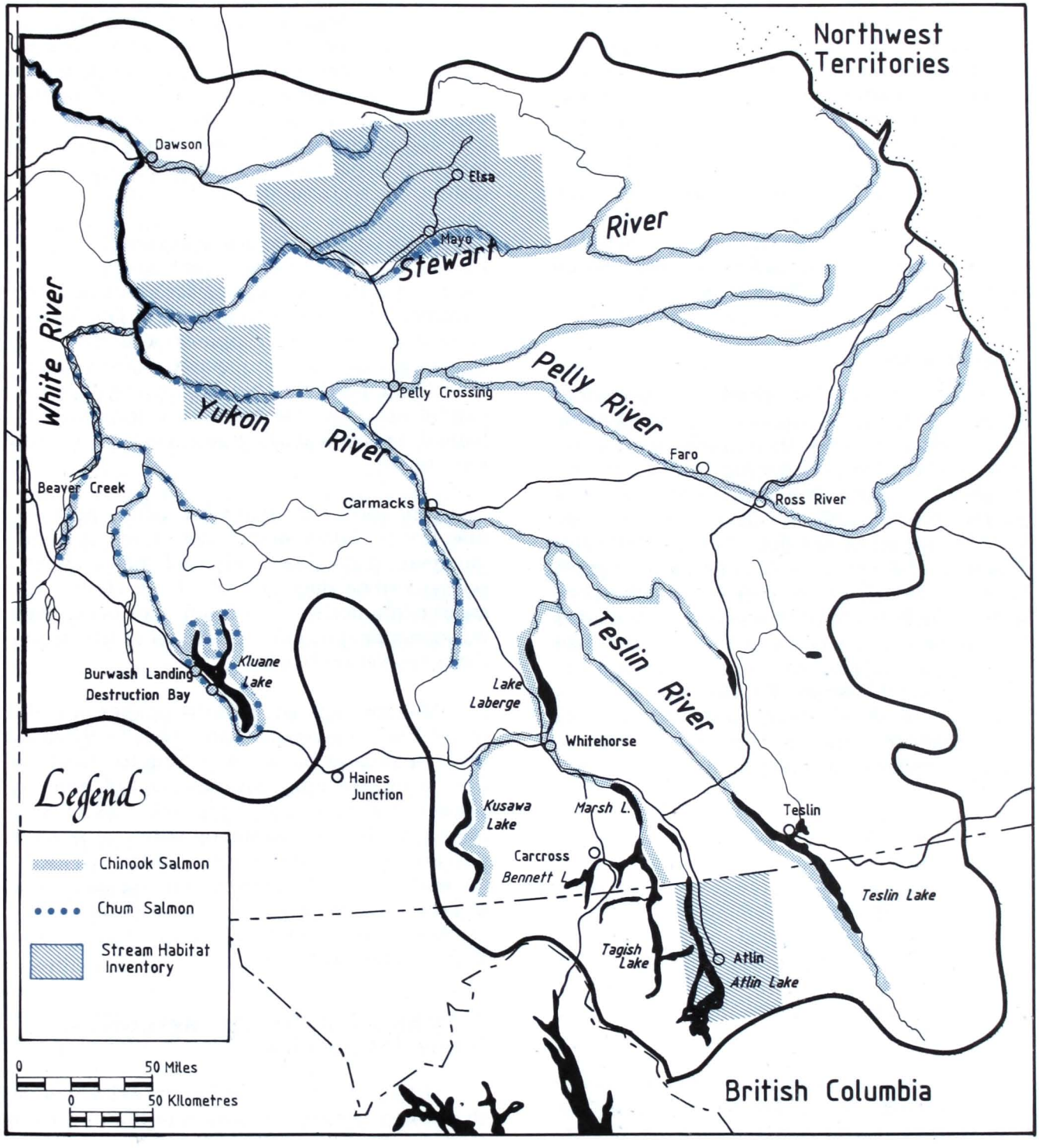
Chum salmon, destined for the Basin, commence their upstream migration in the Yukon River during mid-July. Migration through the Dawson area occurs from August to early October, with an average migration rate of about 38 kilometres per day (Fisheries Program Report). Spawning further upstream generally takes place from mid-September to early November. The chum return to the Basin represents the longest freshwater chum migration in North America (up to 3 000 kilometres).

Information regarding specific chum spawning habitat is limited. However, it is apparent from a number of studies carried out in Yukon and Alaska that chum spawning sites are frequently, although not invariably, associated with upwelling groundwater. It has been suggested that the warmer groundwater in these areas reduces the possibility of freezing and, in systems such as the White River, may help to alleviate sedimentation problems. The majority of chum spawn in medium to large gravel, although spawning substrate may consist of coarse gravel, sizeable cobble or even bedrock strewn with boulders.

In general, the chum spawning distribution in the Basin is not as well known as that for chinook salmon. The major chum spawning sites are located in the Kluane River and the mainstem Yukon. Using 1982-1983 estimates, a sub-basin ranking based on importance for chum production was established:

i. Kluane-White Rivers
ii. Mainstem Yukon River
iii. Upper Yukon-Teslin Rivers
iv. Klondike River

(Fisheries Report No. 5b)



Source:Fisheries Report No. 3,5a,5b.

Figure 7: Documented Migration Routes for Chinook and Chum Salmon and Stream Habitat Inventory Areas.

As is the case with chinook salmon, the Canadian-bred Yukon River chum run is a transboundary stock which is intercepted in significant numbers by the Alaskan commercial fishery. Estimates of spawning chum returns to the Basin were 47,000 in 1982 and 118,400 during 1983 (Fisheries Report No. 5b). The 1983 estimate was the largest ever made for the Basin. Together, the Basin and the Porcupine River in Canada are estimated to produce 50 percent of the chum salmon produced in the entire Yukon River system (Fisheries Program Report).

c. Lake Trout

Lake trout are widely distributed throughout the Basin. Relative abundance varies depending on a number of factors such as fishing pressure, species diversity and habitat characteristics. Longevity is a particularly noteworthy feature of the lake trout. Within the Basin, the maximum recorded age for a lake trout is 31 years. Estimates of potential lake trout production for the Basin's lakes are relatively low in comparison to the more southern river systems. However, recent studies have found that a majority of 19 Basin lakes had food supplies capable of supporting greater fish populations (Fisheries Report No. 4). This suggests that full fish production capacity is not being realized; however, further information would be required to establish the cause of this situation.

Although lake trout may spawn annually in southern areas, it is believed that northern trout spawn during alternate years or even every three years. The majority of spawning activity in the Basin occurs during August, September and October. Preferred spawning habitat is clean rubble substrate with some upwelling groundwater flow. Streams are utilized to a limited extent.

Eggs hatch between mid-February and late March; however, little is known of juvenile lake trout ecology. As trout mature, they move into deeper water. Lake trout are predaceous and feed upon a broad range of organisms including many species of fish, particularly whitefish.

d. Arctic Grayling

Although no comprehensive effort was made to define the distribution and abundance of Arctic grayling, it is apparent that they are widely distributed in lakes and streams throughout the Basin. Their abundance is variable depending on a number of factors including habitat characteristics, species diversity and fishing pressure. A considerable amount of information has been collected on site-specific distribution and abundance of this species.

As ice break-up begins and in preparation for spawning, Arctic grayling move from ice-covered lakes and large rivers into smaller tributaries. This migration may take place as early as late-April or early-May. However, in some areas of the Basin, spawning may occur in mainstem overwintering areas (Fisheries Report No. 8). Grayling appear to exhibit no particular preference for spawning habitat, although sandy gravel seems to be used most often.

Very soon after spawning, adults generally migrate to lakes and larger river systems. However, it has been reported that a general post-spawning migration of all age classes into smaller tributaries of the Basin does occur, with fish continuing to move upstream as late as July (Fisheries Report No. 8).

After the eggs hatch, the fry emerge from the gravel three to seven days later. They feed initially on zooplankton before switching to insects as they grow. Maturing fish move out of tributary systems and into large rivers and lakes prior to freeze-up. The overwintering habits of grayling remain poorly understood, although it is generally assumed that overwintering takes place in lakes and large rivers. The fish utilize the smaller streams only during summer months (Fisheries Report No. 3).

2. Fisheries and Water Resources: Interrelationships

Fish production in the Basin is influenced by the limited carrying capacity of northern streams and lakes. Production is also limited by water uses which alter habitat conditions and by direct fishing pressure. Although each species has its own particular habitat requirements, some generalizations can be made with respect to key factors which potentially limit the Basin's fish populations.

Successful spawning and fry development

require the absence of barriers to spawning movements and adequate numbers of fish, particularly females, at the spawning site. Spawning areas must have suitable permeable gravel substrate, a sustained flow of well-oxygenated water and cover from predation. Furthermore, suitable water temperature and quality are required (Fisheries Program Report).

In any particular stream or lake, usually only one or a few of these factors play a key role in egg and fry survival. Little work has been carried out in the Basin to identify the most common limiting factors during spawning and fry development stages. However, because of harsh winter conditions including low oxygen concentrations, low stream discharges, frozen streams, and ice scour, combined with long periods of egg incubation, it seems reasonable that fall spawners i.e. chinook and chum salmon, lake trout are more often limited in this stage of their life cycle than are spring spawners i.e. Arctic grayling. Spring spawners are probably limited by other factors such as abnormally high sediment levels caused by natural or man-induced actions. Salmon species which leave the Basin may be limited by factors outside the Basin for which there is currently no control.

Limiting factors also act on fish during juvenile rearing and adult growth stages. Although chinook and chum salmon spend the greater part of their development in the ocean and therefore largely avoid the effects of the harsh Yukon climate, most species are subject to a host of potential limiting factors during juvenile rearing and adult growth. Some of these limiting factors include: insufficient nutrients and light, lack of cover from predation, lack of habitat, insufficient spring and summer water flow, insufficient water and oxygen for overwintering in lakes, unsuitable water quality conditions, inappropriate estuarine and ocean survival conditions, and inadequate protection from overharvesting.

Fish, such as lake trout, which rear in the Basin's lakes are usually limited by the amount of available food. For stream fish, survival during the overwintering period is thought to be the critical limiting factor.

D. WILDLIFE

The Basin supports a variety of wildlife including: moose, caribou, sheep, goat, grizzly and black bear, furbearers (at least 13 species), waterbirds (at least 24 species), birds of prey and upland game birds. Some species are unique to the Basin; for other species, the Basin represents the northern extremity of their range.

Many of the Basin's wildlife species are directly dependent upon aquatic and riparian habitats provided by the river and lake systems. Floodplains of major valleys are the most important units for the survival of many species, including aquatic and semiaquatic furbearers, waterfowl, songbirds, shorebirds and several raptors such as bald eagle and osprey. Other raptors, upland game birds and several big game species, such as grizzly and black bear, moose and woodland caribou, make seasonal use of riparian habitats that may be of critical importance to their survival. From the viewpoint of water management, a priority was placed on obtaining a better understanding of the waterfowl, aquatic and semi-aquatic furbearers and moose.

The following section provides an overview of the preceding wildlife species. For each species, a brief description is given and an assessment offered of the present level of understanding. Then, physical and biological water-related processes and habitat requirements important to wildlife are described.

1. Wildlife: Distribution and Abundance

a. Waterfowl

Just under 200 species of migratory birds have been recorded in Yukon. Roughly half of these species are riparian and include, among others, waterbirds, shorebirds, gulls and terns, kingfishers, loons, grebes and swallows. Except for waterbirds, no systematic gathering of data on populations and habitat use has been undertaken (Wildlife Program Report).

Table 5 lists 24 of the more common species of migratory waterbirds that use the Basin. During studies on the staging of migratory birds, 32 species were recorded (Wildlife Report No.5). In 1984, the Government of Yukon and the Canadian Wildlife Service of Environment Canada reached agreement on a Yukon Waterfowl Management Plan. Forty important waterfowl areas within Yukon were identified. Twenty-six of these areas are in the Basin (Figure 8).

TABLE 5
WATERBIRD SPECIES

Geese	Swans
White-fronted	Trumpeter
Snow	Tundra (Whistling)
Canada	
Dabbling Ducks	Diving Ducks
Green-winged teal	Ring-necked
Mallard	Lesser scaup
Northern pintail	Harlequin
Blue-winged teal	Surf scoter
Northern shoveler	White-winged scoter
American widgeon	Common goldeneye
	Barrow's goldeneye
Other	Goldeneye spp.
Common loon	Bufflehead
Horned grebe	Common merganser
Red-necked grebe	Canvasback
	Red-breasted merganser

SOURCE: Wildlife Report No. 4

The Basin is vital to four aspects of the waterfowl life cycle: spring and fall staging, breeding and moulting. During the spring and fall, migrating waterfowl stop at particular locations that provide appropriate habitat. These staging areas are often uniquely productive and are important to the survival of waterfowl species (Wildlife Program Report). Because of the Basin's location on a major flyway its staging areas are used by an estimated one million Alaska-bound birds which pass through annually. The significance of the Basin's staging areas has not been fully assessed, but for some species, such as the trumpeter swan, the areas are critical to a major portion of the world's population.

Both fall and spring staging areas are characterized by falling water levels and related exposure of feeding and resting habitat. However, a number of important hydrologic processes and habitat conditions vary greatly between fall and spring. These processes and conditions and their relationship to waterfowl are not well understood (Wildlife Program Report).

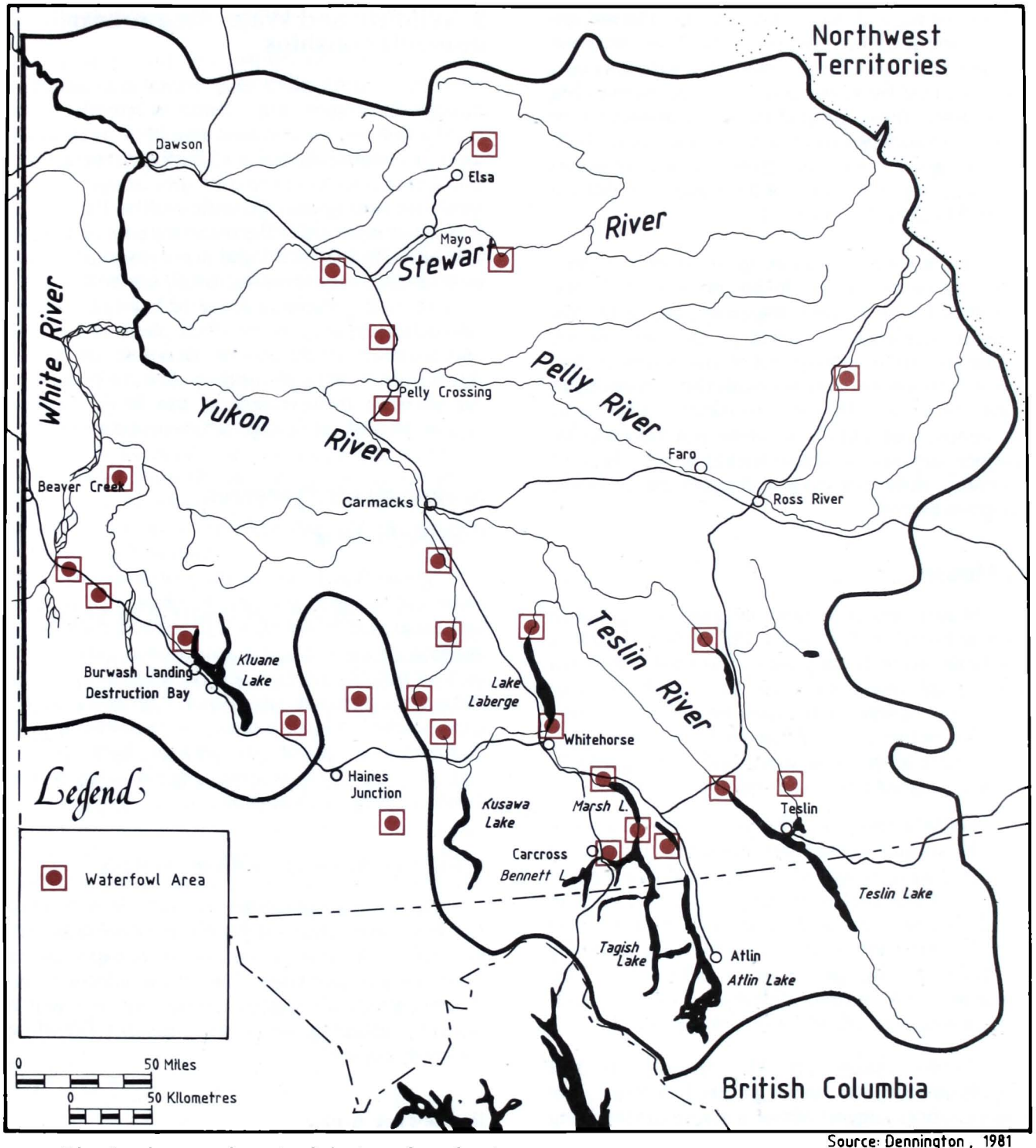
Moulting occurs in various habitats depending on the species. Moulting habitat and related requirements have never been studied in the Basin.

Waterfowl nesting requirements also vary from species to species and require conditions different from moulting and staging. In particular, breeding habitat is broadly distributed. Wetlands characterized by restricted drainages that are recharged by floods but are not directly connected to flowing rivers and lakes, support some of the highest breeding densities. River bars are used by geese for nesting. Some of this habitat has been surveyed; however, a majority of the Basin remains to be examined and understood. Use of nesting habitat likely varies greatly from year to year depending on conditions external to the Basin. Waterfowl are particularly well adapted to a rapidly changing environment; birds that would normally nest on the prairies can bypass them in years of drought and spend the summer on northern wetlands. As a result, the Basin is important to some species as a fallback nesting area (Wildlife Report No.4).

b. Furbearers

Widely distributed furbearer species in the Basin include: beaver, muskrat, otter, mink, ermine (weasel), marten, wolverine, squirrel, red fox, coyote, wolf and lynx (Wildlife Report No.1). Of these species, the first five are critically dependent on river or wetland habitat. Fisher, another species dependent on wetland habitat, is also present.

All populations, except marten, are believed to be healthy within the context of available habitat for each species and allowing for the



Source: Dennington, 1981

Fig.8 : Important Waterfowl Areas.

effects of natural population cycles. Marten are rare in the southern portion of the Basin between Kluane Lake and Teslin Lake. This situation was likely caused by a combination of overharvesting and forest fires. Long-distance movements of wolverine and lynx were noted in 1982 and 1983, indicating food stress for these species. Muskrats are declining in a phase of an apparently natural cycle (Wildlife Report No.1).

The furbearer studies in areas of the Pelly River, Yukon mainstem, Teslin and Stewart Rivers, combined with historic trapping data, generally provide an adequate inventory-type data base for water resource management decisions in the Basin. However, species-specific information gaps exist for beaver, muskrat, otter and wolverine, particularly in areas not covered by project surveys. In these locations, the lack of inventory data remains a significant gap (Wildlife Program Report).

c. Moose

Moose are the most important big game animal found in the Basin. Population densities are believed to be highest in the southern Basin and to decrease towards the north. Moose occupy a variety of habitats from wetland and riparian in the valley floors to forest, subalpine and tundra in the mountains and plateaux. Little is known about how these habitats are used.

In the winters of 1981 and 1982, an area of 24 000 square kilometres between Teslin and Haines Junction was surveyed (Wildlife Report No. 2). Areal survey techniques developed in Alaska were used and improved. About 4,700 moose were estimated to be in the area, a density of 0.21 moose per square kilometre. The variability of moose densities suggests that extrapolation to other areas is not justified.

Calves made up 11 percent of the population in 1981 and 8 percent in 1982. The low numbers suggest either a stable or declining moose population.

In the area surveyed, floodplain habitat is limited and moose were found at or above the tree line (1 250 metres). In other Basin areas moose are found in floodplains in early and mid winter. Floodplains can also serve as calving and summering areas but the extent of use is unknown (Wildlife Program Report).

2. Wildlife and Water Resources: Interrelationships

The distinct plant and animal communities of alluvial sites and their relatively high productivities are the end result of a complex web of climatic, fluvial and biological processes that interact to form areas of special significance to wildlife along river channels in the Basin. The processes involved in these intricate relationships are a result of depositional and erosional forces, vegetational responses to fluvial processes, and a variety of ecological and physiological adaptations that allow resident plant and animal species to effectively use the dynamic habitats of flood-prone areas. A number of these processes are directly dependent on the Basin's water resources and are briefly summarized below.

a. Hydrologic Processes

i. Spring Flooding

Spring floods renew the nutrients critical to river valley productivity. Further, the related erosional and depositional processes maintain a mosaic of vegetation communities critical to various wildlife species. Nutrient loads, timing of deposits, amount of annual deposits, plant community adaptations, the effects of silt deposits on plant succession and animal communities are, at best, poorly understood (Wildlife Program Report).

ii. Fall and Winter Draw-Down Periods

Draw-down periods are poorly documented but have very important ecological effects. For example, fall draw-down results in exposure of feed at waterfowl staging areas and winter draw-down creates air spaces below river ice which provide foraging areas for muskrat (Wildlife Program Report).

iii. Ice-Free Areas

Areas which remain ice-free during winter are of great importance to both resident and migrating waterfowl. Existing ice-free areas are not well understood (Wildlife Report No. 5b).

b. Alluvial Processes

Erosion and deposition of sediment are ongoing river processes. The most dramatic changes are associated with spring break-up but the slower and continuous changes that occur throughout the year are also important.

As rivers flow through valley bottoms, the simultaneous processes of degradation and aggradation are constantly occurring, thus habitat is being destroyed through erosion in one section of the river and created through deposition in another. New sites are invaded by early successional plant communities and their associated animal species. As successive floods deposit sediment and raise the land level, vegetation communities mature. The result is a complex array of alluvial sites in various states of succession. Overall, the delta or river valley remains in a state of dynamic equilibrium providing a more or less constant set of habitats for plants and animals.

c. Timing of Natural Processes

The timing of hydrological events and their seasonal rhythm is a major factor connecting processes critical to the Basin's wildlife ecology (Wildlife Program Report). Virtually all wildlife research that has proceeded beyond the initial reconnaisance and inventory stage has identified the timing of changes in flows and water level as key elements. While the importance of natural process rhythms has been recognized, very little work has been completed that documents the characteristics and significance of this factor to the Basin's wildlife (Wildlife Program Report).

CHAPTER III
EXISTING AND POTENTIAL RESOURCE USE

The Basin's water and related resources have not been significantly affected by human activity, nor has there been much competition for the use of the water resource. However, there are many potential developments foreseen for the Basin that will require substantial water use. Some of these will be in competition for water. As part of the Study program, the Committee identified the current and potential water resource uses in the Basin. This information is essential for the development of an overall planning strategy.

This chapter opens with a brief historical and demographic perspective of the Basin, then outlines the Basin's economy. The Basin's present and potential water use activities are discussed under five headings: energy; mining; tourism, parks and recreation; fisheries; and, wildlife.

A. HISTORICAL PERSPECTIVE

Until the late 1800s, Indians and fur traders were the only occupants of the Basin. Prospecting began in the Basin in 1873 but increased rapidly with the opening of the coastal passes in 1880. Gold was discovered in the Klondike in 1896 and by 1897, Dawson had a population of over 4,000 and by 1898, a population of 40,000 (Wright, 1976). Gold production peaked in 1900 but by 1902 the gold rush was over and the population falling. During the next 40 years, gold and silver mining and trapping provided jobs for many of the Basin's 5,000 residents.

World War II initiated a period of rapid change in the Basin, starting with construction of airfields for the northwest staging route in 1941 and followed by the Alaska Highway and Canol pipeline in 1942 and 1943. In 1950, opening of the road between Whitehorse, Mayo and Dawson led to the abandonment of many communities that had relied on the river for transportation and consolidation of the population in present communities along highway corridors (Cruikshank and Robb, 1975).

By the early 1960s, mining companies and the federal government had begun to realize the mineral potential of the Basin. Exploration led to the opening of three mines in the Basin: Clinton Creek asbestos mine near Dawson, Cyprus-Anvil lead-zinc mine near Faro, and Whitehorse copper mine near Whitehorse. New transportation systems, power facilities and towns were developed to support these mines and to accommodate long-term growth and development.

B. POPULATION

The population of the Yukon Territory in June 1983 was about 23,000, with over 90 percent residing in the Basin (Table 6). In addition, approximately 400 people live in the British Columbia portion of the Basin (Atlin). Over 70 percent of the population resides in or near Whitehorse, with the remainder living in communities throughout the Basin.

Population migration patterns in the Basin respond strongly to economic opportunity. Since 1976, Yukon net migration has been negative, except for 1977 and 1981, reflecting limited economic opportunities in the Basin during most years.

The Yukon has a proportionately younger population than the rest of Canada. A large number of transient young people come to the Yukon to take advantage of relatively high-paying jobs and then leave the Basin as employment opportunities decline (Socio-Economic Program Report).

C. THE YUKON ECONOMY

The Yukon economy has followed a boom and bust cycle since the Klondike gold rush at the

TABLE 6
YUKON POPULATION BY COMMUNITY

	Net Growth 1977-83	1983	1982	1981	1980	1979	1978	1977
Yukon	103	23,216	24,811	25,121	24,138	24,007	23,306	23,113
Beaver Creek	-3	113	108	102	121	117	105	116
Carcross	-7	246	258	274	263	303	263	253
Carmacks	77	369	366	351	339	330	321	292
Dawson	211	1244	1251	1252	1109	1118	1034	1033
Destruction Bay	1	57	76	75	70	65	63	56
Elsa	-389	194	448	519	609	574	601	583
Faro	81	1700	1972	1869	1668	1633	1557	1619
*Haines Junction	118	461	448	468	451	426	397	343
Mayo	-12	465	443	474	489	479	486	477
*Old Crow	34	217	211	219	215	212	197	183
Pelly Crossing	29	125	126	127	112	104	102	96
Ross River	55	274	279	265	257	232	222	219
Teslin	-3	347	367	363	355	372	353	350
*Watson Lake	81	1325	1348	1398	1374	1360	1354	1244
Whitehorse	614	15,771	16,771	17,023	16,362	16,191	15,455	15,157
Other	-784	308	339	342	344	491	796	1092

*Outside the Yukon River Basin

SOURCE: Yukon, 1983

turn of the century. At present, the economy is in an extended period of depression following a mining boom that peaked in 1981. Instability has occurred largely because of this historical dependency on the mining sector. The seasonal nature of other economic activities, such as tourism, have also contributed to the instability.

Mining and tourism are the major industries forming the economic base of the region; smaller industries include forestry, hunting, fishing and trapping. There is limited opportunity for agriculture in the Basin. Secondary industries such as retail and wholesale trade, transportation and construction serve the needs of the area's population. Government is an important sector and, as the largest employer in the region, provides some stability during traditional boom and bust cycles (Table 7).

In 1982, there were over 9,000 full-time employees in Yukon, of which, directly or indirectly, 25 percent was due to the mining industry, 15 percent due to tourism and 60 percent attributable to government. Most activity in construction, communications, utilities, transportation and wholesale and retail trade was dependent upon mining, tourism or government.

TABLE 7

YUKON EMPLOYMENT BY INDUSTRY

Industry	Full-Time Employees				% of Total				% Change
	1972	1975	1978	1982	1972	1975	1978	1982	1972 to 1982
Mining	1203	1404	1429	693	16.4	17.3	15.8	7.3	-42.4
Construction	502	612	801	582	6.9	7.5	8.8	6.1	15.9
Comm & Utils	342	292	346	489	4.7	3.6	3.8	5.2	43
Transport	596	666	741	678	8.1	8.2	8.2	7.1	13.8
Servs & Trade	1940	1710	2081	3051	26.5	21.1	23.0	32.2	57.3
Federal Govt	1028	1378	1373	1415	14.0	17.0	15.2	14.9	37.6
Terr Govt	1209	1543	1755	2141	16.5	19.0	19.4	22.6	77.1
Local Govt	123	146	164	222	1.7	1.8	1.8	2.3	80.5
Other	375	358	371	218	5.1	4.4	4.1	2.3	-41.9
TOTAL	7318	8109	9061	9489	-	-	-	-	29.7

NOTES: Pre-1978 data for construction, communications & utilities, transport, and services & trade are estimated. Mining employment for 1982 is adjusted to exclude 554 employees designated full time by Cyprus-Anvil, a majority of which were on standby, reduced hours, or vacation pay.

SOURCE: Socio-Economic Report No. 4

D. TRANSPORTATION

The transportation system of the Basin has four components: river, rail, road and air. The system has continually evolved to serve the changing requirements of both goods and passengers.

Rivers served as principal transportation routes during the fur trade and gold rush through to the mid-1900s when the road network replaced them. Today the rivers provide recreation, canoeing and powerboating opportunities as well as barge access to isolated mining and exploration sites.

The Whitepass and Yukon Railroad, completed in 1900, provided reliable connections between the Port of Skagway and Carcross and Whitehorse. In 1981, the railroad carried more than 69,900 tons of freight, 44,500 tons of petroleum products, 416,000 tons of mineral concentrates and 55,000 passengers (Canada, 1983). The railroad suspended operations in 1982 when its largest customer, the Cyprus-Anvil Mining Corporation, ceased concentrate production to await more favourable metal prices.

The Alaska Highway provides all-weather road transportation to the Basin from British Columbia and Alaska. The highway was initially constructed to transport war material to the North Pacific in World War II and was later upgraded for civilian use. All communities in the Basin are connected by roads. The Dempster Highway provides transportation links to the Northwest Territories and the Klondike Highway provides summer access to Skagway, Alaska.

CP Air and Pacific Western Airlines provide jet connections to southern Canada from Whitehorse. Air service to other Basin communities is provided by regional carriers and air charter operators.

E. WATER USE ACTIVITIES

Water resource planning for the Basin requires an understanding of current and potential water uses. These uses are influenced by institutional aspects within each legal jurisdiction of the Basin. Some acts and legislation regulate or control activities that use water, others directly pertain to management of the water resource itself and are the final control of water use.

The **British North America Act,** 1867 (now the **Constitution Act,** 1982) allocates ownership and control of the Basin's water resource. Generally, the Act states that provinces own the water resource except on federal and territorial lands. Thus, the federal government is responsible for water management in Yukon and the British Columbia government is responsible for its portion of the Basin.

In the Yukon portion of the Basin, the **Northern Inland Waters Act** provides for allocation of water rights and the regulation of water quality. In the British Columbia portion of the Basin, two provincial statutes are of major importance in water management. The **Water Act** provides for the allocation of water rights and the regulation of water uses. Limited rights for water use are granted through a system of conditional and final licences. The **Waste Management Act** regulates water quality and the disposal of waste to water.

Apart from the specific statutes that provide for the regulation of water use in the Basin, the **Canada Water Act** (CWA) provides for interjurisdictional planning of water resources. The Yukon River Basin Study was implemented under the CWA.

1. Energy

Development of the Basin's hydroelectric resources may be the most significant water management issue to be addressed in the Basin. In this section, a brief review is given of existing and potential hydroelectric facilities. This is followed by a comment on forecasts of electrical energy demand and an identification of agencies responsible for energy management in the Basin.

a. Existing Hydroelectric Facilities

The existing hydroelectric facilities in and near the Basin can generate 77.75 megawatts of electricity (Table 8). The present hydroelectric facilities, together with the several existing community diesel generators, are sufficient to meet present electricity demands in the Basin. There is also sufficient capacity to serve the Cyprus-Anvil mine, if it reopens, and associated population growth.

TABLE 8

EXISTING HYDROELECTRIC FACILITIES IN YUKON

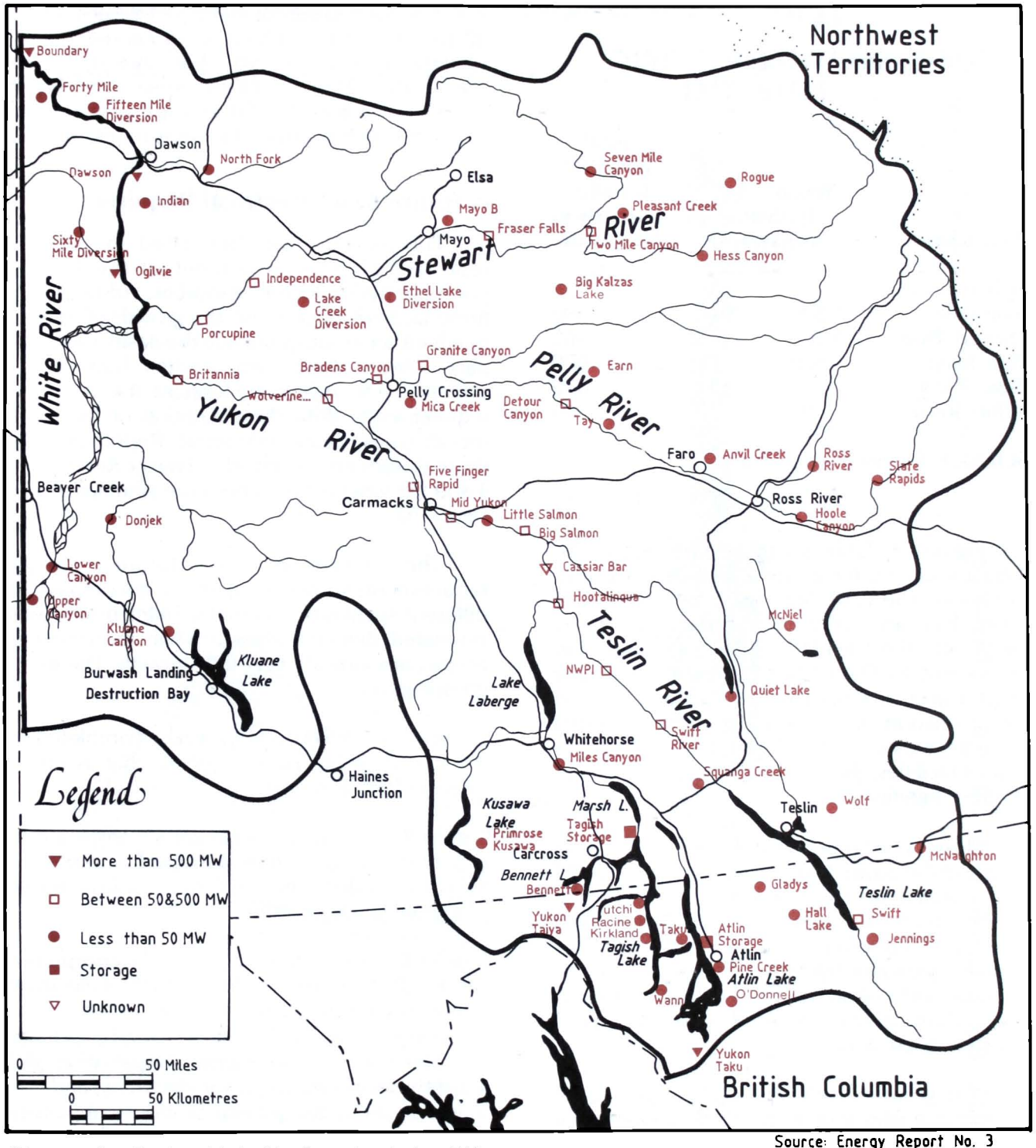
Facility	Location	Installed Capacity (megawatts)
Aishihik Dam	near Haines Junction	31.00
Mayo Lake	near Mayo	5.10
McIntyre Creek	Whitehorse	1.65
Whitehorse Rapids	Whitehorse	40.00
TOTAL		77.75

SOURCE: Hydrology Report No. 2

b. Hydroelectric Potential

About 100 potential sites have been identified in the Basin, not including a great number of small hydroelectric sites (less than 5 megawatts) that remain to be documented. Figure 9 shows the location of these potential sites and the data describing them are summarized in Energy Report No. 3.

An approximate sub-basin breakdown of the hydroelectric potential within the Basin is given in Table 9. The Taku (3 690 megawatts) and Taiya (4 050 megawatts) diversions are two major projects which would divert water from the headwater lakes out of the Basin and are therefore not included in the sub-basin potential figures.



Source: Energy Report No. 3

Figure 9: Potential Hydroelectric Sites

TABLE 9

SUB-BASIN HYDROELECTRIC POTENTIAL

Sub-Basin	Yukon (potential megawatts)	B.C. (potential megawatts)	Total Potential Installed Capacity in Megawatts
Yukon River mainstem	5 500	90	5 590
Stewart River	1 100	-	1 100
Pelly River	800	-	800
Teslin River	230	80	310
White River	90	-	90

SOURCE: Energy Program Report

Figures in Table 9 can be compared with capacity figures for existing facilities in British Columbia. The G.M. Shrum Dam on the Peace River has an installed capacity of 2 680 megawatts, the Mica Dam 1 600 megawatts and the Revelstoke Dam 1 800 megawatts. A similar megaproject developed in the Basin would be on the mainstem where most of the potential capacity exists. If development is limited to smaller facilities, the role of the tributaries would be more significant.

Close to 200 reports have been prepared on energy in the Basin, and most of these are on the hydroelectric resource (Energy Report No. 1). Information for the potential sites has not been developed uniformly and many early studies require upgrading because of changes in dam-building technology and the relatively recent recognition given to socio-economic and environmental factors.

One group of early studies describes about 20 potential sites averaging 335 megawatts. The sites are mainly megaproject possibilities that were identified between 1960 and 1966. Many technical aspects of the studies are adequate; however, socio-economic and environmental factors are not considered. Some updating of project layouts to conform to modern hydroelectric design practice is also required.

A second group of studies evaluates about 40 sites located mainly in south central Yukon, varying greatly in size but averaging 32 megawatts. These studies were completed between 1968 and 1978 and are preliminary. Upgrading of most study factors is required.

c. Future Basin Electrical Requirements

The installed facilities listed in Table 8 represent about one percent of the Basin's potential hydroelectric resources. Additions to these facilities depend on the growth of energy needs either inside or outside the Basin. Over the past fifteen years, ten studies have been undertaken to review and forecast Yukon energy requirements. With the exception of the most recent study (Socio-Economic Report No. 4), these studies are reviewed in Energy Report No. 4 and the various projections are summarized in Figure 10.

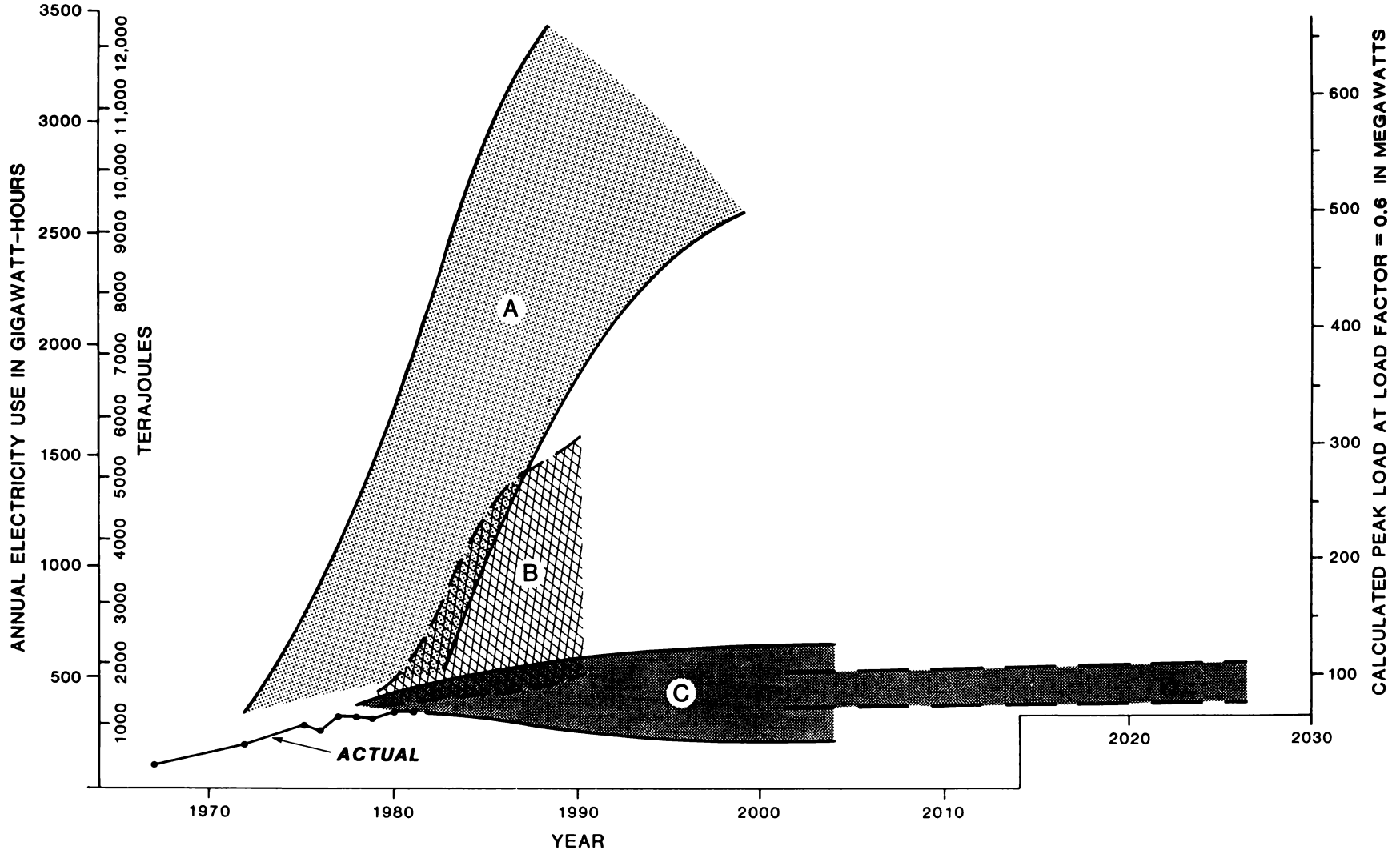
The envelopes of future energy requirements shown in Figure 10 encompass 24 different scenarios. Generally, older projections estimated dramatic growth while more recent projections indicate very little growth. The three groupings are:

Group A — Projections generally completed in the late sixties or early seventies that assumed major industrialization.

Group B — Projections generally completed in the mid-seventies that assumed a range of industrialization but at levels below those projected in earlier studies.

Group C — Projections generally completed since 1981 that assumed low growth of electrical energy use for one of two reasons:
i. severe slowdown of industrial activity combined with some energy conservation and substitution of natural gas for electricity; and,
ii. low to moderate growth of industrial activity combined with more extensive introduction of conservation measures and a minor amount of substitution of natural gas for electricity.

The most recent projections were prepared as part of the Yukon Economic Model (Socio-Economic Report No. 4). These projections of electrical energy use bracket the studies



Source: Energy Report No. 4

Figure 10: Projected Future Energy Requirements

completed in the last three years (Group C in Figure 10) and imply additional capacity requirements up to approximately 40 megawatts by 1988 and 75 megawatts by 2003. These requirements are not large and might be met by appropriately-sized hydroelectric facilities close to the area of demand.

Given current and projected economic trends in Canada and the rest of the world it is difficult to foresee a scenario that would result in high demand for electricity in Yukon. Large scale hydro-development could therefore occur only if there was rapid industrialization in the North in response to a major upswing in the world economy or if the export of electrical energy to meet external demands became feasible.

The possibility of linking the existing Yukon grid with systems outside the Basin is also a possibility (Energy Report No. 3). Such an interconnection would allow either import or export of electricity depending on requirements. It could act as a catalyst for construction of additional power facilities if an export market developed. Conversely, it could reduce the need for more facilities if access to outside power, at economical rates, was available. The evaluated alternatives are shown in Figure 11. All are economically and technically feasible; the Whitehorse- Stikine link appears the least costly.

The point that must be emphasized is that although all present indicators suggest little need for additional hydroelectric facilities, conditions can change and water resource managers must be prepared for such change. Although this hydroelectric resource may represent value only to future generations, it should not be eliminated unknowingly as a result of short-sighted decisions that preclude future options. This management challenge is further discussed in Chapter IV.

d. Institutional Arrangements

At present, parties concerned with energy planning and decision making include the federal, territorial and provincial governments, Yukon Territory Water Board, Yukon Electrical Public Utilities Board, British Columbia Utilities Commission, public and private utilities in both Yukon and British Columbia, petroleum product distribution companies, public interest groups and consumers. A detailed description of relevant legislation is given in Socio-Economic Report 5a and a discussion of institutional arrangements specifically related to hydroelectric power facilities is given in Socio-Economic Report 5d.

2. Mining

Until recently, mining was the largest non-government contributor to the Basin's economy. In the seventies, buoyant world metal prices increased interest in the Basin's mineral potential. However, by 1982 this trend had reversed and for a period during 1983 no hardrock mines were operating in the Basin. Compounding the situation was the closure of Cassiar Asbestos Corporation's mine near Dawson in 1978 and Whitehorse Copper Mines Limited's property near Whitehorse in 1982. Both mines had reached the end of reserves. Currently, the Basin's mining industry includes the silver-lead mine of United Keno Hill Mines Ltd. at Elsa and over 200 placer mining operations, mainly in the Dawson, Mayo and Atlin areas. Relatively stable gold prices and the ability of placer miners to change the scale of their operations to economic conditions have given some stability to the placer industry. The Cyprus-Anvil lead-zinc mine near Faro is undertaking a government-assisted overburden stripping operation but is not mining ore.

a. Hardrock Mining

The output and value of hardrock mineral production from 1978 to 1982 is given in Table 10.

The potential for further mineral production from the Basin's large mineral reserves is high: about 50 mineral deposits not being mined are known. Of these 50, the nine considered the most favourable are listed and described in Table 11 and shown on Figure 12.

b. Placer Mining

The output and value of placer gold production from 1884 to 1984 is shown in Figure 13.

There are four main placer mining areas in the Basin (Figure 12). The Dawson area is by far

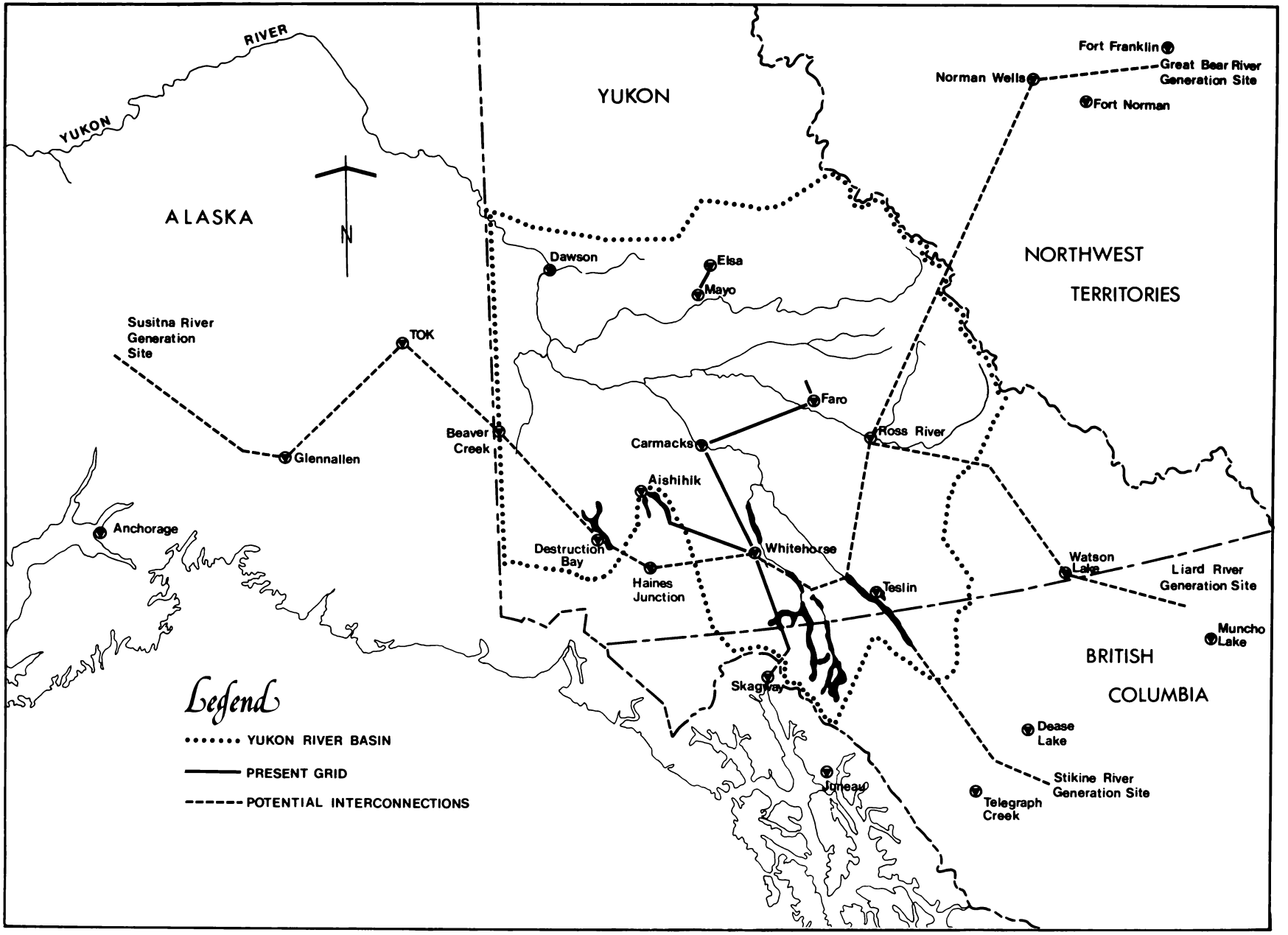
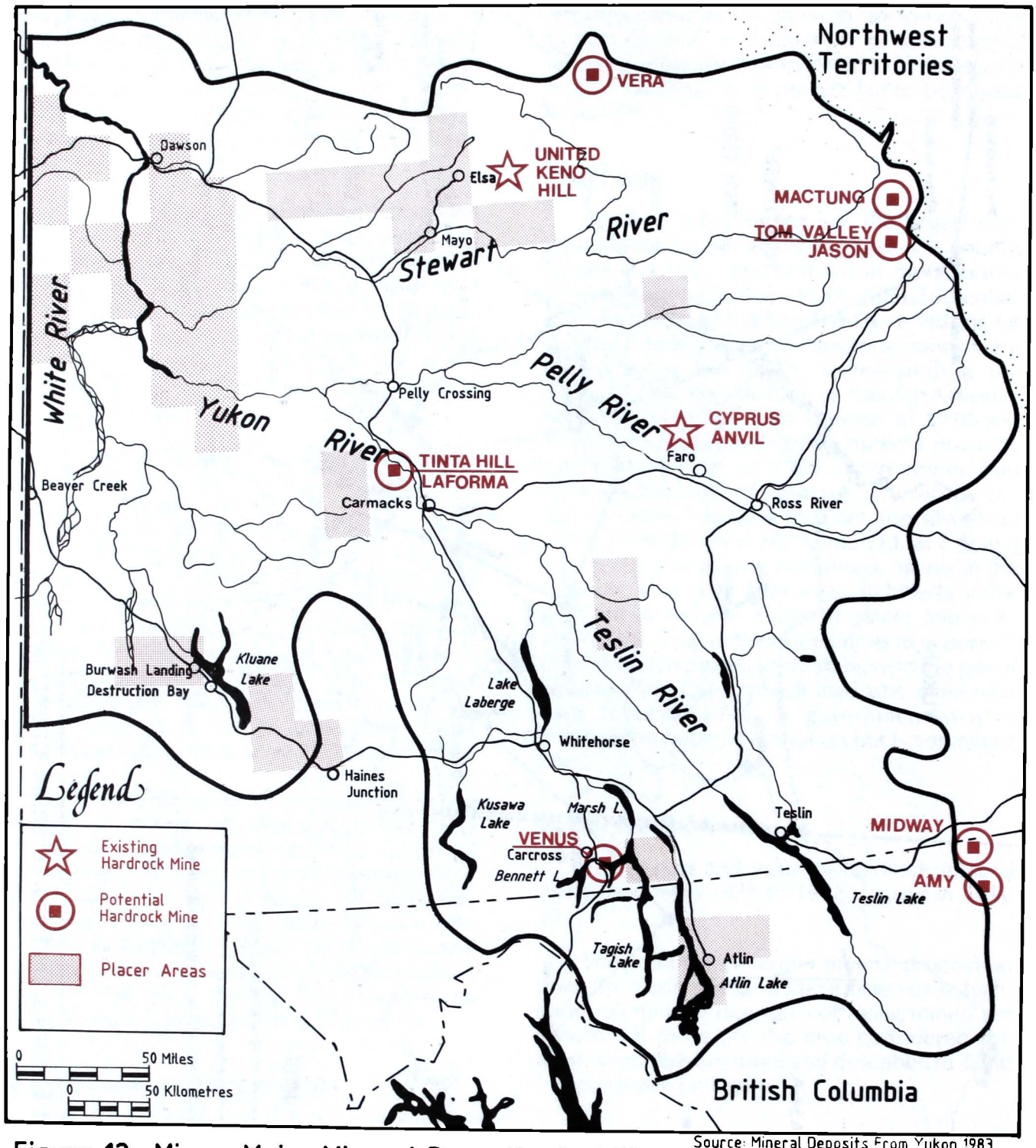


Figure 11: Present Electrical Grid and Potential Interconnections

Source: Energy Report No. 2



Source: Mineral Deposits From Yukon 1983

Figure 12 : Mines, Major Mineral Deposits And Placer Areas

TABLE 10

HARDROCK MINERAL PRODUCTION, 1978-1982

		1978*	1979*	1980*	1981*	1982*
Gold (lode)	$	7,354,000	5,835,000	19,200,000	54,964,000	42,430,000
	grams	1 026 000	523 353	908 550	3 046 000	2 858 000
Silver	$	29,405,000	47,713,000	108,725,000	69,528,000	22,141,000
	grams	148 000 000	125 172 604	137 565 148	172 000 000	70 000 000
Lead	$	65,466,000	104,625,000	76,636,000	50,706,000	25,950,000
	kg	80 643 000	79 744 650	70 154 178	51 651 000	35 838 000
Zinc	$	75,481,000	115,989,000	94,137,000	103,783,000	63,264,000
	kg	98 506 000	120 291 108	97 935 887	86 486 000	58 961 000
Cadmium	$	590	—	—	—	—
	kg	96	—	—	—	—
Copper	$	18,066,000	18,670,000	28,504,000	20,192,000	14,077,000
	kg	11 012 000	7 931 060	10 879 636	9 129 000	7 236 000
Asbestos	$	32,404,000	Clinton Creek	—	—	—
	tonnes	63 000	Mine Closed	—	—	—
Coal	tonnes	26 000	25 356	11 634	28 933	—
TOTAL (excludes coal and placer gold)	$	228,176,590	292,832,000	327,202,000	298,173,000	167,862,000

* Dollar values determined using average metal price during the year, according to Canadian Mining Journal figures

SOURCE: Canada, 1983

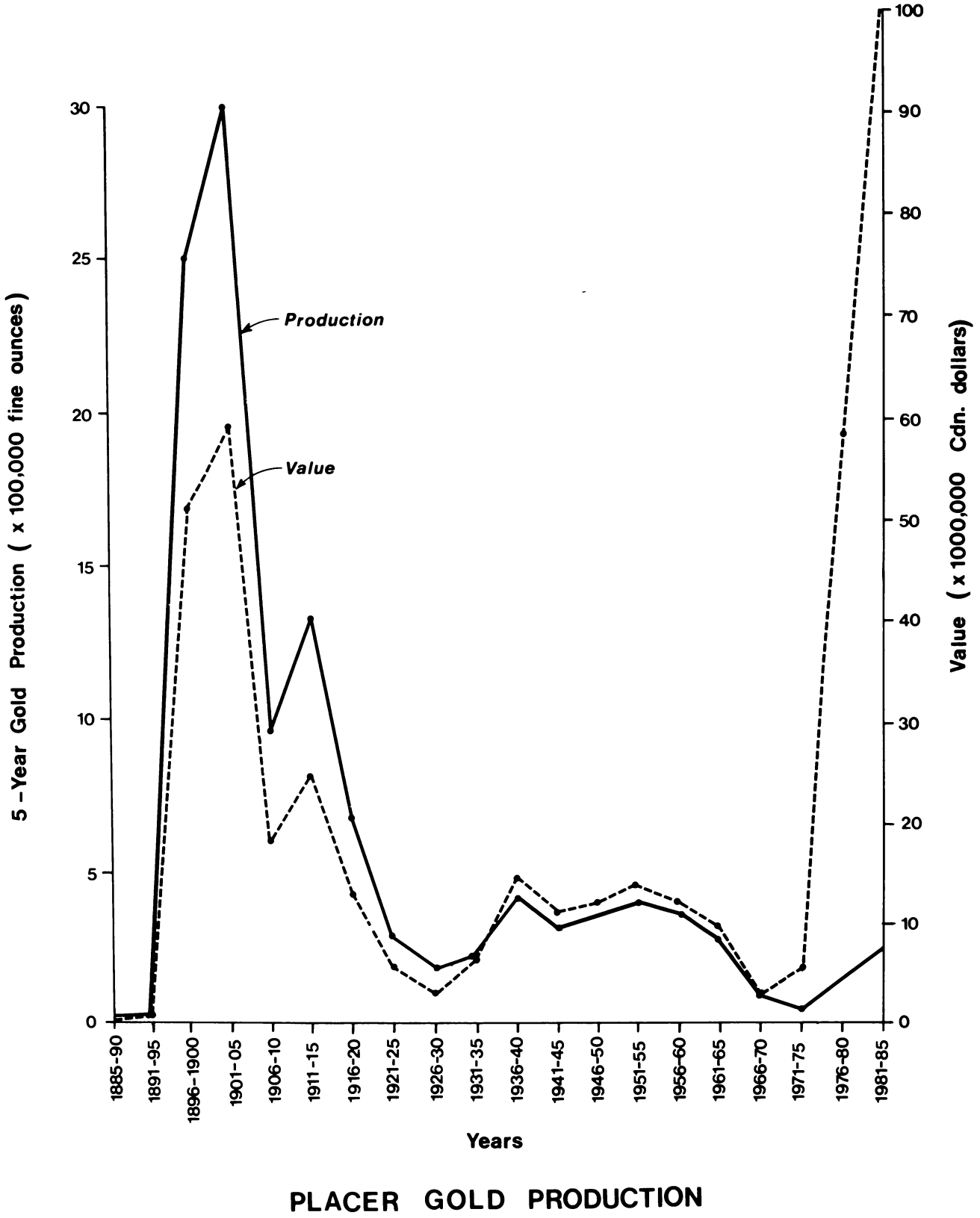
the largest producer, accounting for approximately 80 percent of the gold production between 1978 and 1982. The other areas in descending order of production are Whitehorse, Atlin and Mayo.

c. Institutional Arrangements

Responsibility for all minerals and mineral development within Yukon lies with the federal government and is discharged through DIAND. The **Territorial Lands Act** provides for quarries, oil and gas permits and coal leases, while the **Yukon Quartz Mining Act** and the **Yukon Placer Mining Act** provide for mining leases and mineral rights. In British Columbia the provincial government has given management responsibility for mineral developments to the Ministry of Energy, Mines and Petroleum Resources through the **Mines Act** and the British Columbia **Placer Mining Act.** Relevant mining legislation and regulations are described in Socio-Economic Report No. 5a.

Because of its long history, significance to the economy and potential for affecting the environment (particularly water and related resources), the Yukon placer mining industry has received much attention over the past decade. Most recently, this concern led to the establishment of the Yukon Placer Mining Guidelines Public Review Committee by the Minister of Indian Affairs and Northern Development. Many institutional and water resource management issues are touched upon in its report (Christensen, et al., 1983).

An assessment of the legal and administrative arrangements related to the



PLACER GOLD PRODUCTION

Source: Placer Mining Program Report

Figure13: Placer Gold Production

TABLE 11

MINERAL DEPOSITS WITH HIGHEST POTENTIAL FOR DEVELOPMENT

Project	Commodity	Location	Reserves (Tonnes)	Grade (grams/tonne or %)
1. Venus	gold, silver, lead, zinc	near Carcross	109 000	6.8 g/t gold; 205 g/t silver; 1.9% lead; 1.4% zinc
2. Tinta Hill	gold, silver lead, zinc, copper	near Carmacks	766 000	2.6 g/t gold; 183 g/t silver; 6% zinc; 4.7% lead, 4% copper
3. Laforma	gold	near Carmacks	62 000	15 g/t gold
4. Midway	silver, lead, zinc	in B.C. near Teslin	3 600 000	411 g/t silver; 12% lead; 6% zinc
5. Vera	silver, lead, zinc	near Elsa	864 000	336 g/t silver; 1.8% lead; 1.9% zinc
6. Amy	silver, zinc, lead	in B.C. near Teslin	73 000	366 g/t silver; 6% zinc; 2.8% lead
7. Mactung	tungsten	Macmillan Pass	12 338 000	1% tungsten
8. Tom Valley	lead, zinc, silver	Macmillan Pass	9 616 000	96 g/t silver; 8.4% zinc; 8.6% lead
9. Jason	zinc, lead, silver	Macmillan Pass	10 242 000	86 g/t silver; 7.5% lead, 7.2% zinc

SOURCE:Yukon, 1983

Basin's placer mining industry is contained in Socio-Economic Report No. 5c. Some key topics related to water resource management are described in Chapter IV.

3. Tourism, Parks and Recreation

Basin tourism has experienced steady growth over the last twenty years. With the closure of most of the Basin's hardrock mines in 1982, tourism became the leading non-government economic sector.

The relationship between tourism and water resource management centres on the significance of lakes, rivers and shorelands to the tourism industry. Many historic and cultural features as well as recreational activities are directly linked to water.

a. Tourism

Wilderness and gold rush history are the two major themes which attract most tourists to the Basin. While the focus on gold rush history will continue to be prominent, there is growing interest in Yukon's pristine wilderness. If this trend is realized, careful management of the recreational use of lakes and rivers will be even more essential than it is today.

i. Economic Significance

For 1981, expenditures attributable directly

to tourism included approximately $47 million from non-residents and $4 million from residents (Tourism, Parks and Recreation Report No. 1). Indirect expenditures probably amounted to an additional $15 million. These statistics include the entire Yukon and exclude the British Columbia portion of the Basin; however, most of the Yukon expenditures occurred within the Basin. In 1982, at least 500 businesses derived significant portions of their revenue from direct tourism expenditures (Tourism, Parks and Recreation Report No. 1).

ii. Tourism Characteristics

Basin tourism is highly seasonal, with services and facilities operating to capacity in summer months and often closed down in winter. The number of tourists has increased steadily over the past 20 years, reaching a peak in 1981 of 386,800. Since then a gradual decrease has occurred. Non-resident travellers to and in Yukon comprise about two-thirds of the total and residents comprise one third. Visitors from the United States account for 80 percent of personal vehicle traffic staying one night or more, athough there appears to be a gradual decrease in American visitors and a corresponding increase in Canadian and overseas visitors. While personal vehicles are the preferred travel mode, motorcoach travel is increasing and air travel is decreasing.

iii. Tourism Potential

It is expected that interest in gold rush history and sightseeing in the Basin will continue. However, the most significant shift that appears to be emerging is the increased interest in wilderness adventure travel (Tourism, Parks and Recreation Project Report No. 1). Parallel to this shift is an increased recognition of wilderness as a resource. Most of the growth in wilderness adventure travel is likely to be in water-related recreation, especially river canoeing and rafting.

iv. Institutional Arrangements

Federal government responsibilities for tourism lie with Tourism Canada. For the Government of Yukon, the Department of Tourism Recreation and Culture is responsible and for British Columbia, the Ministry of Tourism is responsible.

b. Parks

Parks Canada, the Government of Yukon, and the Government of British Columbia have classified a number of sites in the Basin as parks and other land designations, such as sanctuaries and reserves (Table 12).

TABLE 12

PARKS AND OTHER LAND DESIGNATIONS

Parks Canada

1. Kluane National Park
2. Chilkoot Trail (Yukon Section)
3. National Historic Sites
   Whitehorse: S.S. Klondike
   Dawson, Bear Creek: various sites

Government of Yukon

1. Kluane Game Sanctuary
2. McArthur Game Sanctuary
3. Territorial Historic Sites
   Whitehorse: several historic buildings
   Dawson: several historic sites
   Carcross: S.S. Tutshi
4. Chadburn Lake Park Reserve
5. Several isolated lots at Fort Selkirk
6. Recreational campgrounds throughout the Basin

Government of British Columbia

1. Chilkoot Trail (B.C. Section)
2. Atlin Provincial Park
3. Charlie Cole Creek - Ecological Reserve #102

SOURCE: Tourism, Parks and Recreation Report No. 1

In addition to the designated lands listed in Table 12, other areas in the Basin have been identified as important by private, public and government groups:

-14 International Biological Program (IBP) sites have been identified by the Conservation of Terrestrial Biological Communities

Subcommittee, Canada's representative to the International Council of Scientific Unions. Of these, one has been established;

-24 Environmentally Significant Areas (ESAs), which include the 14 IBP sites, were identified in a report prepared for the Canadian Arctic Resources Committee, an independent public interest group;

-eight Territorial Park Reserves have been proposed and other areas of biophysical uniqueness have been identified by the Government of Yukon;

-map reserves identifying a number of areas of natural significance in the British Columbia portion of the Basin have been established by the Government of British Columbia;

-Kluane-Aishihik, Southern Ogilive Mountains and Keele Peak have been identified as natural and preliminary areas of Canadian significance by Parks Canada;

-a variety of land designations for areas adjacent to the Yukon River were identified in a joint study undertaken by Environment Canada, Parks Canada and Government of Yukon;

-several heritage (historical and archaeological) sites have been identified, especially along the Yukon River.

(Tourism, Parks and Recreation Report No.1).

Many of the potential designations overlap, and with the exception of the British Columbia map reserves, none enjoy any status in law.

In late 1983, the federal Minister of Indian Affairs and Northern Development established a Task Force on Northern Conservation to develop and recommend policy guidelines for conservation in general and the designation of special conservation areas in particular. The work of this task force was not available to the Yukon River Basin Study, but when completed, will provide a first step for the protection of some of these potential designated areas.

The Northern Affairs Program of DIAND, in cooperation with the Council of Yukon Indians and Government of Yukon, has committed itself to comprehensive land planning. This initiative may serve as a catalyst in untangling the maze of existing and potential land and water area designations in the Basin. This issue, as it relates to water management, is further discussed in Chapter IV.

i. Institutional Arrangements

The establishment and management of parks and other land designations within the Basin are divided between federal, territorial and provincial jurisdictions. Within the British Columbia portion of the Basin, the Government of British Columbia has the mandate for establishing parks and other reserves. This is done under the authority of several acts, including the **Park Act, Wildlife Act** and **Ecological Reserve Act.**

In 1979, the Government of Yukon passed the **Parks Act** establishing its mandate for creating a comprehensive park system in Yukon. Parks planning is now being pursued according to the guidelines in the Act; however, a formal, comprehensive parks policy has yet to be adopted. In addition, land for the purposes of Territorial parks must still be acquired from the federal government.

Parks Canada is responsible for the management of Kluane National Park and several historic sites and features in Dawson and Whitehorse. The **Territorial Lands Act,** administered by DIAND is the enabling legislation under which parks and other land designations are established.

c. Heritage Resources

The Basin's heritage resources are a significant component of northern culture for both native and non-native residents and also play a major role in attracting and holding tourists. Until recently the Klondike Gold Rush has dominated heritage concerns. However, there is now a shift to establish a more balanced representation with greater recognition of archaeological and pre-European contact features and more emphasis on history from before and after the Gold Rush.

Because most historic and archaeological sites are close to waterways, heritage resources are a significant factor to be considered in water resource management. Various government and private agencies and the Council for Yukon Indians have expressed concern that available information is not adequate for effective management decisions: most identified sites are large, often with visible structures or features that lend themselves to tourism marketing. Many

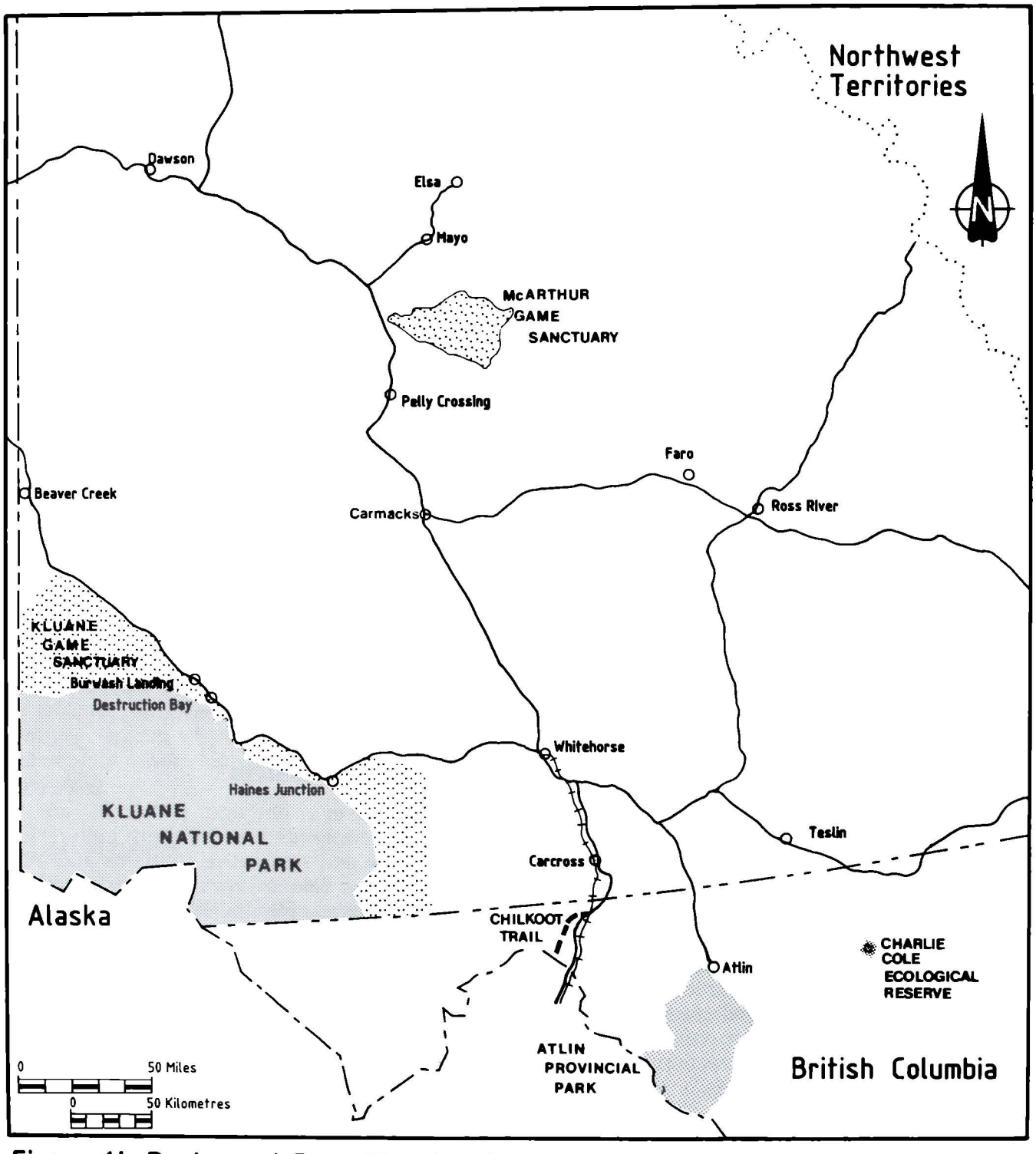


Figure 14: Parks and Game Sanctuaries

smaller but significant sites remain to be inventoried and assessed.

i. Institutional Arrangements

Federal responsibility for heritage resources rests mainly with the Archaeological Survey of Canada, part of the National Museum of Man under Communications Canada. Parks Canada (Department of the Environment) is responsible for a number of National Historical Sites.

Within Yukon, the Heritage Branch of the Department of Tourism, Recreation and Culture is mainly responsible for heritage resources although the Department of Renewable Resources has been given the mandate for restoration of a number of heritage sites.

In the British Columbia portion of the Basin, the Heritage Conservation Branch under the Provincial Secretary and Government Services Department is responsible for heritage resources. The Parks Branch of the Ministry of Lands, Parks and Housing also has responsibility for some designated historic sites.

d. Recreation

Sport fishing, boating, camping, cottage vacations and wildlife-related activities (eg., hunting, photography) are the most popular recreational pursuits in the Basin.

The degree of access to lakes and rivers is the main factor influencing people's use of specific areas of the Basin. For example, recreational use is high for the entire mainstem Yukon River from Carmacks to Alaska because of easy access, while recreational use is limited in much of the White River sub-basin because of difficult access.

i. Water-Related Recreational Activities

Sport fishing is a major Basin recreational activity. A 1977 survey of Yukon outdoor recreational activity showed 70 percent of Yukon residents fish at some time during the year.

Both flat-water and moving-water canoeing are popular in the Basin. Canoe sales are now greater than powerboat sales at local outlets (Tourism, Parks and Recreation Report No. 2). Flat water canoeing is most common on smaller lakes near communities. Moving-water canoeing, kayaking and rafting occur on a variety of rivers requiring different degrees of paddling skills. Use of any particular river depends on the experience sought, paddling skill required and access.

Powerboating generally occurs in association with either fishing or hunting. Because powerboating is limited by water depth, navigability and access, most powerboat use is on the Yukon mainstem, Teslin, Pelly and Stewart Rivers, and major lakes such as Marsh, Tagish, Atlin, Laberge, Teslin and Kusawa. A small number of sailboats are used in the Basin mainly on Atlin and Marsh Lakes.

Camping and cottaging are both land-based activities closely tied to the water resource. Camping occurs throughout the Basin on an ad hoc basis as well as in government and privately operated campgrounds. Nearly all campgrounds in the Basin are located near rivers or lakes. Recreational cottaging and related water-based recreational activities constitute a popular and important use of water and shoreland in the Basin. Apart from skiing and hunting, most activities associated with cottaging are water-based. Most cottages to date have been constructed in planned subdivisions on the large accessible lakes in the Upper Yukon Basin and are within easy access of Whitehorse. Due to a lack of suitable areas, continuation of this trend is unlikely and future cottaging will probably be geared to smaller, lower-serviced developments on lakes further away from Whitehorse (Tourism, Parks and Recreation Report No. 1).

The significance of wildlife-related recreational activities to the water resource lies in the use of water for transportation and access. Hunting, viewing, photographing and otherwise experiencing the wildlife very often depends on lake and river access.

ii.Institutional Arrangements

Several federal, territorial and provincial government departments have jurisdiction over matters pertaining to recreation. For the federal government, they include the Department of Indian Affairs and Northern Development, Department of Public Works, Parks Canada, Tourism Canada, Department of Fisheries and Oceans and Environment Canada. For the Yukon

government, they include Tourism, Heritage and Cultural Resources; Renewable Resources; Municipal and Community Affairs; Highways and Transportation; and, Economic Development. In British Columbia, a similar network of government agencies is involved in recreation management. Additionally, native Indian organizations, public interest groups and municipal agencies also play important roles.

4. Fisheries

Four distinct fisheries exist within the Yukon River Basin. In order of economic importance, they are: sport, Indian food, commercial and domestic.

a. Sport Fishery

The sport fishery takes place on both lakes and rivers, but it is apparent from survey results that Yukon residents, who catch the majority of fish, clearly prefer lakes (Paish, 1981). Although 15 species are taken in the Yukon sport fishery, the primary target species are Arctic grayling, lake trout and northern pike. In terms of weight, lake trout catches are by far the most significant, at 80 percent of the total landings. A limited sport fishery for salmon (primarily chinook) has developed in the Yukon River mainstem and a number of tributaries. Although present salmon catches represent only about two or three percent of the total number of landings in the sport fishery, the demand is increasing.

Sport fishing licence sales, which averaged 12,900 during the period from 1973 to 1977, have increased in recent years to an average of 16,200 from 1978 to 1982. Yukon residents hold more than half of all licences sold (Fisheries Program Report).

In an effort to enhance sport fishery opportunities in Yukon, the Department of Fisheries and Oceans initiated a lake stocking program in 1961. To date, approximately 500,000 fry, primarily rainbow trout and some coho salmon, have been released in Yukon pothole lakes. Most of these lakes are situated in the Yukon River Basin (Canada, 1983). Although limited catch data are available, it appears as though stocked fish account for approximately three percent by number of the total angler harvest in Yukon.

Although the majority of sport fishing activity is concentrated on lakes and streams that are accessible by road, a growing number of remote lakes are experiencing increased fishing pressure due to fly-in sport fishing operations. These operations, which are an important adjunct to the tourist industry in Yukon, can potentially deplete fish stocks (especially lake trout) in lakes with low productive capacity. At present, regulations are being developed by the Department of Fisheries and Oceans to manage these lakes for sustainable yield.

There are three economic elements to the sport fishery:
i. consumer surplus value, which is a measure of satisfaction or feeling of well-being that an angler experiences from fishing. Based on a value of $20 per day, Canadian sport anglers, in 1980, spent an estimated 104,000 days fishing in the Basin, representing a consumer surplus value of $2.08 million;
ii. expenditures by non-resident anglers. In 1980, 9,829 non-Yukoners fished in the Territory and spent approximately $2.8 million; and,
iii.expenditures by Yukon residents. These expenditures act to recycle wages and salaries through the Yukon economy. This money might be spent in southern Canada or elsewhere if the angling opportunity did not exist.

b. Indian Food Fishery

The Indian food or subsistence fishery is the continuation of the traditional dependence of the native people on the fish resources in Yukon. The Department of Fisheries and Oceans gives this fishery priority over other fisheries. A permit system authorizes Indians to take fish for food, with rights applying to both freshwater and anadromous stocks. During 1981-82, some 204 native food fish licences or certificates were issued. This figure dropped to 135 during the 1982-83 period.

Table 13 summarizes catches of chinook and chum in the Yukon Basin over the past decade. The average annual Indian food fish harvest from 1972 to 1983 was 38 502 kg of chinook and 17 897 kg of chum, for a total value of $296,465 and $22,371 respectively. Since no specific information concerning fishing effort is available, it is difficult to accurately interpret present and future trends in the Indian salmon fishery.

TABLE 13
SALMON CATCHES IN THE BASIN, 1972-1983

Year	CHINOOK Commercial	CHINOOK Domestic	CHINOOK Indian Food Fishery	CHINOOK Total
1972	1,769		3,960	5,729
1973	2,199		2,099	4,298
1974	5,503	406	3,364	9,273
1975	3,000	400	2,600	6,000
1976	3,500	500	1,025	5,025
1977	4,720	531	2,247	7,498
1978	2,975	421	2,485	5,881
1979	6,175	1,200	3,000	10,375
1980	9,500	3,500	10,000	23,000
1981	8,593	237	8,129	16,959
1982	8,640	435	7,333	16,408
1983	13,027	400	4,800	18,227

Year	CHUM Commercial	CHUM Domestic	CHUM Indian Food Fishery	CHUM Total
1972	2,532		5,000	7,532
1973	2,806		1,129	3,935
1974	4,646	466	8,636	13,748
1975	2,500	4,600	13,500	20,600
1976	1,000	1,000	3,200	5,200
1977	3,990	1,499	6,990	12,479
1978	3,356	728	5,482	9,566
1979	9,084	2,000	11,000	22,084
1980	9,000	4,000	3,000	16,000
1981	15,260	1,611	5,110	21,981
1982	11,312	683	3,696	15,691
1983	25,990	300	800	27,090

SOURCE: Fisheries Program Report

The major salmon fishing sites occur along the Yukon mainstem in the vicinity of Carmacks and Minto, in the Pelly River near Pelly Crossing and Ross River, in the Teslin River near Johnson's Crossing and the townsite of Teslin, and near Mayo in the Stewart River.

Specific information pertaining to traditional freshwater fishing sites and catch levels is extremely limited. Isolated reports indicate that catches are dominated by lake trout and whitefish, and harvests may be up to three times the number of salmon landings. The Council for Yukon Indians and the federal government negotiated "An Agreement-in-Principle With Respect to Fishing in Yukon" in 1981 which provided for the preparation of a mutually agreeable fisheries policy. To date, negotiations have not been completed.

c. Commercial Fisheries

Both anadromous and freshwater species are taken in the Basin's commercial fisheries. A commercial fishery for chinook and chum has existed in the Basin in the vicinity of Dawson since 1903 (Fisheries Report No. 5a and 5b). Approximately 30 of the 43 commercial licences issued for salmon fishing are for sites in the Dawson area. Other salmon fishing sites are widely distributed along the Yukon River between Tatchun Creek and the Yukon/Alaska border, and on the lower reaches of the Pelly River. Table 13 summarizes commercial salmon catches over the past decade in the Canadian portion of the Basin. Since 1980 when the fish processing facility at Dawson was established, there has been a 43 percent increase in licence sales, a 230 percent increase in the commercial chinook catch and a 460 percent jump in the commercial chum catch. This was a result of the new market potential and storage capability that the facility brought to the area.

The issuance of commercial fishing licences for freshwater species has been limited to 20 designated lakes. Target species in the freshwater commercial fishery include primarly lake trout and several species of whitefish. Table 14 provides a summary of commercial licence sales and fish catches by weight for the period 1972 to 1982.

Management of the commercial freshwater fishery is based on a quota system established for each of the 20 designated lakes by utilizing a somewhat arbitrary production estimate of approximately 0.2 kilograms per hectare per year. Former quotas for the 20 designated lakes were set at 33 000 kilograms each for lake trout and whitefish species; these quotas far exceeded landings. The lake trout quota was lowered in 1984 to 18 840 kilograms. It is not yet known if 1984 landings approached the new quota.

For the most recent five-year period, the commercial salmon fishery is valued at approximately $565,000 (chinook, $456,000; chum, $109,000), and the commercial freshwater fishery at $21,000 for a total of $586,000. It has been estimated that the commercial fisheries provide employment for 150 to 170 people, either directly or in associated activities.

d. Domestic Fishery

Domestic fishing licences are issued annually and authorize non-Indian Yukon residents to take fish for their own or their family's consumption. These licences specify the location of fishing, the species to be taken, and the duration and method of fishing authorized. At present, there are 20 domestic salmon fishing licences issued.

A summary of licence sales for the domestic freshwater fishery is provided, along with lake trout and whitefish species catch statistics for the period 1972 to 1982, in Table 14. The domestic salmon fishery is valued at approximately $32,000 (chinook, $28,000; chum, $4,000) and the domestic freshwater fishery at approximately $2,800.

e. Opportunities for Growth

i. Salmon Stocks

There is little doubt that salmon production and spawning escapements in the Basin could be improved substantially. An impediment blocking such an improvement is the lack of an international treaty with respect to sharing of the Yukon River salmon resources.

Despite this growth potential, the economic feasibility of developing a large-scale salmon fishery, particularly in the commercial sector, appears limited because of high transportation costs to major foreign markets and a small local market.

ii. Freshwater Stocks

The opportunities for growth in the Indian food fishery are set out clearly in the "Agreement in Principle with Respect to Fishing in Yukon" as part of the land claims negotiations.

The potential for growth in the Yukon sport fishery appears high, with large numbers of lakes currently receiving minimal exploitation. However, it must be stressed that due to relatively low fish production throughout the Basin, careful monitoring of catches is necessary in order to ensure that harvest levels do not exceed individual lake production capabilities. Overfishing is now common along some highways.

TABLE 14

SUMMARY OF COMMERCIAL AND DOMESTIC LAKE TROUT AND WHITEFISH CATCHES BY WEIGHT, 1972-82

Year	Licences Issued		Lake Trout (kg)			Whitefish (kg)			Total Catch (kg)		
	Commercial	Domestic	Commercial	Domestic	Total	Commercial	Domestic	Total	Commercial	Domestic	Total
1972-73	56	*	3 897	*	3 897	3 914	*	3 914	7 811	*	7 811
1973-74	81	*	4 550	*	4 550	5 978	*	5 978	10 528	*	10 528
1974-75	74	42	4 048	175	4 223	5 372	1 419	6 791	9 420	1 594	11 014
1975-76	88	69	3 749	232	3 981	3 658	1 322	4 980	7 407	1 554	8 961
1976-77	81	71	4 197	176	4 373	3 501	1 677	5 178	7 698	1 853	9 551
1977-78	86	75	4 138	413	4 551	4 407	1 651	6 058	8 545	2 064	10 609
1978-79	90	116	2 015	964	2 979	4 304	1 689	5 993	6 315	2 653	8 968
1979-80	108	95	3 503	180	3 683	6 012	577	6 589	9 515	757	10 272
1980-81	119	93	2 774	42	2 816	4 570	861	5 431	7 344	903	8 247
1981-82	132	166	3 454	470	3 924	3 970	1 397	5 267	7 324	1 867	9 191
1982-83	156	159	5 102	442	5 544	6 849	1 784	8 633	11 951	2 226	14 177
Mean	97	98	3 766	344*	4 815	4 767	1 375	**5 892	8 533	1 719	9 939

* domestic permits not issued prior to 1974-75
**9-year average

NOTE: Approximate catches in numbers of fish can be derived by dividing the lake trout and whitefish catches by 1.5 kg and 1 kg respectively, which represent the average weights of these species.

SOURCE: Fisheries Program Report

Another area in which growth potential exists is that of aquaculture, or stocking of pothole lakes. The stocking program currently in place has been very successful in terms of providing alternate fishing stocks and locations for various communities. Other enhancement possibilities do exist, such as the artificial propagation of lake trout and grayling. However, before undertaking such measures, a better understanding of the natural limitations on the productivity of these species is needed.

Expansion in the commercial net fishery is currently limited by transportation and marketing. This is reflected in the small portion of the total allowable harvest that is currently being taken (less than 20 percent). Given an increasing concern for the protection of lake trout stocks, it is doubtful that any growth can occur in the harvest of this species. Growth potential appears greater with respect to exploiting other game species such as whitefish and burbot. Nevertheless, because of the characteristic unproductive nature of the Basin's lakes and rivers and slow growth rates of many northern species, it is unlikely that a commercial non-salmon fishery dependent upon native stocks will ever achieve major status.

f. Institutional Arrangements

In the British Columbia portion of the Basin, the provincial government has the responsibility for the management, protection and restoration of all freshwater species, while the federal government retains the responsibility for the salmon fisheries. In the Yukon portion of the Basin, the federal Department of Fisheries and Oceans is responsible for managing all Yukon fisheries, although the Yukon territorial government sells sport fishing licences and shares stock management enforcement responsibilities with the federal government.

5. Wildlife

Human uses and opportunities based on the wildlife resource include consumptive activities, such as hunting and trapping, and non-consumptive activities, such as photographing and viewing. These activities can also be categorized as being associated with subsistence living, sport and recreation or commercial activities.

a. Hunting

Resident and non-resident hunting licence and harvest statistics are given in Tables 15 and 16. These statistics apply to Yukon as a whole but are almost entirely generated within the Basin. Equivalent statistics for the British Columbia portion of the Basin have been collected only at a regional scale and include significant areas outside the Basin. As a result, available British Columbia statistics are not useful to a Basin analysis. No Yukon statistics are available for the post 1980-81 period.

Approximately 5,500 hunting licences are granted annually, the majority of which are Resident Big Game Licences that authorize the hunting of big game, small game and game birds. Roughly 60 percent of the big game species taken

TABLE 15

HUNTING LICENCES ISSUED IN YUKON BETWEEN 1974 AND 1980

Licence Category*	Hunting Licences Issued by Licencing Year**						
	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
Resident Big Game***	3472	3465	3498	3458	3894	3608	3579
Resident over 65 Big Game	146	283	311	412	110	142	135
Indian or Eskimo Big Game					291	496	411
Resident Trapper Big Game****	99	144	143	131	115	116	116
Resident Indian Trapper Big Game****	333	374	375	522	374	206	217
Duplicate Big Game	11	32	44	22	40	36	33
Non-Resident Canadian Big Game	42	35	29	23	42	28	23
Non-Resident Alien Big Game	421	351	307	401	430	443	381
Non-Resident Special Big Game	N/A	N/A	N/A	N/A	N/A	N/A	13
Resident Small Game*****	76	75	152	185	220	304	227
Resident Over 65 Small Game	0	0	2	1	2	1	3
Non-Resident Small Game	40	57	80	86	148	129	250
Non-Resident Small Game (valid licence)	N/A	N/A	N/A	N/A	N/A	46	62
Duplicate Small Game	0	0	0	0	0	5	0
TOTAL	4640	4816	4941	5241	5666	5560	5500

* Licence categories vary between years. Data are summarized by categories now in use.

** Licence year was July 1 to June 30 for 1974-75 through 1978-79. The licence year is now April 1 - March 31.

*** Big game licences authorize the hunting of big game, small game and game birds.

**** In 1979-80 General Hunting Licences which authorized trappers to hunt and trap were replaced by separate licences for each activity.

***** Small game licences now authorize the hunting of both small game and game birds. In some years game bird licences only authorized the hunting of game birds.

SOURCE: Yukon, 1984

are moose; caribou and sheep together comprise 35 percent. Small takes of grizzly, black bear and mountain goat constitute the remainder. No statistics are available on the the annual sport harvest of waterfowl nor on the level of subsistence hunting activity. This data gap is a source of great difficulty in effecting adequate wildlife management. The 1981 "Agreement in Principle with Respect to Indian Harvesting Rights and Management of Wildlife Resources in Yukon" offers an opportunity to resolve this problem. However, at the present time, it is not possible to estimate the amount of additional hunting pressure that could be supported by the Basin's wildlife.

b. Trapping

There are 350 to 400 trappers in the Basin and approximately 300 trapping concessions. The annual value of the fur harvest in 1982 exceeded $1 million. Lynx contributed 82 percent of this total, followed by marten (8 percent), fox (4 percent), wolverine, mink and squirrel (1 percent each).

With the exception of marten, all furbearing species are believed to be healthy within the context of available habitat and natural population swings. Marten are rare in the southern Yukon between Kluane Lake and Teslin Lake. This is believed to have been caused by a

TABLE 16

BIG GAME HARVESTS BY RESIDENT AND NON-RESIDENT HUNTERS IN YUKON BETWEEN 1974 AND 1980

res = by resident hunters non = by non-resident hunters tot = total by all hunters and N/A = not available

	Big Game Harvest* by Hunting Season																				
	1974-75			1975-76			1976-77			1977-78			1979-80			1978-79			1980-81		
Species	res	non	tot	res	non	tot	res	non	tot	res	non	tot	res	non	tot	res	non	tot	res	non	tot
Mountain Sheep	59	235	294	53	192	245	50	197	247	76	199	375	91	233	324	73	213	286	58	184	242
Moose	1160	189	1349	870	150	1020	960	142	1102	1020	177	1197	740	196	936	930	177	1107	856	153	1009
Grizzly Bear	24	86	110	10	75	85	17	63	80	25	71	96	19	71	90	32	52	84	22	245	67
Caribou	340	173	513	240	140	380	430	130	560	210	160	370	155	186	341	420	161	581	249	146	395
Mountain Goat	10	20	30	8	16	24	7	8	15	10	23	33	5	12	17	7	11	18	5	8	13
Black Bear	71	8	79	35	8	43	60	16	76	100	12	112	50	10	60	16	20	36	58	15	73
Wolf	N/A	39	—	N/A	33	—	N/A	19	—	N/A	28	—	N/A	30	—	N/A	24	—	N/A	19	—
Wolverine	N/A	10	—	N/A	9	—	N/A	11	—	N/A	6	—	N/A	11	—	N/A	11	—	N/A	8	—
Coyote	N/A	0	—	N/A	0	—	N/A	0	—	N/A	0	—	N/A	0	—	N/A	0	—	N/A	0	—

* Harvest totals do not include harvests by trappers or status natives

SOURCE: Yukon, 1984

combination of overharvesting and fires (in 1958) and sustained by trapping pressures. No assessment has been made of the possibilities for increased trapping activities.

c. Guiding

There are 17 active guide outfitting businesses in the Yukon portion of the Basin and an additional six in the British Columbia portion. Most guide outfitters concentrate on big game trophy hunting, although a few offer wilderness adventure trips.

The level of use of lakes and rivers by guide outfitters during hunts has not been assessed. However, nearly all offer sport fishing as part of their hunts, and most base and outcamps are located on lakes and rivers for access and aesthetic reasons.

In 1980, guide outfitters in the Yukon employed about 165 people and earned approximately $2.5 million in direct revenue from the 405 tourists who purchased hunts (Thorne, Stevenson and Kellogg, 1982). Additional expenditures before and after hunts have been estimated at approximately $1.5 million.

d. Non-Consumptive Activities and Values

Viewing, photographing or otherwise experiencing the Basin's wildlife without consuming any species or its habitat is an increasingly important aspect of the Basin's tourism industry, although difficult to quantify. Further, the importance of wildlife to the lifestyle and culture of those practising subsistence living is also difficult to quantify, as is the significance of the Basin's wildlife to non-residents concerned about conservation of the world's limited wildlife reserves.

The potential for increases in the non-consumptive uses of wildlife appears large and recent trends in activities within the Basin suggest significant growth (Tourism, Parks and Recreation Report No.1). The significance of this trend to water resource management centres on increased recreational use of lakes and rivers. This topic is further discussed in Chapter IV.

e. Institutional Arrangements

The management of the wildlife resource including big game, furbearers and resident birds in the Yukon and British Columbia is the responsibility of the Wildlife Management Branch, Yukon Department of Renewable Resources and the British Columbia Fish and Wildlife Branch, respectively. Migratory birds are the responsibility of the Canadian Wildlife Service.

CHAPTER IV
CHALLENGES TO MANAGEMENT

The concept of managing for the conservation, or wise use, of water was introduced in Chapter I; subsequent chapters described the Basin's water and related resources and their present and potential uses. Although the Basin's existing water uses have not yet resulted in serious conflicts from a Basin management perspective, many of the Basin's potential developments could compete for use of the water. Achieving the best allocation of this resource among all users is the challenge which will face water and related resource management agencies in the Basin. In many cases, managers will be called on to choose between competing uses or to make compromises among several potential users. In this chapter, the principle of water conservation is presented in more detail and its potential to help resolve some key concerns relating to competing uses is discussed.

A. CONSERVATION AS A PRINCIPLE FOR WATER MANAGEMENT

Conservation is an important principle underlying sound water management. In the context of this report, conservation means the wise use of water and related resources and the management of renewable resources on a sustainable yield basis. Under this concept, the water resource can be used to advance both economic and social goals.

There are three basic criteria which must be adhered to in order to achieve conservation. First, a regional as well as a site-specific perspective is essential to wisely evaluate any resource development option. In specific instances, decisions may be appropriate that support one use at the expense of another. This could mean support for a development option at the expense of natural recreational resources or vice versa. Wise use of the water resource does not imply every use in every area. Rather, it recognizes that in some areas multiple uses are compatible and in other areas single resource uses are appropriate, provided that in the regional context an overall balance is maintained.

Second, developments that result in irreversible changes to natural systems should be avoided where such changes occur on a significantly large geographical scale or are not well understood. Any shortsighted elimination of future options could lead to severe difficulties for future generations.

And third, social and community interests that reflect the broad spectrum of public values must be explicitly considered in the decision-making process. Economic and ecological values are not by themselves adequate to make water management decisions. Mechanisms for incorporating public values in water management decisions should be encouraged.

The Basin represents a good opportunity to use the principle of conservation in water resource management. To date, the Basin's vast land, water and biological resources have not been significantly affected by development decisions. There is a growing body of data and information for sound decision-making. Further, the institutions necessary to enable a conservation approach to water management already exist.

The Study has initiated a process of convergence towards this overall goal. For the first time, the opportunity has been provided for many of the key players to jointly address water and related resource issues. This initiation of cooperative discussions may in fact be one of the most significant legacies of the Study. In time, this could lead towards development of integrated information systems to support joint management processes, both oriented towards wise use of the Basin's water resource.

Although recently there has been little increase in water use in the Basin, this lull should be considered only as a convenient breathing space during which appropriate preparations can be made to improve management and decision-making processes. Continued problems with placer mining controls, regulation of sport and commercial fishing, water and land management coordination, hydroelectric developments and headwater lakes regulation affecting both Yukon

and British Columbia, increased recreation, proposals to designate sections of the mainstem Yukon under heritage status and settlement of native land claims, all point to the necessity to continue development of a framework for water resource planning.

B. SPECIFIC MANAGEMENT ISSUES

During the course of the Study, a number of present and future management concerns were identified. The issues of most importance to water management are discussed in the following paragraphs.

1. Hydroelectric Development and Water Resource Management

The water resource of the Basin has a potential hydroelectric installed capacity of about 7 900 megawatts, based on existing studies. Over 70 percent of this potential is on the Yukon mainstem. Existing hydroelectric facilities in the Basin can generate about 77 megawatts, less than one percent of the total potential. Current growth forecasts indicate a maximum additional requirement of 75 megawatts by the year 2003—still less than two percent of the identified potential. This additional power requirement will most likely be produced from small- to medium-sized developments close to the demand source, such as mines or communities.

The Study has provided some useful information to evaluate the effects of hydroelectric project proposals on water and related resources. For example, the daily flow model was used to simulate the effects of potential flow regulation by the High Granite Canyon, Hoole Canyon, Ross Canyon and Mid-Yukon Phases I and II proposals. These simulations can be used to estimate changes in wetted area and the consequent effects on vegetation. Information from the fisheries studies on the distribution and abundance of fish, spawning habitat, lake productivity and commercial and sport values can be used in a general manner to predict impacts and help focus on site-specific evaluations. Similarly, data obtained on the fall staging of waterfowl in the Nisutlin delta have improved basic understanding of how the area is used by waterfowl on a seasonal basis and of the linkage between this use and lake levels. This information will be of particular significance in relation to reservoirs which are regulated between the historic high and low range of lake elevations. The studies into freeze-up and break-up of the Yukon River improve understanding of the process of ice formation and provide some insights as to the effects that changes in flows due to storages would create.

Additional site-specific analysis would obviously be required for any given project. Some emphasis should be given to further evaluations of headwater storage especially on Atlin Lake, since its regulation has already been proposed by the Northern Canada Power Commission (NCPC). The daily flow model needs to be refined to improve the evaluation of downstream effects and of the water level relationships between these lakes. Additional limnological studies may be required to determine the effects of regulation on biological productivity. Floodplain mapping and designation is also required to ensure settlement does not occur at or below the historic high-water marks, both to avoid flood damages and to maintain the option for regulation of these lakes. Similarly, the design of recreational developments, such as marinas, boat ramps and moorages, should be undertaken with care and forethought regarding the possiblity of regulation.

The effects the Basin's existing hydroelectric projects have had on water and its related resources should be evaluated to improve knowledge and understanding for future developments. These existing projects are small in scale and similar to the types of development that may be required in the future. In particular, the implications of these projects on ice formation, recreational use and fish habitat should be evaluated.

Earlier studies identifying the hydroelectric potential of the Basin considered major multi-project development plans; these included large-scale projects such as Boundary Dam (1 006 megawatts), Ogilvie Dam (897 megawatts) and headwater diversions to tidewater. The prospects of this scale of multiple development ever being required appear remote. Further, these development plans were based on single purpose use of the water resource and it would be difficult to design such projects in a manner

that would be compatible with the principle of conservation. Although the concept of developing the entire Yukon mainstem for hydroelectric must remain an option due to its potential long-term value, it should not be a priority to undertake further engineering or environmental studies at this time.

In Chapter III, parties concerned with hydroelectric energy planning and decision-making in the Basin were identified. These include the federal, territorial and provincial governments, Yukon Territory Water Board, Yukon Electrical Public Utilities Board, British Columbia Utilities Commission, public and private utilities, petroleum product distribution companies, public interest groups and consumers. No single agency holds responsibility for coordinating the variety of interests and concerns represented by these various groups. The result is an absence of coordinated energy planning in the Basin (Socio-Economic Project Report No. 5d). Development of the hydroelectric potential of the headwater lakes, or use of these lakes for storage, will have transboundary effects and jurisdictional implications for British Columbia, Canada and Yukon. Therefore, intergovernmental coordination of energy planning and management for the Basin is essential for effective water management. Factors such as energy conservation, shifts to or from hydroelectricity in relation to other energy sources, the possibility of electrical interconnection and emphasis on internal or export use could have significant effects on the Basin's future hydroelectric requirements.

2. Outdoor Recreation and Water Resource Management

The recreational use of the Basin's lakes, streams and rivers has very important economic and social value. Already, water-based recreation plays a major role in the tourist industry and is expected to increase as tourism and resident recreation demands continue to grow. Elements needed for effective recreation and water resource management in the Basin include a detailed inventory of recreational capability, coordinated recreational planning, management of the sport fishery, management of access development and protection of wilderness areas (Tourism, Parks and Recreation Program Report).

a. Recreational Capability

Since water-related recreation is important to the Basin's economy and its residents, an evaluation of the capability of the Basin's lakes and rivers to support recreational use is a prerequisite to water management planning.

A preliminary inventory of existing recreational use of the Basin's rivers and lakes was undertaken for the Study (Tourism, Parks and Recreation Report No. 2). This review illustrated the need for more information on the natural attributes and limitations of the Basin's waterways and adjacent land resources. This information, if available, would provide the basis for recreation planning and an understanding of future recreational opportunities.

b. Coordinated Recreation Planning

There are at least 16 government agencies as well as many communities, native Indian organizations, and public interest groups concerned with recreation management in the Basin. The need for coordination of recreation planning among these interests has been highlighted now that tourism, with its significant recreational component, has become a major sector of the Basin's economy. The cooperative development of a recreation plan would provide positive support to sound water resource management in the Basin.

c. Recreation and Resource Roads

Roads built to link development projects, such as mines or pipelines, with the existing transportation network can have considerable impact on the recreational use of an area. Generally, construction of access roads has been motivated by developments with little awareness or concern for the resulting recreation opportunities that the road creates. In view of the effects access roads may have on water and related resources, recreation opportunities should be considered during road design. This could include an assessment of the additional recreational pressures created by a road and its resulting impacts on water, wildlife, fish and wilderness. It could also include measures to improve the use and management of the recreational resource, such as boat launches, pullouts, campsites, zoning controls, fisheries regulation and restrictions on access.

d. The Wilderness Ethic

Many residents consider the wilderness character of the Basin an important component of their lifestyle. To these people, the wilderness is vitally important for aesthetic and ethical reasons and for hunting, fishing and touring. They are concerned that potential developments may alter the Basin's wilderness character. Where possible, future developers and resource managers should recognize these local values and incorporate them into the decision-making process.

e. Recreation and Sport Fishing

Sport fishing is a major component of water-based recreation in the Basin. Projects undertaken during the Study identified low levels of fish productivity in the Basin's lakes and indicated that rising angling demands could threaten the long-term sustainability of this resource. Water managers can play a part in protecting streamflows and water quality and avoiding lake level regulation that could damage habitat in lakes with high sport fish production. Increased emphasis will have to be placed on improving information on lake and stream productivity and enforcing angling use regulations to avoid excessive harvests.

3. Placer Mining and Water Resource Management

Placer mining contributes significantly to the economy of the Basin and is a vital part of the economies of many communities, such as Dawson, Atlin and Mayo. There is broad public support for both a viable placer mining industry and for protection of water quality, fish, wildlife and other resources. However, it is not always possible to accommodate other water uses in placer mining areas when large volumes of water are required or where significant changes to landscape or downstream water quality occur.

Prior to 1970 there was little environmental regulation of the industry. After 1970 a new environmentally-sensitive regulatory system was put in place. Changes to the **Fisheries Act** provided more protection for fish habitat through controls over sediment deposited in streams. In Yukon, the **Northern Inland Waters Act** replaced water allocation provisions of the **Yukon Placer Mining Act,** and the **Territorial Lands Act** provided for control of land use activities outside of claims and leases. In British Columbia, similar changes to the legislation have occurred through strengthening of the **Waste Management Act** (formally the **Pollution Control Act).**

In Yukon, further regulatory changes were initiated in 1983 with new guidelines for placer mining being developed by the federal departments of Indian Affairs and Northern Development, Fisheries and Oceans, and Environment. The ensuing discussion resulted in the ministers of these departments establishing the Yukon Placer Mining Guidelines Public Review Committee which held a series of public meetings. Their recommendations were presented in "Resources, Regulations and Reality" (Christensen etal., 1983). The federal government has not yet made a comprehensive response; however, the Minister of the Department of Indian Affairs and Northern Development has provided policy guidelines to the Yukon Territory Water Board.

Many of the problems which have arisen in Yukon can be attributed to the single resource nature of the various acts (Socio-Economic Report No. 5). However, the formation of a Government/Industry Joint Committee on Placer Mining Research and Development, in the spring of 1984, is a step towards a more cooperative approach to management of placer mining in Yukon.

There are also proposed changes to the present regulatory regime in British Columbia. These include the following provisions:

-issuing placer leases at the District office;
-developing three types of placer leases:
  Type A - for hand testing using portable equipment
  Type B - for mechanical testing and exploration
  Type C - for large-scale operations;
-creating coordinating committees composed of provincial agencies and the federal Department of Fisheries and Oceans to review type B and C leases and prepare environmental guidelines for each operation;
-permitting appeals on the staking of placer leases by amendment to the **British Columbia Placer Mining Act.**

These proposed changes would provide site-specific conditions for the discharge of wastes and replace the present colour code system of stream classification.

Recognizing that management of the placer mining industry involves issues that extend beyond the scope of the Study, the Committee restricted its activities to providing supporting data and information relevant to water management in the Basin. A salmon habitat inventory of 65 streams in the Stewart-Mayo area and 33 streams in the Atlin area was undertaken (Figure 7). With this study and previous work about 15 percent of the Basin has now been inventoried.

The effect of sediment on Arctic grayling was studied in the laboratory and in the field. In the laboratory, grayling survived high concentrations of 250 000 milligrams per litre for four days and lower concentrations of 50 000 milligrams per litre for sixteen days. However in both cases such concentrations affected health and productivity of fish. Even concentrations as low as 50 milligrams per litre were found to be stressful (Fisheries Report Nos 2 and 9). As a result, the Department of Fisheries and Oceans has maintained its position that discharges to streams should not exceed 100 milligrams per litre.

Additional information is being collected to further refine the interrelationships between placer mining, fish and wildlife resources. Currently, guidelines are being used to control the direct discharge of sediment from placer operations into fish-bearing streams.

4. The Coordination of Water Resource Planning with Land Use Planning

Historically, water licences in the Basin have been allocated in response to demands as they arise. Applications for water licences are made by communities, operators of tourist developments, utilities or mining and petroleum companies; each application is dealt with on its own merits without regard to any overall plan.

The absence of a water management plan can be attributed, in part, to the historical lack of significant competition among water users. However, water use conflicts have been emerging in recent years. Public debates over regulation of placer mining, hydroelectric development and municipal waste disposal have often been heated and vocal. Consequently, it is now recognized that reactive responses to water use conflicts are no longer adequate.

The integrated nature of land and water resources—the fact that activities associated with one inevitably have impacts on the other — suggests the need for coordinated management and planning (Socio-Economic Report 5b). To date, there has been little explicit attempt to coordinate water and land use management in the Basin. Land and water use allocation and regulation presently operate within different administrative regimes, with communication between them occurring mainly through informal technical advisory committees. Individuals wishing to use Crown land usually must apply for development permits under land use regulations as well as for water licences under water use legislation; they must also satisfy environmental assessment procedures.

In the British Columbia portion of the Basin, several provincial agencies have been given responsibilities for water and land use planning. With respect to water resource planning, the Ministry of Environment under the **Environment Management Act** has powers to prepare environmental management plans which can contain specific provisions for water management. Other provincial ministries, notably Forests and Lands, Parks and Housing, have the responsibility to develop timber harvesting, recreation and settlement plans on Crown-owned lands. Where necessary, coordination of these various activities can occur under the **Environment and Land Use Act,** with policy coordination undertaken by the provincial Environment and Land Use Committee. Technical coordination of land and water use plans can occur by specially appointed committees. The Placer Mining Coordination Committee is an example of inter-agency cooperation to improve regulations and management of land and water use in British Columbia. However, due to priorities in other parts of the province, very little joint planning of any type has occurred to date in the British Columbia portion of the Basin.

In Yukon, the lack of water planning has been essentially paralleled by a lack of land use planning. However, the Government of Canada, Government of Yukon and the Council of Yukon Indians are discussing mechanisms for a land use planning process for Yukon. Its purpose will be to provide a framework for guiding decisions related to the conservation, development, management and use of land, including inland waters and offshore resources. This is an indication that land and water resource planning in Yukon may occur in an explicit and coordinated fashion. The guiding principles for the proposed Yukon land use planning process state that land use planning must be related to other planning processes and that planning for inland waters and offshore areas will be included. However, this new planning initiative has not been formally agreed to and the process itself has yet to be defined (Socio-Economic Report 5b). Implementation of this joint land and water use planning process stands as a significant management challenge.

A preliminary review of this management challenge was completed during the Study but specific solutions were not identified (Socio Economic Report No. 5b). Reconciling the various water use and preservation demands will require sophisticated management if the wise use of all resources is to be achieved. The new land use planning procedure and the opportunities for managing the water resource contained in the **Northern Inland Waters Act** and other legislation should provide a framework for coordinated land and water use planning. This coordination is deserving of the highest priority among the concerns that confront the territorial, provincial and federal governments in these days of fast-changing goals and institutions.

5. Transboundary Considerations for Water Management

Competition for the water resource can occur between upstream and downstream users as well as at the site of the water use. In the case of the Yukon River, these competing uses may cross the international boundary between Canada and the United States as well as the boundary between Yukon and British Columbia. Some of the specific management concerns are dealt with in the following paragraphs.

a. Concerns Linking Yukon and British Columbia

Development projects that could affect both Yukon and British Columbia include hydroelectric-related water diversions or storage facilities, special land designations related to parks and recreation, and mining projects with effluent discharges that could affect both jurisdictions.

The institutional arrangements linking the British Columbia and Yukon portions of the Basin are described in Socio-Economic Project Report Nos 5b and 5d. To date, there has been little need to consider formal transboundary agreements. No project has reached a licensing stage although several projects have come close, such as NCPC's proposal to use Atlin Lake for increased storage. However, the lack of water management coordination between British Columbia and Yukon could become an issue if these proposals, or others, are subject to a formal application. Of particular importance is the potential regulation of headwater lake levels by NCPC. The British Columbia government has proposed several parks or other land designations along the shores of the headwater lakes but no analysis has been undertaken on the effects of headwater lake regulation on these designations. In view of the potential transboundary effects of hydroelectric developments and other transboundary water-related issues, particularly parks and recreational facilities, there is sufficient justification for an ongoing agreement to facilitate cooperative discussions between Yukon and British Columbia.

b. International Concerns

The international obligations of Canada and the United States with respect to the water resource are met through various acts and treaties, such as the **Boundary Waters Treaty.** Past experience suggests that informal discussions between countries often suffice and that where issues of serious proportions arise, the two countries refer to the International Joint Commission for resolution or recommendations. Future international issues might include hydroelectric mega-projects developed in the Canadian portion of the Basin that could have significant effects on the Alaska fishery. Concern that a potential transboundary salmon agreement

may affect the Canadian Yukon River fishery was noted in Chapter III and is discussed in more detail in the Fisheries Program Report. The Study did not undertake any specific projects relating to international matters since the existing institutional arrangements appeared adequate.

CHAPTER V
RECOMMENDATIONS

The Yukon River Basin Committee was assigned the responsibility to undertake studies and recommend steps that would lead to the formulation of a planning framework for the Basin's water resource. In the course of completing the Study, the Committee was presented with numerous recommendations in about fifty project and program reports. The Committee has not accepted all these recommendations; some extend beyond the terms of reference for water resource managment, others the Committee does not agree with. However, the Committee has utilized many of them in developing the following recommendations to the three governments. The Committee is confident that communications and the working relationships between the various federal, territorial and provincial agencies have been strengthened.

1. Establishment of an Interjurisdictional Coordinating Committee

In considering the next steps required to complete the development of a planning framework for water and its uses, the Committee was well aware that no single agency in British Columbia or Yukon has a monopoly on water management in the Basin. Consequently, a framework for planning the wise use of this resource can only be developed through the cooperation of the many public bodies with jurisdictional responsibilities in this area. The Committee is confident that the working relationships developed over the course of this Study constitute a critical first step in developing a framework for water resource planning in the Basin. This process of coordination and cooperation must continue if the challenges facing water managers in the future, discussed in Chapter IV, are to be met in the best interests of the people in the Basin.

Accordingly, the Committee's major recommendation is directed towards establishing a process for coordinating the ongoing planning for management of the water resource. Accordingly, the Committee recommends that:

The governments of Canada, British Columbia and Yukon enter into a formal agreement that will establish a coordinating committee of agencies with water management responsibilities to complete the development of a framework for water resource planning and to coordinate ongoing planning and management activities.

This coordinating committee should include representatives of participants in the current Study Agreement, i.e. the federal Department of the Environment, the federal Department of Indian Affairs and Northern Development; the British Columbia Ministry of Environment and the Yukon Department of Renewable Resources. In addition, due to the importance of fisheries, the federal Department of Fisheries and Oceans should be a participant. Other agencies in the three levels of government with management responsibilities for water and related resources would also participate with the coordinating committee as required.

The responsibilities of this coordinating committee, in addition to those specified in the main recommendation, would include coordination of ongoing studies and information systems required to implement a planning framework. The coordinating committee would utilize existing staff and funds to undertake the necessary planning functions to achieve the objectives of the Agreement. Where necessary, it would recommend funding approval and arrange for the conduct of joint studies to address and help resolve interjurdistictional water use issues.

More specifically, the coordinating committee should undertake the following steps to develop the planning framework:

a. Encourage all jurisdictions involved in the management of the Basin's water resource to accept conservation as a guiding principle for future water management decisions. In Chapter IV the Committee outlined three basic criteria for achieving conservation. The coordinating committee should develop measurable parameters for determining how the basic criteria

can be achieved in the context of decision-making. It should also encourage decision-makers to document specifically in their water management decisions the extent to which these basic criteria were considered.

b. Encourage all agencies involved in managing water and related resources to specify their goals and objectives and if necessary, refine these to be compatible with the conservation principle for water management. This principle can be effectively applied to water resource management only if it is also applied to the users of the water resource. The lack of clearly defined goals, objectives and long-term plans for growth in the energy, wildlife, fisheries and recreational resource sectors in the Basin stand as a serious impediment for achieving water resource planning and management to accommodate competing uses on a sustainable basis. There is little point in restricting alternative water uses to protect water quality or prevent loss of habitat for fisheries if the recreational, Indian food and commercial use of the Basin's fish resources exceed the natural carrying capacity of its rivers and lakes. There is also little point in trying to avoid environmental impacts of hydroelectric developments if there are more efficient alternatives through energy conservation or the use of alternative energy sources.

2. Coordination of Land and Water Use Planning

The Committee supports the development of the northern land use planning process currently under discussion for Yukon and urges that it be closely coordinated with ongoing water resource planning. The coordination would be of particular significance for water and land use management in the headwater lakes area. The Committee therefore recommends that:

Government agencies coordinate water and land use planning activities. Specifically, closer ties should be established to ensure proper management of shoreline development control, access to lakes and rivers, and developments on floodplains.

3. Public Participation

During the Study, the Committee initiated an information exchange and public participation program to provide both information to the public on the objective, expectations and results of the Study and obtain input from the public on various aspects of the Study. A primary goal was to develop public awareness and begin building the trust between the public and the Study to create an avenue for public feedback. 'Public' became the umbrella term to include all public sectors, interested individuals, native bands and organizations, private industry, service clubs, students, special interest groups and politicians from all three levels of government.

A community tour was used to provide the public with information on the Study and to obtain public feedback. The Committee formed a consultative group from people contacted during the community tour; the group was to eventually be known as the Independent Review Group (IRG). IRG was asked to provide input by reviewing Study results and the Committee's final report and by providing an evaluation in light of the overall Study objective.

The Committee was impressed with the overall value of the public participation program completed during the Study. Joint meetings between the Committee and the Independent Review Group provided useful discussion and alternative perceptions for consideration in preparation of the Committee's report. However, the Committee is convinced that initiating the involvement of a public consultative group at the beginning of the Study would have been more beneficial. The Committee is therefore in agreement with the Independent Review Group that the public should participate in planning studies from their inception to completion. The Committee therefore recommends that:

Ongoing activities for planning and management of water and related resources in the Basin should include public participation from their inception.

4. Review of Conclusions and Recommendations of Study Reports

Project and program reports completed during the Study presented conclusions and detailed recommendations. The Committee considers that many of these extend beyond the terms of reference and priorities of water management. Also many do not fit clearly into the

criteria governing conservation or wise use of resources and are poorly documented because resource management objectives are not clear. Accordingly there is a need for the recommendations to be reviewed to determine those that are supported by management agencies and which affect water management activities in the Basin. The Committee therefore recommends that:

Appropriate jurisdictions review the various recommendations found within the Study reports and identify for implementation those which can contribute to water management.

The coordinating committee should ensure that implementation of such recommendations is coordinated and is in keeping with the principle of water conservation.

5. Priority Water Resource Items

In reviewing the various project and program reports, the Committee identified a number of specific items which should receive early consideration by appropriate agencies to provide information necessary for improving water management.

a. Establish water quantity stations required to provide baseline, site specific and small stream data.

b. Establish a water quality network.

c. Integrate the water quantity and water quality networks where practical.

d. Evaluate the effect of the construction and operation of existing hydroelectric facilities on the water resource.

e. Maintain and improve the daily flow model, particularly in terms of the White River contributions and headwater lakes elevations.

f. Evaluate the status of groundwater use and quality, not included in the Study, with particular emphasis on drinking water supplies.

g. Map floodplains and high-water lake elevations and, where appropriate, establish land use controls.

h. Continue examination of the cause of ice jam floods at Dawson to understand processes.

i. Emphasize consideration of the effects of regulation on biological productivity in the current limnological research program on the headwater lakes.

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APPENDIX 1

STUDY AGREEMENT

AN AGREEMENT RESPECTING STUDIES AND PLANNING OF THE WATER RESOURCES IN THE YUKON RIVER BASIN

THIS AGREEMENT made this 24th day of November 1980

BETWEEN

THE GOVERNMENT OF CANADA
hereinafter referred to as "Canada"

AND

THE GOVERNMENT OF THE PROVINCE OF BRITISH COLUMBIA
hereinafter referred to as "British Columbia"

AND

THE GOVERNMENT OF THE YUKON TERRITORY
hereinafter referred to as "Yukon Territory"

WHEREAS possible conflicts among energy, mining, transportation and recreational uses are posed by new resources developments in the Yukon River Basin; and

WHEREAS the Parties established a Preplanning Task Force in 1978 to assess the need for a coordinated intergovernmental approach to water and related resources management; and

WHEREAS the aforementioned Task Force has submitted to the Parties a report dated September, 1979 recommending a framework planning process; and

WHEREAS the Parties have accepted the report and agreed to undertake studies and planning designed to improve their understanding of resource development impacts and alternatives in the Yukon Basin; and

WHEREAS by Order in Council No. P.C. 1980-3/2106 made the 31st day of July, 1980, the Governor in Council has authorized the Minister of the Environment and the Minister of Indian Affairs and Northern Development to execute this Agreement on behalf of Canada; and

WHEREAS by Order in Council No. 1802 made the 21st day of August, 1980, the Lieutenant Governor in Council has authorized the Minister of Environment to execute this Agreement on behalf of British Columbia; and

WHEREAS by Order in Council No. P.C. 1980-3/2106 made the 31st day of July, 1980, and by Territorial Ordinance No. 7, made the 16th day of April, 1980, pursuant to the Yukon Act, the Commissioner of the Yukon Territory has been authorized to execute this Agreement on behalf of the Yukon Territory;

NOW THEREFORE THE PARTIES HAVE AGREED AS FOLLOWS:

DEFINITIONS

1. In this Agreement,

"Basin" means the Canadian portion of the drainage basin of the Yukon River and its sub-basins, excluding those streams which drain into the Yukon River downstream of the Yukon-Alaska boundary;

"Committee" means the Yukon River Basin Committee, as established under Section 4 of this Agreement;

"Ministers" means a) for Canada, the Minister of the Environment, and the Minister of Indian Affairs and Northern Development;

b) for British Columbia, the Minister of Environment;

c) for the Yukon Territory, the Commissioner;

"related resources" means all flora, fauna, fish, habitats and other natural features, the presence or existence of which in the Basin is dependent upon the river system of the Basin.

OBJECTIVE

2. The objective of this Agreement is to undertake jointly studies leading to the formulation of a planning framework under which potential development alternatives in the Basin may be evaluated.

TERMS OF REFERENCE

3. The scope of the studies is defined by the terms of reference and study components which are set out in Schedule "A" to the Agreement.

ADMINISTRATIVE ARRANGEMENTS

4. (1) A Yukon River Basin Committee is established, consisting of one member appointed by the Minister of the Environment and one member appointed by the Minister of Indian Affairs and Northern Development for Canada, one member appointed by the Minister of Environment for British Columbia and one member appointed by the Commissioner of the Yukon Territory.

(2) The Chairman of the Committee shall be one of the members appointed by Canada.

(3) Members of the Committee shall appoint alternates to represent them at meetings which they cannot attend.

5. The Committee shall be responsible for the administration and conduct of the study and for determining the manner in which the funds allocated to the study will be spent. Such approval for funding of activities shall only be given by the permanent members of the Committee.

6. (1) Subject to the approval of the Committee, Canada shall appoint a Study Director, who shall report to the Committee Chairman, and such other staff as may be required to assist the Committee in the performance of its duties.

(2) The Committee may establish sub-committees to assist it in carrying out the terms of this Agreement.

7. The Committee shall prepare:

a) annual reports on the progress of the study program for presentation to the Ministers;

b) a comprehensive final report on the study program for presentation to the Ministers by December 30, 1983.

FINANCIAL ARRANGEMENTS

8. Each Party's obligations under this Agreement are subject to sufficient funds being appropriated by the respective Governments for the purposes of this Agreement.

9. (1) The total costs to be shared under this Agreement shall not exceed $2,200,000, and shall cover the costs of the study program described in Schedule A, including the costs of study coordination, management and reports.

(2) The costs described in Sub-section (1) shall be shared by the Parties in the proportions shown in Column A but the sum payable by each Party to this Agreement in respect of all such costs shall not exceed the amount shown in Column B:

	Column A Percentage Share of Costs	Column B Maximum Amount Payable
Canada		
Environment Canada	50%	$1,100,000
Department of Indian Affairs and Northern Development	40%	880,000
Yukon Territory	5%	110,000
British Columbia	5%	110,000
TOTAL	100%	$2,200,000

10. Where work is carried out by a third party, the Party which entered into the contract shall conduct such monitoring and review, in addition to that carried out by the Committee pursuant to Section 5, as is necessary to ensure that the contract is performed in accordance with the terms of reference.

11. Each Party shall bear the entire costs of the salary and travelling and related expenses of:

a) each of its members on the Committee; and

b) any other employee who, although engaged in any activity hereunder, does not have a specified portion of his day, week, month or year assigned exclusively to the carrying out of this Agreement or work hereunder;

and such costs shall not be included in calculating the amounts payable as stipulated under Section 9.

12. (1) Canada shall assume responsibility for financing this Agreement and shall make payments promptly to British Columbia and Yukon on the basis of progress claims setting out the costs actually incurred by them under this Agreement in a mutually agreed manner and form. British Columbia and Yukon shall each reimburse Canada annually for its proportion of the costs on the basis of claims certified by a senior officer of Canada;

(2) Final claims by the province and territory to expenditures incurred under this Agreement will be made within six calendar months following the termination date of the Agreement. Canada will make a final claim to British Columbia and Yukon for the proportionate shares of the final study cost within twelve calendar months of the termination date of this Agreement.

13. (1) Each Party shall maintain adequate documentation and records of the costs that are to be shared pursuant to Section 9 and which are incurred by it and shall, upon request, make available such documentation and records for examination by auditors of any other Party sharing the costs.

(2) An audit of its expenditures shall be made by each Party as of the end of each fiscal year.

(3) Any discrepancy disclosed by audit between the amount payable and the amount paid by the Party shall be promptly adjusted.

14. Any material, equipment or property:

a) the cost of which was included in the costs of research, surveillance, or assessment shared by the Parties to this Agreement; and

b) which is no longer needed for the purpose for which it was acquired,

shall revert to the Party which acquired it, at its depreciated cost, in accordance with the Income Tax Act capital allowance schedule. In the event that the Party opts not to acquire an asset, the asset should be disposed of in the manner authorized by the statutes of Canada respecting disposal of surplus Crown assets.

DURATION OF AGREEMENT

15. This Agreement shall take effect when signed by all the Parties, and shall terminate on December 30, 1983.

AMENDMENTS

16. This Agreement may be reviewed from time to time by the Parties hereto, and, with the exception of Sections 9 and 15, may be revised by exchange of letters among the Ministers at their discretion.

GENERAL

17. This Agreement shall not operate to vest in Canada any proprietary right, interest or obligation that it otherwise would not have.

18. No member of the Parliament of Canada, or of the Legislative Assembly of British Columbia or of the Council of the Yukon Territory shall hold, enjoy, or be admitted to any share, part or benefit from this Agreement or any agreement, contract or benefit arising therefrom.

IN WITNESS WHEREOF the Honourable John Roberts, Minister of the Environment, and the Honourable John Munro, Minister of Indian Affairs and Northern Development have hereunto set their hands on behalf of Canada, and the Honourable Stephen Rogers, Minister of Environment (British Columbia) has hereunto set his hand on behalf of British Columbia, and Mr. Douglas Bell, Administrator of the Yukon Territory and Mr. Dan Lang, Minister of Renewable Resources have hereunto set their hands on behalf of the Yukon Territory.

In the Presence of:
Original Signed by
"Danielle Wetherup"

Witness

Original Signed by
"Doris E. Taylor"
Witness

Original Signed by
"B.E. Marr"
Witness

Original Signed by
"D.M. Watson"
Witness

Original Signed by
"Marion Morrow"
Witness

GOVERNMENT OF CANADA
Original Signed by
"John Roberts"

Minister of the Environment

Original Signed by
"J.C. Munro"
Minister of Indian Affairs
and Northern Development

GOVERNMENT OF BRITISH COLUMBIA
Original Signed by
"Stephen Rogers"
Minister of Environment

GOVERNMENT OF YUKON TERRITORY
Original Signed by
"D. Bell"
Commissioner of the Yukon Territory

Original Signed by
"Dan Lang"
Minister of Renewable Resources

SCHEDULE A
TERMS OF REFERENCE

The studies to be undertaken and the planning framework to be formulated under this Agreement shall be sufficiently broad in scope that all significant water-related development alternatives in the Yukon River Basin will be evaluated in terms of their social, economic and environmental effects. Major emphasis shall be accorded to recent initiatives reported in four development sectors: energy; mining; transportation; and tourism, parks and recreation.

The study program shall include, but not necessarily be limited to, the following:

1. Information Exchange and Coordination

a) An opportunity shall be provided for as many people as possible to become informed about the Yukon Basin framework planning study, its objective and its progress, and to participate in mutually agreed upon activities in the study. Public presentations, discussions and progress reports shall be incorporated in the study program.

b) Information on the water and related resources of the Basin, on socio-economic considerations and on development proposals and possibilities shall be exchanged among governments and agencies and documented for general use. Intergovernmental and interagency coordination in data-gathering and planning activities is essential to the success of the Agreement and will be a prime function of the Committee members and Study Director.

2. Hydrology

The existing network of stations which monitor surface and ground waters, sediment transport and weather (including snow survey) shall be reviewed to determine deficiencies and need for modification with respect to possible new resource developments. Additional hydrological investigations shall focus on: creation of a daily hydrological model to simulate basin flows for use in alternative project analysis, description of the formation and behavioural processes of winter ice cover, description of ice break up and the cause and effect of ice jams, identification of sediment deposition sites and processes, and collaboration to meet the specific requirements for hydrological information by other sector studies.

3. Water Quality

Existing water quality data are inadequate to assess changes that may be expected through reservoir creation, placer and other mining activities, and associated community growth, in particular altered nutrient levels, sediment loads and dissolved oxygen. Water quality studies shall be designed to monitor existing conditions and trends, develop a better understanding of river processes and identify problems from proposed resource developments. The impact of reservoir creation on water quality shall be assessed on a site-specific basis.

4. Fisheries

Very little information is available on fisheries habitat on the main stem Yukon or its tributaries in the vicinity of potential hydroelectric developments, and surveys shall be required as well with respect to new transportation corridors and for streams where placer mining activities are expanding. Major activities shall include: anadromous and indigenous species usage of riverine areas; spawning, rearing and food studies; surface water interface and related hydrology; limnological reservoir and headwater lakes studies; and socio-economic fishery values.

5. Wildlife

An extensive inventory shall be undertaken to estimate species abundance and habitat use before effects of new resource developments can be addressed. Attention shall be concentrated largely on floodplains of major valleys, the most productive units in northern climates for the survival of most species, including moose, aquatic furbearers, waterfowl and shore birds. Studies shall include: surveys of wintering areas and ground track counts to determine areas and extent of big game habitat; furbearing animals investigations concentrating on beaver, muskrat, mink and otter but considering other species also; waterfowl surveys, by air and ground, to delineate existing and potential habitat (nesting and feeding areas); and other ornithological studies to include raptors and upland game birds that depend on floodplains.

6. Tourism, Parks and Recreation

Recent and ongoing investigations concerning land and water capabilities and projected uses for parks, recreation and heritage river designation, including those initiated under the 1979 DREE subsidiary agreement, shall be reviewed to assess the value of recreational use of water resources on the main stem and certain tributary valleys. A further study of recreational boating shall be undertaken by means of user surveys.

7. Placer Mining

The rapid expansion of placer mining activities in scattered valley locations throughout the Basin poses difficulties for regulation, since an overall appreciation of their scope and impact on the aquatic environment remains to be achieved. A study shall be undertaken to determine the scope of these activities, their economic value and the social, economic and environmental trade-offs for other water uses associated with continued expansion of placer mining.

8. Energy Alternatives

Energy resources of the Yukon River are of a sufficient magnitude to transcend the Basin boundaries. Coordination of an energy overview study involving the specialized agencies of the participating governments is necessary to overcome the jurisdictional constraints involved in a regional approach to assessments of the Yukon River energy potential. Overview studies shall include a projection of energy demands imposed by different development possibilities; an assessment of the comparative merits of meeting energy demands by hydro, thermal or other sources taking into account social, environmental and economic costs; and an assessment of the trade-offs associated with hydro plant siting on the main stem in the Yukon Territory as compared to hydro power sites located in British Columbia.

9. Socio-Economic

Analysis shall be undertaken of the Basin's changing demography and economy and their linkages to water use, and of employment patterns and social impacts likely to result from alternative resource developments. A review of laws and institutions governing water management in the Basin shall be undertaken with reference to interjurisdictional (including international) rights and obligations in a transboundary watercourse.

10. Program Administration

Administration of the three year planning study will require the employment of a Study Director and support staff. The support staff will include, at a minimum, a technical assistant and secretary.

APPENDIX 2

STUDY PARTICIPANTS

STUDY PARTICIPANTS

YUKON RIVER BASIN COMMITTEE

Representing
CANADA

E.M. CLARK, Chairman
Regional Director
Inland Waters Directorate
Pacific and Yukon Region
Environment Canada

D.M. WATSON, Member
Director General
Northern Affairs Program
Indian and Northern Affairs Canada
(to September 30, 1983)

M.J. MORISON, Member
Director General
Northern Affairs Program
Indian and Northern Affairs Canada
(from October 4, 1983)

Representing
BRITISH COLUMBIA

J. O'RIORDAN, Member
Director
Assessment & Planning Branch
B.C. Ministry of Environment

Representing
YUKON

G.R. LIVINGSTON, Member
Deputy Minister
Yukon Department of Renewable Resources
(from July 6, 1982)

M.C. McKAY, Member
Deputy Minister
Yukon Department of Renewable Resources
(to July 3, 1982)

ALTERNATES

M.M.WIGGINS
Inland Waters Directorate
Environment Canada

A.H. JONES
Northern Environment
Indian and Northern Affairs Canada

D.A. HUTTON
Land Claim Secretariat
Executive Council Office
Government of Yukon

SECRETARY

S.A. D'AQUINO
Inland Waters Directorate
Environment Canada

OFFICE OF THE STUDY DIRECTOR

W.G. WHITLEY
Study Director

R.A. SNARY
Information Officer

R.A. HODGE
Technical Consultant

L.G. JAMIESON
Office Manager

TECHNICAL ADVISORY GROUP

ENERGY
B.A. BRICKMAN
Northern Affairs Program
Indian and Northern Affairs Canada

SOCIO-ECONOMIC
S.A. D'AQUINO
Inland Waters Directorate
Environment Canada

FISHERIES
G.L. ENNIS
Habitat Management Division
Fisheries and Oceans Canada

TOURISM, PARKS & RECREATION
D.A. HUTTON
Resources Planning & Management
Yukon Department of Renewable Resources
(to October 19, 1983)

HYDROLOGY
R.O. LYONS
Inland Waters Directorate
Environment Canada

TOURISM, PARKS & RECREATION
A.J. HODGSON
Land Planning Branch
Yukon Department of Renewable Resources
(from October 19, 1983)

PLACER MINING
T. ROBERTS
Waste Management Branch
B.C. Ministry of Environment

WATER QUALITY
J.M. NICKEL
Northern Affairs Program
Indian and Northern Affairs Canada

WILDLIFE
D.H. MOSSOP
Wildlife Management Branch
Yukon Department of Renewable Resources

YUKON RIVER BASIN STUDY
WORK GROUPS

ENERGY

B.A. BRICKMAN, Chairman, Indian and Northern Affairs Canada, Whitehorse

G.K. BAUER, Yukon Electrical Co. Ltd., Whitehorse
F.R. DORWARD, Northern Power Commission, Whitehorse (from January 1, 1984)
W.H. DREHER, B.C. Ministry of Environment, Smithers
D.R. DUGUID, Consultant, Chemainus
P.L. FRASER, Yukon Department of Economic Development, Whitehorse
(Alternate to P. Kent)
P.A. KADAK, B.C. Hydro and Power Authority, Vancouver
H. KALDOR, Northern Canada Power Commission, Whitehorse (to December 31, 1983)
P. KENT, Yukon Department of Municipal and Community Affairs, Whitehorse
M.R. ORECKLIN, Energy, Mines and Resources Canada, Whitehorse (to November 23, 1983)
R.J. WHITE, Environment Canada, Vancouver

FISHERIES

G.L. ENNIS, Chairman, Fisheries and Oceans Canada, Vancouver

D. DAVIES, Yukon Department of Renewable Resources, Whitehorse
(to September 28, 1983)
R.A.C. JOHNSTON, Fisheries and Oceans Canada, Whitehorse
T. PENDRAY, Yukon Department of Renewable Resources, Whitehorse
(from September 28, 1983 to December 16, 1983)
D. REYNOLDS, B.C. Ministry of Environment, Smithers (to September 28, 1983)
M.R. WHATELY, B.C. Ministry of Environment, Smithers (from September 28, 1983)

HYDROLOGY

R.O. LYONS, Chairman, Environment Canada, Vancouver

W.H. DREHER, B.C. Ministry of Environment, Smithers
J.R. JANOWICZ, Indian and Northern Affairs Canada, Whitehorse
(from November 16, 1982)
W.L. KREUDER, Environment Canada, Vancouver
M.R. ORECKLIN, Energy, Mines and Resources Canada, Whitehorse
(to November 16, 1982)

PLACER MINING

T. ROBERTS, Chairman, B.C. Ministry of Environment, Smithers

G.W. GILBERT, Indian and Northern Affairs Canada, Whitehorse
J.A. KUHN, Yukon Department of Renewable Resources, Whitehorse
(from February 1, 1983)
J. PAYNE, Fisheries and Oceans Canada, Vancouver
J.H.C. WALKER, B.C. Ministry of Environment, Victoria (from February 1, 1983)

SOCIO-ECONOMIC

S.A. D'AQUINO, Chairman, Environment Canada, Vancouver

B.A. BRICKMAN, Indian and Northern Affairs Canada, Whitehorse
C.R. HEARTWELL, Yukon Department of Economic Development, Whitehorse

TOURISM, PARKS & RECREATION

D.A. HUTTON, Chairman, Yukon Department of Renewable Resources, Whitehorse
(to October 19, 1983)
A.J. HODGSON, Chairman, Yukon Department of Renewable Resources, Whitehorse
(from October 19, 1983)

B. CHAMBERS, Indian and Northern Affairs Canada, Whitehorse
(to February 28, 1982, from June 4, 1984)
M.A. CROMBIE, Indian and Northern Affairs Canada, Whitehorse
(from September 28, 1983)
B. DALZIEL, B.C. Ministry of Environment, Smithers
S.A. D'AQUINO, Environment Canada, Vancouver (from June 4, 1984)
R.G. GRAHAM, Yukon Department of Tourism and Culture, Whitehorse
(from June 4, 1984)
P. KOPAS, Fisheries and Oceans Canada, Vancouver (from June 4, 1984)
W.J. MASYK, Environment Canada, Haines Junction
H.A. PAISH, Consultant, Whitehorse (from June 4, 1984)
A.E. ROBERTSON, Indian and Northern Affairs Canada, Whitehorse
(to September 28, 1983)
J.W. SPICER, Yukon Department of Tourism, Heritage and Cultural Resources,
Whitehorse (from September 28, 1983)

WATER QUALITY

J.M. NICKEL, Chairman, Indian and Northern Affairs Canada, Whitehorse

C.B.J. GRAY, Environment Canada, Vancouver
M.E. JACK, Indian and Northern Affairs Canada, Whitehorse
(from February 1, 1983)
G.R. MacKENZIE-GRIEVE, Environment Canada, Whitehorse
T. ROBERTS, B.C. Ministry of Environment, Smithers
P.H. WHITFIELD, Environment Canada, Vancouver
B.D. WILKES, B.C. Ministry of Environment, Smithers (Alternate to T. Roberts)

WILDLIFE

D.H. MOSSOP, Chairman, Yukon Department of Renewable Resources, Whitehorse

M.C. DENNINGTON, Environment Canada, Whitehorse
D. REYNOLDS, B.C. Ministry of Environment, Smithers (to September 28, 1983)
B. VAN DRIMMELEN, B.C. Ministry of Environment, Smithers
(from September 28, 1983)

INDEPENDENT REVIEW GROUP

J.P. ADAMS, Atlin
G. ALLISON, Haines Junction
L. BARRETT, Carcross
C.L. CARLSON, Faro
B.S. GILBERT, Mile 1054, Alaska Hwy.
C. GOOD, Ross River
G.J. GORDON, Mayo
J. HUNSTON, Whitehorse
S.R. KENDALL, Destruction Bay
K.McNEVIN, Dawson City
M.S. MORRIS, Atlin
F.M. TAYLOR, Dawson City
D.R. URQUHART, Atlin
K. WEAGLE, Whitehorse

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M.L. HAINES, Environment Canada, Vancouver
D.E. SHERWOOD, Environment Canada, Vancouver

APPENDIX 3

FINANCIAL STATEMENT

Program	Government	Projects	Program Allocation $	1981/82 $	1982/83 $	1983/84 $	Budget 1984/85 $
ENERGY	Yukon	Archival Task		-	7,508	2,492	-
	Canada	Hydroelectric Inventory		-	20,000	25,000	-
	B.C.	Potential Interconnections		-	5,000	-	-
	Yukon	Demand Study Review	120,000	-	5,000	-	-
	Canada	Hydroelectric Planning		-	-	25,000	-
	Yukon	Energy Alternatives		-	10,000	20,000	-
FISHERIES	Canada	Inventory Existing Fish Data		19,764	4,064	-	-
	Canada	Salmon Inventory		-	119,402	140,598	-
		Fisheries Placer Mining Studies:					
	Canada	Sediment Effects on Grayling			50,000	49,967	-
	Yukon	Stream Habitat Inventory		-	81,597	3,149	-
	Yukon	Stream Habitat Evaluation	572,756	-	-	41,000	-
		Fisheries Socio-Economic Studies:					
	Canada	Lake Productivity Index		-	4,652	20,348	-
	Canada	Creel Census of Three Yukon Lakes		-	-	10,000	-
	Canada	Creel Census of Atlin Lake		-	-	9,216	-
	Canada	Program Report		-	-	4,387	14,612
HYDROLOGY	Canada	Network Assessment		-	-	9,002	-
	Canada	Daily Hydrologic Flow Model		-	7,621	6,379	-
	Canada	Evaluation of Scenarios	105,219	-	-	4,000	-
	Canada	Winter Ice Cover and Break-Up		-	17,142	34,743	1,332
	Canada	Natural Flooding		-	-	25,000	-
PLACER	Canada	Description of Placer Mining	8,912	-	8,912	-	
SOCIO-ECONOMIC	Yukon	Input/Output Tables		5,850	11,850	16,322	-
	Yukon	Economic Accounts		1,601	-	20,000	-
	Yukon	Simulation Model	167,598	-	40,264	-	-
	Yukon	Socio-Economic Data Analysis		-	-	37,812	-
	Canada	Socio-Economic Institutional Analysis		-	-	33,899	-
TOURISM, PARKS & RECREATION	Yukon	Tourism Parks & Recreation Program		-	8,698	37,302	-
	Yukon	Recreational Capability of Lakes		-	-	23,840	-
	Yukon	Recreational Capability of Rivers	107,840	-	-	25,000	-
	Yukon	Descriptive Study		-	-	5,000	-
	Yukon	Program Report		-	-	-	8,000
WATER QUALITY	Canada	Water Quality Monitoring Network	167,108	-	61,705	52,519	-
	Canada	Dissolved Oxygen		-	33,664	16,720	2,500
WILDLIFE	Yukon	Waterfowl - Nisutlin Delta		14,888	10,056	10,000	-
	Yukon	Moose Inventory		30,000	69,736	264	-
	Yukon	Furbearer Track Sampling		11,033	-	-	-
	Yukon	Furbearer Inventory	349,889	-	63,825	22,386	-
	Canada	Waterfowl/Raptor Inventory		-	37,863	35,963	-
	Canada	Spring Staging		-	15,807	26,068	-
	Yukon	Program Report		-	-	2,000	-
INFORMATION EXCHANGE	Yukon	Newsletter		757	-	-	-
	Yukon	Information Exchange & Coordination	109,605	-	25,149	45,763	37,936
STUDY ADMINISTRATION AND PLANNING	Yukon	Annual Reports and Final Report, Study Director's Office, Travel Reimbursement	491,073	58,823	119,463	155,473	157,314
	TOTAL		2,200,000	142,716	838,978	996,612	221,694

APPENDIX 4

YUKON RIVER BASIN STUDY REPORTS

A. HYDROLOGY PROGRAM

Hydrology Program Report.

July 1984.

Hydrology Report No. 1

"Yukon River Basin Flood Risk Study." October 1983.
Underwood McLellan Limited. Vancouver, B.C.

Dawson, Mayo and Ross River face significant flood risk during runoff each year. During break-up, Dawson also faces unpredictable flooding from floating ice jams. Two problems should be addressed: provision of a reasonable level of flood protection for existing development and establishment of strategies to prevent uncontrolled development on floodplains.

Hydrology Report No. 2

"Yukon River Basin Hydrometeorologic Data Network Assessment." March 1984. Janowicz, J.R. Department of Indian Affairs and Northern Development. Whitehorse, Yukon.

Networks collecting streamflow, precipitation, snow pack, temperature, sediments and other variables are operated by a variety of agencies in the Basin. The peripheral regions of the Basin have insufficient network coverage. The headwater areas of the upper Yukon and Teslin Rivers and the middle to upper Pelly and Stewart Rivers require overall network improvements and more data for potential development sites. The various networks should be assessed and updated periodically to meet changing needs.

Hydrology Report No. 3

"Yukon River Daily Hydrologic Flow Model." March 1984. Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

A streamflow model of the Yukon River in Canada was developed that computes the downstream effects of existing and proposed developments on river levels and flows.

Hydrology Report No. 4

"Yukon River Freeze-up and Break-up Study." June 1984. Gerard,R. University of Alberta, Edmonton for Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

Freeze-up and break-up of the Yukon River was observed in 1982 and 1983. Break-up was not found to proceed sequentially downstream as expected. The studies conclude that the effects on the ice regime of large-scale flow regulation would likely be substantial; therefore, ice effects should be examined in more detail in the event of a firm proposal for hydroelectric development.

B. WATER QUALITY PROGRAM

Water Quality Program Report.

April 1984.

Water Quality Report No. 1

"Water Quality - Yukon River Basin." December 1983. Jack, M.E., T.R. Osler and B.E. Burns. Department of Indian Affairs and Northern Development. Whitehorse, Yukon.

A network of 21 sites was sampled for 37 variables between September 1982 and September 1983. Major ions were found to reach the highest concentrations during winter when most of the flow originated as groundwater. Sediment-related variables were found to reach maximum concentrations coincident to peak discharge.

Water Quality Report No. 2

"Optimization of Water Quality Monitoring in the Yukon River Basin." 1984. Whitfield, P.H. Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

Data collected from the water quality network at frequencies of one and two weeks was analyzed to determine the optimum sampling frequency. The optimum sampling frequency for most variables at most sites was determined to be more frequent than once per week.

Water Quality Report No. 3

"Comparison of Dissolved Oxygen Processes Under Ice in Two Southern Yukon Rivers." 1984. Whitfield, P.H. and B.McNaughton. Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

Oxygen concentrations in the Nordenskiold and Takhini Rivers were found to be reduced during the winter under ice cover. The most severe reduction was in the organic-rich Nordenskiold River which reached 50 percent saturation. The reduction appears to be due to biological and physical processes. The theoretical model is extended to include two events not previously documented: the rapid depletion of oxygen during ice cover formation and the increase in oxygen levels in spring when light penetrates the ice cover before break-up.

Water Quality Report No. 4

"Field Equipment and Procedures for Water Quality Measurements Under Ice." 1984. McNaughton, B. Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

Water quality work in subarctic winter conditions was found to be a challenge. A propane-heated insulated box was used to protect a 'Hydrolab' 8000 continuous water quality monitoring system. An insulated field box was used to protect samples collected through the ice during analysis or preservation.

Water Quality Report No. 5

"Operation of the 'Hydrolab' 8000 System for Collection of Water Quality Data." 1984. Whitfield, P.H. Environment Canada, Inland Waters Directorate, Pacific and Yukon Region. Vancouver, B.C.

A 'Hydrolab' 8000 System was used to collect and store continuous temperature, depth, dissolved oxygen, conductivity pH and oxidation- reduction potential data. Data was transferred to an 'Osborne 1' system and by telephone line to a main-frame computer. A program for plotting each of the variables on standard scales was developed.

Water Quality Report No. 6

"Bibliography of Water Quality Information." December 1983. Environment Canada, Environmental Protection Service. Whitehorse, Yukon.

References gathered by the Water Quality work group for an overview of water quality information in the Basin are listed. Selected references on processes relevant to water quality in the Basin from other watersheds are also listed.

C. FISHERIES PROGRAM

Fisheries Program Report.

June 1984.

Fisheries Report No. 1

"An Annotated Bibliography and Information Summary on the Fisheries Resources of the Yukon River Basin in Canada" and map set "Fisheries Resource Maps". Ennis, G.L., A. Cinader, S. McIndoe and T. Munsen. June 1982. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 1657, Fisheries and Oceans Canada. Vancouver, B.C.

Two hundred and twenty-three reports related to the Basin's fisheries resources are summarized. The document also discusses fish processes, applicability of information and data gaps on a sub-basin basis. The distribution of freshwater species, salmon species, salmon migration routes and salmon spawning sites are presented on 1:250,000 scale maps.

Fisheries Report No. 2

"Effects on Arctic Grayling (**Thymallus arcticus**) of Short-Term Exposure to Yukon Placer Mining Sediments: Laboratory and Field Studies." May 1983. McLeay, D.J., A.J. Knox, J.G. Malick, I.K.Birtwell, G. Hartman and G.L. Ennis. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1171, Fisheries and Oceans Canada. Vancouver, B.C.

This report outlines the results of studies designed to assess the impacts to Arctic grayling of short-term exposure to Yukon placer mining sediments. Laboratory tested grayling survived in high concentrations of sediment (up to 10 000 mg per litre with variable mortalities above that concentration, dependent upon test conditions). However, surviving fish exhibited a number of abnormalities including acute stress response in sediment concentrations as low as 50 mg per litre. Field bioassays confirmed the stress response results while some mortalities occurred at lower concentrations of sediment (1 200 mg per litre) than occurred in laboratory tests.

Fisheries Report No. 3

"Stream Habitat Inventory and Evaluation for Two Study Areas in the Yukon River Basin" and map set "Aquatic Resource Inventory. Stewart River/Atlin Area." November 1983. Pendray, T. Department of Renewable Resources, Government of Yukon. Whitehorse, Yukon.

Sixty-five placer streams in the Stewart-Mayo area and 33 in the Atlin area were studied in the summer of 1982. Streams were divided into reaches of similar characteristics from aerial photographs, then sampled for physical and biological characteristics including fish presence. The information is summarized on maps at a scale of 1:100,000.

Arctic grayling were the most numerous species found. They preferred glide and pool habitat in streams with reach slopes of less than 1.5 percent. Chinook salmon fry were found in the Stewart-Mayo area in shallow, low velocity areas along the margins of larger streams. The inventory is suitable for implementation of a stream classification system. Approximately 15 percent of the Basin has now been inventoried by this method.

Fisheries Report No. 4

"Limnology of selected lakes in the Yukon River Basin." 1983. Shortreed, K., and J. Stockner. Fisheries and Oceans Canada. West Vancouver, B.C.

"An Assessment of the Fisheries Resource in 18 Lakes within the Yukon Territory, Canada." December 1983. Horler, A., R.A.C.Johnston and G.M.W. Cronkite. Fisheries and Oceans Canada. Whitehorse, Yukon.

Limnological investigations were carried out on 17 Basin lakes; a wide range of limnological variables was measured including light; temperature; water chemistry; bacterioplankton numbers; phytoplankton biomass and species composition; and, zooplankton biomass and species composition. On the basis of average total phosphorus concentration the lakes were oligotrophic to mesotrophic.

Fish species presence and abundance data were collected to provide essential information for the estimation of fish yield and the development of fisheries management strategies. Whitefish made up 41.4 percent and lake trout 36.2 percent of the samples netted from 18 lakes during 1982 and 1983. Lake trout, northern pike, humpback and round whitefish each occurred in at least 12 of the lakes. However, lake trout less than four years old were not caught in any lake. Lake trout were slow growing and most were mature at 11 years, several years older than in southern Canadian lakes. Lake trout were judged to be vulnerable to overfishing.

A management strategy based on fish yield estimates and species composition is recommended in order to respond to increased pressure on fish stocks in Basin lakes.

Fisheries Report No. 5a

"The Distribution and Abundance of Chinook Salmon (**Oncorhynchus tschawytscha**) in the Upper Yukon River Basin as Determined by a Radio-Tagging and Spagetti-Tagging Program: 1982-1983." 1984. Mulligan, P.A., W.O. Rublee, D.D. Cornett and R.A.C. Johnston. Fisheries and Oceans Canada. Whitehorse, Yukon.

In 1982 and 1983 spagetti tags were applied to chinook salmon near Dawson City. Recaptures of tagged and untagged salmon were used to generate estimates of the number of adult chinook returning to the Basin of 36,000 and 47,700 in 1982 and 1983 respectively. In 1983 roughly 18,000 of these fish were harvested in Canada.

Radio tags were applied in 1983 and chinook were tracked to their spawning streams. Sixty-one spawning sites (in excess of 100 spawners) have now been identified and sub-basins have been tentatively ranked in order of chinook production as follows: mid-Yukon mainstem, Teslin, Pelly, Stewart, upper Yukon mainstem, White, and lower Yukon mainstem.

Fisheries Report No. 5b

"The Distribution and Abundance of Chum Salmon (**Oncorhynchus keta**) in the Upper Yukon River Basin as Determined by a Radio-Tagging and Spagetti-Tagging Program: 1982-1983." January 1984. Mulligan, P.A., W.O. Rublee, D.D. Cornett and R.A.C. Johnston. Fisheries and Oceans Canada. Whitehorse, Yukon.

Estimates of the number of adult chum salmon returning to Basin waters were 49,900 and 118,400 in 1982 and 1983 respectively. In 1983, the chum catch in Canada was about 27,000 fish. In 1982 radio tags were applied to chum salmon and they were tracked to their spawning grounds. It is felt that most of the spawning locations which support over 1000 chum have now been documented. The White, mainstem Yukon and Teslin Rivers rank high in terms of chum production, whereas the Pelly and Stewart appear to support only low numbers of spawners.

Fisheries Report No. 6

"Creel Census Study on Fox, Marsh and Tagish Lakes in the Yukon Territory, 1983." June 1984. Horler, A., M.E. Jarvis and R.A.C.Johnston. Fisheries and Oceans Canada. Whitehorse, Yukon.

Anglers on Fox Lake (1 700 ha), Marsh Lake (9 600 ha) and Tagish Lake (35 400 ha) were interviewed and their catches sampled during the summer of 1983. The 1103 anglers surveyed retained 981 fish (1 528 kg) caught in 3004 hours of fishing. The majority of anglers were Yukon residents.

Lake trout, Arctic grayling and northern pike were the principal species caught. Lake trout comprised 58 percent of the Fox Lake catch, 61 percent of the Marsh Lake catch and 94 percent of the Tagish Lake catch.

Fisheries Report No. 7

"Some Notes on the 1983 Sport Fishery, Atlin Lake, B.C." December 1983. Chudyk, W.E. British Columbia Ministry of Environment. Smithers, B.C.

Anglers on Atlin Lake (64 000 ha) were interviewed in the summer of 1983. Three hundred and twenty-one anglers caught 299 lake trout and 72 grayling in 427 days of effort. Sixty-six percent of the anglers were Atlin residents participating in a local fishery.

Fisheries Report No. 8

"Life History and Habitat Utilization of Arctic Grayling (**Thymallus arcticus**) in Two Central Yukon Drainages." November 1983. Pendray, T. Department of Renewable Resources, Government of Yukon. Whitehorse, Yukon.

Spawning and movements of Arctic grayling, the most common fish in Basin streams, were observed in the South McQuesten and Mayo Rivers and three tributaries. Spawning began in the rivers in mid-May in 5°C water and ended by May 31. Throughout June and early July grayling of all ages migrated into tributaries.

Grayling in the Mayo River were largest and were mature at six years. The oldest grayling captured was 10 years. In the South McQuesten River most grayling matured at seven or eight years and the oldest captured was 15 years.

Fisheries Report No. 9

"Effects on Arctic Grayling (**Thymallus arcticus**) of Prolonged Exposure to Yukon Placer Mining Sediment: A Laboratory Study." January 1984. McLeay, D.J., G.L. Ennis, I.K. Birtwell and G.F. Hartman, Canadian Technical Report of Fisheries and Aquatic Sciences No. 1241, Fisheries and Oceans Canada. Vancouver, B.C.

Underyearling Arctic grayling survival throughout six week test exposures to sediment concentrations of 100, 300 and 1 000 milligrams per litre was high and unaffected by sediment strength. Fish growth decreased slightly but significantly at 100 and 300 mg/l and more markedly at 1 000 mg/l (33 percent relative to controls). The time to detect and consume live prey increased with increasing sediment strengths; the majority of fish failed to detect live food at 1 000 mg/l. In addition fish were displaced downstream at concentrations greater than 100 mg/l, they were paler in sediment-laden water and showed decreased resistance to other stresses.

D. WILDLIFE PROGRAM

Wildlife Program Report.

July 1984.

Wildlife Report No. 1

"Furbearer Inventory, Habitat Assessment and Trapper Utilization of the Yukon River Basin." (2 Volumes) January 1984. Slough, B.G. and R.H. Jessup. Wildlife Management Branch, Department of Renewable Resources, Government of Yukon. Whitehorse, Yukon

Wolves, red fox, coyote, red squirrel, weasel, marten, mink, otter, wolverine, beaver, muskrat and lynx are widely distributed in the Basin. All populations except marten are believed to be healthy. Long distance movements of wolverine and lynx were noted in 1982 and 1983, indicating food stress on these species. Wolverine, lynx and marten are harvested near the upper level of a sustainable harvest. Two prey species, grouse and snowshoe hare reached a low point in their cycle in 1981.

In the Basin, 350 to 400 people are employed by trapping. The Yukon-wide harvest exceeded one million dollars for the first time in 1982. Lynx comprised 82 percent of the harvest, marten contributed 8 percent, fox 4 percent, wolverine 1 percent, mink 1 percent and squirrel 1 percent.

One hundred and fifty-four documents on the furbearer resource and trapping are annotated in the appendix.

Wildlife Report No. 2

"Moose Population Dynamics and Habitat Use, Southern Yukon River Basin." May 1984. Johnston, W.G., D.G. Larsen, H.A. McLeod and C.A. McEwen. Northern Biomes Ltd. Whitehorse, Yukon.

Moose are the most important ungulate in the Basin providing food and income for many residents. In recent years, approximately 1000 moose were taken annually by licensed hunters and an unknown number by native hunters and poachers. Moose populations in southern Yukon are suspected to be declining.

A 24 219 km^2 area was divided into seven sub-areas and surveyed in early and late winter. The estimated population was found to be 4747 moose (0.21 moose per km^2) with adult cows comprising 45 percent of the population and adult bulls 19 percent. In 1981, yearlings comprised 13 percent of the population and in 1982, 2.5 percent. Calves comprised 11 percent of the population in 1981 and 8 percent in 1982. The low numbers of calves suggest a stable or declining moose population. The variability of densities suggests that extrapolation of estimates to other areas is not justifiable.

In the survey area, floodplain habitat is limited and moose were found at or above the treeline (1 250 metres). In other areas of Yukon, moose are found in floodplains in early and mid-winter. Floodplains also serve as calving and summering areas but the extent of use has not been assessed.

Wildlife Report No. 3

"Factors Affecting the Fall Staging of Waterfowl at Nisutlin Delta, Yukon." July 1984. Mossop, D.H. and T. Coleman. Department of Renewable Resources, Government of Yukon. Whitehorse, Yukon.

The Nisutlin Delta was confirmed to be the most intensively used waterfowl habitat in the Basin. About 4000 ducks, 2000 geese and 1000-3000 swans used the delta annually. Large variation occurred in species composition between the years. Band returns indicated that most ducks wintered in the Pacific flyway. Goose feeding strategy involved feeding flights from safe roosting areas over water to submerged aquatic communities of pondweed. As water levels dropped during the fall increasingly larger feeding areas were made available.

The water level regime and susceptibility to disturbance are two major management sensitive parameters identified. The processes described may have more general application throughout the Basin.

Wildlife Report No. 4

"Spring Staging of Waterbirds at Early Open Water Sites in the Yukon River Basin." December 1983. Johnston, W.G. and C.A. McEwen. Northern Biomes Ltd. Whitehorse, Yukon.

During spring migration, waterbirds arrive at the open-water outlets of Marsh, Tagish, Teslin and Little Atlin Lakes. These outlets offer large expanses of shallow water and exposed mudflats for feeding and loafing.

Trumpeter swans were the first arrivals, staying from March to May. The peak abundance of birds was reached with 10,000 on May 10, 1982 and 8,500 on April 23, 1983. A total of 33 species of waterbirds use the sites. Some of the common species include trumpeter swan, tundra swan, green-winged teal, American wigeon, mallard, northern pintail, canvasback, scaup and common goldeneye. Some of the rarer species were snow goose, white-fronted goose, American black duck, blue-winged teal, cinnamon teal, Eurasian wigeon, hooded merganser and oldsquaw.

Seventy-nine open-water sites west of Teslin Lake in the British Columbia portion of the Basin were also surveyed. Waterbirds used all but three of the sites.

Wildlife Report No. 5a

"Inventory of Canada Geese and Other Waterfowl on the Stewart, Pelly and Big Salmon Rivers of the Yukon River Basin, June-August 1982." April 1983. Johnston, W.G. and C.A. McEwen. Northern Biomes Ltd. Whitehorse, Yukon.

Canada geese were found to be concentrated between Fraser Falls and the mouth of the Lansing River on the Stewart River and between the MacMillan River and Earn River on the Pelly River. The maximum number of geese occurred on the Stewart River (482 birds or 0.85 geese/km) and the Pelly

River (109 or 0.32 geese/km) in early August. Canada geese definitely breed on the Stewart River, may breed on the Big Salmon and may not breed on the Pelly River. About 90 percent of non-breeding geese were associated with backwaters and shore bars which provided safe areas for feeding and loafing, good visibility for avoidance of predators and high quality forage from horsetails.

Breeding duck density was 44.3 pairs/km^2 of total water areas on 36 wetlands in the Pelly River valley and 15.3 pairs/km^2 on 37 wetlands in the Big Salmon River valley. The lesser scaup was the most abundant and widespread breeding species. River channels, bars and backwaters were used by significant numbers of non-breeding waterfowl for loafing and by common mergansers for nesting and brood rearing.

Wildlife Report No. 5b

"Inventory of Canada Geese and Other Waterfowl within the Yukon River Basin, June-August 1983." December 1983. McEwen, C.A. and W.G. Johnston. Northern Biomes Ltd. Whitehorse, Yukon.

The abundant wetlands of the Basin provide significant breeding and moulting areas for waterfowl. Northern wetlands provide critical alternate breeding and summering areas for drought displaced prairie waterfowl. Lesser scaup, mallard, American wigeon, green-winged teal, ring-necked duck, bufflehead and goldeneye were found to be the most abundant ducks on the marshes and shallow water wetlands of the Morley, Swift and Teslin Rivers.

There were 800 Canada geese on the Teslin (5.03 geese/km), Swift (0.71 geese/km) and Morley (0.41 geese/km) Rivers. Brood rearing was restricted to shore bars and backwaters on the rivers while non-breeding geese used both the rivers and large shallow water wetlands.

The Stewart, Pelly and MacMillan Rivers were used principally by non-breeding geese who prefer backwaters with horsetail forage. It appeared that geese used the headwater rivers for nesting and early brood rearing and progressively migrated downstream. As a result geese density increased on these rivers during the summer.

E. PLACER MINING PROGRAM

Placer Mining Program Report.

In press.

Placer Mining Report No. 1

"Placer Mining Industry in Yukon and Atlin Mining Division, British Columbia." February 1983. Debicki, R.L. Geology Section. Department of Indian Affairs and Northern Development. Whitehorse, Yukon.

Placer mining is important to the Yukon economy; Yukon placer miners produced 11,187,525 fine ounces of gold worth $365 million between 1885 and 1982. Atlin placer miners produced 615,234 crude ounces worth $21 million.

Between 1978 and 1982, placer miners were mining ground which had been mined before or was previously uneconomic. In 1982 the miner, working average ground containing 0.014 crude ounces per cubic yard at a cost of $4.50 per cubic yard, had to receive $329.50 U.S. per ounce of gold to break even. During part of 1982 the price of gold was below this price. In 1982, 215 mines employed 650 people in Yukon and 31 mines near Atlin employed 78. Should the price of gold increase again the industry is likely to expand into new areas.

F. ENERGY PROGRAM

Energy Program Report.

In press.

Energy Report No. 1

"Yukon Energy Bibliography." November 1983. Al Wright and Associates Limited and R.A. Hodge. Whitehorse, Yukon.

Complete citations and retrieval locations for 171 Yukon energy documents are provided. A partial collection of photocopied title pages, contents and abstracts and a partial collection of reports are filed in the Yukon Territory Archives as the Yukon Energy Collection.

Energy Report No. 2

"Electric Transmission Interconnection Study." May 1983. System Engineering Division, British Columbia Hydro and Power Authority. Vancouver, B.C.

Five alternative electrical interconnections between load centres in the Basin and outside sources were evaluated considering a single 500 kV transmission line at load levels of 150, 300 and 475 MW. Connections to the Susitna River generation site in Alaska and the Great Bear River site in the Northwest Territories appear to be feasible but expensive due to long transmission distances. The Stikine River and Liard River generation sites in British Columbia offer technically sound interconnections. Of the three Yukon - British Columbia alternatives the Stikine River - Whitehorse alternative is the least expensive. A load level of 475 MW would have a direct capital cost of $227 million and an annual cost of transmission of $19 million.

Energy Report No. 3

"The Inventory of Yukon Hydroelectric Sites - A Review of Investigations Carried out Between 1960 and 1983." October 1983. Monenco Consultants Pacific Limited. Vancouver, B.C.

In 1976 the hydroelectric potential of Yukon was estimated at 11 000 MW. A reliable inventory is required for planning and improving this estimate. Of the 100 sites in Yukon and northern British Columbia identified in 11 studies, more information is required on 25 sites before their potential can be evaluated, information on 65 is inadequate and information on 10 is adequate for planning. An improved estimate of potential cannot be made until studies of sites which represent 75 percent of the potential are revised to relate to socio-economic conditions and mitigation of negative impacts. Recent studies confirmed earlier studies for less than half the sites examined and suggest that there are more sites to be discovered.

A phased program over five to ten years to improve the reliability of the inventory is recommended. Studies of sites close to load centres should continue for short and medium term planning. The potential of larger scale sites must be established for long term planning.

Energy Report No. 4

"Review of Yukon Energy Demand Studies." March 1983. Hodge, R.A. Whitehorse, Yukon.

During the 1960's and early 1970's, nine studies estimated future Yukon energy requirements. More recently, two studies which considered all forms of available energy illustrated how the anticipation of fast growth and industrial activity in the 1960's has changed to slow growth and moderate industrial activity in the 1980's.

It is difficult to predict Yukon energy needs because of the economic dependence on the erratically performing mining industry: there is no compilation of baseline energy statistics, and the energy price regime and end-use differ from other areas.

Energy use predictions should be used as models to identify, test and evaluate conditions which could occur in future to assist policy decision-making. It is recommended that such a model be computerized to allow for continuous review and updating of assumptions and results.

Energy Report No. 5

"Storage and the Yukon Hydroelectric Potential - A Long Range Planning Issue." March 1984. Monenco Consultants Pacific Limited. Vancouver, B.C.

Yukon rivers with no large lakes can have maximum flows in excess of 300 times minimum flows; however, it is the minimum flow that determines the dependable rate of power generation. Electric demand is highest in winter when river flows are lowest. Man-made storage, while not increasing the annual flow, makes more of the flow useful.

Comparison of artificial lake storage and augmented natural lake storage suggests that the latter floods less land, requires lower dams, causes fewer fish migration problems, requires less land clearing and involves less drawdown.

Without regulation of the lakes in the Basin only 60 percent of a potential 4 500 megawatts could be developed. With water storage within the historic water level range, 79 percent of the potential could be developed.

Protection of the option of regulation of water levels within historic level ranges on Yukon River Basin lakes is recommended. In the upper Yukon River Basin, Teslin Lake is the most important lake with respect to storage potential.

Energy Report No. 6

"Yukon Energy Inventory and Utilization Review." October 1983. Marvin Shaffer & Associates Limited. Vancouver, B.C.

Development of Yukon's reserves of renewable and non-renewable energy is limited by small local markets and distance from large markets. The Basin's present energy needs are met by refined petroleum products, hydroelectricity, propane and wood. Future energy requirements may be met by increased hydro and wood; coal; waste diesel heat; geothermal; and natural gas.

Further investigation of community wood inventory, environmental problems and wood chipping is recommended. More information on small-scale coal heating applications is needed. The quality and feasibility of geothermal sources should be investigated as well as small-scale hydro, coal, geothermal, large-scale wind and wind-assisted diesel. Conservation should receive continuing emphasis in energy planning and programs.

G. TOURISM, PARKS AND RECREATION PROGRAM

Tourism, Parks and Recreation Program Report.

September 1984.

Tourism, Parks and Recreation Report No. 1

"Tourism, Parks and Recreation in the Yukon River Basin, Descriptive Synthesis" (3 volumes). 1984. Paish, C. Department of Renewable Resources, Government of Yukon. Whitehorse, Yukon.

Boating, angling, cottaging, camping, hunting and wildlife viewing are major water-related components of tourism and recreation. These activities are regulated or managed by a myriad of government agencies. Since tourism was the Basin's leading industry in 1983 and continued growth is expected, coordination and planning among the agencies is essential. Further, information is needed on both the availability of wilderness areas and visitor satisfaction. Improvements to destination areas, features, services and facilities are required. A more balanced presentation of heritage resouces is also recommended.

Tourism, Parks and Recreation Report No. 2

"Inventory, Analysis and Evaluation of the Recreational Capability of the Yukon River Basin " (4 volumes). November 1983. Reid Crowther & Partners Limited. Whitehorse, Yukon.

Participation in outdoor water-based recreation is expected to grow at a rate of six to ten percent a year during 1983 to 1993, especially in the areas of whitewater boating, recreational canoeing, and power boating. To manage this growth, information is needed on the various user groups.

Priority management areas with high recreation potential and competing uses are the lower Yukon, Nisutlin, Teslin, upper Yukon and Big Salmon Rivers and Kluane, Pickhandle, Teslin, Atlin, Kusawa, Nares and Tagish Lakes.

Water-based recreation is not the responsibility of any single government agency and as a result there is no common policy or planning approach. A structure to connect the requirements of each recreation use with the conservation of its resource base is needed.

Tourism, Parks and Recreation Report No. 3

"A Physical Description of Lakes and Rivers in the Yukon River Basin" (2 volumes). February 1984. Howard Paish & Associates Limited. Whitehorse, Yukon.

A physical description of 195 lakes and 81 rivers in the Basin is provided to permit an assessment of recreational capability and potential. Features described include name, drainage for lakes, location, access, elevation, mean depth, and alignment and length for rivers. Other information provided includes site description, vegetation, hydrological characteristics, water quality, fishery features, landscape aesthetics, existing uses, recreational features, recreational capability and recreational potential.

H. SOCIO-ECONOMIC PROGRAM

Socio-Economic Program Report.

June 1984.

Socio-Economic Report No. 1

"Update and Extension of Yukon Economic Account." (Report expected December 1984). Statistics Canada. Ottawa, Ontario.

The Yukon Economic Accounts summarize monetary transactions during a given time period and identify the most significant transactions, measure the value of goods and services in the economy and reveal the structure and major parts of the economy.

Time series data for monetary transactions in Yukon was extended from 1967-77 to 1961-81. The economic accounts data was converted from current to constant dollars, eliminating inflation and providing a more realistic picture of Yukon's economy over the past twenty years.

Socio-Economic Report No. 2

"Input-Output Table for Yukon." December 1983 (2 volumes). Mid-West Economic Research and Development, Incorporated. Saskatoon, Saskatchewan.

Input-output tables were developed for the Yukon and Yukon River Basin as a mechanism for organizing and gathering statistical data, for demonstrating how the production and consumption of goods and services is carried out and for indicating the interrelationships between sectors of the economy.

A basic 13 sector table was constructed for the Basin's economy using 1978 data and the data was updated utilizing a questionnaire that was circulated to randomly selected firms from each sector of the economy.

In 1978 the hardrock mining industry provided 76 percent of exports while tourism provided 22 percent (in the form of retail sales and services). Hardrock mining and government together accounted for 48 percent of all labour income.

Socio-Economic Report No. 3

"The Yukon Economic, Cohort-Survival and Energy Models." June 1983. Reaume, D.M. Alaska Economics, Incorporated. Juneau, Alaska.

A three-part model of the Yukon economy has been created to assist planning and policy formulation. The economic model is based on employment, income and consumption, population, labour force, housing, bank deposits and government. The cohort-survival model estimates Yukon population by age (five year intervals), race (native, non-native) and sex for the economic model. The energy model estimates energy demand by sector and fuel type for the period 1978 to 2006 using variables obtained from a previous simulation of the economic model.

Socio-Economic Report No. 4

"Economic Growth in Yukon, 1983 to 2003." February 1984. Alaska Economics, Incorporated. Juneau, Alaska.

Four simulations of potential growth scenarios were analyzed for Yukon's economy to the year 2003: base case, high-growth case, low-but-positive case and negative-growth case.

The negative-growth simulation suggested that the population will not drop below 20,000 unless the federal government drastically reduces spending in Yukon. The high-growth simulation suggested that the population would not exceed 70,000 unless there were major new mineral discoveries or significant changes in world metal markets. In the base case, total energy demand per capita would likely continue to decline unless the increase in real crude oil prices fell below two percent; however, electricity demand was expected to grow at about the same rate as population.

Simulations such as these will provide the basis for gauging the range of socio-economic impacts and are an important ingredient to planning for long-term management of the Basin's natural resources.

Socio-Economic Report No. 5 (4 Volumes)

Volume 1: (5a)

"Legal and Administrative Arrangements for Yukon River Basin Water Management." March 1984. Thompson, A.R. and A. Ourom. Westwater Research Centre, University of British Columbia. Vancouver, B.C.

In British Columbia, water resources are managed by the provincial Ministry of Environment and in Yukon by the federal Department of Indian Affairs and Northern Development. In both British Columbia and Yukon, water rights remain with the Crown; the right to use water is granted through a licence with attached conditions. In British Columbia, the Comptroller of Water Rights issues licences through the provisions of the **Water Act,** and the Waste Management Branch manages water quality through the provisions of the **Waste Management Act.** The Yukon Territory Water Board issues licences for water rights and waste disposal under the provisions of the **Northern Inland Waters Act** following a public hearing.

The **Canada Water Act** provides the authority for joint federal-provincial basin water studies such as the Yukon River Basin Study. Internationally, the Canada-United States Boundary Waters Treaty provides for the resolution of disputes along the international border.

Volume 2: (5b)

"Water Management in the Yukon Territory, Integration with Land Use Planning." March 1984. Thompson, A.R. and H. Reuggeberg, Westwater Research Centre, University of British Columbia. Vancouver, British Columbia.

Planning defines goals and criteria by which alternative courses of action can be weighed and resource use proposals assessed. It allows goals and actions to be periodically reassessed and changed. Planning is the purpose of a proposed "Agreement on Land Use Planning - Yukon Territory" under consideration by Canada and Yukon. The proposed agreement states that "land use planning will provide for the conservation, development and utilization of land, resources, inland waters and offshore". How water will be incorporated into the planning process is unclear. This report recommends that the Yukon Territory Water Board contribute to the development of the plan and implement it as appropriate through water use licences.

Volume 3: (5c)

"An Assessment of Legal and Administrative Arrangements Related to Placer Mining in the Yukon River Basin." March 1984. Fox,I.K. Westwater Research Centre, University of British Columbia. Vancouver, British Columbia.

In Yukon, there has been public controversy over the allocation and use of water required for placer mining. The existing institutions are perceived as inadequate to achieve a publicly acceptable balance between the needs of the placer miner and the needs of fisheries and other resources.

The **Yukon Placer Mining Act** makes no provision for other resources. The **Fisheries Act** is directed solely at the protection of the fishery and fish habitat. No process exists to resolve the strongly held differences between the placer miners and the Department of Fisheries and Oceans. A process of negotiation is recommended to determine the type and level of protection that should be given to fisheries and other resources.

Volume 4: (5d)

"An Assessment of Institutional Arrangements in the Yukon River Basin for Planning, Constructing and Operating Hydroelectric Power Facilities." March 1984. Fox, I.K. Westwater Research Centre, University of British Columbia. Vancouver, British Columbia.

The Northern Canada Power Commission is responsible for meeting electrical demand in Yukon. There is no formal means of integrating electric generation planning with overall energy use planning or planning for other resources. British Columbia has well-developed institutions for planning and developing electric power.

The **Canada Water Act** is the only formal means for cooperation across the B.C.-Yukon boundary and it does not provide for allocation of water. A formal arrangement between the governments should be considered if a project were proposed which concerned both jurisdictions. Additionally, the Boundary Waters Treaty and the International Joint Commission can resolve disputes between Canada and the United States of America in respect to Basin water resources.

APPENDIX 5

THE INDEPENDENT REVIEW GROUP REPORT

THE INDEPENDENT REVIEW GROUP REPORT

ON THE

YUKON RIVER BASIN STUDY

AUGUST 1984

The views, conclusions and recommendations are those of the Independent Review Group and are not necessarily those of the Yukon River Basin Committee or the Governments of Canada, British Columbia and Yukon.

LETTER OF TRANSMITTAL

September 4, 1984

E.M. Clark, Chairman
Yukon River Basin Committee
Vancouver, British Columbia

Dear Sir:

On behalf of the Independent Review Group, I am pleased to submit this report to the Committee of the Yukon River Basin Study. In the same breath, the Group expresses its enthusiasm at being able to participate in this valuable experience.

The Independent Review Group Report is a step towards a better understanding of how government and public are able to work together. This letter includes comments on the penultimate draft of the Committee Report in response to our Terms of Reference. Time restrictions made the inclusion in the Group's Report impossible.

Our Report discusses the problems of a Study that was predicated on a booming economy, which, in reality, did not happen. If there was a lesson to be learned from this, it is not evident in the Committee's Report. The predicted demand for hydroelectricity prompted the Study. Within the Report, tourism and recreation use seems to have usurped it as the primary use of the Basin's water, and thus is given more attention than other equally viable uses. The tendency to be swayed either by political pressures, or by the most economically advantageous use at the time indicates near-sightedness. The broader vision that results from regarding all the Basin's components with equal development potential is what the planners must focus on.

The overall feeling is that a more holistic and less specific approach to what the Basin is could have helped create a better Study.

It is our hope, however, that the Study will serve as a basis not only for the planning of our resources, but also provide a better understanding of how to conduct similar studies in the future.

Yours, most respectfully,

"J. Philip Adams"

J. Philip Adams, Author
Independent Review Group

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The author is indebted to the Independent Review Group members for their support and direction. In particular, the following deserve commendation: Douglas Urquhart for his personal dedication and invaluable advice during the writing of this Report, Maureen Morris who designed the cover and the staff of the Study Office who made the job easier and pleasant.

PART I

STATEMENT OF THE INDEPENDENT REVIEW GROUP

This report has a dual purpose:

-to provide a review of the study philosophy, process, and Yukon River Basin Study Report; and,
-to address the future participation of the public in similar government projects.

We found foresaken opportunities in the concept, oversights in the planning and holes in the gathered data. But we believe this Study is a step towards a more complete picture of what the Yukon River Basin is and how some of its parts interrelate.

The most significant part of our work was to strengthen the quality of the Yukon River Basin Committee's Report. We also considered how the public can cooperate more fully with government by contributing to the process of planning for the future use of our resources.

In an effort to improve the quality of decisions that must be made and the direction of future studies, we offer the following recommendations:

1. It is recommended that:
   a. at the preplanning stage a complete picture of existing and relevant information be provided to support a study rationale; and,
   b. at least 50% of the Preplanning Task Force be drawn from private agencies and the general public.

2. It is recommended that management of the Study itself be autonomous to ensure that the priorities remain faithful to the Study Objective and are not modified by government departments.

3. It is recommended that a survey of the past and present use of water by Native people be completed before any development plans are undertaken.

4. It is recommended that Basin studies adopt a holistic approach that will maintain emphasis on the interrelationship of all the Basin's components, rather than the individual parts.

5. It is recommended that future studies be flexible to adapt to a variety of economic development patterns.

6. It is recommended that the problems associated with in-house contracting be alleviated by:
   a. developing improved methods of assuring that government agencies meet deadlines; and,
   b. contracting more tasks to non-government agencies.

7. It is recommended that studies provide for direct public involvement at the preplanning stage, during the project and in the development of any plans to use the Basin's resources. (A public participation plan which could meet this objective is described in Appendix A.)

PART II

INTRODUCTION

1. The Independent Review Group

The Independent Review Group (IRG) was one facit of the public information and consultation plan of the Yukon River Basin Study (Study). It was designed to act as a "review mechanism in the preparation of the Study Report . . . so that it is sensitive to the attitudes and opinions of the Basin residents".[1]

The public in a democratic society has the right and responsibility to work with their elected representatives to create policies that reflect the concerns and needs of that society. This report is one effort, by a group from the public, at taking an active role in the planning of our future. It documents our feelings, thoughts and recommendations on the Study, the philosophy behind it and the process it underwent.

The job was for a cross-section of Basin residents to scrutinize each component of the Study and discuss their ideas with the Committee of the Study. Further, it is our hope that this report will serve as a precedent for the continued integration of public input into government planning.

2. Our Task

The Terms of Reference did not provide a clear mandate for how a review by the public would be undertaken. Thus we were concerned that IRG was created to become a "rubber stamp" of public approval for another government project and its expenditures. However, with the cooperation and approval of the Committee we established our own set of priorities and terms of reference. We proceeded with the confidence that our recommendations would be listened to and incorporated into the Study Report.

3. Terms of Reference

We determined that our job was:

i. to review and make recommendations to the Committee on the philosophy of the Study;
ii. to review and make recommendations on the process of the Study;
iii. to review and make recommendations to the Committee on the Program Reports and drafts of the Study Report;
iv. to review the Study Report and make recommendations on topics not addressed by the Study;
v. to review the Study Report to ensure that it was comprehensible and that the recommendations were sensitive to the concerns of the average citizen.

We decided to write an independent report of our activity including our recommendations for resource planners.

4. The Participants

Simply put, we were the ones who were most vocal during the public tour in the fall of 1982. We were not elected by our communities; we were selected by the Study Office. In the subjective opinion of the Director and the Information Officer a certain level of involvement and commitment to our Basin and our neighbours brought us to the meetings and opened our mouths. This, coupled with the criteria that such a group "provide a cross-section of attitudes and concerns . . . (that would be) . . . open-minded and receptive to a balanced discussion",[2] determined their invitation list. Appendix B is a list of those who accepted.

[1]W.G. Whitley - IRG meeting, November 10, 1983
[2]R.A. Snary - Ibid

We felt we could not represent the public at large. We were not experts in public opinion, nor agents for the numerous concerns of Basin residents. We were, however, individuals from the public working as an apolitical group to make a layperson's perspective an integral part of government policy-making. Informal communication with our community concerning the Basin and its Study enhanced the scope and accuracy of our contribution.

We were given the name "Public Task Force". After concluding we were not a public body and the words "Task Force" were not specific, we renamed ourselves the Independent Review Group, because that's what we were and that's what we did.

PART III

REVIEW OF THE YUKON RIVER BASIN STUDY

1. Philosophy

A discussion of the ideas behind the Study and how it was interpreted will serve as a basis for the comments in this report.

The task of the Study was to collect information about water in the basin of the Yukon River, to determine its uses and its users, and to assess how one could affect another, both now and in the future. Accordingly the Study attempted to describe the Basin "mainly through a synthesis of existing data but in some cases through the generation of new data".[3] The end product was to be a picture of the Basin framed with guidelines for the best possible use of its water resources.

The Study was needed. Raw materials, such as oil, fresh water, wilderness and minerals, are being depleted in the South. Recent attention has been focused on the North as a possible supplier. Development of these resources would mean specific changes, which in turn would put pressure on the environment and its inhabitants. Little information existed about the nature of that pressure and how it might affect the ecological, economic and social conditions within the Basin.

Considerable data about the Basin's resources was already available, although often inaccessible and/or redundant. The requirement was for an analysis of this data that would lead to responsible and efficient uses of the resource.

The Study was unique. It was designed to:
a) act as an intermediary between the caretakers and the planners;
b) assemble information from the government and private sources;
c) take specific information and give it a broader meaning; and,
d) research areas that were not the responsibility of a specific ministry.

1.1 Preplanning Task Force

The interpretation of this philosophy was the responsibility of the Study Committee. Its development and implementation was the task of the Study Director. **Somewhere between the philosophy and the implementation a major misinterpretation occurred**. Studies were developed that did not fall under the mandate of the Study; rather they seemed to fit neatly into the responsibilities of government departments. **Consequently, the priorities and objectives of these individual ministries transcended the objectives of the Study.**

[3]Study Components

The origin of this misinterpretation was the Preplanning Task Force and its Report. The Task Force was instructed ". . . to assess potential conflicts, to identify studies and/or decisions required . . ."[4] that would promote the effective management of a resource. To determine if further studies were required it was necessary to know what information was already available. **The collection of this information was the responsibility of the Preplanning Task Force.** This information could have been analysed by the Study to determine solutions to the conflicts and thus provide the planners with a clear picture of how the resource could be put to use. Then, and only then, could a Study have been created to provide the "synthesis of existing (and new) data."[5] Just a simple listing of available information, such as bibliographies and inventories, is not sufficient to allow planners to make those decisions. In order to evaluate the development alternatives,[6] this analysis of what should or should not be developed must be presented. This is the basic rationale behind the need for a study of a river basin.

The Preplanning Task Force erred by going directly to the "various (government) agencies . . . to determine their responsibilities, ongoing programs and information needs".[7] The predictable result was that each ministry identified data gaps within their own departments and saw an opportunity for them to be filled at the expense of the Study. This is what IRG called "in-house tunnel vision". By this we mean, **the Preplanning Task Force, because its members were pooled from various government agencies, focused its attention and recommendations on filling the requirements and mandates of those agencies.** This limited their ability to perceive that such a Study could provide valuable and needed research in areas not covered by any one ministry. It was this information that would allow the planners to see "the trade-offs involved in choosing one course of action over another".[8] (For example: to know how moose **use** the shoreline, not how many there are, helps decide whether it is better to let them live there or force them to move because of a potential hydro development.) Originally the Task Force identified this question of "trade-offs" as a rationale for the Study, but somewhere it got lost in the shuffle.

THEREFORE IT IS RECOMMENDED THAT AT THE PREPLANNING STAGE:
A) A COMPLETE PICTURE OF EXISTING AND RELEVANT INFORMATION BE PROVIDED TO SUPPORT A STUDY RATIONALE; AND,
B) THAT AT LEAST 50% OF THE PREPLANNING TASK FORCE BE DRAWN FROM PRIVATE AGENCIES AND THE GENERAL PUBLIC.

IT IS FURTHER RECOMMENDED THAT THE MANAGEMENT OF THE STUDY ITSELF BE AUTONOMOUS TO ENSURE THAT THE PRIORITIES REMAIN FAITHFUL TO THE STUDY OBJECTIVE AND ARE NOT MODIFIED BY GOVERNMENT DEPARTMENTS.

[4]Preplanning Task Force Report (1979)
[5]Study Components
[6]Study Objective
[7]Preplanning Task Force Report (1979)
[8]Ibid

1.2 Data Collection

Ministries are created to be the curators of the resources. It is their job to conduct inventories, provide an up-to-date bibliography of existing information, to have an accurate assessment of the various networks and institutions pertaining to their charge and above all to manage the resource. Just because this information was not available does not automatically make its collection a Study responsibility. In other words, it was not the Study's job to count the ducks. To this the Committee responded "It does not matter who did the studies . . . the concern was the need for information".[9] The majority of what the Committee chose to study, therefore, was a misapplication of what IRG believes to be the philosophy. The Study had another highly specialized task: to synthesize, analyze and integrate the data. **Potential conflicts over water use will be resolved when researchers are encouraged to study the significance of the environmental factors influencing species, i.e., how they use their environment instead of studying abundance and distribution.**

There are several aspects to this conclusion. Inventories monitor the range and density of populations. Because species abundance varies with time, inventories may be considered relevant for only a few years. For example, to know the number of moose in an area at a given time is significant only when compared to previous inventories. Consequently a single census contributes nothing to the purpose of this Study. It provides few answers to managerial issues such as habitat use, response to change, shared use of a resource, etc.

The Basin Study had the opportunity to examine and provide research towards a better understanding of how one use affects another. For example, the work done on the sediment effects of grayling (Project No. 33) was an excellent topic and will be of great value now and in the future, regardless of how many grayling there are. Conversely, the Water Quality Work Group did not study the relationships between sewage treatment and disposal, water-borne bacteria and groundwater, all of which are vital issues facing managers in all of the North, not just the Basin.

Thus IRG estimated that the diversion of funds to fulfill ministerial mandates rather than studying the significance of water use resulted in 58% ($917,456) of the budget being allocated outside the Study mandate (excluding Information Exchange and Administration). The remaining 42% was money well spent and contributed to what IRG believes valuable for managers as they create a Plan (Table 1).

1.3 Native People

IRG feels strongly about the distinct lack of any specific work regarding Native people in the Basin and their dependency on water. Indians, more than any other single group, use and depend on the waterways of Yukon as an integral part of their heritage, culture and lifestyle. Water provides a source of income, food and transportation. If any changes were to occur to the resources as a result of a water development project, the Native people would be the most directly affected.

THEREFORE IT IS RECOMMENDED THAT A SURVEY OF THE PAST AND PRESENT USE OF WATER BY THE NATIVE PEOPLE BE COMPLETED BEFORE ANY DEVELOPMENT PLANS ARE UNDERTAKEN.

1.4 Topics Not Addressed

Although forestry and agriculture are land-based, they would be directly affected by any major change in the water systems. Further, IRG believes that aesthetic, non-consumptive values are vital to both residents and non-residents of Yukon. The Study should have devised methods to assess this value

[9]E.M. Clark - IRG/Committee meeting, March 10, 1984

TABLE 1
AN ANALYSIS OF PROJECTS INSIDE AND OUTSIDE THE Y.R.B.S. MANDATE

Program	Project	Outside $	Inside $
Hydrology	Network Assessment	9,002	
	Daily Hydrologic Flow Model		14,000
	Evaluation of Scenarios		4,000
	Winter Ice Cover & Break-Up	53,217	
	Natural Flooding	25,000	
Energy	Archival Task	10,000	
	Hydroelectric Inventory	45,000	
	Potential Interconnections		5,000
	Demand Study Review	5,000	
	Hydroelectric Planning		25,000
	Energy Alternatives		30,000
Fisheries	Inventory Existing Fish Data	23,828	
	Salmon Inventory	260,000	
	Fisheries Placer Mining Studies:		
	Sediment Effects on Grayling		99,967
	Stream Habitat Inventory		84,746
	Stream Habitat Evaluation		41,000
	Fisheries Socio-Economic Studies:		
	Lake Productivity Index		25,000
	Creel Census of Three Yukon Lakes	10,000	
	Creel Census of Atlin Lake	9,216	
	Integrate Fisheries Data		18,999
Placer Mining	Description of Placer Mining		8,912
Socio-Economic	Input/Output Tables		34,022
	Economic Accounts		21,601
	Simulation Model		40,264
	Socio-Economic Data Analysis		37,812
	Socio-Economic Institutional Analysis	33,899	
Tourism, Parks & Recreation	Tourism, Parks & Recreation Program	46,000	
	Recreational Capacity of Lakes		23,840
	Recreational Capacity of Rivers		25,000
	Descriptive Study		5,000
Water Quality	Water Quality Monitoring Network	114,224	
	Dissolved Oxygen		52,884
Wildlife	Waterfowl - Nisutlin Delta		34,944
	Moose Inventory	100,000	
	Furbearer Track Sampling	11,033	
	Furbearer Inventory	86,211	
	Waterfowl/Raptor Inventory	73,826	
	Spring Staging		41,875
	Integrate Wildlife Data	2,000	
	TOTAL	917,456	673,866
	PERCENTAGE	58%	42%

and its application to the shared use of the resources. In addition, archaeological sites along the shorelines are the cornerstones of our shared cultures, the importance of which was ignored. In point of fact, the Socio-Economic Report is a misnomer - it did not study the "sociology" of the Basin. Any development, be it hydro or wilderness is for people and ultimately the focus must be directed towards them. Therefore, it is vital to have a better understanding of how people live and recreate here.

THEREFORE IT IS RECOMMENDED THAT BASIN STUDIES ADOPT A HOLISTIC APPROACH THAT WILL MAINTAIN EMPHASIS ON THE INTERRELATIONSHIP OF ALL THE BASIN'S COMPONENTS, RATHER THAN THE INDIVIDUAL PARTS.

Soon after the Study was established, its motive disappeared - the economy plummeted and with it the demand for hydro. It became obvious that there was no built-in mechanism by which the Study could adapt to a fluctuating economy. (Only one program, Tourism, Parks, and Recreation, had its budget altered.) It was not the luxury of hindsight that allowed IRG this observation; the creators of the Study were aware of the "boom and bust" syndrome of the northern economy, but did not address it.

THEREFORE IT IS RECOMMENDED THAT FUTURE STUDIES BE FLEXIBLE TO ADAPT TO A VARIETY OF ECONOMIC DEVELOPMENT PATTERNS.

2. Process

In the opinion of the Independent Review Group, the Yukon River Basin Study did not fulfill its Objective to "undertake jointly studies leading to the formulation of a planning framework under which potential development alternatives may be evaluated".[10] This Report has identified a serious misapplication of the philosophy which precludes any satisfaction of that Objective. The majority of funds were allocated to inventory instead of integration. As a result, the "preplanning framework" which was to be prepared was impossible to complete.

The individual project reports consistently identified the need for more information before a management plan could be written, instead of providing a synthesis of the work done. IRG saw this as self-service. By "self-service" we mean that stating the need to fill these gaps can be construed as creating the next job for the researchers and authors of those reports. **An evaluation, if it is to lead to responsible decisions, cannot be made under a framework that, for the most part, is the identification of more data gaps.** The work done on the impacts and relationships are the materials used to construct an "interjurisdictional framework". This was the main priority of the Committee. It alone would allow planners to evaluate the opportunities for best use.

2.1 Process Flaws

A serious problem occurred with the scheduling of the work groups. Many contractors were late in submitting their reports. IRG feels that this was largely due to in-house contracting. Within a government bureaucracy it seems difficult to establish and adhere to deadlines. However, the Study was outside any specific government and, like any other general contractor, should have established a control mechanism by which an effective "hammer" could have been used against the recalcitrant authors. The ripple effect of late submissions reduced the time available to prepare the final Study Report, so that to date, the thrust seemed to be just to get it done - not necessarily to do it well.

THEREFORE IT IS RECOMMENDED THAT THE PROBLEMS ASSOCIATED WITH IN-HOUSE CONTRACTING BE ALLEVIATED BY:
A) DEVELOPING IMPROVED METHODS OF ASSURING THAT GOVERNMENT AGENCIES MEET DEADLINES;
B) CONTRACTING MORE TASKS TO NON-GOVERNMENT AGENCIES.

[10] Study Objective

3.1 Public Participation

The gap that exists between what government does and what the public wants them to do is a serious one. To bridge this, the government must not isolate itself with a bureaucratic formality and the public must speak with a clear and concise voice about its priorities.

In response to the Inland Waters Directorate mandate that "public participation be an integral part of (river basin) studies", the Committee invited the public to assist them. Citizens volunteered to help because they were concerned about how the government makes policy and in particular, those policies affecting the environment of their Basin. They saw this participation as an opportunity to have direct input into the development of efficient and effective policies that spoke to the needs and concerns of the Basin residents.

Soon after IRG was established, we realized that the public was brought in too late to have any influence on the nature or direction of the Study. Essentially our job became editorial. We took information that the Committee and Study staff thought to be important and assessed their treatment of it as presented in the Program and final Study Reports. We were then asked to help make it "sensitive to the attitudes and opinions of the Basin residents". However, we discovered that those "opinions" played no direct role in the initial design of the Study.

The Study is not just a product; it is a process as well. IRG was asked to work with the Committee to formulate their recommendations from the work done by the Study, but we feel **the public has a deeper responsibility than to act as literature reviewers. It must also participate in designing the structure so that the Study itself, not just the final Committee Report, is "sensitive to the Basin residents".** Otherwise the Report will only be a symptom of problems that began at the preplanning stage. A review by a public group (IRG) can do more than patch up a weak report - it can identify potential problems at an earlier stage.

The Committee delayed going to the public earlier because "there was nothing to give them".[11] To IRG, this thinking was backward. At this stage it is not a question of what to give them, it is what to take. **Members of the public should have an opportunity at the preplanning stage to express their feelings in concert with the experts from the government and together create the Study's Terms of Reference.** The public takes its job seriously and is willing to help. Fourteen people volunteered their time for six days of meetings in an effort to strengthen the quality of the Study Report.

During the planning stages an evaluation of public input in the Okanagan Basin Implementation Agreement Public Task Force Report (1980) was ignored. It states that "Public input at an earlier stage, before the Agreement was drawn up, would have soon made (the neglected areas of study) evident". Albeit, the Study is the stage before the implementation level, still the nature of their recommendation remains constant and is endorsed by this IRG - **that public input at all stages is valuable.** Further, the Committee did not adhere to a statement in its own Preplanning Task Force Report that ". . . the public would participate in the preparation of a public involvement program (which) could include selected meetings to detail the proposed planning study . . ." If it had, the problem of a Study being derailed from its Objective might not have occurred. The Public Tour (Autumn 1982), although a valuable exercise for both the Study and the public, left no opportunity to reorient the Programs that many residents felt were misaligned. The Study was half over before the tour and subsequent public participation plan got underway.

An external monitor in the form of an IRG at the preplanning stage might have:
a. kept the Study oriented towards its objective;
b. ensured a more responsible allocation of the budget;
c. defused public criticism regarding wasted public funds; and,
d. produced a more beneficial report.

[11] E.M. Clark - IRG/Committee meeting, March 10, 1984

The provision for direct public input was a step in the right direction. The conclusion is that another one must be taken.

Our work with the Committee has had a two-fold reward. The Report has reaped benefits from having undergone a pre-publication review. We also produced a description of how the public can become directly involved with the formation of government policy. The Committee of the Study is to be commended for their sincerity and commitment towards creating a meaningful dialogue with members of the public. Both groups expressed their enthusiasm that the system worked - the public spoke clearly and the bureaucrats listened and responded.

IRG is also committed to the participation of the public in the government planning process. If the resources of the Basin are to be used, the public voice would be heard before irreversible decisions are made. The provision for this ongoing contribution strikes at the heart of a truly responsible government.

THEREFORE IT IS RECOMMENDED THAT STUDIES PROVIDE FOR DIRECT PUBLIC INVOLVEMENT AT THE PREPLANNING STAGE, DURING THE PROJECT, AND IN THE DEVELOPMENT OF ANY PLANS TO USE THE BASIN'S RESOURCES. (A PUBLIC PARTICIPATION PLAN WHICH COULD MEET THIS OBJECTIVE IS DESCRIBED IN APPENDIX A.)

APPENDIX A

GUIDELINES FOR THE CREATION AND FUNCTION OF A PUBLIC PARTICIPATION PLAN

A modified description of how the Independent Review Group was established for the Yukon River Basin Study (1984) could serve as a prototype for the future involvement of the public in government policy-making processes. The rationale for these guidelines is that, in the opinions of those concerned, this process worked.

Establishing a Review Group from the Public

For future projects or studies where a review group is seen as beneficial, the following selection process is suggested:

a. Convene a series of Public Meetings in the designated area to describe the proposal and request public input. A Liaison Officer will be responsible for recording the minutes. (See Logistics);

b. Review of these proceedings will produce a list of individuals who displayed the requisite criteria of being apolitical, open to balanced discussion and having a specific, non-professional interest in the project. This list will include not less than three individuals from each sub-area and have a total not less than ten people. (This will create a diverse, yet manageable group, which, given the constraints of "volunteer time", will ensure a quorum);

c. The people selected will be briefed on the purpose and function of an independent review group and be invited to participate; and,

d. The review group will be established prior to the planning of the project (as per IRG Report Recommendation #7) and will function throughout all phases of the project until the final Report is complete.

Functions of an Independent Review Group

The fundamental purpose will be to provide a sounding board and internal critic that will report directly to the management team of the project. The intention of the group is to provide a constructive review and make recommendations that will assist management in their decisions.

The review group functions at the various project phases will be:

PLANNING

1. review project philosophy;
2. identify the group's priorities for a Terms of Reference;
3. review budget allocation;

PROCESS

4. monitor progress of components;
5. monitor progress of individual studies;
6. review individual studies and subsequent program reports;
7. review drafts of the Committee's report;
8. prepare an independent report.

Logistics

Liaison Officer

The establishment and management of this process will be the responsibility of a Liaison Officer. This position requires a person to intermediate and be sensitive to the diverse needs and responsibilities of both management and the public review group. The success of this type of public participation may depend on this person.

The Liaison Officer will:

a. provide the management team with a list of potential group members and participate in the selection process;

b. establish and manage the group's affairs (expense accounts, meeting arrangements, etc.);

c. act as a point of contact for the group;

d. facilitate communication between the group members;

e. facilitate communication between the group and management; and,

f. produce a report of the review process.

Cost

Participation will be voluntary. However, expenses incurred by the membership will be subsidized (travel, communication, etc.). Provision will also be made for the preparation, writing and distribution of the independent review group's final report.

These costs will vary depending on the size, scope and duration of the project, but are to be considered prudent.

APPENDIX B

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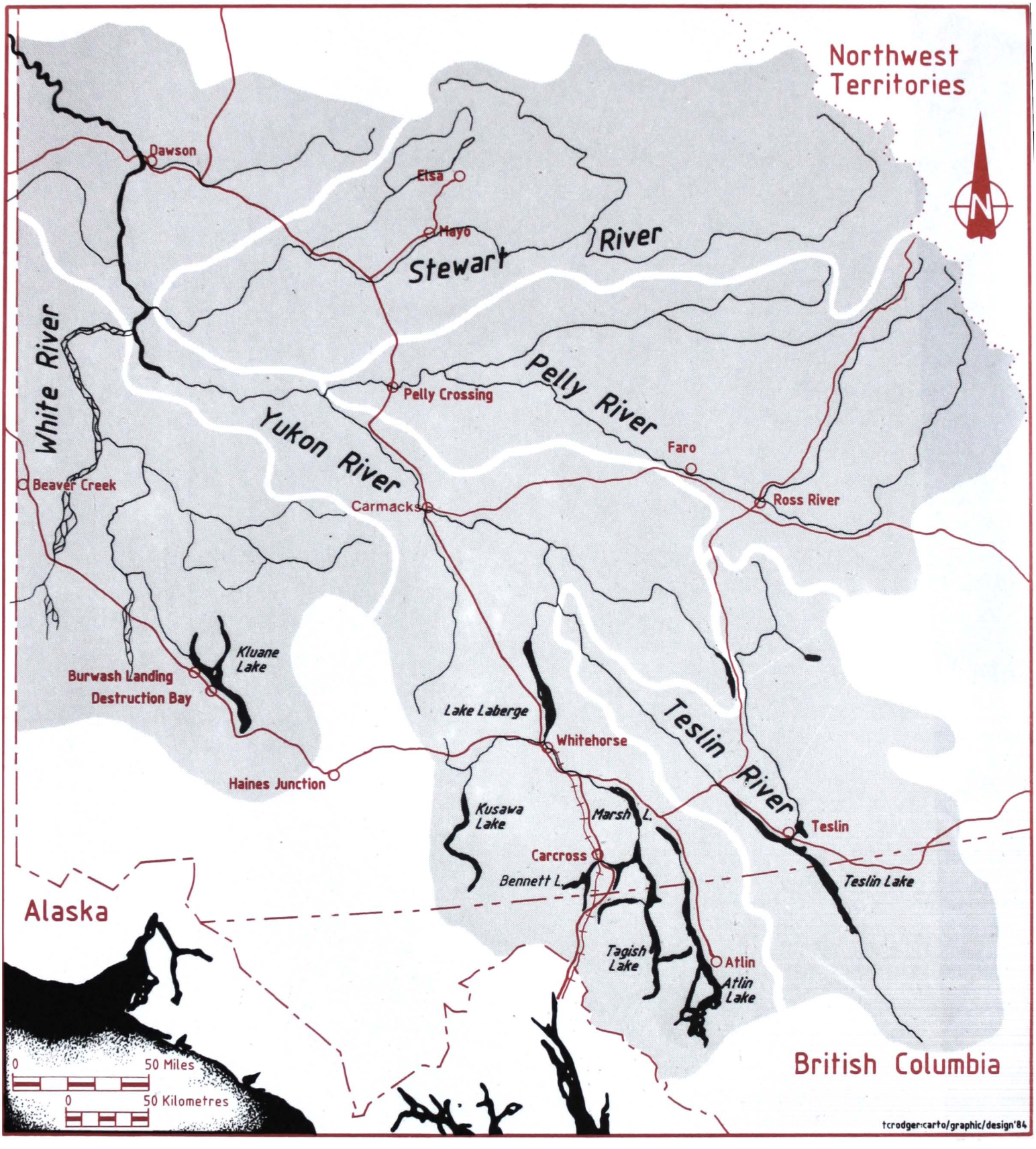

Yukon River Basin