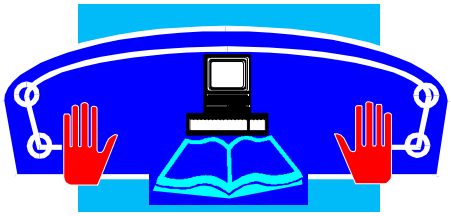

A Strategic Plan For Forestry Development In The Lower Liard Area Of The Northwest Territories; Volume I; Main Report

Type of Study: Planning / Strategy Forestry, Forestry In The Liard

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Author: Wr Dempster And Associates Ltd

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May 31, 1986

Our ref: A3

Mr. John Sheehan.
Dept. of Economic Development & Tourism
Government of the N.W.T.
P.O. Box 240
Fort Simpson, N.W.T.
X0E ONO

Dear Mr. Sheehan,

Re: Lower Liard Forestry Development Project

Please find enclosed four draft copies of our report, each consisting of Volumes 1, 2, and 3. I understand that you will distribute these for review by the Project Manager (Mr. Harry Deneron) and others.

The study was challenging, and took considerably more time than we initially scheduled, but we are favorably impressed by the potential of both the project and the LVBDC. We should be very happy to provide further assistance in implementation of the Strategic Plan.

We have computerized the planning model used in economic analyses. Consequently, we are in a good position to conduct additional analyses inexpensively, should (for example) the LVBDC require evaluation of financing options not covered by this study.

I look forward to discussing the study with Mr. Deneron and yourself once you have had a chance to review the enclosed report.

Yours truly,
W.R. DEMPSTER & ASSOCIATES LTD.

Per:
W.R. Dempster

WRD/bc
Enclosures

A STRATEGIC PLAN FOR

FORESTRY DEVELOPMENT IN THE LOWER LIARD AREA

OF THE NORTHWEST TERRITORIES

prepared by

W.R. Dempster & Associates Ltd.

for the

Liard Valley Band Development Corporation

VOLUME 1

MAIN REPORT

May 1986

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SUMMARY

Previous studies by the Department of Indian and Northern Affairs indicated that the Lower Liard valley contains sufficient timber to sustain sawmill production of up to 20 MMfbm (million feet board measure) of lumber annually. In spite of the presence of extensive stands of spruce sawtimber, the resource has so far hardly been utilized.

In the present study, forest inventory information required as a basis for development planning and sawmill design was collected on the most suitable area for supplying a wood-processing facility at Fort Liard. Results confirmed high volumes of white spruce sawtimber with generally favorable characteristics of size, form, and operability.

However, much of the timber is prone to "shake", a defect which could have a very adverse effect on lumber grade realisation, log export potential, and profitability. The defect was impossible to fully assess in the field study because, to a large extent, it is not manifested until the timber is sawn and dried. It is therefore recommended that a mill test should be undertaken before development proceeds beyond the planning phase. This would involve taking sample logs from the supply area to a sawmill, where they would be sawn, dried, and graded under controlled conditions and skilled supervision.

Overmaturity of the timber (much of which is over 200 years old) renders it increasingly susceptible to fire, wind-throw, and insect infestation. Provisions for reducing the associated risks to timber supply must be incorporated into forestry planning concepts.

An analysis of markets and competitive supply sources indicated that the most promising market is for dried planed construction lumber within the Northwest Territories. It would be overly optimistic at this time to assume that a Fort Liard mill could successfully compete for more than about 5 MMfbm of Territorial consumption per year. Other promising options, such as log exports, were investigated, but their attainment is made uncertain by the defect problem and other factors. This uncertainty could be

substantially reduced by the mill test proposed above. For the forseeable future, forestry development is likely to be constrained by markets to a level of roundwood consumption far less than the sustainable harvest potential of the Lower Liard forests.

Successful development of a wood-based industry at Fort Liard will need to accommodate some special constraints. These include: employment of a small group of initially inexperienced people; a small and limited market; short logging, shipping, and construction seasons; overmature timber containing a high proportion of shake; a location remote from industrial service centres; and the maintenance of traditional land uses.

Consideration of these and other factors eventually led to the design of a combined sawmill and planermill in which the two processes of sawing and planing operate consecutively during the summer. A kiln, heated by waste-wood fuel, would be used to dry the rough lumber before planing. Logging, including hauling of wood to the mill and associated road construction and maintenance, would be undertaken during the winter. Lumber would be shipped by barge and road transportation.

The project at maturity would employ between about 17 (winter) and 24 (summer) local people in the logging and manufacturing operations, and annually produce 5.2 MMfbm of lumber worth over $1.3 million, plus about 800 cords of firewood for community use. It would provide reliable and ongoing opportunities for local contractors such as Beaver Enterprises.

It must be stressed that first-class planning and training are imperative to the success of the project. Training Is particularly important in the manufacturing operation.

Economic analyses of development alternatives were conducted with a computerized planning model developed especially for the purpose.

The recommended 10-year development program which was finally selected encompasses six stages to plan, construct, start-up, and bring to maturity an operation which substantially meets the goal of expanding and stabilizing the community-s economic base. However,

it was found that a conventionally financed project of the scope considered necessary for successful operation would not be economically viable, given the limited markets so far identified and the capital costs of the manufacturing facility.

It is suggested that the project would have a high level of social benefit and sufficient economic potential to merit serious consideration by government to support the capital cost (approximately $4 million) through a combination of grants and interest-free loans, and to fund training programs during the development and growth phases. Given this sort of support, the project would break-even, and be in a position to begin loan repayments, within three to four years. Sensitivity analyses suggested that the project has sound economic potential given favorable capital financing, especially if larger and more diverse markets can be identified in the future.

1. INTRODUCTION

The people of Fort Liard have established the Liard Valley Band Development Corporation as a vehicle for ensuring economic benefits for residents of the community from resource development activity in the Lower Liard. The extensive stands of white spruce sawtimber in the area have long been considered a potentially valuable resource. In March 1985 personnel of the Government of the Northwest Territories met with executives of the Development Corporation to discuss forestry-related development opportunities.

It was concluded that a strategic plan for wood processing was required, of a form and content suitable for submission by the Corporation as an application for financial assistance at least through a development phase. This conclusion led to the formulation of terms of reference for the study described in this report. The consultants were requested to prepare a strategic plan for wood processing in Fort Liard, based on an evaluation of the timber supply and a thorough examination of markets, logging, and investment alternatives.

The following report is divided into two parts. The first is a summary of the information on resources, markets, and infrastructure which formed the basis of the plan. The second is the strategic plan for a forest-based industry in Fort Liard. This includes an evaluation of objectives, constraints, issues, and alternatives for development and a recommended 10-year phased development program supported by operational plans and economic analyses.

2. RESOURCES AND MARKETS

2.1 FOREST RESOURCES

2.1.1 The Regional Timber Resource and Its Management

The Lower Liard River watershed contains the main concentration of merchantable-sized timber in the Northwest Territories. The Lower Liard Timber District occupies an area of over two million hectares, of which more than 80 percent has been classed as stocked productive forest land. However, much of this land contains immature timber, low-valued hardwoods, or is marginally productive, inaccessible, or otherwise unsuitable for harvest operations.

In 1982 the Department of Indian and Northern Affairs (DIAND) completed a forest inventory of the Lower Liard, and defined a Harvest Area containing 73 000 ha of relatively accessible stands with about 10 000 000 m3 of white spruce sawtimber (see Figure 1). It was concluded that a sustainable annual cut of 87 600 to 100 000 m3 could be harvested from this area. These estimates (wisely, in view of the lack of data) did not take into account the contribution of immature stands and growth which may increase the long-term harvest potential, nor the possibility of catastrophic losses of growing stock which might result from fire or other influences before the overmature inventory can be harvested.

To date there has been little demand for timber utilization and no significant drain on the resource. There is one small sawmill near the Blackstone River (downstream from Nahanni Butte) producing less than 300 Mfbm (thousand feet board measure) per year. In the Fort Liard area small amounts of timber have been harvested for log-building and fuelwood. There have been no recent catastrophic losses of timber in the Harvest Area although unquantified amounts of irregular mortality (die-back and wind-throw) are evident.

The lack of demand for timber has created little demand for timber management. There are no timber harvesting agreements active in the area. Timber cutting is controlled through the issuance of

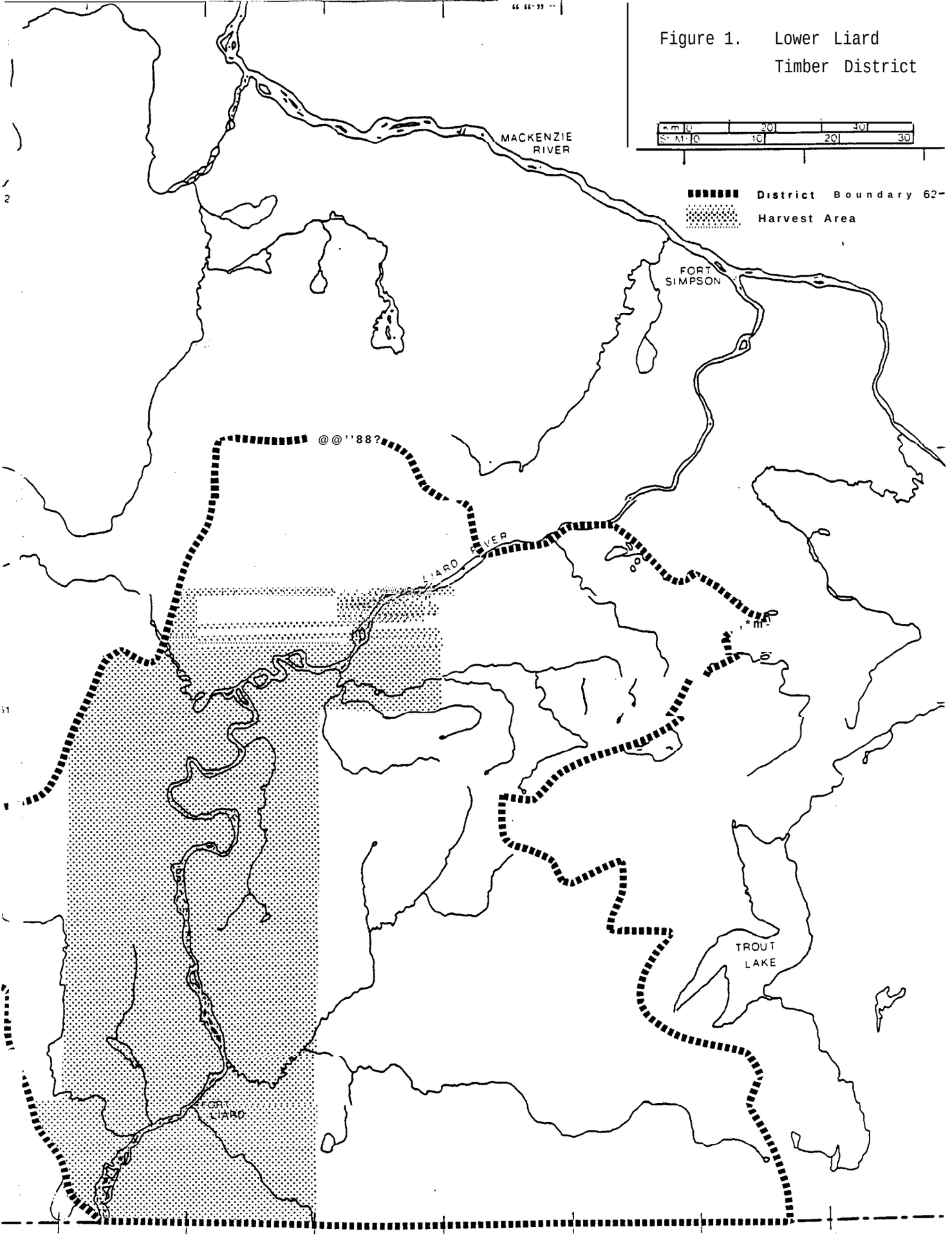


Figure 1. Lower Liard Timber District

timber permits under the Territorial Timber Regulations. DIAND has, in the past, been responsible for forest management, fire protection (most of the Harvest Area falls within the high-priority Sustained Action Zone), and forest inventory. The Canadian Forestry Service , conducts cursory insect and disease surveys annually. The Federal and Territorial Governments are presently finalizing transfer of forest management and fire suppression responsibilities to the Government of the Northwest Territories.

2.1.2 Choice of Operating Area

In order to meet the study terms of reference, it was necessary to develop a profile of the type of timber to be harvested over the life of the manufacturing facility, and to delineate an " operating unit with sufficient capacity to support at least five (and preferably 10 to 20) years of harvest.

The 1982 DIAND Inventory report identified five major areas containing merchantable stands of white spruce sawtimber, and divided the Harvest Area into 10 Harvest Blocks, each containing about 1 000 000 m3 of merchantable sawtimber.

In October 1985 the consultant undertook an aerial and ground reconnaissance of the Harvest Area, with the objective of defining a unit within the Area which would most logically be selected for the first 5 to 20 years of operation. Criteria used in selecting such an **area were** as follows:

- It should contain a high concentration of white spruce sawtimber suitable for existing markets, with sufficient volume to support at least 10 years of harvest at full allowable cut.
- The area should be accessible for winter logging and delivery of wood to Fort Liard at costs lower or at least competitive with delivery costs incurred by other producers competing for Territorial markets.
- Areas the subject of native land claims should be avoided, since the Client is concerned that

development of logging plans on such areas would complicate and possibly prejudice the claims process.

Areas where forestry development is likely to result in serious land use conflicts or environmental damage should be avoided.

The area should contain a high concentration of mature/overmature timber. Conversely areas with higher proportions of immature timber and spruce understories should be avoided.

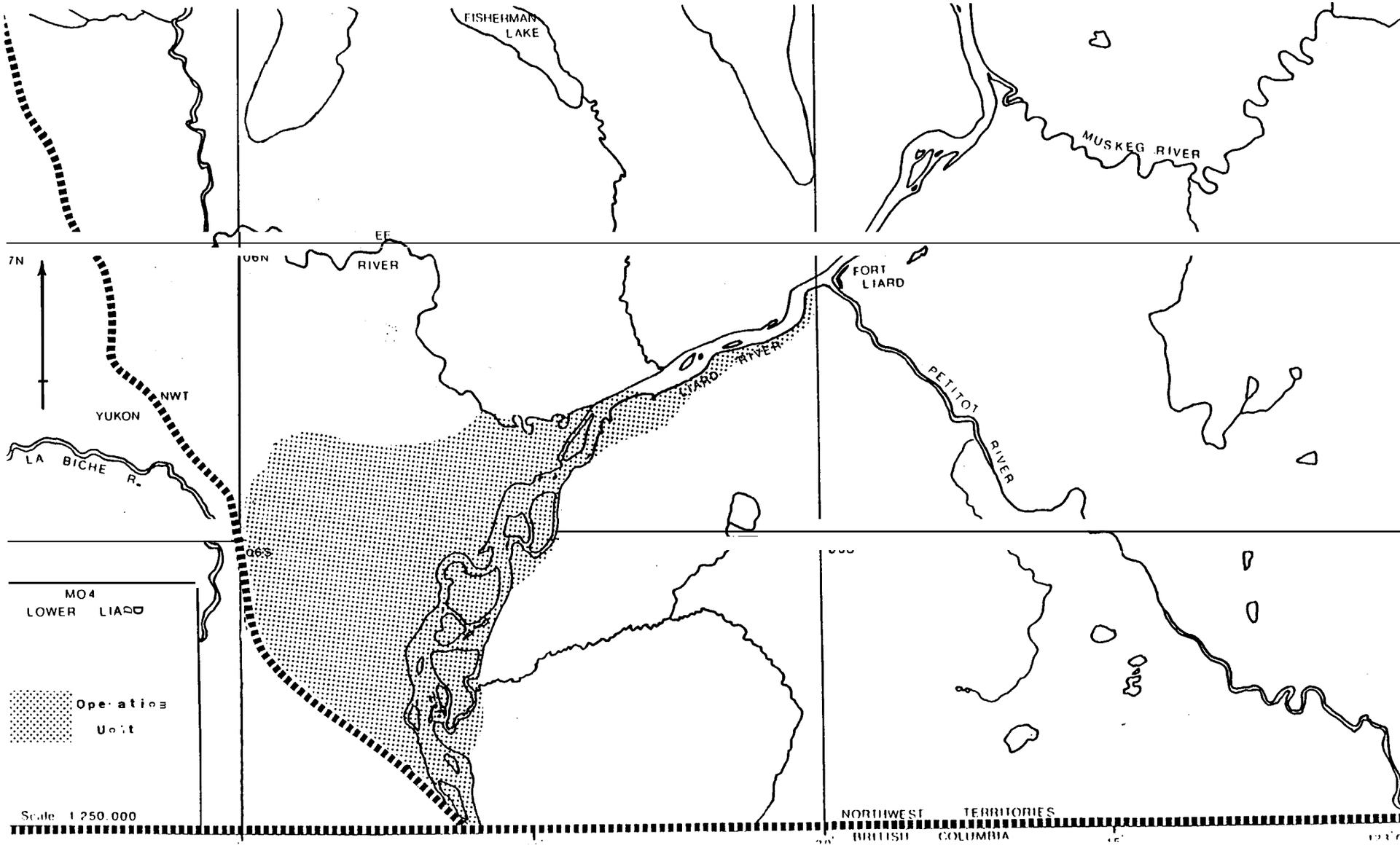
Consistent with the maintenance of long-term forestry potential, initial operations should be concentrated where timber, if not harvested, is most likely to be lost or depleted by fire, insects, or disease.

The selected area is Identified in Figure 2. It can be accessed from Fort Liard for winter logging at competitive costs. Unlike the area between the Petitot and Muskeg Rivers to the north, it is not the subject of a land claim. Neither are any serious land-use conflicts or environmental problems anticipated (see Section 2.1.3 below).

The area contains a high concentration of white spruce sawtimber, apparently suitable for logging and manufacturing. The timber is mostly overmature and showing signs of imminent deterioration. The main part of the area west of the Liard River is probably the most extensive contiguous block of virgin overmature white spruce in the Northwest Territories, and is highly vulnerable to catastrophic destruction of timber should outbreaks of fire or insect pests occur within the area, or spread in from elsewhere. Although other areas surveyed during the reconnaissance may well lose timber before they can be harvested, generally the overmature and high-risk timber is more scattered and interspersed with younger mixed stands, and there is less potential for whole-scale loss of the resource.

The proposed operating unit is bounded on the southwest by the Yukon border. The eastern boundary in the south follows the east bank of the Liard River and in the north follows the foot of the

Figure 2. Proposed location of Forestry Operating Unit



environmentally-sensitive steep slope separating the flood plain from the eastern benchland, where insufficient timber was judged to occur to justify the access cost and environmental disturbance. The northwest boundary generally follows an unnamed tributary of the Kotaneelee River, and the Kotaneelee itself. Environmentally sensitive areas close to these rivers will not be logged. North of the Kotaneelee tributary the timber appears younger with higher proportions of aspen understories.

2.1.3 Environment and Land Use

For the people of Fort Liard and other communities in the Northwest Territories the forests have always played an important role by supporting their traditional lifestyle. The use of the forest for hunting and trapping is more important to most of the Dene than its use as a source of timber for economic gain. Furthermore, in the Northwest Territories, tourism is second only to non-renewable resources as a source of income, and Fort Liard can expect to benefit from tourism in the future given its location on the River and the new Liard Highway. Forestry development is therefore unlikely to be acceptable to the people of Fort Liard if it results in significant disruption of traditional land uses, environmental damage, or negative aesthetic Impacts.

This important fact has been taken into consideration in the delineation of the proposed forestry Operating Unit. The boundary has been drawn to avoid environmentally sensitive areas on the east shore of the Liard River and along portions of the Kotaneelee and its tributary. There is within the area a narrow zone of steep ground where the slope could create erosion problems if disturbed indiscriminantly. No logging has been scheduled in this area, and road construction would be limited to one short well-planned section of winter road (see Map 2 in Map Folio).

Some logging on the alluvial flood plain close to the Liard River is proposed, but most operations will be concentrated on the lacustrine benchlands and morainal plateaus to the west of the river. Logging will thus largely be confined to overmature stands in

locations where watershed damage can easily be avoided, where there will be little visual impact on river and highway travelers, and where the only access will be by ice-bridge and winter road.

2.1.3.1 Traditional land uses. Information on traditional land uses was provided by the Dene/Metis Land Use and Occupancy Data Base*, which records the Twentieth Century land use of a 30% sample of Dene/Metis hunters and trappers throughout most of the western mainland of the Northwest Territories. A map of individual hunter/trapper trails was generated for the Fort Liard area (see Figure 3). Each trail segment shown on the map represents the route used by one or more individuals for a discrete period of time. Land-use activities were also reported by UTM grid cell (each ,cell represents an area of 100 km2).

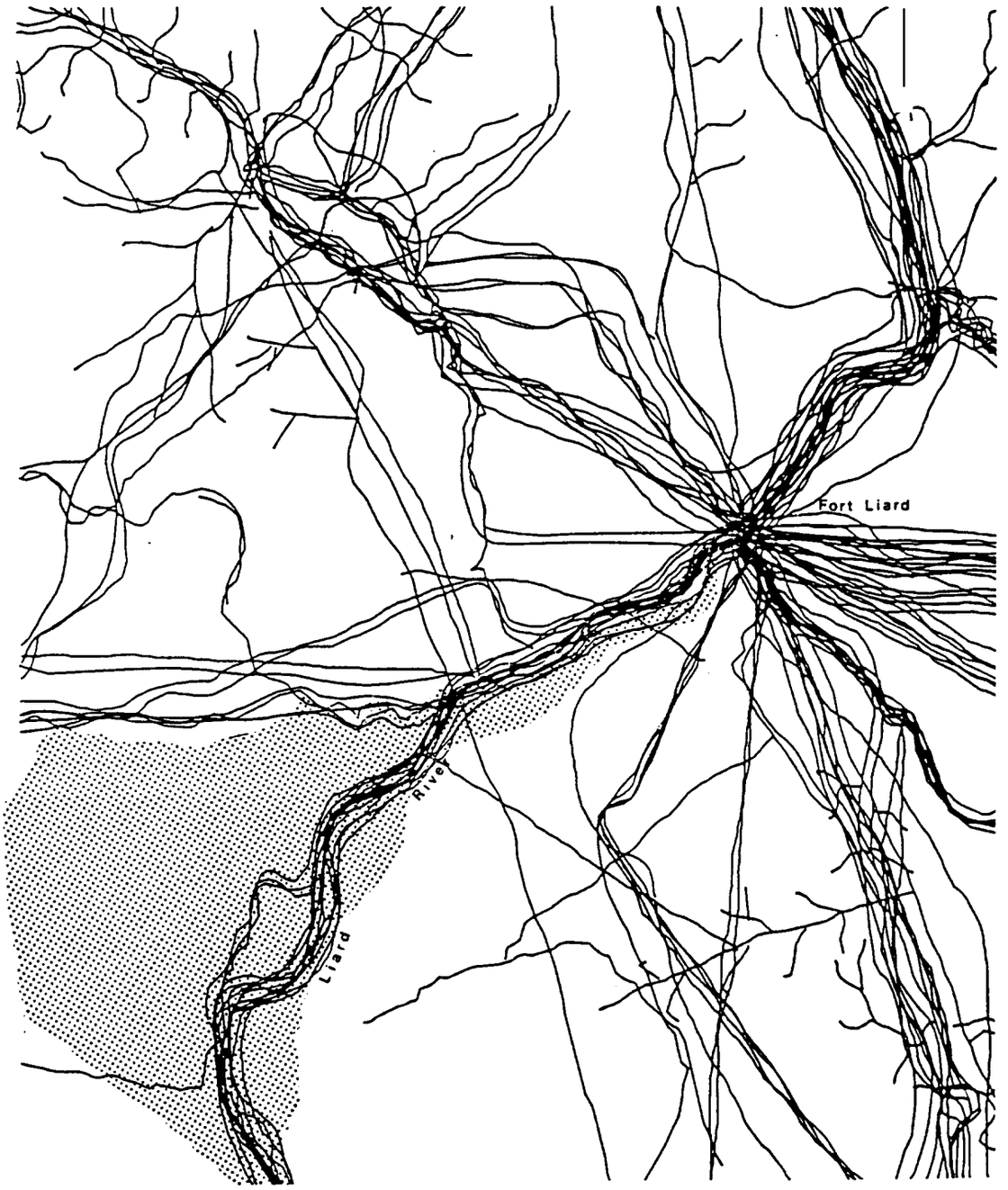
Recorded land use activities for grid cells in which the proposed operating unit falls include travel, trapping, and moose and woodland caribou hunting. Of these activities, travel along the main river valley was the most frequent, followed by trapping, and to a lesser extent, moose hunting. Only isolated records of woodland caribou hunting were recorded in the area, and this does not appear to be significant to the present community at Fort Liard. It will be noted from Figure 2 that trails are concentrated along the Liard and tributory streams, and none cross or penetrate the main concentration of timber to the west of the Liard. Most activities are limited to these river corridors; there appears to have been very little use of the plateaus and benchlands for trapping and hunting.

2.1.4 Timber Inventory

2.1.4.1 Objectives and sampling procedures. The scope of the timber cruise undertaken as part of this study was limited to the

* Information provided by the Dene Mapping Project, Department of Anthropology, University of Alberta, December 1985. The Project is funded by the Dene Nation, who also undertook and funded the original data collection.

Figure 3. Hunting and trapping routes in relation to proposed operating area.



Operating Unit area discussed in 2.1.2 above. The cruise was intended to provide:

1. Verification of the level of timber availability indicated by the DIAND inventory of 1982;
2. Information, required for development planning and sawmill design, on the type and quality of timber which would be harvested in the next 10 to 20 years;
3. The basis for planning access and logging operations for at least the next five years.

Maps, listings, and areas of forest cover types, assessed during the 1982 Lower Liard Timber Inventory, were provided by DIAND. The photo-interpreted delineation of stand types and classification of height, density, and species composition provided by the DIAND inventory were observed (during the consultants' reconnaissance) to be accurate and quite adequate as a basis for the timber cruise.

Sample allocation was restricted to height classes 4 or greater (i.e., stands over 17.5 m in height) in softwood and mixedwood stands. The location of 3S0 prism sample plots was pre-planned on a line-transect system. An attempt was made to allocate numbers of plots to stands in proportion to stand area. Cruise lines were located on aerial photographs and maps. To the extent possible, locations of the lines were selected to traverse topographic and site variation. On the areas west of the Liard River, the location of lines was constrained by the availability of access for cruisers, specifically the availability of helicopter landing sites. Plots were placed at 200 m intervals along the cruise lines.

The purpose of the prism plots was to provide information on timber volumes and trees per hectare, species composition, tree size distributions, condition and form of the timber, and operability.

Trees were tallied with prisms of Basal Area Factor 3 (this means that each tree tallied represents 3 m^2 of basal area per hectare). The diameter at breast-height (DBH) of each tallied tree was measured. Any visible defects were noted. Heights of about one in every five coniferous trees were measured. Ages at stump height

were assessed for at least one spruce in every fourth plot or every stand sampled. Notes were also made on operability and other stand conditions at the plot locations, along the cruise lines, and during ferrying by helicopter.

A sub-sample of 60 white spruce trees were felled and sectioned to provide further information on individual tree volumes (used in the analysis of the plot data and for comparison with the 1982 inventory), log-size distributions, internal defects, and for checking height and diameter relationships developed from the plot data. Plots were selected so as to obtain representation of each major species and site class. Two or three live white spruce trees were felled and sectioned into 5 m logs on each of the selected plots. Sawlog cull (defective wood which would be subtracted fr'om the log volume when it was scaled) was tracked through the log with intermediate cuts. Log diameters, length, and defect volume were measured. If fractures or checks were apparent, their orientation and size were noted on cross-sectional diagrams of the logs. The assessment of wood quality and defect is further described below (see 2.1.5).

2.1.4.2 Analyses and results. Table 1 shows the height-diameter and volume equations used for computing tree volumes from diameters measured on the cruise plots.

Table 1. Tree volume and height-diameter equations.

	Volume		Height-diameter		
Species	v = a + b((dbh**2)*ht)		Ht = a + b(dbh) + c(dbh**2)		
	a	b	a	b	c
White spruce	0.04316	0.000031526	0.06010	1.02912	-0.00798
Black spruce/Fir	0.00432	0.000035718	0.07845	1.32343	-0.01532
Aspen	0.04591	0.000031133	0.38003	1.48572	-0.01777
Balsam poplar	-0.01008	0.000029254	0.24770	1.23773	-0.01549

For species other than white spruce, all values in Table 1 were obtained from the 1982 Lower Liard Timber Inventory. White spruce was the only species considered to have major significance to the present study. The height-diameter coefficients for white spruce shown in Table 1 were obtained by regression analysis of 414 undamaged trees measured for height during the cruise (the analysis indicated on R-square value of 0.59 and a standard error of 3.4 m). The relationship between height and-diameter shown by these trees was consistent with that demonstrated by analysis of the 60 trees destructively sampled, but somewhat different to that indicated by the 1982 Lower Liard study.

The volume equations in Table 1 compute total volumes of tree stems, and were all obtained from the DIAND 1982 Inventory study. Because the stumps and tops of trees are not usually utilized, a conversion factor **(CF),** developed in the 1982 Inventory, was used. It takes into account stump height, diameter at breast-height (DBH) and the top diameter inside-bark **(DIB)** to which the tree is utilized:

$$CF = 0.9603903 - 0.537645X - 7.6021409X^2$$

where $X = (\text{top DIB/DBH})^2 \times (0.3048 + (\text{stump ht./total ht.}))$.

Before the **DIAND** volume equations for white spruce were used in the compilation of the operational cruise data, they were compared against volumes scaled directly from the destructively-sampled trees. Volumes predicted by the equations were about 5 percent less than scaled volumes. This was considered sufficiently good agreement to validate the DIAND equations, which were used in the subsequent calculation of plot and stand volumes.

The following stand variables were calculated for each of the 350 sample plots: stump age (if measured), total coniferous roundwood volume per hectare, total deciduous roundwood volume per hectare, coniferous sawtimber volume per hectare, deciduous sawtimber volume per hectare, number of coniferous sawtimber trees per hectare, and average height of coniferous sawtimber trees. Trees were categorized as roundwood if their diameter at breast-height was 15 cm

or greater, and as sawtimber if it was 25.4 cm or greater. Roundwood volumes were computed to an 8 cm merchantable top diameter, sawtimber to 15 cm. A stump height of 30 cmwas assumed throughout.

A listing of summary plot data is included in the Map Folio. Map 1 shows the location of cruise lines. The listing identifies each plot by cruise line and the number of the mapped timber type in which it fell.

Selected stand variables are further summarized in Table 2. The summaries in Table 2(b) exclude stands with hardwood overstories. These timber types are considered relatively low priority for harvesting owing to their high (currently unuseable) hardwood content and the less overmature condition of their softwood content. It was anticipated such stands would be by-passed during the first harvest entry into the operating unit; therefore the summary statistics in Table 2(b) best represent the stock being considered for harvest. The relative standard error of the estimated average coniferous sawtimber volume per hectare is 3.07 percent, without stratification. This implies a precision of about plus or minus 6 percent at the 95 percent confidence level. Coniferous sawtimber constitutes 86 percent of the total coniferous roundwood volume, and 70 percent of all roundwood, including hardwoods.

Table 3 shows area and volume data stratified by the main species and height classes present in the Operating Unit. The Table includes only those classes considered as mature/overmature coniferous sawtimber having priority for harvesting. Black spruce and hardwood stands, and all stands less than 17.5 m in height, are excluded. Environmentally sensitive areas and portions of stands destroyed by river erosion were subtracted from stand areas. The volumes and number of trees stated in the Table refer to coniferous sawtimber. The three height classes included (4, 5, and 6) were classified in the 1982 Inventory as having average heights of about 20, 25, and 30 m respectively. The stratum estimates of volumes and stems per hectare shown in Table 3 were assigned to individual stands according to their species and height class. A stand type listing is included in the Map Folio recording these assignments together with

Table 2 y statistics for selected stand variables

(a) Based on all sample plots in operating unit.

VARIABLE	MEAN	S.E. MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N	LABEL
AGE	172.675	6.433	40.685	117	252	40	Stump age in years
SWDR	211.107	6.010	113.075	.0	634.4	354	Total coniferous roundwood (m3/ha)
HWDR	53.970	3.493	65.714	.0	324.9	354	Total deciduous roundwood (m3/ha)
SWDS	179.309	5.491	103.315	.0	610.0	354	Coniferous sawtimber (m3/ha)
HWDS	47.729	3.287	61.852	.0	314.4	354	Deciduous sawtimber (m3/ha)
TPH	163.420	5.365	100.951	.0	565.7	354	Coniferous sawtimber (trees/ha)
SAWHT	26.575	.129	2.424	16.0	32.8	351	Height of coniferous sawtimber (m)

(b) Excluding plots in stands with hardwood overstories

VARIABLE	MEAN	S.E. MEAN	STD DEV	MINIMUM	MAXIMUM	VALID N	LABEL
AGE	175.833	6.948	41.686	7	252	36	Stump age in years
SWDR	218.997	6.351	113.956	.0	634.4	322	Total coniferous roundwood (m3/ha)
HWDR	46.818	3.252	58.359	.0	324.9	322	Total deciduous roundwood (m3/ha)
SWDS	187.308	5.756	103.293	.0	610.0	322	Coniferous sawtimber (m3/ha)
HWDS	41.596	3.099	55.603	.0	314.4	322	Deciduous sawtimber (m3/ha)
TPH	168.614	5.708	102.425	.0	565.7	322	Coniferous sawtimber (trees/ha)
SAWHT	26.674	.134	2.394	6.0	32.8	319	Height of coniferous sawtimber (m)

the map location, map type, gross area, net area, age, and other descriptions of each merchantable type in the Operating Unit.

Table 3. Area and coniferous sawtimber data stratified into main species and height classes.

Species class	Height class	Net area (ha)	Volume (m3/ha)	Stems per ha	# of plots	Total vol.(m3)
White spruce	4	992	133.9	154.9	29	132 795
	5	1 276	198.1	215.7	46	252 786
	6	1 192	253.5	177.5	61	302 205
W. spruce - Hardwood	4	589	177.5	179.9	15	104 592
	5	1 439	177.5	179.9	44	255 360
	6	787	214.7	165.9	40	168 956
Hardwood - W. spruce	4	379	111.7	109.0	5	42 344
	5	1 988	139.8	135.1	43	277 971
	6	716	159.6	139.7	39	114 197
Totals		9 358	176.4	165.2	322	1 651 207

The analyses and results described so far refer only to mean and total volumes and tree sizes. Equally important for development planning, particularly sawmill design, are the distributions of tree and log sizes. The DIAND equations used for predicting tree volumes do not facilitate estimation of log-size distributions. In order to produce approximate forecasts of log-size distributions, the stem analysis data from the destructively-sampled white spruce trees were used to predict merchantable length (ML) from total height (TH) and diameter breast-height (DBH), and diameter inside bark at the top of the first 5 m log (D1) fromML and DBH.

The resulting equations were:

$$ML = 0.7639*TH + 7.1415*\ln(DBH) - 27.2074$$

R-square = 0.939 standard error = 0.32 m

and

$$D1 = 10.4225 + 0.3597*ML + 0.008997*(DBH**2)$$

R-square = 0.968 standard error = 1.36 cm

These estimates permitted diameter at the top of the first log, and average taper for the remaining merchantable portion of the tree, to be calculated from cruised tree height and diameter data. They were incorporated into a cruise compilation and log-profile model developed by the consultants. Table 4 shows the tree diameter and length distributions of coniferous sawtimber in the stands being considered for harvest. (The estimated average total number of stems per hectare is slightly less than that in Table 2(b) because in Table 4 trees which fail to produce at least one merchantable log are ignored.) Table 5 shows the equivalent log diameter distribution once the trees have been sectioned into 5 m logs. The information in Table 5 was used in the sawmill production simulation (see Appendix). Average log taper was approximately 1.24 cm per metre.

2.1.5 Wood Quality

The 1982 Liard Timber Inventory study reported a very low incidence of decay in white spruce and insignificant loss of volume associated with decay. Several authorities contacted during the present study commented on the good quality of the Liard timber. This notion is certainly reinforced by the general size, form, volumes per hectare, low decay, and operability of the timber, all of which are favorable for logging and manufacture.

However, inspections of trees cut in the bush, log cabins built with local timber, and (most significantly) lumber sawn by RAMTEC Enterprises Ltd. from an extension of the same forest block just over the Yukon border, alerted the consultants to the potentially serious defect problemof “shake”. “Shake” is the longitudinal splitting of lumber which occurs when stresses, built up in the standing trees, are released as the wood is sawn and dried.

Table 4. Stand table for merchantable coniferous sawtimber.
(SW = white spruce SB = black spruce LEN = merchantable length)

NUMBER OF TREES PER HA 25.40 CM+ DBH
FROM 0.30 M. STUMP HEIGHT TO 15.00 CM TOP DIAMETER INSIDE BARK.

DIAMETER CLASS MIDPOINT (CM.)	SPECIES SW	SB	FIR	PINE	AW	BW	LT	FD	PB	TOTAL	LEN
14	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
16	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
18	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
20	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
22	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
24	0.0	0.0	0	0	0	0	0	0	0	0.0	0.0
26	13.5	0.9	0	0	0	0	0	0	0	14.5	12.5
28	18.3	1.8	0	0	0	0	0	0	0	20.1	13.9
30	10	0.3	0	0	0	0	0	0	0	16.4	15.1
32	8.6	0.6	0	0	0	0	0	0	0	19.3	16.3
34	4.9	0.2	0	0	0	0	0	0	0	15.1	17.3
36	5.1	0.1	0	0	0	0	0	0	0	15.2	18.5
38	2.2	0.0	0	0	0	0	0	0	0	12.2	19.3
40	1.0	0.1	0	0	0	0	0	0	0	11.1	20.2
42	1.3	0.0	0	0	0	0	0	0	0	11.3	21.4
44	8.4	0.0	0	0	0	0	0	0	0	8.4	22.3
46	5.7	0.0	0	0	0	0	0	0	0	5.7	22.8
48	4.6	0.0	0	0	0	0	0	0	0	4.7	23.4
50	3.9	0.0	0	0	0	0	0	0	0	3.9	24.4
52	2.9	0	0	0	0	0	0	0	0	2.9	24.4
54	2.3	0	0	0	0	0	0	0	0	2.3	25.6
56	1.1	0	0	0	0	0	0	0	0	1.1	25.3
58	9	0	0	0	0	0	0	0	0	0.9	26.8
60	6	0	0	0	0	0	0	0	0	0.6	26.3
62	5	0	0	0	0	0	0	0	0	0.5	27.8
64	5	0	0	0	0	0	0	0	0	0.5	27.5
66	1	0	0	0	0	0	0	0	0	0.1	27.9
68	1	0	0	0	0	0	0	0	0	0.1	27.0
70	0	0	0	0	0	0	0	0	0	0.0	22.0
72	1	0	0	0	0	0	0	0	0	0.1	28.9
TOTAL	162.3	3.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	186.9	
QUAD MEAN DBH	40.6	29.5	33.0	0	0	0	0	0	0	40.4	
AVERAGE DBH	40.1	29.5	33.0	0	0	0	0	0	0	39.9	
AVE HT (C/D)	26.8	23.6	21.4	0	0	0	0	0	0	26.8	
AVE MER LNGTH	18.2	14.8	15.5	0	0	0	0	0	0	18.1	

Table 5. Number of 5 m logs per ha by top diameter class and species
(SW = white spruce SB = black spruce)

LOG TOP DIAMETER MIDPOINT (CM.)	SPECIES SW	SB	FI	PI	PW	BW	LT	FB	PB	TOTAL	%
14	2.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.6
16	64.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.0	12.7
18	62.5	2.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	65.2	12.5
20	61.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.6	12.0
22	65.8	2.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	68.8	13.2
24	56.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.8	11.1
26	45.8	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	46.5	8.9
28	37.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.2	7.1
30	30.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5	5.9
32	20.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	20.6	4.0
34	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	3.4
36	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	2.5
38	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	1.8
40	5.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	5.9	1.1
42	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.9
44	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.7
46	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.5
48	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3
50	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2
52	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2
54	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1
56	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1
58	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
60	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
62	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
68	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LOGS/HA	508.7	9.9	1.2	0.0	0.0	0.0	0.0	0.0	0.0	519.7	100.0

The resulting fractures occur at right angles to the orientation of the annual rings, or as ring separations. The situation is exacerbated by spiral grain. The presence of both shake and spiral grain can have a very adverse effect on grade realization and profitability. For lumber the impact is on the grade of lumber that is produced and this has a substantial effect on the value of the production. For export logs the impact is even more severe. For example, the Japanese are not prepared to accept any proportion of shake. Consequently, if logs with shake cannot be identified and excluded at the time of merchandising there is a real possibility that no potentially profitable log export programme could be developed.

To make matters worse, shake is difficult to assess until the timber is sawn into lumber and dried, and no reliable techniques exist for predicting the extent of the problem from standing timber or even from logs. Symptoms of the problem were noted during the initial reconnaissance throughout much of the Harvest Area. There was some evidence that timber in the north of the area (around Blackstone River) was less prone, but it was concluded that the wood supply for a sawmill at Fort Liard would be subject to high, and possibly excessive, levels of shake and spiral grain. Consequently, in spite of the difficulties of assessment, these defects were given further attention in the operational cruise and stem analyses.

Table 6 indicates the frequency of selected defect indicators observed in approximately 3000 standing trees during cruising of the Operating Unit. Levels of occurrence of crook and sweep and of conks (fungal fruiting bodies indicative of decay) are considered low, and support earlier favorable observations regarding timber quality. The level of top damage (die-back and breakage) is high, but is to be expected in timber of this age and, because it is concentrated in the non-merchantable portions of the trees, it is not so far a serious constraint to utilization. The reported incidence of spiral grain is high, especially in view of the fact that it is not always detectable during cruising of standing timber. This and

Table6. Percentage frequency of selected defect indicators observed in standing timber.

Type of defect	Percent occurrence
Top damage	9.5
Spiral grain	7.9
Frost crack	4.9
Crook/sweep	4.0
Conks	1.8

the incidence of frost crack tended to confirm that initial concerns over the possibility of shake were justified.

Wood quality was further examined in the 60 white spruce trees which were destructively sampled. As in standard sawlog scaling, defects such as decay, checks, and shakes were allowed for by measuring the "boxed" areas of the defects on the log-ends, estimating the length of the defect, and subtracting the defect volume from the gross scale. Results obtained by measurement immediately following cutting were not themselves particularly onerous: a total of 4.8% cull, 2.9 of which is attributed to decay, and 1.9% to split , check, and shake.

Ten "cookies" 2 to 3 cm thick were selected at random and allowed to dry at room temperature and moisture for 2 to 5 days. By observing the response to drying and relating this to the stem analysis data, it was attempted to predict the order of magnitude of shake which might be expected in dried lumber. An optimistic assessment, whereby cracks and checks thought to be associated with quick end-drying were ignored, indicated that drying would result in an increase in scaled shake of 5.3 times, relative to shake-related defect observed at the time of felling. A more pessimistic assessment indicated that the factor could be higher than 8.5 times. These subjective estimates suggest that shake-related defect can be expected to amount to 10 to 17% of gross merchantable volume.

Allowing an additional 3% for rot,, total defect could be in the range 13 to 20%.

Given that most of the expected defect is shake, which will not be detected or removed before the wood is sawn into lumber, allowances for defect were incorporated into assumptions regarding grade recovery at the sawmill, rather than being treated as deduction factors applicable to tree or log inventories.

Little information from actual production experience was available, but some insights were provided by an Interior B.C. sawmill that processes high levels of shake in a portion of its wood supply.

2.1.6 Security of Long-term Supplies

The timber cruise conducted as part of this study confirmed the volume of standing inventory indicated by the 1982 Liard River study, but the age and condition of the timber raise concerns over the stability of stands which, although already clearly over-mature, would be required to support harvests far into the future. The continued longevity of the presently merchantable stands is the major uncertainty in long-term planning of timber supplies, and will continue to be so for a very long time.

In the Northwest Territories, the major and most dramatic agent of forest destruction is fire. Even with a well-planned and executed fire management policy in place, individual fire sizes have on occasion exceeded **500 000 ha, and during the five-year period from 1979 to 1983 approximately 5 000 000 acres of land were visited by fire. The Liard Harvest Area has not recently been subject to any major conflagrations, but the occurrence of fires just across the BC border are a reminder of the vulnerability of any large contiguous blocks of timber.**

Top-damage, wind-throw, and evidence of insect infestations and terminal stand conditions were observed during the reconnaissance and timber cruise, bringing into question the stability of the forest in relation to age, wind, and insects, as well as fire. Samples of insect-damaged foliage taken to the Northern Forest Research Centre

were confirmed to be the result of light to moderate spruce budworm (Choristoneura fumiferana) infestations.

According to the 1982 Inventory Study, an endemic budworm population was known to be present, and major infestations occurred from 1962 until 1965, when the population collapsed.

In 1982 new budworm infestations were detected. Moderate to severe defoliation (30% or more of current foliage removed) were noted on two large islands near Swan Point, comprising approximately 1000 ha. By 1983 the outbreak in the Nahanni Butte area increased to about **10** 600 ha. In 1984 scattered outbreaks were noted upstream to the BC border. By 1985 the original outbreak in the Nahanni Butte area was reducing in intensity, but a substantial increase of light-to-moderately defoliated area (approximately 6500 ha) was observed west and south of Fort Liard, including portions of the proposed Operating Unit.

The key question now is whether the population in the Fort Liard area will collapse, as has happened previously, or continue to build. Researchers suggest that little tree mortality occurs until the fourth or fifth year of outbreak. Six or more years of moderate to heavy infestation could result in severe mortality. The worse-case scenario would be if 1985 was the first of six or more years of sustained attack. If this were the case, timber not salvaged by 1993 to 1995 would probably not be recoverable, and the damaged forest would be highly vulnerable to fire, wind-throw, and beetle attack.

Whilst historically there is some encouraging evidence of budworm attacks in the Liard not being sustained, it must be expected that susceptibility to attack by budworm and other agents will increase over time. Spruce beetles (Dendroctonus rafipennis) occur in the Northwest Territories, where they are often present in low numbers in wind-thrown spruce, fresh-cut stumps, and logs. In northwestern Alberta an attack which began in about 1977 has caused tree mortality ranging from 5 to 70% over an area of at least 100 000 ha. Researchers consulted at the Northern Forest Research Centre considered the risk of beetle outbreaks to be fairly high in

the Liard, particularly if incidence of budworm infestations, wind-throw, and logging-slash increase.

It is apparent that the long-term timber supply potential of the Lower Liard is made uncertain by overmaturity, stand instability, spruce budworm infestation, and fire risk. These factors are likely to be more important to strategic decision-making than the growth of sub-merchantable stands, and to override conventional allowable-cut considerations. Clearly, any manufacturing and logging development plan must recognize and attempt to minimize the risk and impact of catastrophic losses in timber supply.

2.2 MARKETS

2.2.1 Lumber Markets Within the Northwest Territories

2.2.1.1 Overall volume. An extensive analysis of the lumber consumption in the Northwest Territories was undertaken in 1984 by the Canadian Forestry Service (CFS).* This was undertaken in the context of a feasibility analysis for a sawmill near Fort Smith. The essential conclusion of this study was that the total annual lumber consumption in the Northwest Territories was a little in excess of 27 million board feet.

From the discussions held with some of the major distributors and suppliers, it would appear that the total level of consumption identified in the CFS study may be higher than is currently applicable.

For the purposes of this analysis, it is believed that a somewhat lower, more conservative figure of 20 to 25 million board feet would be more appropriate.

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* Ondro, W. 1984. Marketing plan for lumber products and feasibility analysis for proposed Fitz-Smith Sawmill near Fort Smith, NW?. Canadian Forestry Service, Northern Forest Research Centre, Edmonton.

2.2.1.2 Consumption sectors. The lumber consumed in the Northwest Territories is utilized in the following main sectors:

Public housing;
Private housing;
Public non-residential construction;
Private non-residential construction;
Oil and gas industry;
Repairs and renovations (residential and non-residential).

The lumber requirements for public housing are controlled by the NWT Housing Corporation. They are put out to public tender, together with all the other materials needed, on an annual basis. Though some preference is given to NWT based suppliers, there is not control, at present, over where these suppliers source the materials. The great majority of the lumber needs is in standard 2 inch thicknesses, dried and dressed. The use of rough green lumber is negligible.

The volume of private housing is relatively small. With the exception of Yellowknife, the great majority of housing being built in the Northwest Territories is supported by public funding. Where private housing is required, the demand is often met by the import of trailer homes.

Total annual expenditures byNWT departments on buildings and public works have been around $70 000 000 in recent years. Plans for the future suggest a significant increase in this level even after discounting for inflation.

The CFS report indicates that government projects account for nearly half of total lumber consumption in the region. It is believed that the majority of this lumber is dried and dressed dimension lumber (as for housing construction).

Private commercial construction, apart from that in the oil and gas industry, is fairly limited and would appear to account for a relatively small volume of lumber consumption.

In the case of the oil and gas industry, there does not seem to be any substantial volume of demand. It is in this area that

there is some disagreement with the CFS study. The study included about 5 million board feet for the oil and gas industry. This figure was derived from an average of consumption over a number of years and seems high relative to current demand. Discussions with a number of the major companies indicated that they use only marginal volumes of rough timbers. These are often of low quality and used for pipe racks, dunnage and so on. In addition, the companies purchase from local retailers some quantity of dressed lumber for the repair and construction of sheds and utility buildings.

It had been suggested that large volumes were used in the construction of rig mats. Further investigation showed that most rig mats are prefabricated in Alberta. The lumber used is 2 x 6 dressed #3 spruce, which is readily available at comparatively low prices.

The remaining consuming sector of any significance is believed to be in the general area of repairs and renovations. It is always difficult to quantify this sector since the volume is the aggregate of a great variety of uses by a large number of individual consumers. Clearly, however, it is a sector of great importance. In the U.S., for example, about 25 percent of all softwood lumber consumption is for repairs and renovations. Analysis of consumption factors related to construction activity in the Northwest Territories and a comparison with the volumes that are handled by the distribution/retail centres indicates that repair and renovation is even more significant. According to the information from the distributors, the majority of the volume in this sector tends to be dressed dimension.

2.2.1.3 Specifications of the market. The analysis of consumption by the different sectors indicates that the bulk of the demand is in terms of dressed dry lumber in 2 **inch thicknesses by a variety of widths, from 4 inches to 12 inches.**

There is also some demand for rough lumber in sizes ranging from 2 x 4 (limited) to 10 x 10, but this tends to be no more than 10 percent of demand. The CFS study estimated 10 to 15 percent. This demand can fluctuate, and any substantial increase in mining

activity could result in sizeable volumes of rough timber being required.

In addition, there is a small volume of 1 inch boards consumed. According to the CFS study, this could be as high as , 15 percent of demand. Recent information from the distributors, however, suggested that the share would be substantially less at only 5 to 10 percent.

2.2.1.4 Regional distribution. Apart from some small volumes of very local production, the lumber consumed in the Western part of the Northwest Territories is distributed through Hay River or Inuvik, via the Dempster Highway. The percentage shares by region are shown in Table 7.

Table 7. Percentage lumber consumption by region.

Inuvik and Arctic Islands	48%
Yellowknife	19%
Norman Wells	13%
Hay River	11%
Fort Smith	5%
Fort Simpson	4%

Source: Ondro 1984

The most important region in volume terms is Inuvik and the Arctic Islands, supplied out of Inuvik and Tuktoyaktuk. Lumber is delivered into the area by barge from Hay River or by truck from the Yukon, BC, or even Alberta. Delivery costs by barge are less, but shipment can only be undertaken in the short summer season. In contrast, truck delivery via the Dempster Highway can be obtained reasonably regularly throughout the year and inventories can be kept low. The proportion that is delivered by the two methods vary considerably and depends on both the distributor and the consumer. For example, where Igloo Building Supplies is supplying under a NWT Housing Corporation contract, barge delivery is often used. On the other hand, Norm-s Building Supplies in Inuvik, having a need to

supply early summer demand from local consumers, obtains truck loads by road for a significant proportion of its needs.

According to the CFS report, between one quarter and a third of consumption was delivered by barge at the time of the study. Discussions with distributors indicated that, currently, this may be somewhat higher at close to half of the volume.

In addition, there are also significant volumes consumed in Norman Wells and other communities on the MacKenzie, which are also well served by barge.

The areas that can be supplied by barge are of particular importance to the potential mill at Fort Liard. Barges could be loaded at Fort Liard and shipped directly to Inuvik and intermediate points. According to Cooper Barge in Fort Nelson, the shipping season starts earlier in the year from Fort Liard than from Hay River. Using the road to Fort Simpson later in the year, when levels on the Liard drop, allows the season to be extended to early October.

The freight rate from Fort Liard to Inuvik at $8.00/100 lbs would appear to be reasonably competitive with the rate from Hay River. There would be little need, therefore, to transport by road to Hay River prior to barge shipment. There may also be the possibility of loading NTCL (Northern Transportation Company Ltd.) barges at Fort Simpson.

Other major consumption areas are Yellowknife and Hay River. The Fort Liard mill would, however, be at some disadvantage relative to competing suppliers. This is not to say that product cannot be sold, but mill returns are likely to be less favourabl.e. The cost for shipping lumber by road to Yellowknife is in the **region of $50 to $60 per Mfbm (thousand board feet). In contrast, it was stated that Patterson, a sawmiller at Hay River, was delivering to Yellowknife in his own trucks at a rate of only $30 per. Mfbm.**

2.2.1.5 Lumber sources. Lumber production in the Northwest Territories is concentrated in the Hay River and Fort Smith regions. About 90 percent of Territorial production is produced in these two areas and the balance is sawn near Fort Simpson. In addition, there

are some small volumes produced on an adhoc basis at small local mills that can satisfy demand, often for rough sawn timbers, in the immediate vicinity.

There are two mills that produce significant volumes on a consistent basis, and both have planing facilities. At present, there is no kiln drying capacity in the Northwest Territories, but it is claimed that one of the companies, Patterson, will be installing a kiln this year.

This local production satisfies between 20 to 25 percent of total demand and the balance is imported mainly from Alberta, with some lesser volumes from British Columbia and the Yukon. After allowing for the imports of Douglas Fir which cannot easily be substituted by S-P-F from Territorial production, there are still substantial volumes of S-P-F that could be produced locally to compete with imports from Alberta-based suppliers.

It should be emphasized that the demand is mainly for dried and dressed lumber. Furthermore, there appears to be some consumer bias against lumber that has been air dried instead of kiln dried. There is, however, little technical reason for this bias, and it may have resulted from some bad experiences in the past when air drying was undertaken poorly.

2.2.1.6 Prices. Prices are heavily influenced by the North American market. Even though actual delivered prices, particularly in the more remote regions of the Territories, bear a large proportion of transportation and handling cost, the base always tends to be the current level for sales to the U.S. This is influenced by current exchange rates and by the supply/demand/price fluctuations that occur in the total North American market.

In recent years, prices have been low even though demand has been strong. Dimension lumber mills have been reducing costs and increasing production. Over-supply has been the critical factor keeping prices down. There seems little reason to suppose that any radical increase in price is likely in the foreseeable future.

Recently quoted prices fob Hay River, are in the range shown in Table 8.

Table 8. Lumber prices fob Hay River.

Product and grade	Dimension (nominal inches)	Price (C $/Mfbm)
#2/btr KD R/L (8 ft/16 ft)	2 X 4	290
	2x6, 8	270
	2 x 10	350
	2 x 12	380
Rough mill run (heavy to 16 ft)	2, 3x4, 6, 8	210
	2, 3X10, 12	240
	4X10	255
	6, 8x8	240
	10X10	265
1 in boards #3/btr KD	1 X 4	265
	1 x6, 8	285

Note: KD = Kiln-dried R/L = random-length

It is clear from these levels that there is a considerable premium for dried and dressed lumber. It should also be noted that when rough green lumber is transported, substantially higher costs are incurred due to the much greater weight.

2.2.2 Markets Outside the Northwest Territories

2.2.2.1 Lumber. The total demand for lumber south of the Northwest Territories is vast. However, it is very questionable.whether a mill in Fort Liard can expect to compete for this demand. The cost disadvantage faced would be overwhelming. There is, first, the

disadvantage due to the size of the operation. The British Columbia and Alberta mills are very large and are able to obtain considerable economies of scale, both in the harvesting of the timber and in lumber production. Second, there is the disadvantage of location. The competing mills are on rail, whereas the Fort Liard mill would have at least a $10 to $15 cost per Mfbm to ship to the nearest rail head at Fort Nelson.

The only serious competitive possibility would lie in the production of some unique specifications for a particular market niche. Such market niches certainly exist, but often demand a high level of sophistication, both in terms of production (quality control, supply reliability and so on), and in term of marketing.

It is not believed that it would be realistic to build a mill based on this type of market at the outset. Once the mill is in existence and has proven capable of producing quality lumber to standard specifications, it may be possible to consider developing more specific consumer oriented products for sale to the south.

The products to be produced would vary from finger jointed or patterned lumber to metric sizes for export to Japan or elsewhere.

2.2.2.2 Export logs. Bearing in mind the substantial timber resource in the area and the relatively small demand for lumber, an alternative may be the sale of logs. There seems little possible to sell logs to the north, therefore, the potential outlet must be to the south.

At present, the available softwood timber in the Fort Nelson area is fully committed to the processing facilities that exist. Potential would clearly exist to sell logs to these facilities. There are, however, two problems. The only active operation currently in full production is Tackama "and the delivered price that would be paid for logs would be unlikely to exceed $20/m3. After allowing for freight of at least $10/m3 from Fort Liard, this would provide a very low return.

There is however, a further possibility. A very large market exists in Japan for the import of logs. Although,

traditionally, this has tended to emphasize the coastal species, some exports have been made of spruce. It appears that this species is regarded quite highly. Log export restrictions in BC limit the amount that this business can be developed within that province. Such a“restriction does not apply to timber harvested in Fort Liard.

Current indications in price suggest that good quality spruce logs (no shake) with 8 inch minimum top diameters (allowing 10 percent at 6 inches) are at around $78/m3 FAS at Prince Rupert. This would be equivalent to $35 to 40/m3 FOB Fort Liard. Larger logs with over 12 inch top diameter would be worth over $5/m3 more.

It must be emphasized that the content of shake in the logs is critical, and that not all the timber harvested would be of a suitable quality or size for export. Therefore, either the merchandising would be undertaken in Fort Nelson with unsuitable logs being sold at low returns to local mills, or the logs would be merchandised at Fort Liard with the sawmill utilizing the lower qualities. In the first case, the average returns could be lowered substantially. Local buyers would be in a strong negotiating position, since no alternative outlet exists. In the second case, the log diet for the sawmill would be of substantially lower quality than available from the log profile in the woods. The mill would need to be designed to process smaller diameter logs or logs with defects, such as shake, that were unacceptable for export. Production costs are likely to be higher and the yield of lower quality product would also be higher. It seems likely, however, that the output from the mill would still be saleable, though the production of the larger sizes, such as 2 x 10 and 2 x 12 would be reduced.

The economics of the various options need further analysis, but It should be appreciated that the possible variations in all the factors are so great that to establish with total confidence which option is the most profitable, at a theoretical level, will prove difficult and unreliable. It is preferable, therefore, to design the

facility (both harvesting and sawmilling) so that the approach can be varied as market conditions change.

2.2.3 Conclusions

The analysis of the markets and competitive supply sources indicates that the most promising market is in the North. It would be overly optimistic, however, to assume that the Fort Liard mill can capture more than a proportion of this market. Taking a conservative view it is felt that the following estimate of sales could readily be achieved in the second year of operation.

Table 9. Market distribution and initial target volumes (Mfbm).

	Market total	Target Volume from Fort Liard
Inuvik and Arctic	10 000	1 750
Yellowknife	4 000	400
Norman Wells	3 000	650
Hay River	2 000	150
Fort Smith	1 000	neg.
Fort Simpson	1 000	350
	21 000	3 300

The levels for the total market volume are somewhat below the estimates from the CFS report. In addition the market penetration achieved in Norman Wells and Inuvik has been kept quite modest. Once the mill is able to prove to customers that good quality lumbewr can be delivered, in accordance with required shipment dates, it would be probable that the target volume could be increased to over 5 million board feet. The history of mills in the Territories has not necessarily shown that quality and reliability are certain. There will therefore be some initial hesitancy on the

part of buyers despite the strong bias to utilize domestic supply sources.

It is vital therefore that the mill establishes a good reputation from the outset. Any initial problems with offgrade , material or poorly kept shipment schedules could have a bad long term effect on the viability of the operation.

The level of sales effort required is relatively modest. The number of customers to be contacted and serviced is limited and the volumes low. The normal practice in an operation of this size is that sales are handled by the manager. It is necessary, therefore, that the production supervisor is capable of running the mill while the manager is away on sales visits.

The main conclusions of the market study may be summarised as follows:

1. Potential markets exist for lumber produced by a sawmill at Fort Liard.
2. The most favorable market for the sale of lumber would be the Northwest Territories.
3. Though some demand exists for rough lumber, the major volume lies in dried and dressed 2 inch specification for construction. It is essential, therefore, that the mill can produce this product.
4. There may be some subsequent development opportunities for special specifications to specific non commodity consumer areas. There would require a considerable level of expertise in production and marketing, and should not form part of the sawmill development at this time.
5* The annual volume that could be sold into the Territorial market would be up to 5 million board feet, once the mill is Well-established and as the market demand continues to grow. initially, a level of around 3 million board feet would be a reasonable target.

6. Profitable cash flow opportunities could exist in the offshore export of good quality logs. The impact of depriving the mill of the best logs needs to be assessed.
7. Air drying lumber, though technically adequate, is a time consuming process, even during the summer months. The option of installing a dry kiln either initially or once the mill is in operation satisfactorily needs serious consideration.
8. Average mill nets depend on the yield of grades and sizes from the raw material input. It is estimated that the average returns, after allowing for some lower grades developing, would be in the range of $250 per 1000 board feet.

2.3 COMMUNITY AND INFRASTRUCTURE

Fort Liard, situated at the confluence of the Liard and Petitot Rivers, is one of the oldest continuously occupied sites in the Northwest Territories. In the recent past, access to the community, other than by air, was restricted to a winter road and summer barge transport. However, the Liard Highway (N.W.T. Highway 7) was completed in 1983, and now provides all-weather year-round access to Fort Nelson, British Columbia (225 km) and Fort Simpson, N.W.T (280 km).

The Liard River is ice-free from mid-May to October. Low water levels in the late summer effectively limit the barging season from mid-May to August. Ice-bridging of the Liard and Petitot Rivers in the vicinity of Fort Liard is possible from mid November or earlier until March 20 at the latest.

Fort Liard has a population of approximately 400 people. The median age is about 20 years. Eighty percent are Status Slavey Indians. Traditionally, the economic base has been hunting, trapping and fishing. At present, such activities continue to be important. Approximately half the native families spend much of the winter on the land, and others continue their involvement with traditional

activities on a part time basis. In 1982, the total fur harvest income of 41 trappers from the community was over $100 000.*

Local government is by the Band Council, which since the mid 1970°s has combined strong leadership with an effective administration base aimed at fostering successful community development. Initiatives of the Band include the establishment of the Liard Valley Band Development Corporation (LVBDC).

The LVBDC now owns Beaver Enterprises Ltd., a locally operated company established in 1977, which has been instrumental in expanding employment opportunities in construction and maintenance projects. Beaver has made a very significant positive impact on the area, producing substantial economic benefits totaling over $8 000 000 in one four-year period, whilst dramatically reducing social assistance payments.

The Band and the LVBDC wish to continue expansion and stabilization of the community-s economic base, and would like to see a forestry project providing year-round employment for 20 to 25 local people, with emphasis on providing work opportunities during the summer, when traditional occupations and the non-renewable resource industry are relatively inactive. The formal education level of most potential employees is low but, largely as a result of opportunities provided by Beaver, they have acquired skills in operating and maintaining heavy machinery. Little or no housing is presently available for permanently accommodating imported labour or expertise.

The LVBDC has identified a potential site for a sawmill just north of the community access road, 1 km northeast of the airstrip and 2.8 km by road from the barge-loading point in Fort Liard. The site has road access, and approximately 3 ha are cleared of bush. The consultants inspected the location during the winter under snow and have not had the opportunity to investigate soil conditions.

Electricity and fuel are very expensive. Electrical power is supplied to Fort Liard by an unmanned local power station,

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* Source: Liard Valley Band. 1985. Corporate development strategy and related business plans.

equipped with three 150 to 175 kW diesel generator units. A local operator is on call. Capacity is fully utilized. Standard commercial rates are $4.25 per kW month of demand, plus 38.79 cents per kWh. Local diesel costs per litre are about 33 cents wholesale, , and 60 cents retail.

Fort Liard is remote from normal supporting industrial services. However, Beaver Enterprises have heavy-duty machinery repair and maintenance facilities. It is stressed that the experience and proven abilities of the LVBDC and Beaver in the successful operation of heavy machinery and local labour are considered invaluable assets for the successful development of a forest-based industry.

3. STRATEGIC DEVELOPMENT PLAN FOR A FOREST-BASED INDUSTRY

3.1 OBJECTIVES AND CONSTRAINTS

Based on the study Terms of Reference, consultations with the Client, and the findings described in Section 2 of this report, it was concluded that a successful forestry development project in Fort Liard must:

1. Be economically viable;
2. Employ a small group of up to 25 local people who have some experience in bush work and machine operation, but no experience in lumber manufacture;
3. Provide reasonable year-round continuity of employment, with emphasis on the summer. (Job opportunities during the summer are currently scarce);
4. Supply a small and limited market, the penetration and acceptance of which will require the consistent manufacture of quality dried and planed lumber;
5. Accommodate short logging, shipping, and construction seasons;
6. Process timber containing a high proportion of shake;
7. Operate in a location remote from industrial service centres;
8. Facilitate expansion and diversification of production if market and higher-profit opportunities arise;
9. Avoid environmental damage and significant adverse disruption of traditional land uses;
10. Reduce the risk and impact of losses in timber supply by giving priority to the harvest of high-risk timber and by maintaining reserve supply areas.

3.2 MANUFACTURING

Consideration of development objectives and constraints led to a manufacturing design with the following features:

A large developed site extending beyond the cleared area of the selected location. The site development

has to be able to accommodate large inventories dictated by the short logging and shipping seasons.

A combined sawmill and planermill rather than the usual separate processes. To limit capital cost, without sacrifice of quality of machinery, advantage has been taken of the short operating seasons to design a mill which operates consecutively: first to saw lumber, then to finish by planing. Only the saws and planer are specialized, most of the other equipment is shared.

At Maturity the mill will operate on a 2 shift/day basis for 6 months of the year to produce 5.2 MMfbm (million feet board measure). Should the market expand beyond the 5.2 MMfbm capacity of the mill, the operating season could be extended or the mill could be modified inexpensively to permit the planer to run at the same time as the sawmill.

Kiln drying, and an electrical generation system.

It has been assumed that Beaver Enterprises will perform a contracting role in the following aspects of the manufacturing operations:

Periodic maintenance of the log and lumber storage areas as well as the off-highway roads;

Heavy-duty maintenance on the sawmill mobile equipment;

Transportation of lumber to the barge loading storage area.

3.2.1 Lumber Manufacturing

The initial concept for this mill envisaged a year-round operation with the capacity to double production in the future. It was understood that capital costs were not a problem because of the good track record of Beaver Enterprises and the availability of Government Grants for such a project. Therefore the project was first designed and estimated as a complete mill comprised of new

equipment In a fully winterized building, employing between 20 and 30 local inhabitants, depending upon the time of year. The economic viability of this concept proved to be unsound because of the very high financing and manufacturing costs. Thus the revised concept is based on a seasonal mill (mainly summer operation), running on two shifts at maturity. This results in better productivity, and, in conjunction with the logging operation, provides fairly level year-round employment.

The capital cost has been reduced by scaling down the size of the operation, but is still estimated mainly on the basis of new equipment. It would be very reasonable to utilize good quality used equipment more extensively than is assumed in this study. However, the procurement of such equipment depends upon circumstances prevailing at the time, and requires careful purchasing. Therefore it was felt imprudent to base this study on used equipment.

The following sections provide a brief outline of the operation.

3.2.1.1 Log handling and storage. A log storage area will be required adjacent to the mill and this is shown on the proposed site plan (see Figure 4). A versatile utility vehicle, (Caterpillar-Integrated Tool Carrier Series 28), will be equipped with quick interchange log grapple, lumber forks and bucket. This machine will handle the log supply into the mill and also movement of lumber piles to and from the mill. A capital cost allowance has been made for a back up, used machine but this service could probably be effectively supplied by Beaver, thereby reducing the capital cost.

The infeed log deck will accept tree length logs from the log inventory and have storage capacity for about twenty logs. The cut-off-saw operator, located adjacent to the conveyor into the sawmill, will buck the tree length logs into desired lengths (8 ft to 20 ft) depending on log diameter and quality, and then the logs will be transported by conveyor to the headrig log infeed deck. Export quality logs can be bypassed from this system into sorting-storage bunks and be bundled for export shipping.

3.2.1.2 Sawmill. The sawmill has been designed, on the basis of the market studies described in Section 2.2, to produce about 40 Mfbm per shift at maturity with a crew of eight men. This has established a fairly low piece count at each machine centre but still provides an acceptable productivity figure of 5 Mfbm per man shift. It should be appreciated that with some improvements the sawmill could produce at least 50% more than its designed capacity. Therefore production could be readily increased if a larger market can be developed.

The equipment selected is fairly simple and robust, recognizing that the local employees have no sawmilling experience. It is felt that with a good training program and the "machine smart" background of some of the key employees that an effective operation can be sustained.

The primary breakdown machine consists of a circular-saw headrig and twenty-foot log carriage. This machine has been selected to provide flexibility of cutting (manufacture of timbers) and also permits the sawyer to minimize the effect of shake in the logs. However, the type of equipment selected for the headrig will require close examination prior to final mill design because of its consequential impact on lumber grade, yield, and capital cost.

All of the lumber from the headrig is routed to the edger for further processing into pieces of dimension lumber. This machine is a combination edger and gang which permits three saws to shift to any position to allow edging and ripping of a board, or a battery of four saws to cut a cant into several pieces of dimension lumber.

A circular resaw is also provided in the mill to re-edge or split an imperfect piece of 2 inch dimension to produce a saleable 1 inch thick board.

The lumber flow from the edger and resaw outfeed will transfer on a deck to the multisaw trimmer which trims the individual piece of lumber to saleable lengths. Unacceptable edgings and pieces with excess wane will be slashed into two foot lengths. A waste wood conveyor under the trimmer will convey the trim wood into a fire wood bin.

Green rough lumber emerging from the trimmer will transfer to a pull chain where four men will pull off the individual pieces and pile them by length and width sorts on a cart whilst placing spacer strips between the layers of lumber. When this rough lumber package is completed the cart will be moved out to allow the forklift truck to pick up the load and transport it to the assigned rough storage area.

Figure 5 illustrates the general arrangement of the sawmill.

3.2.1.3 Lumber drying. A side-loading dry kiln with a capacity of 50 Mfbm per charge is located adjacent to the mill building. The average drying cycle for typical Northern spruce dimension lumber is two days. The terms of reference of this study do not permit a full evaluation of kilns and kiln heating systems but allowance has been included for a hot water and glycol heated kiln with automatic controls. The hot water will be generated in a boiler using prepared waste wood fuel. The majority of the fuel will be dry shavings from the planermill which will be stored in a fuel storage bin which automatically feeds the boiler on demand.

3.2.1.4 Planing. In an attempt to maximize the equipment use and reduce capital expenditures the planermill has been incorporated into the sawmill and the following equipment is common to both operations:

- Planer infeed transfer;
- Planer outfeed landing table;
- Planer grading area and trimmer infeed;
- Trimmer and waste wood conveyor;
- Lumber pull off chain and load carts.

At maturity the planermill will process 80 Mfbm per eight hour shift with a crew of seven men.

3.2.1.5 Lumber handling and storage. Because of the geographic location of the proposed Fort Liard sawmill the operating schedule is unique in some respects:

The shipping season is short on the river and trucking access to market is restricted and expensive.

The construction season which this mill will service is also short, therefore lumber should be at market early in the season.

The limited barge service must always have a full load of lumber ready to be shipped.

Finished lumber packages will require to be trucked to the barge loading storage area.

Four lumber storage areas will be required:

A green lumber inventory of rough stripped loads awaiting kiln drying;

A dry lumber inventory of rough lumber ready for dressing;

A finish lumber inventory of dry dressed lumber ready for shipping;

A barge loading storage area at the barge dock to accommodate at least one barge load.

The lumber storage areas must be of reasonable surface quality to minimize damage to lumber from uneven forks and excessive spilling of lumber loads. The yield outturn of a sawmill can be adversely affected by such damage. Several production schedules have been analysed and the required storage spaces calculated for each situation. The most favorable schedule will require about 2 MMfbm of green and dry stripped lumber to be carried throughout the winter.

The same versatile vehicle described in Section 3.2.1.1, with one operator per shift, can handle the following duties:

Haul tree length logs from storage to infeed deck;

Remove green stripped lumber from pull chain;

Load-unload dry kiln (2 hours every 2 days);

Load finished lumber onto flat decks (1 day every week).

3.2.2 Log and Lumber Shipping

3.2.2.1 Export logs. If market opportunities permit, logs of export quality would be cut out from the tree lengths as they are processed into the sawmill. The log decks will permit two sorts (initially 8 inch to 11 inch diameter in one, and over 11 inch in the other) with space provided for another two sorts if required.

The sorted export logs would be stored in the log yard until a reasonable volume has been assembled. Transportation to the coast could be either by truck for the total distance or by truck to Fort Nelson for loading on rail cars. The comparative economics could vary from time to time. In either event it will be desirable that the customer and an official log grader (authorized to grade on the Scribner scale) should view the logs at Fort Liard prior to shipment.

3.2.2.2 Lumber. Lumber, strapped and plastic-wrapped for shipping, would be accumulated in the sawmill inventory until barge or road transport is available.

Lumber destined for barge transport would be loaded onto a contractor-s truck by the sawmill. Off-loading and handling into and out of inventory at the barge loading area would also be handled bv the subcontractor (Beaver Enterprises).

For the first part of the summer season barges can be loaded at Fort Liard for shipment down the Mackenzie River. Later in the season, however, the lumber will have to be shipped by truck to Fort Simpson for barge loading. In addition, part of the sales will be to areas, such as Yellowknife, where road haulage is more appropriate. Consequently a substantial volume will be handled by truck.

The sawmill operation will generate wood refuse in excess of the heating-fuel and firewood needs. Disposal of this refuse will be either by an on-site pit-burner or by landfill.

3.2.3 Site and Services

The area required for the sawmill, with necessary log and lumber storage, is illustrated on the proposed Site Plan (see Figure 4). It is based on the level and cleared area referred to in Section 2.3.

The capital cost estimates allow for the necessary clearing and soil removal together with gravel placement, compaction, grading and drainage of the whole site. The development of service roads are also included.

A storage area for approximately 300 Mfbm of lumber adjacent to the barge loading area will also be required. This is estimated to require 3 200 sq ft (0.03 ha).

The estimates allow. for improvements to the existing well at the site to provide a domestic water supply to the sawmill complex and also for a septic field for sewage disposal.

3.2.4 Heat and Power

The location, with the high cost of electrical energy and imported fuel, makes it essential that the operation should be as self-sufficient as possible for heat and power.

The sawmill and planermill will generate more than enough wood refuse for all heating needs. This has been incorporated into the planning as described below.

3.2.4.1 Heating system. A packaged boiler will heat a hot water and glycol mixture to provide heat to the lumber dry kiln. This boiler will burn either hogged sawmill refuse or planer shavings which will be stored in a fuel storage silo.

3.2.4.2 Power generation. The electrical demand of a small mill is critically affected by the choice of equipment and we are confident that under final design review the total connected load could be reduced. Power supplied by NCPC is prohibitive in cost, therefore the mill estimate includes an allowance for a 400 kw generator complete with necessary services. Diesel fuel costs are high so

every effort would have to be made to maximize the efficiency of this equipment.

3.2.4.3 Community heating. Consideration was given to a heat distribution system for the community. The local oil fuel heating costs are high and the main community buildings are located on what could be a reasonable network of steam, or hot-oil, distribution piping.

However, the high cost and technical sophistication of an adequate steam or hot-oil heat generation plant, combined with both a piping system and the need to install new heating systems in the buildings, make such a system impractical.

Because all except the government homes have wood stoves it is considered that the most practical system would be to manufacture firewood at the sawmill and to sell it by the pick-up load. The sawmill trimmer lends itself readily to this purpose so that this type of heating and distribution system can be implemented at minimal cost.

3.3 FORESTRY

The objectives of forestry development are based on the raw-material requirements of the manufacturing facility described in Section 3.2 and other considerations discussed previously. They include:

1. Sustained delivery of 25 000 m3 of sawlogs annually to Fort Liard at wood costs competitive with those incurred by other lumber producers competing for Territorial markets;
2. Avoidance of environmental damage and significant adverse disruption of traditional land uses;
3. Reduction of the risk and impact of timber losses.

Obviously, the conduct of forest operations should be consistent with public land use, environmental, and forestry policy.

The following sections discuss how some of the main forest planning issues should be addressed, and outline specific development

and operational plans for the Operating Unit defined in Section 2.1.2.

3.3.1 Forest Policy and Silviculture

Northern Forest Policy has been the subject of much discussion, but to date only very limited Forest Policy and legislation exists in the Northwest Territories. In particular, there is no formal concensus on yield-sustention and reforestation requirements, let alone on the distribution of costs associated with any such requirements between the public and private sectors. In view of this, the Consultant was instructed not to include silvicultural costs in assessing the feasibility of the project. It was felt that the viability and economics of a local forest-based industry should be analysed and established in relation to the market and infrastructure situation, before policies regarding the level, distribution, and priorities of forest management inputs are finalized. In this regard, the timing of the study, in relation to current initiatives for policy development by the Government of the Northwest Territories, is fortuitous.

Although silvicultural plans and costs have not been included in this study, it has been assumed that forest regeneration will be an important consideration in harvest design.

3.3.2 Allowable Cut

The 1982 Lower Liard Timber Inventory conducted by DIAND recommended setting the annual allowable cut level for spruce sawtimber between 87 600 and 100 000 m3. The present study has been able to identify markets for only 25 000 m3. Thus, for the forseeable future, demand levels will be well below supply potential. This finding has important implications for the prioriziation of forest inventory and management efforts.

For example, the consultants were requested, as part of this study, to include a summary workplan and budget for an assessment of immature stands, hardwood types, and annual allowable cuts. We suggest that as a result of the study findings,

consideration be given to delaying such assessments until serious possibilities are identified for utilizing a much larger proportion of the timber in the Liard Harvest Area.

In the meantime, priority should be given to developing strategies for assessing and managing the risks of losing currently merchantable stands. As discussed in Section 2.1.6, these risks override conventional allowable-cut and productivity considerations. The Operating Unit proposed for initial harvest contains 1 650 000 m3 of spruce sawtimber, theoretically sufficient to maintain the planned harvest level for 66 years. However, the average total age of the timber is over 180 years, with a significant proportion over 200 years; and the critical questions facing forest managers relate to the stability and quality of the resource, and priorities for scheduling harvests. Proposals addressing these questions are included in the following pages.

3.3.3 Land Use and Environment

The study terms of reference stipulate that full consideration be given to environmental impacts, protection of wildlife habitat, and maintenance of traditional hunting and trapping lifestyles. These factors have therefore been fully taken into account in the selection of operating areas and seasons, the location of logging operations and roads within the selected Operating Unit, and harvest cut-block design.

The selection of the Operating Unit defined in Section 2.1.2 confines the logging operation to winter access, therefore limiting the potential for soil erosion and excessive hunting access. Examination of traditional uses of the area indicated that no significant adverse disruptions of these uses need occur. The area contains a high concentration of dense overmature coniferous forest; under this condition, logging will have a positive impact on browsing wildlife species (especially moose), predatory hunters, and bears.

Within the Operating Unit environmentally-sensitive areas on steep slopes and bordering watercourses can be permanently deleted

from the operable forest land base. (This has been assumed in this study.) One area of moderate sensitivity requires crossing by winter road. In this case a preliminary route Iocation was selected and field checked (see Map 2); no erosion problems are anticipated, assuming adherance to proper construction practices. Timber on the east side of the Liard, and on the river islands, will be reserved temporarily (with the exception of a small volume required to support the first year of operation while the road system is being developed). These areas can be logged without significant negative impacts, but they are more secure from fire, and more frequently used by human travelers (see Figure 3) and wildlife than is the main concentration of timber further west. They are therefore suitable for retention until overmature timber in the main area has been logged or lost, and until local experience in sound environmental logging has been developed.

Harvest cut-block design can have a major impact on both wildlife habitat and the regeneration of the forest, and will be discussed below.

3.3.4 Harvest Design

The 1982 Inventory report by DIAND recommends adoption of guidelines for harvest cut-block design similar to those used by the Alberta Forest Service for northern areas*, but with local modification. Guidelines would specify such parameters as percentage removal of forest cover within an operating area, cut block size and configuration, and requirements for residual buffer-strips along watercourses etc.

The Wildlife Service of the Government of the Northwest Territories has proposed more stringent guidelines, including limiting clear cuts to 20 ha with maximum widths of 100 m, creation of maximum edge effects, retention standing of all dead and submerchantable timber, retention of residual blocks until regrowth

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* Henderson C. 1977. Timber harvest cut-block design. Alberta Dept. of Energy and Natural Resources, Report #43.

is 4 m high, and maintenance of buffers along rights-of-way and watercourses.

It must be emphasized that such guidelines for the creation of wildlife habitat, if applied arbitrarily in large blocks of overmature forest, may be deleterious to other legitimate objectives, and ultimately self-defeating. Natural wind-throw is already occurring in the Operating Unit. The location of wind-firm boundaries will be a major challenge in cut-block layout. Inflexible application of general guidelines can result in failure to maintain reserve blocks, expensive salvage operations, and, most important, dangerous accumulations of decadent and wind-thrown timber, with the ultimate loss of aesthetic, wildlife, and timber values.

In the main block of timber to the west of the Liard, emphasis in harvest design should be on removal of the most unstable stands, utilization as cut-block boundaries of what few natural stand edges occur, and hazard reduction. This will almost certainly mean not always adhering to general guidelines for block size and width, and not relying entirely on natural regeneration for forest renewal. It would be naive to assume that ground rules covering all eventualities could be established before local operational experience is acquired. Flexibility, combined with ability to identify and respond to specific site and stand conditions, are imperative to the successful long-term management of the area.

With these factors in mind, the following recommendations are made for harvest design in the project Operating Unit.

1. The Alberta Forest Service operating guidelines for Northern Alberta serve as a useful initial model for timber harvest cut-block design. The guidelines recognise that, in areas of anticipated blowdown, the layout may have to be modified by exceeding width and area constraints to locate cut unit boundaries along the most wind-firm edges.
2. Alternate clear-cutting should be adopted as the basic harvesting system. This involves, for each block harvested, deferring cutting in an adjacent block of

similar area. If they remain stable, deferred blocks should not be removed until the first pass through the Operating Unit has been completed. At the scheduled rate of cut, this first pass would take more than 30 years. More likely, at least some of the deferred blocks should be re-visited earlier to avoid excessive accumulation of decadent and wind-thrown timber.

3. The annual harvest of 25 000 m3 will require, on average, clear-cutting about 140 ha. As general guidelines, cut-block size should be limited to about 35 ha (implying the layout and harvest of four cut-blocks per year), and width should be restricted to about 200 m.

4. The arbitrary retention of narrow buffer-strips along rights-of-way and watercourses is not recommended in the project Operating Unit. The recommended approach for dealing with sensitive permanent watercourses is to avoid them altogether. Thus we have recommended no logging near the Kotaneelee and along unnamed tributaries of the Liard further south, and the placement of the initial operating area away from drainages (see Map 2). Where timber is endangered by active water erosion, as in the east bank of the Liard, banks can be carefully logged by cable skidder providing soil and bank stability are taken into consideration. The best spruce stands on the large river islands tend to be well-separated from the river by poplar stands which are probably fairly wind-firm.

5. Live hardwoods, which on average constitute about 17.5 percent of the standing timber, may be left standing where it is safe to do so. This will have the effect of reducing slash and suckering, and maintaining forest cover.

6. The general approach of restricting cut-block size and width, with harvesting followed by scarification, will

favour natural regeneration. However, the approach will have to be modified to accommodate problems such as instability, slash disposal, standing hardwoods, unreliable seeding, and soil conditions unsuitable for scarification. When these problems occur, site-specific action will be required, possibly involving various combinations of control-burning, artificial seeding, and planting.

7. The project forester, possibly with initial assistance from Canadian Forestry Service specialists, should conduct an annual survey to identify endangered stands and to revise harvest schedules accordingly. Although the logging operation should be based on an Annual Operating Plan with a three to five year look-ahead, flexibility must be retained to continually modify harvest schedules, especially if stand conditions referred to in Section 2.1.6 deteriorate. Flexibility to respond in this way will be aided by the development of the main haul road system discussed below.

3.3.5 Access Development

Access to and within the Operating Unit will rely entirely on winter roads crossing the Petitot and Liard Rivers by ice bridges. To facilitate harvesting and hazard reduction throughout the extensive block of overmature timber west of the Liard, it is proposed to construct. during the first five years of operation, approximately 55 km of main haul road. Map 2 shows the proposed location of this system, with the exception of 4.6 km (of which 2.5 km requires new construction) between the Operating Unit and the sawmill.

The design should accommodate a sustained speed of 40 km per hour, with a minimum sight distance of about 90 m. Grades on adverse pitches should not exceed about 8 percent; on the proposed route there should be no difficulty in keeping sustained adverse

grades well below this. Surface and right-of-way widths of 6 and 20 m respectively have been assumed. The system should be regarded as permanent.

Considerable savings will be effected by using existing right-of-way and cut-lines. A capital cost of $181 "500 has been budgeted for initial construction in the economic analysis. This does not include the salvage of merchantable timber, which will be charged to the logging operation. We believe the early development of the road system, by providing access to high-risk timber, flexibility in harvest scheduling, and the opportunity for prompt hazard reduction, is a sound investment, not only for the LVBDC, but for Territorial forest management as a whole.

The existing ice-bridge location will be used for the Petitot River. A tentative location is Identified for the Liard on Map 2.

The main road system will be fed by spur roads connecting to the actual cut-blocks. These roads will have similar specifications to the main haul, and their location will again take advantage of existing cut-lines. Map 2 is neither complete nor exact with respect to the location of spur roads, but shows the general routing for the Unit, and most of the access required for the first five years.

Within cut-b'locks, temporary roads will be constructed, probably at an intensity of about 5 km per square kilometre.

Average haul distance at maturity will eventually be about 35 km.

All road planning and layout would be the responsibility of the Project Forester. It has been assumed that all construction and maintenance operations would be contracted, presumably to Beaver Enterprises.

3.3.6 Five-year Operating Plan

Year 1 of the forestry Operating Plan corresponds to the Development Phase of the 10-year Development Program (see

Section 3.4.2.1), Year 2 to the Growth Phase, and Years 3 to 5 to the first three years of the Maturity Phase.

Manning requirements are outlined in Section 3.4.3.2. Details of.work schedules, machine requirements, and cost analyses are included in the Appendix.

In all five years ice-bridges will be constructed over the Liard and Petitot Rivers, as early as possible In the winter season.

During Year 1, 16 km of new main road construction should be completed. Work will include:

Approximately 2.5 km of construction from the Petltot crossing, skirting the south and east sides of the airstrip, to connect with the main community access road and hence the sawmill;

New construction and upgrading of the existing road to complete the section between the Liard and Petitot crossings;

Construction west of the Liard as far as the east edge of the initial operating area (see Map 2).

Also during the first season, 12 500 m3 of timber will be harvested and delivered to the sawmill. About 2500 m3 may be obtained from the road right-of-way. Consideration may also be given to salvaging timber endangered by active erosion along part of the east bank of the Liard. The balance will be harvested from two small cut-blocks, of approximately 25 ha each, between the Petitot and Liard ice-bridges. The precise location of these cuts will not be determined until the Planning Phase of the project, but average volume per hectare is expected to be about 200 m^3, and the average haul distance to be 12 km. Tree size in this area, at about 0.81 trees per m3, is somewhat larger that average for the Operating Unit.

Logging with a single skidder has been assumed for the first year. It will be backed up by a D8K or smaller unit for construction of block roads and landings. Logging will take 65 to 70 days. Hauling, employing three trucks and a loader, will require about 30 days.

The remainder of the first five year-s operation will be restricted to the area indicated on Map 2, unless other locations are identified as having higher priority because of the need for hazard-reduction or salvage. The initial operating area contains approximately 190 000 m3 of sawtimber, of which 90 000 m3 (slightly less than 50 percent) will be harvested in the four-year period. Average volume per hectare is about 166 m3, with approximately 1.0 tree per $m3_0$ The area will require 7 km of main road, plus between 7.5 and 9.5 km of spur road, to complete access to cut-blocks.

During Year 2 approximately 90 ha will be clearcut. If reasonably wind-firm boundaries can be found, the cut will be distributed between three blocks of about 30 ha each. During the remaining three years, about 150 ha will be harvested per year, probably in cut-blocks ranging from 35 to 40 ha in size.

The logging operation at maturity is expected to involve two skidders and a dozer for up to 80 days per year (not including construction of main and spur roads). Hauling will require one loader and three trucks for about 70 days per year.

Skidding, loading, and hauling would most logically be undertaken on contract by Beaver Enterprises, who already have experience in machine operation and maintenance. Felling could be undertaken either by project employees, Beaver Enterprises, or other contractors.

3.4 DEVELOPMENT PROGRAM

3.4.1 Annual Operating Schedule

A typical annual Operating Schedule has been developed for the project in the form of a bar graph highlighting the key events in the year and projected production rates, inventories and approximate manning strengths (see Figure 6). This schedule has been prepared only for the operation at maturity.

The following assumptions have been made:

The mill will produce 5.2 MMfbm of saleable kiln-dried dressed lumber per year at maturity, and require 25 000 m3 of sawlogs annual.

The manufacturing season will be confined to the summer (March - September).

The mill will be operated on a two shift basis for most of that time but, combined with the winter logging operation, will result in a relatively well balanced year-round work force. This is illustrated in the manning section of Figure 6.

Organisation of the crew and training will provide flexibility of operation.

The sawmill complex will commence operation mid-March as the weather becomes mild and during the initial six weeks will concentrate on drying lumber inventory carried over from the previous year and tuning up the mill ready to start operation mid-April. This will require a crew of three.

Operations will commence on a single shift basis with only the planermill operating for the first three weeks. This will develop an inventory of 1.2 MMfbm of dressed lumber ready for shipping as soon as the Liard River Is open to traffic. The crew will then transfer to the sawmill for two weeks of single shift operation. From this time on the mill will operate on two shifts per day.

The running inventories of green and kiln-dried wood appear low at times but until more analysis of sawmill outturn by width and length is completed this is a reasonable base which is controlled .by the size of winter inventories.

The manning schedule for the forest products enterprise appears to satisfy the general requirements for employment in the Fort Liard area. The project will employ more people for

manufacturing in the summer (16 to 18) than for logging in the winter (13), but historically oil and gas exploration and traditional occupations have provided other opportunities in the winter. There will be two hourly employees engaged in mill maintenance year round.

3.4.2 Recommended 10-Year Development Program

A computerized planning model was used to assess all alternatives considered in selection of the development program having the greatest overall potential. (see Section 3.4.5 and Appendix A).

The recommended program encompasses six stages of development designed to plan, construct, start-up and bring to maturity an operation meeting the objectives and. constraints discussed In Section 3.1.

3.4.2.1 Planning. This is the most important phase of the program. Aspects of particular importance are itemized below:

Timber defect. It has not been possible within the scope of this study to fully evaluate the seriousness of shake and related defects in the timber. This could be done only by taking samples from the supply area to an existing sawmill and having them sawn, dried, and graded under controlled conditions. Such a mill test is highly recommended before proceeding beyond the Planning Phase.

Sawmill design. The study design concept Incorporates a conventional headrig and carriage because of the need for selective sawing of logs with shake content. This equipment requires skilled operation and maintenance. More confident assumptions regarding shake content may permit use of a gang saw which would be less demanding of operation, more highly productive, and manufacture a higher quality product with less waste. The overall affect would be a more profitable operation.

Used equipment. The Planning Phase would be close enough to the construction phase to consider, more seriously than possible in this study, the potential to incorporate used equipment. The modernization of the sawmill industry is phasing out equipment which is eminently suited to this small sawmill. Carefully selected, properly overhauled equipment of high quality, would be very practical. This could result in capital savings of several hundred thousand dollars. The recruitment of the training staff and the development of a detailed training program would be another important element of the Planning Phase.

Scheduling. The seasonal nature of the operation, with extended periods between logging, manufacturing, and delivery to market will require a large operating reserve. Further manipulation of the operating schedules could improve this situation, so this subject should receive serious attention during detailed project planning.

3.4.2.2 Construction. Nine months is allowed for construction. Site preparation, concrete placement, and the Installation of the log infeed section for sawlog merchandisation, will take place in the summer and fall. The sawmill, planermill, kilns and buildings would be built the following spring. Training would begin during construction.

3.4.2.3 Start-up. Start-up would begin in the second summer using sawlogs cleared from the construction site. Full scale operating training would be in affect.

3.4.2.4 Development. One year of operation at 50 percent of the production level at maturity would follow the start-up period. This would involve initiating forest road construction and logging 12 500 m3 of sawlogs during the winter following completion of

construction. Forest road construction would not yet be sufficiently advanced to provide access to the targetted initial operating area (see Map 2 in Map Folio), so the logging would take place on the east side of the Liard south of the Petitot. The following summer the sawmill would produce approximately 2.6 MMfbm, operating on a single shift basis. This would be sufficient production to commence the establishment of a market niche and to consolidate the training program. Emphasis during the Development phase will be on developing a quality product, training, and forest access development.

3.4.2.5 Growth. A further year of limited production has been assumed. During this time the training program would be concentrated on quality standards, and the selection of key operators and those with supervisory potential. The training staff would commence handing over to the permanent staff. Production has been assumed at 3.1 MMfbm, requiring 15 000 m3 of sawlogs. Logging would take place in the main initial operating area which will have been accessed the previous winter. Construction of the main haul road system would continue. The year-s operating schedule would be similar to that shown in Figure 6, but manufacturing would be still restricted to a single shift basis. This will provide flexibility and facilitated concentration of efforts to upgrade training and consolidate customer acceptance of a quality product.

3.4.2.6 Maturity. By the third year of operation it should be possible to secure a market for 5 MMfbm annual, and commence production at this level. The typical annual operating schedule for the Maturity Phase has been described in Section 3.4.1 and Figure 6. Completion of the entire Main Haul road system for the Forestry Operating Unit within the first three years of the Maturity Phase will provide flexibility to procure wood from areas having the highest priority for harvesting.

Although training would now be complete and the permanent staff in control, opportunities for higher profitability should be pursued, exploiting the higher production potential of the sawmill

and its flexibility. The development of markets for more lumber and higher-return items such as timbers, ties, and export logs should now be given **high priority.**

3.4.3 Manning Requirements

3.4.3.1 Manufacturing. Table 10 details the operating positions in the mill and shows the number of persons involved and the status of training during the first three years of operation through to the maturity phase.

The following notes apply:

"T" denotes that this position is filled by a trainee during the Development and Growth phases.

"A" that **in** the Development and Growth phases, four men will be trained as operators in sawmill and planermill.

"B" that minimal training required for these positions.

"C" that in the Development and Growth phases one man will be trained as utility driver.

"D" that millwright, electrician and sawfiler trainees will be on full time training throughout their first year and become the key maintenance men in the mill. They would be involved during the mill construction. In the growth phase two previously trained operators should be given training in maintenance to provide back up for the tradesmen, thus expanding the all round knowledge of the crew.

3.4.7.2 Logging. Table 11 identifies the numbers of seasonal employees involved in the logging operation. Much, if not all, of this operation is expected to be contracted to Beaver Enterprises. It is assumed that no formal training will be required. Production and hourly rates assumed in the economic model for these positions are those of skilled workers. Lower skill levels would require more workers at lower rates or renumeration.

Table 10. Manning schedule for manufacturing operation.

Position	Development phase		
	Development	Growth	Maturity
Sawmill (per shift):			
Head sawyer (A)	T	T	1
Cut-off saw (A)	T	T	1
Edger/resaw (A)	T	T	1
Trimmer (A)	T	T	1
Green chain (B)	2	3	4
Total Sawmill	2	3	8
Planermill (per shift):			
Tilt hoist (A)	T	T	1
Planer feeder (A)	T	T	1
Grader (A)	T	T	1
Trimmer (A)	T	T	1
Dry chain (B)	2	2	3
Total Planermill	2	2	7
Utility driver (C)	T	T	1
Shipping and packaging (B)	1	2	2
Millwright, electrician and sawfilers (D)	T	T + 2	2
Management Staff:			
Manager	0.5	0.5	1
Production supervisor	0.5	0.5	1
Clerical			2
Total Management Staff	3	3	4
Training Staff:			
Manager	0.5	0.5	0
Production supervisor	0.5	0.5	0
Controller/sales			0
Maintenance supervisor	1	1	0
Total Training Staff	3	3	0
Trainees:			
Operations	4	2	0
Sawfiling	1	2	0
Millwright/electrician	1	2	0
Utility driver	1	1	0
Total Trainees	7	7	0

Table 11. Seasonal manning requirements for logging operation.

	Development phase		
Position	Development	Growth	Maturity
Failers	1	1	2
Landing workers	1	1 - 2	2 "
Skidder operators	1	1 - 2	2
Cat operators	1 + 1P	1 + 1P	1 + 1P
Grader operator	1P	1P	1P
Loader operator	1	1	1
Truckers	2	2	3
Total	9	9 - 11	13

P = part-time

The operation would be managed by a technically or professionally qualified Project Forester on full-time salary, who would also be responsible for all forestry planning, engineering, and silvicultural functions.

3.404 Training Program

The financial success of this project will depend upon the efficiency of the operation and the quality of product shipped to market. Lumber manufacturing is a skilled business which requires good knowledge of the process and equipment and of quality and grading requirements. A lack of good control over the fundamentals of **sawmilling** can be very expensive and will quickly spell disaster. The grading requirements for lumber produced in this mill are straight-forward and most of the skills can be easily learned if a good training program is organised and instituted at the start.

It will be essential to have two knowledgeable and enthusiastic persons keeping control over the mill for several years until the skill and knowledge base of this crew is fully developed. Therefore these are considered to be permanent positions. These two

men, the mill manager and the production supervisor, will be the key to the success of this operation.

Two temporary training positions are proposed:

A financial controller with lumber sales capability to establish the payroll and accounting systems, train the clerical workers, and to help the manager establish the sales program.

A maintenance supervisor to ''train the sawfiling, millwright, and electrician trainees.

In addition to overseeing construction and developing the organisation and sales, the trainers will have to actually operate and demonstrate the equipment. The Development Phase will be very demanding of their time in training the crew and solving all the start-up problems which inevitably develop.

Because of the flexibility required in this operation, a small group of initial trainees will receive training in most aspects of the sawmill and planermill operations and will also be involved in construction and start-up. Procedures should be developed to identify and test the local people to select the ones with the highest skill potential for the key operating and maintenance positions.

In the second year (Development Phase) this same group will commence serious training and operate the mill on a single shift basis for six months.

The following year of operation (Growth Phase) will rely on these original employees to assist the management personnel in upgrading the pull-chain operator and a few more new employees by initiating them to the training program. Thus after a second year of one-shift operation sufficient people will be trained to operate a two-shift mill. Proper training of the maintenance staff is absolutely essential. lt will be necessary for the first two maintenance staff to develop both sawfiling and millwright skills. They will also have to be familiar with all of the production jobs and hopefully in.time could develop into shift lead hands capable of trouble-shooting both equipment and mill-production problems.

In the economic analysis, a small training budget has been continued into the Maturity Phase. This has not been charged as an operating cost. Mill Management at the time will have to decide what level of net revenue would be re-allocated to continued training and upgrading.

Little formal training should be necessary as part of the logging operation. Planning, control, and problem identification and resolution will be undertaken by the forester who will have a formal forestry education and technical experience. Operator performance and training will be the contractor-s responsibility.

3.4.5 Economic Analysis

The planning model described in the Appendix was used to assemble and evaluate the logging, market, and production simulation data. A large number of operating conditions were tested before the sawmill design and recommended Development Program presented in this report were identified.

It has been concluded that a conventionally financed operation of the scope considered necessary for successful operation would not be economically viable. However, it is felt that the operation has such high potential and social benefits that the case for unusual financing should be presented.

All possibilities which used conventional financing, even with grants totalling 50% of the required capital costs, failed to generate sufficient accumulated cash over the 10-year Development Program to repay any normal commercial loan. The interest payments, combined with the need for an unusually large operating reserve to bridge the long seasonal periods between logging, manufacturing and delivery to market, proved to be too large a drain on the revenue.

Therefore a Base Case was developed which assumed grants totalling 50% of the capital cost and an interest-free loan to cover the remainder of the operating budget. This Base Case is presented in the Appendix.

The computer program was then used to evaluate a range of sensitivity analyses to determine the economic performance of the

operation under a variety of possible conditions. These can be summarised as:

- Reduced capital cost by the selective purchase of quality, reconditioned used equipment;
- Increased operating cost In the event that the training program was sufficiently unsuccessful to necessitate a 20% higher manning than planned for the Base Case;
- Decreased production levels in the event that the market development was 10% less than predicted in the Base Case;
- Increased production levels in the event that the lumber sales market was able to absorb the full production potential of the sawmill. This would be 7.8 MMfbm per year, 50% higher than the Base Case;
- Decreased sales values in the event that the average selling price was 5% lower than predicted;
- Increased sales values in the event that they were 15% higher;
- The affect of normal financing on the capital cost outstanding after the application of grants totalling 50%.

The computer program evaluated these sensitivity ranges by generating an accumulated Profit and Loss schedule over each of the 120 months of the 10-Year Development Program. The results of this evaluation are summarised in Table 12.

It should be noted that three other opportunities for increased profitability were not tested due to their unpredictable nature at the present level of knowledge. These are:

- Increased lumber grade realisation, which further study of the shake question may identify as feasible;
- A higher market for timbers, ties, and 1 inch lumber;
- A log export program.

There are minimal royalties on the export of walleye, lake trout, and whitefish from Saskatchewan.[4] Current royalty levels are:

whitefish - 1/2 cent per pound (1.1 cents per kg)
lake trout - 1 cent per pound (2.2 cents perkg)
walleye - 1 cent per pound (2.2 cents per kg).

Royalties amount to less than, $50 thousand per year.

Catch levels are monitored mainly through fishermen's reported catch through the FFMC waybill system. Until 1985, fishermen selling fish to other than the FFMC were not required to report harvest or sale information. Present direct sales to consumers are estimated to represent about 10% of total sales. The non-reporting of direct sales can lead to over-harvest.

4.3 Sport Fishing Regulations and Allocation Mechanisms

There are regulations for Saskatchewan anglers. There are also guidelines on lodge capacities for the commercial outfitting industry.

4.3.1 Angler Regulations[5]

As mentioned above, there are no explicit lake quotas for the sport fishery.

There are daily limits. In 1985, the daily limit was 8 fish plus 25 perch. The daily limit may be any combination of the following species limits:

Northern Pike -	6 fish, no more than one which of may exceed 5 kg (11 lbs)
Walleye	5 fish, no more than one of which may exceed 2.5 kg (5.5 lbs)
Lake Trout	4 fish, no more than one of which may exceed 5 kg (11 lbs)
Arctic Grayling -	5 fish, no more than one of which may exceed 1 kg (2.2 lbs)

Sauger	- 5 fish	Splake	- 5 fish
Goldeye	- 8 fish	Kokanee Salmon	- 5 fish
Whitefish	- 8 fish	Sturgeon	- 1 fish
Rainbow Trout	- 5 fish	Perch	- 25 fish
Brook Trout	- 5 fish	Burbot	- No limit
Brown Trout	- 5 fish		

The daily limit of 8 fish has been in effect for over 30 years. Prior to 1985, the daily limit could be taken all from one species of fish. In 1985, limits for walleye, northern pike, and arctic grayling were specified to provide extra protection for species under pressure.

In 1985, the possession limit was: twice the daily limit for each species, but not more than 16 fish plus 50 perch and no more than 1 fish per designated species exceeding the specified upper size limits. There were no minimum size limits and no annual (bag) limits for each angler.

The upper size limits noted above do not apply to the Southern Management Zone.

The number of anglers is not restricted. However, everyone must possess a Saskatchewan angling licence while fishing in the province. The only exceptions to this requirement are Treaty Indians, persons under 16 years-of-age, and Saskatchewan residents 65 years-of-age and older. An angling licence allows the person to fish any lake that is open to fishing, i.e., there is no regional licensing.

There are three legally recognized methods of sport fishing: hook and line, underwater spear fishing, bow and arrow fishing. Special regulations are in effect for the latter two methods.

It is illegal to fish with more than one line during the open water season, to fish more than two lines when ice fishing or to use more than four hooks on one line.

Under the Sport Fishing Conservation Program implemented in May 1985, the province is divided into three management zones. In 1985 the open seasons were:

Southern Zone	May 3 - March 31
Central Zone	Hay 17 - March 31
Northern Zone	June 1 - March 31

Angler opening dates are staggered to provide protection for spawning walleye. In the Central and Southern regions certain waters are closed for all or part of the year to conserve fish.

In 1985 annual angling licence fees were $10 and $20 for Canadian residents and non-residents of Canada respectively. In addition, Canadian residents could buy a one-day angler licence for $4.

In summary, access to the sport fishery is unrestricted (subject to the payment of the licence fee) . There are no overall sport fishery catch limits on a provincial, regional, or lake basis. There are daily limits for individual anglers, but no annual limits for anglers.

4.3.2 Outfitter Guidelines

Lodge capacity guidelines were introduced by Saskatchewan Parks and Renewable Resources in 1978 in an attempt to protect both existing outfitters and the fish resource from excess capacity and undue competition for a limited resource. The capacity guidelines were also an implicit attempt to allocate the resource among outfitters. The guidelines embody four steps:

- to estimate the sustainable supply of game fish in lakes,
- to estimate the potential harvest of game fish by guests of outfitters (assuming everybody fishes and catches

their limit),

- to relate this potential harvest to that of other users and to sustainable supplies, and

- to determine the maximum guest capacity of an establishment in terms of the number of beds to keep the total harvest of all users within the sustainable supplies.

The guidelines are applied annually as a condition of the outfitter's leases on provincial lands. There are different procedures for new lodges and established lodges.

For new lodges, allowable bed capacity is based on three assumptions: that each guest fishes, that each guest catches and retains the limit, and that the lodge operates at 60% capacity for the season. Essentially, the maximum number of guests at any one time is controlled.

For established lodges, control is over the total number of guests in a year rather than over the maximum number of guests at any one time.

Note that the above are guidelines and not regulations. Since the guidelines were implemented as a function of the land lease, lodges that exist on purchased land are not under control. Further, it is of interest that the number of lodges purchasing their lease is increasing.

4.4 Subsistence Fishing Regulations'

The native people of Saskatchewan use the fish resources of the province as a food source for themselves, their families, and their dogs. The subsistence fishery has three major components: Indian, domestic, and angling.

Treaty Indians may fish for food throughout the year and do

not have to pay a fee for their permit. Non-treaty Indians and others purchase domestic licenses at a cost of $5 per license. Domestic licenses are issued on the basis of need according to criteria of financial hardship, geographic isolation,and/or possession of sled feds. Treaty Indians may harvest fish for food by angling without a license throughout the year. Most Indian or domestic fishermen fish 100 yards of gill nets of 5 inch extended measure.

Each license and permit possesses an identification number, indicates the waterbody to be fished, and describes the conditions which must be met. Nets must be marked with the identification numbers. The fish are to be used by the license holder and his family, with not more than 50 kg of fresh or frozen fish in possession at any time. Despite these restrictions, fish are shared among families, and some may even be sold inside or outside the communities in which the fishermen live.

FOOTNOTES

1 For a discussion of generic classes of fisheries regulations see:

Gordon S. Gislason, James A. MacMillan and Jack W. Craven, The Manitoba Commercial Freshwater Fishery: An Economic Analysis, University of Manitoba Press, Winnipeg, 1982, Page 10-11.

2 Fisheries and Oceans, "Saskatchewan Fishery Regulations Under the Fisheries Act", Ottawa, September 25, 1984.

3 For a listing of quota levels by lake in Saskatchewan, see:

A.R. Murray, "Estimated Sustainable Yields and Supplies of Fish in Saskatchewan Lakes", Saskatchewan Parks and Renewable Resources, Fisheries Branch, Regina.

4 Royalties also exist on the export of brine shrimp eggs, brine shrimp, and crustaceans.

5 Ibid and Saskatchewan Parks and Renewable Resources, "Saskatchewan Anglers Guide 1985", November 1985, Regina, 1985.

6 The description of outfitter guidelines is drawn from:

Saskatchewan Parks and Renewable Resources, "Conservation Options for the commercial Use of the Fish Resources: A Discussion Paper", Fishery Branch, Regina, October 1985.

7 The description of the subsistence fishery is taken from:

A.R. Murray and J.W. Clouthier, Involvement of People of Indian Ancestry in Saskatchewan Fisheries, Saskatchewan Parks and Renewable Resources, Fisheries Branch, Regina, 1986, P.2.

5.0 FEDERAL AND PROVINCIAL PROGRAMS

There are a variety of federal and provincial programs and activities to conserve, enhance, and develop the fish ' resources and fisheries of Saskatchewan. As well, several other programs act indirectly to affect fisheries conservation, enhancement, and development.

There are six activity categories for government involvement: enforcement, management, development, assessment, enhancement, and habitat protection.

Enforcement refers to activities of the operations sector and includes activities which range from issuing licences to enforcing fishing regulations by the province, and conducting plant and fish quality inspections by DFO. Commercial, sport, and subsistence fishing regulations are summarized in Section 4.0.

Fisheries management in the context of this study refers to: planning and setting regulations, allocation decisions, and the consultation process with user and non-user groups.

Fish stock assessment includes biological and limnological fisheries research concerned with determining the effects of fishing on fish populations. It also includes operation of the provincial fisheries laboratory in Saskatoon.

Enhancement includes stocking and culturing fish, e.g., the operations of the provincial Fort Qu'Appelle Fish Culture Station. Enhancement refers to augmentation of stocks to bring them up to full productive potential. There is also a replenishment program in which game trout not native to Saskatchewan are introduced. Fish enhancement programs of rearing ponds, lake rehabilitation, fishways, and lake aeration have been funded under the Fish and Wildlife Development Fund.

Habitat protection involves monitoring and testing for deleterious substances (e.g., mercury and acid rain) to fish populations as well as the impact of major resource developments such as hydroelectric dams and mines.[1]

Development encompasses the promotion of economic benefits to man through consumptive use of the fish resource and through the infrastructure required to capture, process, and transport the fish. Main activities are: subsidies/grants, training initiatives, extension work, and other programs/assistance.

The categories are not completely exhaustive or non-overlapping. Some discretion is required in designating a particular activity to one of the six main categories. However, the classification system is compatible with federal and provincial government fisheries expenditures classifications given in the next major section (Section 6.0).

In Tables F.1 and F.2 (in Appendix F), major program activities of the provincial and federal governments are summarized. The documentation of provincial activities is drawn from annual reports of Saskatchewan Parks and Renewable Resources (and its forerunners, the Department of Northern Saskatchewan and the Department of Tourism and Renewable Resources) as well as several provincial planning documents.[2] The documentation of federal activities is less exhaustive. It is drawn from planning documents and some material brought together for this study by the Freshwater Institute (DFO, Winnipeg) .

Considerable controversy surrounds fisheries development activities of the provincial and federal governments. Areas of controversy include:

- the rationale for government involvement in private sector fish harvesting and processing operations,
- the encouragement of industry excess capacity through

the array of government financial assistance programs, and
the extent to which different development programs and activities promote conflicting goals, e.g., economi,c efficiency versus employment generation.

Some of the key aspects of provincial and federal development programs are discussed below. The vast majority of these are directed at the commercial fishery as opposed to the sport, subsistence, and other fishery sectors.

5.1 Provincial Development Programs

Fisheries development activities by the Fisheries Branch can be classified under: subsidies/grants, training, extension, and other development activities (see Table F.1).

The main subsidy program is the fish transportation subsidy for fish caught in Saskatchewan. The program was instituted in 1975-76 and pays 90% of the cost of transportation of fish from lakes where the fish were caught to Prince Albert. There was also an outlying lake subsidy program for a few years in the late 1970s. In addition, there is a provincial fish price support program. The program provides a subsidy to the price of certain species of fish, e.g., continental whitefish. Pike has received subsidies in the past. The total of fish transportation and price support subsidies is approximately $500 thousand annually.

The province supplied a grant to Co-operative Fisheries Ltd. (CFL) of $172 thousand to cover an operating deficit arising from 1974-75 operations. Subsequently, CFL was replaced by the Freshwater Fish Marketing Corporation (FFMC).

Financial assistance has also been extended with regard to ice-house and packing house construction, gas tax rebates, the start-up of a Fishermenis Supply Co-op, and Special ARDA fishing equipment grants.

Provincial training has occurred in the areas of skiff building, and fish scale reading (for determining age).

The Fisheries Branch has funded user group committees to liase with the department. A guide on commercial fishery procedures was published. Extension assistance in rainbow trout fish farming has been provided. Education and assistance has been provided to commercial fishermen in dealing with cost accounting, income taxi excise tax, and unemployment insurance.

Many of the above activities were funded under the Fisheries Development Program (FDP) initiated in 1974-75. Other program/assistance areas include: an experimental whitefish roe program, establishment of Stanley Mission Fish Aging Co-operative, system of processing and analyzing fishermen's daily catch records at La Ronge, and a commercial fishermen's identification program.

In addition to the assistance programs noted above, other government departments are involved in fisheries development through identification of tourism opportunities, manpower training, etc. These include Tourism and Small Business (TSB), Indian and Native Affairs Secretariat, Northern Affairs Secretariat, and the Saskatchewan Research Council.

TSB provides low interest loans to qualified northern fishermen for fishing equipment and supplies and has funded research projects for crayfish development and aquiculture. The Northern Affairs Secretariat is provincially responsible for the ERDA Sub-Agreement on Northern Development. The Indian and Native Affairs Secretariat is responsible for Special ARDA administration. The Department of Economic Development also has potential for involvement in the fisheries by way of government-entrepreneur cost-sharing in development assessments such as processing facilities. The Saskatchewan Research Council is involved in various aspects

of fisheries, primarily aquiculture, in a sponsorship role as well as a contractor role.

5.2 Federal Development/Assistance Programs

There are various federal subsidy and/or Einancial assistance programs for Saskatchewan fishermen. These include:

- FVIP (Fishing Vessel Insurance Program). Provides protection from abnormal capital losses at premiums which are affordable by fishermen, where insurance is otherwise unavailable from commercial sources.
- FVAP (Fishing Vessel Assistance Program). Provides financial assistance towards the capital cost of vessel replacement.

- FILP (Fisheries Improvement Loans Program). Facilitates the availability of credit to fishermen through guaranteed loans.

In addition, shore-based infrastructure developments (e.g., docks, ice-houses, packing plants) have been undertaken jointly by the federal and provincial governments, e.g., Fish Chilling Assistance Program and the Special ARDA Program. There have been accelerated tax write-offs for new vessels constructed.

In a special amendment to the Unemployment Insurance Act in 1956, self-employed fishermen were covered under the unemployment insurance (UI) system. Although fishermen do make contributions, the program serves as a transfer mechanism because:

- benefits received by fishermen far exceed their contributions, and
- benefits are paid without regard to the fishermen's total earnings. Some individuals earn high income from fishing and/or from other occupations and still receive UI benefits.

The Freshwater Fish Marketing Corporation (FFMC) was established in 1969 as a federal crown corporation with exclusive jurisdiction over the inter-provincial and export trade in freshwater fish for the region comprising the three prairie provinces, the NWT, and Northwestern Ontario.[4] The FFMC Head Office is located in Winnipeg, although smaller plants/receiving stations are located in Saskatchewan. Individual fishermen may sell directly to the final consumer within the province in which the fish was caught. Approximately 90% of fish caught by Saskatchewan commercial fishermen is sold to the FFMC with 10% being sold directly to the final consumer. Consequently, the FFMC is the main mechanism for pricing and marketing Saskatchewan fish.

The Freshwater Institute in Winnipeg is a facility for research on fisheries and aquatic problems which are national in scope. It is a centre of national and international prominence for inland waters. In addition to basic biological, environmental and limnological research, it has conducted research into new products/fishery development (e.g., marketing fish sticks from underutilized species, whitefish roe, brine shrimp, crayfish etc.). The Institute also provides the capacity for economic analysis and is responsible for fish product inspection. It has the mandate for fisheries management in the Northwest Territories (including the Arctic Ocean and Hudson Bay).

Apart from DFO, other government departments and activities affect the Saskatchewan fishery. These include DRIE and the Department of Indian Affairs and Northern Development.

In the next section, present public revenues and costs associated with the six activity categories are presented.

FOOTNOTES

1 For discussion of fish habitat management issues and potential activities see:

R.P. Johnson, "Land Use and the Fish Resource of Saskatchewan", Report No. 12, Water Studies Institute, Saskatoon, 1978.

W.K. Liaw, "Land Use Effects on Saskatchewan Lakes", Fisheries Technical Report 79-6, Saskatchewan Tourism and Renewable Resources, 1979.

Canada Fisheries and Oceans, 'Proposed Policy and Procedures for Fish Habitat Management", Department of Fisheries and Oceans, Ottawa, May, 1985.

2 Saskatchewan Department of Northern Saskatchewan and Department of Tourism and Renewable Resources, 'Proposed Goals and Strategies for Fishery Management in the 1980's, 1981; Saskatchewan Parks and Renewable Resources, "Saskatchewan Anglers Guide 1985", 1985; and Saskatchewan Parks and Renewable Resources 'Conservation Options for The Commercial Users of the Fish Resource: A Discussion Paper", Research Branch, October 1985.

3 Canada Fisheries and Oceans, 'Pacific and Freshwater Fisheries Planning Overview 1982-86" Pacific and Freshwater Fisheries, Department of Fisheries and Oceans, Ottawa, April, 1982.

4 For discussion of the mandate and operation of the FFMC, see:

Gordon S. Gislason, James A. MacMillan and Jack W. Craven, The Manitoba Commercial Freshwater Fishery: An Economic Analysis, University of Manitoba Press, Winnipeg, 1982, Chapter 5.

6.0 PUBLIC EXPENDITURES AND REVENUES

In the previous section provincial and federal activities related to the conservation, enhancement, and development of the Saskatchewan fishery are documented. In this section, estimates of expenditures and revenues associated with these activities are presented.

Appendix D presents detailed information on Saskatchewan Parks and Renewable Resources expenditures by major activity, sector, and management zone for years 1974-75 through 1984-85. The data represent prorated expenditures from the Public Accounts of Saskatchewan and were provided by the Department. Subsidies as reported in departmental annual reports are also given in Appendix D.

The basic provincial data are summarized in Table 6.1. In 1984-85 $2.8 million was expended, the bulk of which went to the recreational fishing sector. Enforcement is the major departmental activity.

In 1984-85, $526 thousand in fish transportation and price support subsidies were paid to commercial fishermen (Table D.1).

In 1984-85, $424 thousand was spent on fisheries and aquiculture by Saskatchewan Tourism and Small Business (Table 6.2).

DFO Western Region operating and maintenance expenditures attributable to Saskatchewan operations exceeded $200 thousand in 1984-85 (Table 6.4). In addition, 15 person-years (PYs) were involved. Total (O&M plus PY salary) costs exceeded $700 thousand.

The above expenditure and subsidy estimates are somewhat crude and represent underestimates for at least three reasons:

TABLE 6.1: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY, FISHERIES BRANCH, PROVINCE OF SASKATCHEWAN[a,b]

	Departmental Activity						
	Enforcement	Management	Development	Assessment	Enhancement	Habitat Protection	Total
	...$000...						
1974-75	369	445	124	473	128	-	1,539
1975-76	425	336	264	587	143		1,756
1976-77	480	317	176	538	172	72	1,755
1977-78	624	340	132	635	IW	70	2,000
1978-79	603	362	89	462	225	68	1,809
1979-80	707	417	133	465		106	1,829
1980-81	663	482	144	573	260	80	2,200
1981-82	788	497	153	554	329	28	2,350
1982-83	988	613	181	662	430	39	2,914
1983-84	908	1,174	191	541	386	40	3,241
1984-85	WI	644	36	739	387	41	2,838

	Fishery Sector				
	Commercial	Domestic and Indian	Aquaculture	Recreational	Total
			...$000...		
1974-75	656	36	40	807	1,539
1975-76	854	55	39	807	1,756
1976-77	741	47	%	912	1,7s5
1977-78	865	61	71	1,003	2,000
1978-79	662	59	78	1,010	1,809
1979-80	763	70	83	914	1,829
1980-81	801	65	66	1,268	2,200
1981-82	874	78	58	1,340	2,350
1982-83	1,022	97	128	1,666	2,913
1983-&4	1,132	89	228	1,791	3,241
1984-85	925	132	144	1,637	2,838

Sources: Estimates darived from the Public Accounts of Saskatchewan and provided by A.R. Murray, Saskatchewan Parks and Renewable Resources.

[a] Excludes subsidies, e.g., transportation and price support, and excludes Fish and Wildlife Development Fund expenditures.

[b] Total may not equal sum of entries due to rounding.

TABLE 6.2: ESTIMATED EXPENDITURES BY SASKATCHEWAN DEPARTMENT OF TOURISM AND SMALL BUSINESS"

	Commercial	Domestic and Indian	Aquiculture	Recreation	Totelᵇ
1982-83	155	124	137	85	543
1983-84	44	133	51	103	3i3
1984-85	64	191	20	107	424
1985-86	59	177	65	167	510

[a] Expenditures by Program, Management and Tourism Development Branches in Fisheries and Aquaculture in the Northarn Administration District (MAD).

[b] Includaa administration expenditrues of S42 thousand annual ly.

Source: Saskatchewan Tourism and Small Business, Northarn Business Development La Ronge.

TABLE 6.3: LICENCE REVENUES BY FISHERY SECTOR, SASKATCHEWAN

	enc evenue							
	Cosmarcial	Sport*	Domestic Net	Fur Farm	Bait	Brine Shrimp	Fish Farm (Aquiculture)	Total
			...s000...					
1974-75	13	635	1	I	-	-	1	651
1975-76	13	674	1	1	1	•	1	691
1976-~	14	734	2	1	1	•	1	733
1977-78	13	742	1	1	1	•	1	759
1978-79	13	745	2	1	1	•	1	763
1979-80	Ib	729	1	1	1	•	1	747
1980-81	28	1,131	3	1	1	•	1	1,165
1981-82	24	1,152	1	1	1	•	1	1,180
1982-83	25	1,166	4	1	1	•	1	1,198
1983-s4	20	1,062	3	1	1	•	1	1,088
1984-85	23	1,%1-	2	•	1	•	1	1,988

•Includaa vendor's commission.
** Includes Fish and Wildlife Development Fund contributions.

TABLE 6.4: ESTIMATED SASKATCHEWAN FISHERIES EXPENDITURES BY UESTERN REGION, DEPARTMENT OF FISHERIES AND OcEAns

	Economic Analysis	Economic Intel 1.	Smal 1 Craft Harbours	Resource Develop-ment	Fishing Vessel Assis. (FVAP)	Inspec-tion	Fisheries Oevelop-ment	Total
O&M (s000)								
1979-80	·	5.3	130.7	43.0[d]	14.2	37.0:	5.0:	235.2
1980-81	·	5.3	136.0	47.0[d]	43.0	40.0[d]	5.0	276.3
1981-82	·	7.2	33.0	53.0[d]	8.5	45.0*	5.0	151.7
1982-83	14.0	9.7	20.0	59.0:	8.1	50.0[d]	4.0	164.8
1983"84	18.0	8.3	-	62.0[d]	·	53.0[d]	3.0	144.3
1984-85	6.0	9.8	-	66.0	19.5[d]	56.4	50.5	209.0
1985-86	5.0	12.6		69.0	20.0	59.9	60.2	226.7
PY's								
1979-80	.2	[a]	.5[b]	4.8;	.2[c]	9.0:	.2[b]	14.9
1980-81	.2	[a]	.5[b]	4.8	.2[c]	9.0[b]	.2[b]	14.7
1981-82	.2	[a]	.1[b]	&.8[b]	.2[c]	9.0	.2	14.5
1982-83	.7	[a]	.1	&.8[b]	.2[c]	9.0[b]	.2	15.0
1983.84	1.1	[a]		&.8[b]	.2[c]	9.0:	.1	15.2
1984-85	.7	[a]	-	4.8[b]	.2[c]	9.0	.3	15.0
1985-86	.8	[a]	-	4.8	.2[c]	9.0[b]	.2	15.0

• Excludes habitat protection. It is assumed the FFt4C is break even. DIAND, UI, DFO Ottawa and other federal government expenditures sra excluded.

x included in Econolsic Analysis.

b Estimates bYDPA Group Inc.

c Includes Fishins Vessel Insurance Program (lWIP). FVIP is essuned to break even except for PY's.

d Projected beck on the basis of Canadian Consumer Price Index movements.

Source: Derived from information provided by Oepertment of Fisheries snd Oceans, Freshwater Institute, Winnipeg.

- Expenditures quoted exclude activities by DIAND, UIC, provincial government departments other than Saskatchewan Parks and Renewable Resources and Saskatchewan Tourism and Small Business.

- Federal expenditures exclude 'head office" activity (e.g. , DFO Ottawa) and several activities for which the constituency group is wider than just the Province of Saskatchewan (e.g., Freshwater Institute Research).

- Expenditures on salaries include only direct costs, i.e., the employee's gross salary, and not government contributions (to UI, CPP, government pensions plans, etc.), and not government overhead (office rent, materials) .

Prior to 1985, licence revenues accruing to the province were roughly $1.1 million annually (Table 6.3). Over 95% of licence revenues is derived from angler licences. Provincial revenues from royalties and fines, infractions, etc. are not reported. The federal government reaps no direct revenue from its involvement in the conservation, enhancement, and development of the Saskatchewan fishery.

In 1984/85, angler license fees doubled with the result that angler license revenues increased to $2.0 million. Three dollars of each license fee were ear-marked for the Fish and Wildlife Development Fund. Fish enhancement programs funded from these monies included rearing ponds, lake rehabilitation, fishways, and *lake* aerations.

Table 6.5 summarizes expenditures and revenues. In 1984-85 the provincial government incurred a deficit of $2.o million in managing the Saskatchewan fishery. The federal deficit was $0.7 million. As indicated previously, due to the omission of several cost/expenditure categories, the overall deficit of $2.7-million represents a lower bound. It, however, does suggest the order of magnitude of the short-

TABLE 6.5: PROVINCIAL AND FEDERAL GOVERNMENT EXPENDITURES AND REVENUES, THE SASKATCHEWAN FISHERY*

	Provincial Expenditurea						
	Fisheries Branch	Tourism & Small Business	Subsidies	Subtotst	Licence Revenues	Provincisl Dof ici t	Federal Expenditures/ Deficit
				...$000...			
1974-75	1,539	MA	·	1,539	651	(888)	NA
197S-76	1,756	HA	322[b]	2,078	691	(1#387)	MA
1976-~	1,735	MA	698[b]	2,453	753	(1,790)	MA
1977-78	2,000	MA	557	2,557	759	(1 ,790)	NA
1978-79	1,809	MA	500[c]	2,309	763	(1 ,546)	MA
1979-80	1,829	MA	489	2,318	747	(1 ,571)	(573)
1980-81	2,200	MA	538	2,m	1,165	c1 ,s73)	(644)
1981-82	2,350	MA	439	2,789	1,180	(1 ,609)	(561)
1982-83	2,913	543	476	3,932	1,198	(2,m)	(633)
1983-84	3,241	373	400	4,014	1,088	(2,926)	(646)
1984-85	3,079*	424	526	4,029	1,988**	(2,041)	(734)

a Expenditures represent minimum estimates.

b Winter 1975-76 payments included in 1976-77.

c Estiaate.

* Includes Fish and Wildlife Development Fund expenditures of S241,000.

** Excludes fish royalties ($33,252 f ish royalties in 1984/85).

sources: Derived from Tables 6.1, 6.2, 6.3, and 6.4. It was assumed the average DFO wage rate was S35 thousand Per person year ($1984).

fall and implicit transfer of funds from federal and provincial tax payers/resource stockholders to users of the Saskatchewan fish resource.

APPENDIXA

PROVINCIAL DATA ON SUSTAINABLE SUPPLY OF AND DEMAND FOR SASKATCHEWAN FISH

Table 1. Commercial and recreational harvests of selected species of fish in Saskatchewan, 1975-76.

Species	Commercial Fishery [a]	Recreational Fishery [b]	Combined Fisheries
	kg	kg	kg
Pike	577,960	3,091,671	3,699,631
Walleye	501,249	1,372,650	1,873,899
Lake Trout	342,808	333,828	676,636
Whitefish	2,015,005	...	2,015,005
Perch	...	289,912	289,912
Rainbow Trout	...	130,155	130,155
Grayling	...	34,972	34,972
Goldeye	...	13,694	13,694
Brook Trout	...	21,507	21,507
Other Species[c]	1,286,704	33,866	1,320,570
All Species	4,723,726	5,322,255	10,045,981

[a] Data from the 1975-76 Annual Reports of DNS and DTRR;
[b] Data from Brickley and Johnson, 1978; and
[c] Other species include suckers, buffalo fish, cisco and carp.

Table 2. Commercial and recreational harvests of selected species of fish in Saskatchewan, 1980-81.

Species	Commercial Fishery [a]	Recreational Fishery [b]	Combined Fisheries
	kg	kg	kg
Pike	752,415	2,690,706	3,443,121
Walleye	637,625	1,537,293	2,174,918
Lake Trout	562,819	284,891	847,710
Whitefish	1,642,795	...	1,642,795
Perch	...	363,276	363,276
Rainbow Trout	...	64,715	64,715
Grayling	...	4,690	4,690
Goldeye	...	14,383	14,383
Brook Trout	...	12,631	12,631
Other Species[c]	1,112,724	...	1,112,724
All Species	4,708,378	4,972,585	9,680,963

[a] Data from the 1980-81 Annual Reports of DNS and DTRR;
[b] Data from Mu-rray et al, 1984; and
[c] Other species include suckers, buffalofish, cisco and carp.

Table 3. Estimated harvests and sustainable supplies of walleye, Saskatchewan, 1975.

		Management Zone			
		Northern	Central	**Southern**	Total'
		kg	kg	kg	**kg**
Harvest	Commercial	36,108	464,285	856	501,24$
	Recreational	51,388	959,824	361,438	1,372,65<
	Total	**87,496**	**1,424,109**	**362,294**	**1,873,899**
Sustainable Supply[a]		1,164,192	1,068,846	190,555	2,423,59;

[a] Data from Murray, 1989. "

Table 4. Estimated **harvests** and sustainable supplies of walleye Saskatchewan, 1980.

		Management Zone			
		Northern	Central	Southern	**Total**
		kg	kg	kg	**kg**
Harvest	Commercial	51,673	583,534	· 2,418	637,625
	Recreational	57,551	1,074,951	404,791	1,537,293
	Total	109,224	1,658,485	407,209	2,174,918
Sustainable Supply[a]		1,135,376	1,000,712	**172,248**	**2,308,336**

[a] Data from Murray, 1985.

Table 5. Estimated harvests and sustainable supplies of lake trout, Saskatchewan, 1975.

		Management Zone			
		Northern	Central	Southern	Tota
		kg	kg	kg	kg
Harvest	Commercial	322,652	20,156	0	342,80
	Recreational	180,734	140,415	12,679	333,82:
	Total	**503,386**	160,571	12,679	**676,63{**
Sustainable Supply[a]		769,622	388,752	23,312	**1,181,68**

[a] Data from Murray, 1985. "

Table 6. Estimated harvests and sustainable supplies of lake trout, Saskatchewan, 1980.

		Management Zone			
		Northern	Central	Southern	Tota
		kg	kg	kg	kg
Harvest	Commercial	522,948	39,848	23	562,81
	Recreational	154,240	119,831	10,820	284,89
	Total	**677,188**	159,679	**10,843**	**847,71**
Sustainable Supplya		750,572	370,411	21,072	1,142,05

[a] Data from Murray, 1985.

Table 7. **Estimated harvests and sustainable supplies of pike, Saskatchewan, 1975.**

		Management Zone			
		Northern	Central	Southern	Total
		kg	kg	kg	kg
Harvest	Commercial	68,066	507,687	2,207	577,960
	Recreational	209,833	1,869,255	1,012,583	3,091,671
	Total	277,899	2,376,942	1,014,790	3,669,631
Sustainable Supply[a]		4,514,870.	2,728,800	456,372	7,700,042

[a] Data from Murray, 1985.

Table 8. Estimated harvests and sustainable supplies of pike, Saskatchewan, 1980.

		Management Zone			
		Northern	Central	Southern	Total
		kg	kg	kg	kg
Harvest	Commercial	83,508	664,535	4,372	752,415
	Recreational	182,619	1,626,828	881,259	2,690,706
	Total	266,127	2,291,363	885,631	3,443,121
Sustainable Supply[a]		4,403,120	2,562,231	412,526	7,377,877

[a] Data from Murray, 1985.

Table 9. Estimated harvests and sustainable supplies of whitefish, Saskatchewan, 1975.

	Management Zone			
	Northern	Central	Southern	Toti
	kg	kg	kg	kg
Harvest Commercial	506,058	1,349,295	159,652	2,015,0(
Sustainable Supply[a]	1,509,545	2,537,780	344,525	4,391,8

[a] Data from Murray, 1985.

Table 10. Estimated harvests and sustainable supplies of whitefish, Saskatchewan, 1980.

	Management Zone			
	Northern	Central	Southern	Tota
	kg	kg	kg	kg
Harvest Commercial	401,697	1,012,098	229,000	1,642,79
Sustainable Supply[a]	1,472,182	2,344,290	311,424	4,127,89

[a] Data from Murray, 1985.

TABLE 11. COMMERCIAL HARVESTS OF WALLEYE BY MANAGEMENT ZONE, SASKATCHEWAN, 1960-85.[a]

YEAR	MANAGEMENT ZONE			
	NORTHERN	CENTRAL	SOUTHERN	TOTAL
	kg	kg	kg	kg
196Q-62	51,964	773,840	2,358	788,162
1961-62	48,875	750,936	6,547	806,358
1962-63	61,825	995,829	3,033	1,060,687
1963-64	73,285	1,016,500	12,573	1,102,358
1964-65	60,139	975,855	2,295	1,038,289
1965-66	65,445	867,626	1,339	934,410
1966-67	78,810	781,419	2,003	862,232
1967-68	48,214	772,218	1,939	822,371
1968-69	53,036	913,413	680	967,129
1969-70	40,873	1,043,747	3,653	1,088,273
1970-71	97,548	916,350	1,988	1,015,886
1971-72	81,347	700,512	1,557	783,416
1972-73	85,569	535,015	1,956	622,540
1973-74	54,938	547,114	2,283	604,335
1974-75	54,579	464,701	1,281	520,561
1975-76	36,108	464,285	856	501,249
1976-77	46,964	583,817	883	631,664
1977-78	60,895	752,023	1,247	814,165
1978-79	27,323	568,871	1,397	597,591
1979-80	25,389	473,653	2,950	501,992
1980-81	51,673	583,534	2,418	637,625
1981-82	54,221	678,911	1,722	734,854
1982-83	48,657	673,581	1,250	723,488
1983-84	43,618	602,242	2,446	648,306
1984-85	53,721	623,576	1,073	678,370

[a] Landed Weight

Source: Saskatchewan Parks and Renewable Resources, Fisheries Branch

TABLE 12. COMMERCIAL HARVESTS OF LAKE TROUT BY MANAGEMENT ZONE, SASKATCHEWAN, 1960-85. [a]

YEAR	MANAGEMENT ZONE			
	NORTHERN	CENTRAL	SOUTHERN	TOTAL
	kg	kg	kg	kg
1960-61	**893,280**	44,218	0	**937,498**
1961-62	**921,048**	59,544	0	**980,592**
1962-63	**859,454**	1.42,045	0	**901,499**
1963-64	**792,360**	32,874	**0**	**825,234**
1964-65	**799,927**	24,342	0	**824,269**
1965-66	670,754	32,167	0	**702,921**
1966-67	701,531	36,737	0	**738,268**
1967-68	618,104	30,302	0	**648,406**
1968-69	561,029	19,865	0	**580,894**
1969-70	551,460	22,932	0	**574,392**
1970-71	487,925	30,805	0	**518,730**
1971-72	359,833	26,648	0	**386,481**
1972-73	273,953	24,696	0	**298,649**
1973-74	353,843	26,745	0	**380,588**
1974-75	277,417	30,767	0	**308,184**
1975-76	322,652	20,156	0	**342,808**
1976-77	496,974	15,969	**0**	**512,943**
1977-78	474,141	23,107	**59**	**497,307**
1978-79	329,981	18,956	**23**	**348,960**
1979-80	527,838	39,996	**29**	**612,863**
1980-81	**522,948**	39,848	23	**562,819**
1981-82	**367,853**	35,402	65	**403,320**
1982-83	**288,739**	36,246	0	**324,985**
1983-84	**215,920**	21,089	0	**237,009**
1984-85	**379,005**	21,652	0	**400,657**

[a] Landed Weight

Source: Saskatchewan Parks and Renewable Resources, Fisheries Branch

TABLE 13. COMMERCIAL HARVESTS OF PIKE BY MANAGEMENT ZONE, SASKATCHEWAN, 1960-85.[a]

YEAR	MANAGEMENT ZONE			
	NORTHERN	CENTRAL	SOUTHERN	TOTAL
	kg	kg	kg	kg
1960-61	29,561	592,357	1,966	623,884
1961-62	30,394	622,234	4,328	656,956
1962-63	39,900	536,290	7,747	583,937
1963-64	38,864	474,690	12,510	526,064
1964-65	53,859	675,578	3,413	732,850
1965-66	57,997	584,615	1,887	664,499
1966-67	33,065	550,989	2,139	586,193
1967-68	34,640	483,100	2,459	520,199
1968-69	50,120	572,217	1,767	624,104
1969-70	70,792	702,634	2,809	776,235
1970-71	112,026	684,637	2,840	799,503
1971-72	76,907	723,336	5,991	806,234
1972-73	69,146	616,861	5,134	691,141
1973-74	49,547	716,958	6,100	772,605
1974-75	48,475	672,964	1,809	723,248
1975-76	68,066	507,687	2,207	577,960
1976-77	52,169	663,616	4,688	690,473
1977-78	71,811	675,356	4,705	751,872
1978-79	54,066	673,823	6,263	734,152
1979-80	89,841	820,756	4,959	915,556
1980-81	83,508	664,535	4,372	752,415
1981-82	53,699	591,749	5,292	650,740
1982-83	85,733	664,376	7,785	757,894
1983-84	52,245	434,252	5,720	492,217
1984-85	69,170	578,187	6,659	654;016

[a] Landed Weight

Source: Saskatchewan Parks and Renewable Resources, Fisheries Branch

TABLE 14. COMMERCIAL HARVESTS OF[a] WHITEFISH BY MANAGEMENT ZONE, SASKATCHEWAN, 1960-85.

YEAR	MANAGEMENT ZONE			
	NORTHERN	CENTRAL	SOUTHERN	TOTAL
	kg	kg	kg	kg
1960-61	754,031	2,570,326	205,717	3,530,074
1961-62	774,246	2,429,875	241,714	3,445,835
1962-63	863,543	2,312,410	175,511	3,351,464
1963-64	839,635	2,213,411	185,795	3,238,841
1964-65	859,414	1,844,427	158,185	2,862,026
1965-66	1,110,204	2,206,484	179,936	3,496,624
1966-67	973,861	1,850,917	195,273	3,020,051
1967-68	794,444	1,512,790	178,664	2,485,898
1968-69	707,654	1,261,694	222,028	2,191,376
1969-70	927,343	1,682,484	232,405	2,842,232
1970-71	920,496	1,425,807	226,253	2,572,556
1971-72	839,279	1.403,078	182,973	2,425,330
1972-73	688,848	1,177,433	135,370	2,001,651
1973-74	824,193	1,018,699	193,388	2,036,280
1974-75	442,234	1,403,529	88,952	1,934,715
1975-76	506,058	1,349,295	159,652	2,015,005
1976-77	437,866	1,337,177	195,899	1,970,942
1977-78	477,967	1,144,465	224,481	1,846,913
1978-79	209,978	1,040,679	227,441	1,478,098
1979-80	391,826	1,163,298	237,837	1,792,961
1980-81	401,697	1,012,098	229,000	1,642,795
1981-82"	225,496	831,446	189,955	1,246,797
1982-83	159,162	815,925	252,995	1,227,082
1983-84	140,581	723,598	190,347	1,054,526
1984-85	359,375	726,652	100,955	1,186,982

[a] Landed Weight

Source: Saskatchewan Parks and Renewable Resources, Fisheries Branch

APPENDIX B

FFMC DATA ON HARVESTS
BY SASKATACHEWAN FISHERMEN

TABLE B.1: COMMERCIAL HARVESTS OF WALLEYE (LANDED WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			Total
		Northern	Central	Southern	
		..... Kg.			
1973-74	17,255	53,596	535,103	1,108	589,797
1974-75	17,262	60,190	462,359	408	522,957
1975-76	15,621	34,859	455,003	119	490,061
1976-77	16,985	50,754	552,456	147	603,357
1977-78	19,257	69,792	730,330	97	800,219
1978-79	13,939	26,359	540,940	752	568,051
1979-80	18,209	30,228	454,336	542	485,106
1980-81	16,905	49,226	570,732	3,253	623,211
1981-82	14,798	54,965	636,526	226	691,717
1982-83	15,037	39,499	627,619	522	667,640
1983-84	10,190	35,848	568,679	559	605,086
1984-85	11,375	52,678	585,884	272	638,834

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute? Winnipeg.

TABLE B.2 : COMMERCIAL HARVESTS OF PIKE LANDED (WEIGET) BY MANAGEMENT ZONE, SASKATCHEWAN

	No.	Catch			
	Deliveries	Northern	Central	Soutbern	Total
			..... Kg.		
1973-74	17,255	48,755	664,992	1,123	714,960
1974-75	17,262	50,831	656,064	180	707,075
1975-76	15,621	62,087	498,860	23	560,970
1976-77	16,985	50,576	592,050	134	642,760
1977-78	19,257	69,118	635,377	150	704,653
1978-79	13,939	49,510	636,890	2,182	688,590
1979-80	18,209	105,632	777,031	560	883,223
1980-81	16,905	89,961	647,382	118	737,461
1981-82	14,798	51,669	566,418	6,948	625,035
1982-83	15,037	74,283	629,476	1,177	704,936
1983-84	10,190	45,990	411,996	1,750	459,736
1984-85	11,375	69,399	555,885	611	625,895

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Instituter Winnipeg.

TABLE B.3 : COMMERCIAL HARVESTS OF WE ITEFISH (LANDED WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	No.	Cat			
	Deliveries	Northern	Central	Southern	Total
			.....Kg.....		
1973-74	17,255	614,072	956,381	43,635	1,613,988
1974-75	17,262	515,941	1,276,024	17 ,703**	1,809,668
1975-76	15,621	484,226	1,230,572	74 ,834**	1,789,632
1976-77	16,985	431,i80	1,200,224	73,727	1,705,131
1977-70	19,257	419,226	1,007,478	96 ,312**	1,523,016
1978-79	13,939	167,178	920,588	85,304	1,193,070
1979-80	18,209	401,310	1,034,593	91,749	1,527,652
1980-61	16,905	411,877	943,099	103 ,336**	1,458,312
1981-82	14,798	219,924	757,809	99,953	1,077,686
1982-83	15,037	134,459	726,020	84,387	944,866
1983-84	10,190	132,798	608,895	91,838	833,531
1904-85	11,375	331,839	602,897	18 ,762*	953,498

• Includes whitefish roe.

• * Export whites only.

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute Winnipeg.

TABLE B.4 : COMMERCIAL EARVESTS OF LAKE TROOT (LANDED WEIGET) BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			
		Northern	Central	Southern	Total
		..... Kg.			
1973-74	17,255	258,324	24,059	NA	282,383
1974-75	17,262	307,823	27,471	NA	335,294
1975-76	15,621	325,216	19,602	NA	344,818
1976-77	16,905	491,236	8,662	"NA	499,898
1977-78	19,257	486,559	14,729	NA	501,288
1978-79	13,939	320,996	4,944	265	326,205
1979-80	18,209	579,243	20,055	NA	599,298
1980-81	16,905	574,159	27,162	NA	601,321
1981-82	14,798	362,290	17,121	NA	379,411
1982-83	15,037	243,291	22,711	1,529	267,531
1983-84	10,190	203,063	8,971	2,455	214,489
1984-85	11,375	375,770	9,605	743	366,118

• Includes whitefish roe.

• * Export whites only.

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.5 : COMMERCIAL HANVESTS OF ALL SPECIES (LANDED WEIGET) BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			
		Northern	Central	Southern	Total
		..... Kg.			
1973-74	17,255	974,756	2,297,558	443,344	3,715,658
1974-75	17,262	943,801	3,071,121	682,544	4,697,466
1975-76	15,621	906,388	2,482,372	573 ,a34	3,962,594
1976-77	16,985	1,023,745	2,414,087	538,848	3,976,680
1977-78	19,257	1,046,077	2,446,570	443,376	3,936,023
1978-79	13,939	597,906	2,123,025	311,969	3,032,900
1979-80	18,209	1,123,697	2,501,517	428,559	4,053,773
1980-81	16,905	1,125,252	2,217,890	711,284	4,054,426
1981-82	14,798	688,850	2,093,512	309,642	3,092,004
1982-83	15,037	491,536	2,016,785	271,612	2,779,933
1983-84	10,190	417,699	1,614,187	158,695	2,190,581
1984-85	11,375	829,654	1,778,008	233,468	2,841,130

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.6 : COMMERCIAL HARVESTS OF WALLEYE (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			Totsl
		Northern	Central	Southern	
		..... Kg.			
1973-74	17,255	64,560	678,602	1,072	744,234
1974-75	17,262	79,535	583,546	411	663,492
1975-76	15,621	41,575	587,370	119	629,064
1976-77	16,985	57,451	692,529	159	750,139
1977-78	19,257	89,772	915,494	98	1,005,364
1978-79	13,939	30,917	656,393	752	688,062
1979-80	18,209	38,968	569,123	542	608,633
1980-81	16,905	61,110	712,273	3,256	776,639
1981-82	14,798	68,908	804,415	241	873,564
1982-83	15,037	47,178	792,655	670	840,503
1983-84	10,190	41,639	689,493	671	731,803
1984-85	11,375	62,071	695,959	272	758,302

Source: Special tabulations by Department of Ff sheries and Oceans, Freshwater Institute? Winnipeg.

TABLE B.7: COMMERCIAL HARVESTS OF PIKE (ROUND EQUIVALENT WEIGHTI BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			
		Northern	Central	Southern	Total
			Kg.		
1973-74	17,255	66,352	889,483	1,499	967,334
1974-75	17,262	68,543	896,884	230	965,427
1975-76	15,621	83,085	683,264	30	766,379
1976-77	16,985	68,206	810,614	173	878,993
1977-78	19,257	88,225	866,099	204	954,528
1978-79	13,939	64,297	855,028	2,947	992,272
1979-80	18,209	135,131	1,049,435	758	1,185,324
1980-81	16,905	116,448	887,480	152	1,004,080
1981-82	14,798	66,177	743,881	9,299	819,357
1982-83	15,037	95,379	851,911	1,527	948,817
1983-84	10,190	58,485	555,940	2,263	616,688
1984-85	11,375	89,549	742,582	836	832,967

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.8: COMMERCIAL HARVESTS OF WHITEFISH (ROUND EQUIVALENT WEIGHT) By MANAGEMENT ZONE, SASKATCHEWAN

	No.	Catch			
	Deliveries	Northern	Central	Southern	Total
			Kg.		
1973-74	17,255	750,401	1,184,911	45,700	1,981,012
1974-75	17,262	626,087	1,574,993	20,742**	2,221,822
1975-76	15,621	563,898	1,526,309	89,801	2,180,008
1976-77	16,985	506,853	1,460,306	88,505	2,055,744
1977-78	19,257	479,879	1,243,845	115,575**	1,839,299
1978-79	13,939	228,444	1,123,373	102,402	1,454,219
1979-80	18,209	490,051	1,272,423	110,098	1,872,572
1980-81	16,905	507,842	1,167,899	124,002**	1,799,743
1981-82	14,798	267,359	935,954	119,944	1,323,257
1982-83	15,037	174,738	917,859	101,331	1,193,928
1983-84	10,190	160,348	747,871	109,299	1,017,518
1984-85	11,375	411,592	739,006	22,440*	1,173,038

* Includes whitefish roe.

** Export whites only.

source : special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.9: **COMMERCIAL HARVESTS** OF LAKE **TROUT (ROUND EQUIVALENT** , WEIGHT) BY **MANAGEMENT** ZONE, **SASKATCHEWAN**

	No. Deliveries	Catch			
		Northern	Central	Southern	Total
		..... Kg.			
1973-74	17,255	318,130	29,569	**NA**	347,699
1974-75	17,262	371,796	33,804	NA	405,600
1975-76	15,621	391,961	24,129	NA	416,090
1976-77	16,985	591,719	10,466	NA	602,185
1977-78	19,527	588,625	18,132	NA	606,757
1978-79	13,939	386,799	6,188	333	393,320
1979-80	18,209	727,434	26,768	NA	754,202
1980-81	16,905	699,724	33,539	NA	733,263
1981-82	14,798	438,250	21,427	NA	459,677
1982-83	15,037	292,983	27,886	1,837	322,706
1983-84	10,190	245,872	11,049	2,948	259,869
1984-85	11,375	453,829	11,918	892	466,639

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.10 : COMMERCIAL HARVESTS OF ALL SPECIES (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	No. Deliveries	Catch			
		Northern	Central	Southern	Total
		..... Kg.			
1973-74	17,255	1,199,452	2,943,145	569,468	4,712,065
1974-75	17,262	1,158,583	3,992,943	7ao ,9a4	5,932,510
1975-76	15,621	1,080,519	3,204,128	619,373	4,904,020
1976-77	16,985	1,224,228	3,046 ,a2a	579,005	4,850,061
1977-78	19,257	1,248,159	3,108,347	470,154	4,826,660
1978-79	13,939	729,866	2,664,699	336,378	3,730,943
1979-80	18,209	1,398,820	3,155,295	447,426	5,001,541
1980-81	16,905	1,385,159	2,828,563	732,260	4,945,982
1981-82	14,798	840,696	2,651,355	337,098	3,829,149
1982-83	15,037	610,283	2,604,267	289,409	3,503,959
1983-84	10,190	506,345	2,023,523	177,455	2,707,323
1984-85	11,375	1,017,041	2,220 ,4a9	238,096	3,475,626

Source: Special tabulations by Department of Fisheries and Oceans? Freshwater Institute, Winnipeg.

TABLE B.11 : NUMBER OF DELIVERIES BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch			
	Northern	Central	Southern	Total
		..... Kg.		
1973-74	2,653	14,407	195	17,255
1974-75	2,294	14,871	97	17,262
1975-76	2,401	12,895	245	15,621
1976-77	2,940	13,471	574	16,985
1977-78	3,506	15,594	1s7	19,257
1978-79	1,053	11 ,854	232	13,939
1979-80	3,536	14,427	246	18,209
1980-81	3,672	12,909	324	16,905
1981-82	2,255	12,301	242	14,798
1982-83	1,516	13,266	235	15,037
1983-84	977	8,948	265	10,190
1984-85	1,819	9,442	114	11,375

source : Special tabulationa by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

TABLE B.12: NLIMSER OF COMMERCIAL FISHERMEN IN SASKATCHEWAN BY MANAGEMENT ZONE

	No. Fishermen[a,c]			
	Northern	Central	Southern	Total[b]
1973-74	241	1,197	114	1,552
1974-75	173	1,088	13	1,274
1973-76	196	1,015	138	1,369
1976-77	200	1,104	129	1,433
1977-78	261	1,193	14	1,468
1978.79	191	1,025	26	1,242
1979-80	253	1,028	27	1,308
1980-81	297	1,021	26	1,344
1981-82	192	885	28	1,105
1982-83	122	586	24	732
1983-84	68	454	21	543
1984-8S	113	485	18	616

Sources: Special tabulations by Department of Fisheries and Oceans, Freshwater, Institute, Winnipeg.

a Number of entities delivering fish to the FFMC. Aco-operative ia counted as one entity only.

b Fisherman fishing in more than one zone are counted more than *onca*.

c Theae operator numbers differ from numbers of fisherman prwided by Saskatchewan Parks and Renewable Resourcas (SPRR). For example, in 1984/85 SPRR estimated the numbers of fishermen in the Northern, Central, and SouthernZones as91, 570, and349, respectively. The difference batueen the tuo sets of numbers presumably represents those fisherman selling all their catch to final consumers.

TABLE B.13: NUMBER OF LAKES COMMERCIALLY FISHED IN SASKATCHEWAN BY MANAGEMENT ZOUE

	No. Lakes Fished			
	Northern	Central	Southern	Total
1973-74	47	105	6	158
1974-75	43	117	5	165
1975-76	51	113	6	170
1976-77	50	127	6	183
1977-78	53	132	5	190
1978-79	46	114	6	166
1979-80	61	138	9	208
1980-81	74	166	10	250
1901-82	48	132	7	187
1982-83	72	144	8	224
1983-84	40	114	6	168
1984-85	80	137	6	223

Sources: special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

[a] Number of lakes for which landings delivered to FFMC.

TABLE B.14 : LAUDED OR LAKE VALUE OF COMMERCIAL HARVESTS OF ALL SPECIES BY MANAGEMENT ZONE, SASKATCHEWAN

	No.	Catch Value*			
	Deliveries	Northern	Central	Southern	Total
		.. **=$.0 -00			
1973-74	17,255	412,844	1,234,013	78,113	1,724,970
1974-75	17,262	450,985	1,416,618	102,161	1,969,764
1975-76	15,621	410,043	1,381,895	127,204	1,919,142
1976-77	16,905	529,999	1,722,275	150,698	2,402,972
1977-70	19,257	669,101	2,122,678	129,877	2,921,656
1978-79	13,939	522,650	2,114,563	149,379	2,786,592
1979-80	18,209	1,010,115	2,494,173	185,845	3,690,133
1980-81	16,905	935,685	3,021,610	210,486	4,167,781
1981-82	14,798	593,511	2,790,886	124,956	3,509,353
1982-83	15,037	365,322	1,862,811	121,891	2,350,024
1983-84	10,190	609,937	2,393,787	103,760	3,107,484
1984-85	11,375	1,132,838	2,819,142	66,595	4,018,575

* Includes FFMC initial plus final payments, but excludes value of peddled fish.

Source: Special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg.

APPENDIX C

CATCH PER DELIVERY DATA

TABLE C1: WALLEYE CATCH PER DELIVERY (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch per Delivery			
	Northern	Central	Southern	Average
	...kg per delivery...			
1973-74	24	47	5	43
1974-75	35	39	4	38
1975-76	17	46		40
1976-77	20	51		44
1977-78	26	59	1	52
1978-79	17	55	3	49
1979-80	11	39	2	33
1980-81	17	55	10	46
1981-82	31	65	1	59
1982-83	31	60	3	56
1983-84	43	77	3	72
1984-85	34	74	2	67

Source: Derived from data in Tables B.6 and B.11 (Basic data from special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg) .

TABLE C.2: PIKE CATCH PER DELIVERY (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch per Delivery			
	Northern	Central	Southern	Average
	...kg per delivery...			
1973-74	25	62	8	56
1974-75	30	60	2	56
1975-76	33	53		49
1976-77	23	60		52
1977-78	25	56	1	50
1978-79	35	72	13	71
1979-80	38	73	3	65
1980-81	32	69		59
1981-82	29	60	38	55
1982-83	62	64	6	63
1983-84	60	62	9	61
1984-85	49	79	7	73

Source: Derived from data in Tables B.7 and B.11 (Basic data from special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg) .

TABLE C. 3 : WHITEFISH CATCH PER DELIVERY (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch per Delivery			
	Northern	Central	Southern	Average
	...kg per delivery...			
1973-74	283	82	234	114
1974-75	273	106	213**	129
1975-76	227	118	367	140
1976-77	172	108	154	121
1977-78	137	80	736**	96
1978-79	123	95	441	104
1979-80	139	88	448	103
1980-81	138	90	383**	106
1981-82	119	76	496	89
1982-83	115	69	431	79
1983-84	164	84	412	100
1984-85	226	78	197*	103

* Includes whitefish roe.
** Export whites only.

Source: Derived from data in Tables B.8 and B.11 (Basic data from special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg).

TABLE C.4: LAKE TROUT CATCH PER DELIVERY (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch per Delivery			
	Northern	Central	Southern	Average
	...kg per delivery...			
1973-74	120	2	NA	20
1974-75	162	2	NA	23
1975-76	158	2	NA	27
1976-77	201	1	NA	35
1977-78	168	1	NA	32
1978-79	209	1	"1	28
1979-80	206	2	NA	41
1980-81	191	3	NA	43
1981-82	194	2	NA	31
1982-83	193	2	8	21
1983-84	252	1	11	26
1984-85	249	1	8	41

Source: Derived from data in Tables B.9 and B.11 (Basic data from special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg) .

TABLE c .5 : ALL SPECIES CATCH PER DELIVERY (ROUND EQUIVALENT WEIGHT) BY MANAGEMENT ZONE, SASKATCHEWAN

	Catch Per Delivery			
	Northern	Central	Southern	Average
	...kg per delivery...			
1973-74	452	204	2920	273
1974-75	505	269	8051	344
1975-76	436	249	2528	314
1976-77	416	226	1009	286
1977-78	356	199	2995	251
1978-79	394	224	1450	268
1979-80	396	219	1819	275
1980-81	377	219	2260	293
1981-82	373	216	1393	259
1982-83	403	196	1232	233
1983-84	518	226	670	266
1984-85	559	235	2089	306

Source: Derived from data in Tables B.10 and B.11 (Basic data from special tabulations by Department of Fisheries and Oceans, Freshwater Institute, Winnipeg) .

APPENDIX ⊃

LEVEL OF PROVINCIAL SUBSIDIES AND EXPENDITURES

TABLE D. 1 : **PROVINCIAL SUBSIDY PAYMENTS**

	Subsidies			
	Transportation	Price Support	Transportation	**Total**
1975-76	197,462[a]	125,032[a]		322,494
1976-77	392,015	274,080	31,796	697,891
1977-78	338,000	190,000	29,000	557,000
1978-79	359,335	43,197		402,532
1979-80	440,332	48,410		488,742
1980-81	511,686	26,677		538,363
1981-82	409,449	29,294		438,743
1982-83	458,316	17,662		475,978
1983-84	388,522	11,872		400,394
1984-85	507,777	17,932		525,709

a Summer season only. Winter season payments were made in following fiscal year.

Sources: Saskatchewan Parks and Renewable Resources Annual Reports.

TABLE 1: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON KA EWA FISHERIES, 1974-75

Management	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	[illegible]	
Northern	Enforcement	42,227	9,815	1,323	36,618	89,983
	Management	74,602	0	0	74,602	149,204
	Development	62,086	0	0	0	62,086
	Assessment	36,742	0	0	36,742	73,484
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	215,657	9,815	1,323	147,962	374,757
Central	Enforcement	52,208	14,822	[illegible]	[illegible]	[illegible]
	Management	74,602	0	0	74,602	149,204
	Development	62,086	0	0	0	62,086
	Assessment	112,276	0	0	112,276	224,552
	Enhancement	0	0	0	32,114	32,114
	Habitat Protection	0	0	0	0	0
	TOTALS	301,170	14,822	4,829	270,630	591,551
Southern	Enforcement	28,926	11,8[illegible]	10,293	[illegible]	[illegible]
	Management	36,587	0	17,087	92,456	146,130
	Development	0	0	0	0	0
	Assessment	73,786	0	0	101,052	174,838
	Enhancement	0	0	0	96,340	96,340
	Habitat Protection	0	0	0	0	0
	TOTALS	139,301	11,847	33,382	388,387	572,744
Total	Enforcement	123,361	36,511	22,[illegible]	[illegible]	[illegible]
	Management	185,791	0	17,087	241,660	444,538
	Development	124,172	0	0	25,000	124,172
	Assessment	222,804	0	0	120,470	472,874
	Enhancement	0	0	0	8,454	128,454
	Habitat Protection	0	0	0	0	0
	TOTALS	656,128	36,311	39,473	883,379	1,539,052

Source: Saskatchewan Parks and Renewable Resources

2: MAT EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MA EM ZONE ON KAT EWAN FISHERIES, 1975-76.

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
		$				
Northern	Enforcement	48,718	11,323	1,526	42,247	103,814
	Management	37,712	0	0	37,712	75,424
	Development	132,067	0	0	0	132,067
	Assessment	80,973	0	0	80,973	161,946
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	299,470	11,323	1,526	160,932	473,251
Central	Enforcement	60,232	17,101	5,688	59,313	142,334
	Management	37,712	0	0	37,712	75,424
	Development	132,067	0	0	0	132,067
	Assessment	80,973	0	0	80,973	161,946
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	310,984	17,101	5,688	178,280	512,033
Southern	Enforcement	33,375	13,469	18,799	113,687	179,330
	Management	83,294	9,254	9,255	83,294	185,097
	Development	0	0	0	0	0
	Assessment	127,170	4,130	4,130	127,170	262,600
	Enhancement	0	0	0	143,258	143,258
	Habitat Protection	0	0	0	0	0
	TOTALS	243,839	26,853	32,184	467,409	770,285
Tota	Enforcement	142,325	41,893	26,013	215,309	425,740
	Management	158,718	9,254	9,255	158,718	335,945
	Development	264,134	0	0	0	264,134
	Assessment	289,116	4,130	4,130	289,116	586,492
	Enhancement	0	0	0	143,258	143,258
	Habitat Protection	0	0	0	0	0
	TOTALS	854,293	55,277	39,398	806,601	1,755,569

Source: Saskatchewan Parks and Renewable Resources

TABLE 3: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON SASKATCHEWAN FISHERIES, 1976-77

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
Northern	Enforcement	54,911	12,760	1,720	47,611	116,994
	Management	28,386	0	0	28,386	56,772
	Development	87,753	0	0	0	87,753
	Assessment	84,200	0	0	84,200	168,400
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	255,242	12,760	1,720	160,197	429,919
Central	Enforcement	67,879	19,272	6,409	67,139	160,699
	Management	28,386	0	0	28,386	56,772
	Development	87,753	0	0	0	87,753
	Assessment	175,541	0	0	125,962	301,503
	Enhancement	0	0	0	43,124	43,124
	Habitat Protection	0	0	0	14,007	14,007
	TOTALS	359,559	19,272	6,409	278,618	663,858
Southern	Enforcement	37,612	15,179	21,100	129,126	203,017
	Management	54,960	0	25,025	123,632	203,617
	Development	0	0	0	0	0
	Assessment	34,067	0	0	34,067	68,134
	Enhancement	0	0	0	129,373	129,373
	Habitat Protection	0	0	0	57,528	57,528
	TOTALS	126,639	15,179	46,211	472,720	660,749
Total	Enforcement	160,394	47,211	29,313	243,876	479,794
	Management	111,732	0	25,025	180,404	317,161
	Development	175,506	0	0	0	175,506
	Assessment	293,808	0	0	244,229	538,037
	Enhancement	0	0	0	172,497	172,497
	Habitat Protection	0	0	0	71,535	71,535
	TOTALS	741,440	47,211	54,340	911,535	1,754,526

Source: Saskatchewan Parks and Renewable Resources

TABLE 4: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE SASKATCHEWAN FISHERIES, 1977-78

Management Zone		mm	nestic Indian	Aquaculture	Recreational	Totals
			$	$	$	$
Northern	Enforcement	71,382	16,591	2,236	61,901	152,110
	Management	27,096	0	0	27,096	54,192
	Development	66,003	0	0	0	66,003
	Assessment	83,638	0	0	83,638	167,276
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0			
	TOTALS	248,119	16,591			
Central	Enforcement	88,252	25,056	8,333	87,290	208,931
	Management	27,096	0	1,314	27,096	55,506
	Development	66,004	0	0	0	66,004
	Assessment	271,335	0	0	110,878	382,213
	Enhancement	0	0	0	49,699	49,699
	Habitat Protection	0	0	0	7,004	7,004
	TOTALS	452,687	25,056	9,647	281,967	769,357
Southern	Enforcement	48,901	19,735	27,545	166,574	262,755
	Management	63,612	0	31,576	134,845	230,033
	Development	0	0	0	0	0
	Assessment	1,312	0	0	34,781	8,093
	Enhancement	0	0	0	149,072	14,072
	Habitat Protection	0	0	0	62,732	6,732
	TOTALS	163,825	19,735	59,121	548,004	79,685
Total	Enforcement	208,535	1.3	38,114	15,765	623,796
	Management	117,804		32,890	89,037	339,731
	Development	132,007	0	0	0	132,007
	Assessment	406,285	0	0	29,297	635,582
	Enhancement	0	0	0	98,771	198,771
	Habitat Protection	0	0	0	69,736	69,736
	TOTALS	864,631	1,382	71,004	1,000,606	1,999,623

Source. Saskatchewan Parks and Renewable Resources

TABLE 5: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE OF SASKATCHEWAN FISHERIES, 1978-79

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
Northern	Enforcement	69,049	16,049	2,163	59,878	147,139
	Management	25,806	0	0	25,806	51,612
	Development	44,254	0	0	0	44,254
	Assessment	83,075	0	0	83,076	166,151
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	222,184	16,049	2,163	168,760	409,156
Central	Enforcement	85,368	24,237	8,060	84,438	202,103
	Management	25,806	0	2,627	25,806	54,239
	Development	44,255	0	0	0	44,255
	Assessment	95,794	0	0	95,795	191,589
	Enhancement	0	0	0	56,256	56,256
	Habitat Protection	0	0	0	0	0
	TOTALS	251,223	24,237	10,687	262,295	548,442
Southern	Enforcement	47,303	13,030	26,645	161,130	254,108
	Management	72,275	0	38,128	146,058	256,451
	Development	0	0	0	0	0
	Assessment	68,357	0	0	35,495	104,052
	Enhancement	0	0	0	168,770	168,770
	Habitat Protection	0	0	0	67,935	67,935
	TOTALS	188,125	19,090	64,773	579,388	851,376
Total	Enforcement	201,720	59,376	36,868	305,446	603,410
	Management	123,877	0	40,755	197,670	362,302
	Development	88,509	0	0		88,509
	Assessment	247,426	0	0	214,366	461,792
	Enhancement	0	0	0	225,026	225,026
	Habitat Protection	0	0	0	67,935	67,935
	TOTALS	661,532	59,376	77,623	1,010,443	1,808,974

Source: Saskatchewan Parks and Renewable Resources

TABLE 6: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON SASKATCHEWAN FISHERIES, 1979

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
		$	$	$	$	$
Northern	Enforcement	80,887	18,800	2,534	70,144	172,365
	Management	47,253	0	0	47,253	94,506
	Development	66,715	0	0	0	66,715
	Assessment	71,135	0	0	71,135	142,270
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	265,990	18,800	2,534	188,532	475,856
Central	Enforcement	100,004	28,392	9,442	98,915	236,753
	Management	47,253	0	0	47,253	94,506
	Development	66,715	0	0	0	66,715
	Assessment	110,365	0	0	110,365	220,730
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	8,378	8,378
	TOTALS	324,337	20,392	9,442	264,911	627,082
Southern	Enforcement	55,414	22,363	31,213	188,758	297,746
	Management	70,942	0	29,294	127,743	227,979
	Development	0	0	0	0	0
	Assessment	46,026	0	10,229	46,026	102,281
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	97,702	97,702
	TOTALS	172,382	22,363	70,736	460,227	725,708
Total	Enforcement	236,305	69,555	43,189	357,815	706,864
	Management	165,448	0	29,294	222,249	416,991
	Development	133,430	0	0	0	133,430
	Assessment	227,526	0	10,229	227,526	465,281
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	106,080	106,080
	TOTALS	762,709	69,555	82,712	913,670	1,828,646

Source: Saskatchewan Parks and Renewable Resources

TABLE 7: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON SASKATCHEWAN FISHERIES, 1980-81

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	[illegible]	[illegible]
Northern	Enforcement	75,833	17,826	2,375	65,762	161,596
	Management	51,055	0	0	51,055	102,110
	Development	72,084	0	0	0	72,084
	Assessment	93,821	0	0	137,121	230,942
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	292,793	17,826	2,375	253,938	566,732
Centra	Enforcement	93,756	26,018	[illegible]	[illegible]	[illegible]
	Management	59,751	0	0	59,751	119,502
	Development	72,084		0	0	72,084
	Assessment	117,034	000	0	117,034	234,068
	Enhancement	0	0	0	65,038	65,038
	Habitat Protection	0		0	37,808	37,808
	TOTALS	342,625	26,819	8,853	372,365	750,462
Southern	Enforcement	51,951	20,[illegible]	[illegible]	[illegible]	[illegible]
	Management	79,502	0	5,870	154,512	259,884
	Development	0	0	0	0	0
	Assessment	33,923	0	0	73,747	107,170
	Enhancement	0	0	0	195,113	195,113
	Habitat Protection	0			41,892	41,892
	TOTALS	165,376	20,845	55,133	641,727	883,201
Total	Enforcement	221,540	63,210	[illegible]	[illegible]	[illegible]
	Management	190,308	0	25,870	265,318	481,496
	Development	144,168	0	0	0	144,168
	Assessment	244,778	0	0	327,402	572,180
	Enhancement	0	0	0	260,151	260,151
	Habitat Protection	0	0	0	79,700	79,700
	TOTALS	800,794	65,210	66,361	1,268,030	2,200,395

Source: Saskatchewan Parks and Renewable Resources

TABLE 8: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MA ZONE ON SASKATCHEWAN FISHERIES, 1981-82

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
		$	$	$	$	$
Northern		90,260	20,979	2,827	78,273	192,339
	Management	54,221	0	0	54,221	108,442
	Development	76,555	0	0	0	76,555
	Assessment	122,101	0	0	122,101	244,202
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	343,137	20,979	2,827	254,595	621,538
Central	Enforcement	211,593	31,683	10,537	110,376	264,189
	Management	70,125	0	0	70,125	140,250
	Development	76,556	0	0	0	76,556
	Assessment	120,993	0	0	120,992	241,985
	Enhancement	0	0	0	82,182	82,182
	Habitat Protection	0	0	0	0	0
	TOTALS	479,267	31,683	10,537	383,675	805,162
Southern	Enforcement	61,835	24,954	34,830	210,629	332,248
	Management	57,243	0	9,529	181,941	248,713
	Development	0	0	0	0	0
	Assessment	32,743	0	000	34,727	67,470
	Enhancement	0	0	000	246,532	246,532
	Habitat Protection	0	0	000	28,039	28,039
	TOTALS	151,821	24,954	44,359	701,868	923,002
Total	Enforcement	263,688	77,616	48,194	399,278	788,776
	Management	181,589	0	9,529	306,287	497,405
	Development	153,111	000	0	0	153,111
	Assessment	275,837	000	0	277,820	553,657
	Enhancement	0	000	0	328,714	328,714
	Habitat Protection	0	000	0	28,039	28,039
	TOTALS	874,225	77,616	57,723	1,340,138	2,349,702

Source: Saskatchewan Parks and Renewable Resources

TABLE 3: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON SASKATCHEWAN FISHERIES, 1982-83

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
					$	
Northern	Enforcement	113,113	2[illegible],291	3,543	98,090	241,037
	Management	64,123	0	0	64,123	128,246
	Development	90,335	0	0	0	90,335
	Assessment	96,182	0	0	96,182	192,364
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	3[illegible]3,753	2[illegible],291	3,543	258,395	651,982
Central	Enforcement	139,847	3[illegible].7[illegible]4	13,204	138,323	331,078
	Management	81,453	0	13,336	81,453	176,242
	Development	90,335	0	0	0	90,335
	Assessment	141,274	0	0	157,342	298,616
	Enhancement	0	0	0	107,560	107,560
	Habitat Protection			0	9,677	9,677
	TOTALS			26,540	494,355	1,013,508
Southern	Enforcement	77,491	31,272	43,649	263,959	416,371
	Management	66,455	0	54,467	187,746	308,668
	Development	0	0	0	0	0
	Assessment	60,940	0	0	110,011	170,951
	Enhancement	0	0	0	322,678	322,678
	Habitat Protection	0	0	0	29,031	29,031
	TOTALS	204,886	31,272	98,116	913,425	1,247,699
Total	Enforcement	330,451	97,267	60,396	500,372	988,486
	Management	212,031	0	67,803	333,322	613,156
	Development	180,670	0	0	0	180,670
	Assessment	298,396	0	0	363,535	661,931
	Enhancement	0	0	0	430,238	430,238
	Habitat Protection	0	0	0	38,708	38,708
	TOTALS	1,021,548	97,267	128,199	1[illegible].[illegible]7[illegible]	2,913,189

Source: Saskatchewan Parks and Renewable Resources

TABLE 1[illegible] ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT [illegible]E ON SASKATCHEWAN FISHERIES, 1983-8[illegible]

Management Zone	Departmental Activity	Commercial	Domestic and Indian	Aquaculture	Recreational	Totals
Northern	Enforcement	103,913	24,152	3,255	90,113	221,433
	Management	44,603	0	0	44,603	89,206
	Development	63,371	0	0	0	63,371
	Assessment	81,648	0	0	81,648	163,296
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
	TOTALS	293.5[illegible]5	24.152	3,255	216,364	537,306
Central	Enforcement	128,473	3[illegible],475	12,130	[illegible]7.[illegible]72	304,150
	Management	78,337	0	14,819	[illegible]6, 35	199,191
	Development	63,371	0	16,108	0	79,479
	Assessment	76,587	0	0	7[illegible]587	153,174
	Enhancement	0	0	0	9[illegible]617	96,617
	Habitat Protection	0	0	0	0	0
	TOTALS	346,768	3[illegible],475	43,057	4[illegible].3[illegible]1	832,611
Southern	Enforcement	71,188	28,729	40,099	242,489	382,505
	Management	354,352	0	93,739	437,444	885,535
	Development	0	0	48,322	0	48,322
	Assessment	66,411	0	0	158,604	225,015
	Enhancement	0	0	0	289,849	289,849
	Habitat Protection	0	0	0	40,104	40,104
	TOTALS	491,951	28,729	182,160	1,168,490	1,871,330
Total	Enforcement	303,574	89.35[illegible]	55,484	459,674	908,088
	Management	477,292		108,558	588,082	1,173,932
	Development	126,742	0	64,430	0	191,172
	Assessment	224,646		0	316,839	541,485
	Enhancement	0	000	0	386,466	386,466
	Habitat Protect[illegible]	0		0	40,104	40,104
	TOTALS	1,132,254	89.35[illegible]	228,472	1,791,165	[illegible],241,247

Source: Saskatchewan Parks and Renewable Resources

TABLE 11: ESTIMATED EXPENDITURES BY DEPARTMENTAL ACTIVITY AND MANAGEMENT ZONE ON AN FISHERIES, 1984-85. (Revised)

Management	Departmental	Commercial	Domestic and Indian		.onal	Totals
Northern	Enforcement	113,371	26,351	3,948	98,913	241,583
	Management	47,592	5,287	5,287	47,592	105,758
	Development	17,878	0	0	0	17,878
	Assessment	71,124	0	0	71,124	142,248
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	0	0
		[illegible]	[illegible]	8,835	217,029	507,467
Central	Enforcement	140,154	[illegible]	[illegible]	62,899	139,774
	Management	62,899	6,988	6,988	0	17,878
	Development	17,878	0	0	131,314	264,451
	Assessment	131,314	0	1,823	96,905	96,905
	Enhancement	0	0	0	0	0
	Habitat Protection	0	0	0	429,758	850,835
		[illegible]	[illegible]	22,041	,597	417,300
Southern	Enforcement	77,673	[illegible]	[illegible]	226,446	398,383
	Management	129,173	12,522	30,242	0	0
	Development	0	0	0	175,101	332,046
	Assessment	116,048	9,233	31,664	290,717	290,717
	Enhancement	0	0	0	33,518	41,185
	Habitat Protection	0	0	7,667	990,379	1,479,697
		[illegible]	63,110	111,312		
Total	Enforcement	331,200	[illegible]	[illegible]	[illegible]	990,776
	Management	239,664	24,797	42,517	336,937	643,915
	Development	35,756	0	0	0	35,756
	Assessment	318,486	9,233	33,487	377,539	738,745
	Enhancement	0	0	0	387,622	387,622
	Habitat Protection	0	0	7,667	33,518	41,185
		926,106	131,539	144,188	1,637,166	,837,999

Source: Saskatchewan Parks and R[illegible]ble Resources

APPENDIX E

LICENCE REVENUES AND PROFILES OF OTHER FISHERY SECTORS

TABLE E .1 : SASKATCHEWAN COMMERCIAL AND SPORT FISHING LICENCES

	Commercial		sDort	
	No. Licences[a]	Revenue ..$..	No. Licences	Revenues[b] ..$..
1960-61	3,043	15,215	97,260	$240,208
1961-62	2,796	13,980	96,623	245,839
1962-63	3,187	15,935	96,904	248,686
1963-64	3,308	16,540	93,694	252,287
1964-65	3,161	15,805	100,717	272,813
1965-66	3,128	15,640	101,480	275,030
1966-67	2,976	14,880	110,007	295,271
1967-68	2,769	13,845	112,510	297,008
1968-69	2,237	12,305	130,442	344,303
1969-70	3,223	16,115	143,579	367,818
1970-71	3,487	17,435	132,764	482,466
1971-72	3,088	15,440	139,362	523,245
1972-73	2,585	12,925	152,073	566,524
1973-74	2,157	12,185	156,197	591,903
1974-75	2,206	12,550	170,037	634,816
1975-76	2,253	12,945	177,322	674,276
1976-77	2,305	13,695	196,529	733,626
1977-78	2,271	13,305	201,415	741,767
1978-79	2,178	12,765	202,527	744,998
1979-80	2,063	13,795	197,785	729,246
1980-81	2,245	27,930	194,273	1,131,167
1981-82	1,944	24,440	205,948	1,151,508
1982-83	2,100	25,150	201,361	1,166,116
1983-84	1,585	20,040	197,403	1,062,328
1984-85	1,715	23,246	178,901	1,961,268[c]

[a] A distinct licence is required for each lake fished. Consequently, number of licences is greater than number of operators.

[b] Includes vendors commissions.

[c] Includes Fish and Wildlife Development Fund contributions.

Sources: Saskatchewan Department of Natural Resources, Northern Saskatchewan, Tourism and Renewable Resources, and Parks and Renewable Resources

TABLE E.2: THE SASKATCHEWAN BAIT FISHERY LICENCES

	Bait Fishery		
	No. Licences	Licence Revenue ($)	Production ('000kg)
1971-72	13	195	3
1972-73	21	315	6
1973-74	30	330	10
1974-75	33	495	10
1975-76	39	585	12
1976-77	42	630	22
1977-78	46	690	39
1978-79	50	750	14
1979-80	62	930	8
1980-81	62	1,260	22
1981-82	57	1,120	14
1982-83	50	1,000	18
1983-84	50	1,000	7
1984-85	63	1,245	15

Sources: Saskatchewan Department of Natural Resources, Northern Saskatchewan, Tourism and Renewable Resources, and Parks and Renewable Resources

TABLE E.3: SASKATCHEWAN BRINE SHRIMP INDUSTRY LICENCES

	Brine Shrimp Fishery		
	No. Licences	Licence Revenue ($)	Production (000 kg)
1971-72	4	60	29
1972-73	3	45	78
1973-74	6	90	22
1974-75	8	120	28
1975-76	9	135	33
1976-77	9	135	16
1977-78	1	15	24
1978-79	8	120	22
1979-80	9	135	21
1980-81	9	180	2
1981-82	9	180	2
1982-83	7	140	
1983-84	8	160	14
1984-85	3	60	19

Sources: Saskatchewan Department of Natural Resources, Northern Saskatchewan, Tourism and Renewable Resources, and Parks and Renewable Resources

TA8LE E.4: SASKATCHEWAN FISH FARMING INDUSTRY LICENCES

	No. of Licenses			Commercial License Revenue[ab]	No. Piecaa Stocked (lo@)	Production ('000 kg)
	Domestic	Commercial	Total	...$...		
1970-71	144	22	166	330	230	4
1971 "n	446	36	482	540	600	36
1972-n	894	40	934	600	800	52
19%$-74	1,223	41	1,264	615	809	59
1974-75	2,370	42	2,412	630	907	70
1975-76	2,492	46	2,538	690	1,043	88
1976-~	2,409	57	2,466	855	893	131
1977-78	1,614	46	1,660	690	625	75
1978-79	2,077	57	2,134	8S5	678	81
1979-80	2,27b	57	2,331	855	800	113
1980-81	2,097	57	2,154	855	670	72
1981-82	1,698	55	1,753	825	588	N/A
1982-83	1,973	52	2.025	780	685	100
1983-84	2,202	63	2,265	945	745	100
1984-8S	2,069	72	2,141	1,080	548[c]	75

[a] NO fee for domestic fish farming licenses.

[b] Excludes fish royalties.

[c] Not including 415,000 eggs.

Sources: Saskatchenen Department of Natural Reaources, Northern Saskatchewan, Tourism end Renewable Resources, and Parks end Reneuable Resources

TABLE E.5: SASKATCHEWAN FUR FARM FISHERY LICENCES

	Fur Farm Fishincf Industrv		
	No. Licences	Licence Revenue ..*$**	Production ...'000kg...
1960-61	79	14,449	2,722
1961-62	73	13,193	2,545
1962-63	66	10,070	2,345
1963-64	60	12,359	2,175
1964-65	62	12,044	2,646
1965-66	61	10,202	1,955
1966-67	60	15,816	2,732
1967-68	31	6,217	2,703
1968-69	31	8,732	1,802
1969-70	21	3,409	935
1970-71	17	3,547	913
1971-72	9	1,765	475
1972-73	9	1,686	452
1973-74	8	1,249	374
1974-75	8	1,070	249
1975-76	7	861	177
1976-77	9	973	205
1977-78	8	1,049	146
1978-79	8	833	176
1979-80	8	723	223
1980-81	8	880	175
1981-82	7	922	142
1982-83	6	700	150
1983-84	5	565	96
1984-85	4	327	49

Sources: Saskatchewan Department of Natural Resources, Northern Saskatchewan, Tourism and Renewable Resources, and Parks and Renewable Resources

TABLE E. 6: DOMESTIC NET AND FREE INDIAN FISHERIES LICENCES

	No. Licences/Permits			Domestic Net Licence Revenue .*9$.00	Production (Domestic Plus Free Indian) '000kg
	Domestic Net	Free Indian	Total		
1960-61	1,394	782	2,176	2,790	1,010
1961-62	1,256	276	1,532	2,594	797
1962-63	1,162	486	1,648	2,254	754
1963-64	1,016	545	1,561	2,180	635
1964-65	896	324	1,220	1,792	544
1965-66	1,121	329	1,450	2,242	508
1966-67	939	298	1,237	1,878	N/A
1967-68	710	410	1,120	1,420	486
1968-69	779	193	972	1,763	567
1969-70	920	164	1,084	1,840	567
1970-71	917	NA		1,834	567
1971-72	500	NA		1,000	386
1972-73	573	NA		1,146	390
1973-74	442	NA		884	467
1974-75	676	NA		1,352	531
1975-76	595	NA		1,190	534
1976-77	760	NA		1,520	
1977-78	472	NA		944	
1978-79	868	NA		1,736	
1979-80	621	NA		1,241	
1980-81	517	NA		2,585	
1981-82	293	332	625	1,465	
1982-83	704	443	1,147	3,520	
1983-84	538	541	1,079	2,690	
1984-85	479	599	1,078	2,392	

Sources: Saskatchewan Department of Natural Resources, Northern Saskatchewan, Tourism and Renewable Resources, and Parks and Renewable Resources

APPENDIX F

PROVINCIAL AND FEDERAL ACTIVITIES AND PROGRAMS

TABLE F. 1 : SUMMARY OF PROVINCIAL GOVERNMENT ACTIVITIES AND PROGRAMS AFFECTING THE SASKATCHEWAN FISHERY, 1970 TO PRESENT

Enhancement

operation of Fort **Qu'Appelle** Fish Culture station.
stocking waters with fry or fingerlings.
construction of rearing ponds.
lakes treated to remove indigenous predator species before exotic species (game trouts) are introduced.
lake aeration, fishways.

Habitat Protection

testing for mercury pollution
watershed protection studies where "forest harvesting operations were scheduled e.g., ecological baseline study on waters affected by proposed Athabaska Forest Products pulp mill **in** 1972
studying of acid rain and road construction.

Enforcement/operations

licence revenue **collection/issuing** licences
closed seasons and closed areas enforcement
spot checks for bag limit and gear infractions
spot checks for licence infractions.

Assessment

sampling commercial catches
sampling sport catches (creel **surveys)**
fish aging
information processing
determination of sustained yields/development of criteria for specifying quota levels (based on lake size, **location,** productivity, previous harvest).
establishing experimental commercial and bait fisheries e.g. , Lake Diefenbaker for commercial whitefish in fall of 1976
walleye tagging studies
spawning studies
test fishing e.g., **Amisk** Lake **survey**
operation of Saskatchewan Fisheries Laboratory in Saskatoon
test netting.
limnological and **biological** studies
establishing fisheries management information system
study of raising walleye to fingerling stage in a rearing pond rather than by stocking fry directly
investigation of water bodies for suitability to winter fishing
liaison with DFO-re 1975 and 1980 angler mail **surveys**

. . continued

TABLE F.1: continued

establishing regional offices of the Department of Northern Saskatchewan in La Ronge, Buffalo Narrows and Creighton
investigation of suitability of waters for developing trout fisheries

Management

1. Regulations and Planning

regional management plans
formation of Fish Hatcheries Review Committee and 5 year plan for northern first culture
development of planning document: "Proposed Goals and Strategies for Fisheries Management in the 1980's", 1981
- development of planning dooument: Saskatchewan Fisheries Policy Action Plan", 1983
- development of planning document: "Conservation options for the Commercial Users of the Fish Resource: A Discussions Paper", 1985
- proposal for more stringnet disease control of imported rainbow trout fingerlings

setting quotas and changing regulations e.g., closing Big Peter Pond Lake to commercial fishing in 1974-75.

2. Allocation

development of commercial fisheries allocation process (originally applied to Lac La Ronge and Lake Athabasca) in which local fishermen's associations develop eligibility criteria
- local allocation meetings

3. Consultation

consultation with user groups e.g., Commercial Fisheries Development Committee, Tourist Sport Fisheries Committee, and Fishery Advisory Committee.
- regional meetings.

Development

1. Subsidies/Grants

- fish transportation subsidy
- fish price support
- outlying lake subsidy
- redundancy payments

Special ARDA grants to construct two packing plants
- Special ARDA equipment grants

...continued

TABLE F.1: continued

grant to Co-operative Fisheries Ltd. (CFL) to cover operating deficit in 1974-75 ($172 thousand)
ice house facility construction grants (cost shared provincially and federally under Fish Chilling Assistance Program)
grant for start-up of Fishermen's Supply Co-op ice-house, packing house, dock upgrading and construction grants
supplied CFL with management consulting services (to develop cost accounting practices)
ice harvesting grants
grants to cover transportation of ice harvesting equipment between locations
gas tax rebates.

2. Training

Stanley Mission residents trained in fish age analysis
- guide training school
skiff building course

3. Extension

re commercial fishing procedures publication (Commercial Fisheries Extension Training Program)
FishermenSs Cost Accounting Program
technical extension assistance on fish farming (including fish farm newsletter)
education and assistance to commercial fishermen in dealing with income tax, excise tax, and unemployment insurance.
testing mechanized net pullers
financial assistance to Fishermen's Association and Northern Saskatchewan Outfitters Association
funded Commercial Fisheries Development Committee for liaison between fishermen and Departments.

4. Programs/Assistance

umbrella Fisheries Development Program (FDP) implemented in 1974-75
experimental whitefish roe program
commercial fishermen's identification program
establishment of Stanley Mission Fish Aging Co-operative
study to define investment opportunities in sport fisheries in the Stanley Mission - South end of Reindeer Lake area
system of recoding fishermen's daily catch at La Ronge.
TSB low interest loans to qualified northern fishermen to prepare and/or purchase various supplies and fishing equipment ($528 thousand to 176 persons between January 1982 and September 1985).

TABLE F. 2 : SUMMARY OF FEDERAL GOVERNMENT ACTIVITIES AND PROGRAMS AFFECTING THE SASKATCHEWAN FISHERY

Assessment

analysis of fishermen transactions with FFMC i.e., waybill analysis
"willingness to pay" surveys of Saskatchewan anglers
Saskatchewan lodge industry study
aquiculture research
fisheries rehabilitation (walleye studies)
1975 and 1980 sport fishing surveys
experimental cropping of lakes
fish disease protection studies
biennial Canadian Sport Fishing Conferences
costs and earnings survey
walleye enhancement program.

Habitat Protection

pollution monitoring
acid rain studies
impact studies of hydro-electric power developments
impact studies of logging.

Enforcement (Inspection/Quality Improvement)

quality control of processing plants
quality protection during unloading, handling at dockside and water and transportation to plants
monitor water and ice supplies
certification of vessel construction and certification
on-board quality protection measures e.g., plastic tubs replacing wooden boxes
inspection of final product grade standards
laboratory *in* Prince Albert.

Development/Subsidies

Fishing Vessel Insurance Plan (provides protection from abnormal capital losses at premiums which are affordable by fishermen, where insurance is otherwise available from commercial sources)
Fishing Vessel Assistance Program (provides financial assistance towards the capital cost of vessel replacement)
Fisheries Prices Support Program (provides deficiency payments when markets are depressed: not active in FFMC jurisdiction for several years)
accelerated depreciation on newly constructed vessels
shore-based.infrastructure developments undertaken jointly by federal and provincial governments e.g. , Fish Chilling Assistance Program, Special ARDA Program

. . . continued

TABLE F. 2 : continued

maintenance of docking facilities by Small Craft Harbours
- UI payments to self-employed fishermen
- new product developments e.g., fish sticks
  development of whitefish roe, brine shrimp and crayfish
  feasibility studies
  energy conservation studies
- redundancy payments
- the charging of less than normal mark-ups on nets by the FFMC.