FERIC *FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA*
INSTITUT CANADIEN DE RECHERCHES EN GÉNIE FORESTIER

The Economics of Utilizing Decadent Interior Cedar and Hemlock

Alex W.J. Sinclair

Technical Report No. TR-59
June 1984

PROFIT (LOSS) STATEMENT
($/MFBM)

	HEMLOCK	CEDAR	SPF
Logging Cost	$146.90	$167.65	$103.60
Sawmill Cost	106.00	133.15	92.50
	252.90	300.80	196.10
Sales Revenue	204.90	365.95	236.75
Profit (Loss)	($ 48.00)	$ 65.15	$ 40.65

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PREFACE

The Forest Engineering Research Institute of Canada is indebted to the B.C. Science Council for funding this exploratory project. The co-operation and advice of the B.C. Ministry of Forests, Crown Forest Industries Ltd., Lavington Planer Mills Ltd., Riverside Forest Products Ltd. and Weyerhaeuser Canada Ltd. is also gratefully acknowledged. Suggestions and advice were also offered by Carroll Hatch (International) Ltd., Q.E.D. Engineering Associates Inc., Industrial Mill Installations Ltd., Sandwell and Co. Ltd. and J.A. McIntosh (FORINTEK), J.V. Hatton (PPRIC) and G.H. Manning (CFS).

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SUMMARY

The objective of this study was to determine harvesting and processing methods that could economically utilize the Interior stands of decadent cedar-hemlock. The four major Lumby mills and the surrounding Spallumcheen PSYU were chosen for analysis as typical of an Interior supply area with a sawlog timber demand. Unfortunately, it was not possible to achieve the study objective of economic utilization. The decadent cedar-hemlock stands are climax stands and their main end products are hog fuel, pulp logs and pulp chips. Existing chip surpluses and lack of demand for hog fuel and pulp logs mean either no market or unprofitable prices for the products of the stands. Until these conditions change or harvesting modifications and incentives are introduced it will continue to be uneconomical to harvest the stands.

Logging costs increase when logging decadent stands as a result of inaccurate cruise data, moist sites, greater log breakage, increased supervision and higher proportions of non-merchantable logs. A range of costs and productivities for logging the better-quality decadent cedar-hemlock stands with conventional ground skidding systems is given in Table S-1. Using cable logging systems would further increase logging costs by \$6 to \$8 per m^3 and they could easily double if poorer quality stands were logged. At present, harvesting is limited to better-quality, overmature stands.

TABLE S-1. LOGGING COSTS AND PRODUCTIVITIES IN DECADENT CEDAR-HEMLOCK (\$/m^3).

	HIGH	LOW	AVERAGE
Logging	\$15	\$12	\$13.50
Transportation	8	6	7.00
Other	9	7	8.00
Total	\$32	\$25	\$28.50

Logging Productivity/Manday = 25-30 m^3/manday.
Logging Productivity/Machine Hour = 4.7-5.6 m^3/machine hour.

Lumber recovery, production and grade outturn all decline when sawing decadent logs. Chip quality decreases because of poor chip sizes and rot content. The operating and fixed costs of the sawmill remain the same and lower profitability or losses result, particularly with hemlock. Table S-2 gives sawmill results typical for better-

quality decadent cedar-hemlock, compares these with SPF* and illustrates that it is really a decadent hemlock problem and not a decadent cedar-hemlock problem. At present, sawmills only process better-quality, cedar and hemlock logs from the overmature stands.

TABLE S-2. DECADENT CEDAR-HEMLOCK AND SPF SAWMILL PRODUCTION MODEL.

	HEMLOCK	CEDAR	SPF
Production (FBM/shift)	125 000	100 000	160 000
Lumber Recovery Factor (FBM/m^3)	194	170	222
Manufacturing Cost ($/MFBM)	$106.00	$133.15	$ 92.50
Logging Cost ($/MFBM)	$146.90	$167.65	$103.60
Production Cost ($/MFBM)	$252.90	$300.80	$196.10
Sales Return ($/MFBM)	$204.90	$365.95	$236.75
Gain or (Loss)	($48.00)	$ 65.15	$ 40.65

There is currently a chip surplus of over 200 000 BDU** in the area the Kamloops pulp mill draws from and an additional supply of chips from Lumby decadent cedar-hemlock would be difficult to market. There are no hog mills in Lumby nor is there a market for hog fuel. In terms of coastal or export chip markets, transportation costs to the coast equal coastal selling prices for hemlock chips, and cedar chips are in surplus. The export market prefers SPF chips over cedar and hemlock. Until there is a demand for the products that come from decadent cedar-hemlock stands there is no incentive to harvest these stands.

The balance between mature timber supply and demand in both the short and long-term in the Spallumcheen PSYU is given in Table S-3. As can be seen, there are supply deficits in both the short-term and long-term, with the short-term being more serious. However, the estimated 5 900 000 m^3 of overmature cedar-hemlock is not being harvested. If harvesting was intensified on the decadent stands then approximately 885 000 m^3 of sawlogs would result and the harvested areas could enter a positive new growth cycle rather than deteriorating further. However, the chips produced from the pulp log content would be of low quality and would add to the present southern interior surplus which is in excess of 200 000 bone dry units (BDU).

*SPF = Spruce, Pine and Fir species
**BDU = Bone dry unit = 1.09 tonnes

TABLE S-3. BALANCE BETWEEN SUPPLY AND DEMAND IN SPALLUMCHEEN PSYU.

	LONG-TERM	SHORT-TERM (20 YEARS)
Net Mature Volume Available (m^3)	29 074 000	10 356 000
Four Lumby Mills' Double Shift Capacity (m^3/yr)	1 200 000	1 200 000
Net Mature Volume/Double Shift Capacity (yrs)	24	9

A log merchandising and chipping plant was examined as a potential solution that would overcome some of the inherent scaling, grading, sawmill cost and chipping problems. However, until chip prices reach $95.00 per BDU FOB mill, the economics are not attractive. A particle board plant attached to the chipping plant at a cost of $40-$50 million was suggested as a solution but was not examined in detail because it was beyond the scope of this study.

The recommendations of the study are:

1. Decadent cedar-hemlock presents a many-faceted, difficult problem when considering methods to increase its utilization. Consequently, a relatively sophisticated, graduated utilization policy is needed. It should reflect the variation in economic opportunity offered by the variety of terrain and wide range of log quality and stand composition of the overmature cedar-hemlock types. This system would range from declaring one to all species in a stand off-quota. Provision should also be made for rehabilitation of the site by the licensee whereby any log values recovered would help offset rehabilitation costs. A more simplistic recommendation of declaring all decadent cedar-hemlock stands off-quota was considered but was discarded because it did not address the entire problem.

2. Research should be undertaken to determine the costs and productivity of applying land-clearing techniques to the poorer decadent stands. Ground skidding systems, although efficient, are not cost effective in decadent stands.

3. Encourage continuation of research by the Pulp and Paper Research Institute of Canada to develop equipment and processes to reduce the rot content and increase the quality and value of chips produced from decadent stands.

4. The B.C. Ministry of Forests (MOF) and industry should clearly define what constitutes a sawlog and a pulp log in a sawmill economy and change the scaling rules. Present definitions are a disincentive to harvesting decadent stands.

5. The Lumby area has a timber shortage and a chip surplus. Therefore, the government should encourage utilization proposals that use more low quality fibre and discourage proposals that use more timber quality fibre.

6. Grant long-term export permits for the additional chips and pulp logs produced from decadent stands.

7. Modify the logging utilization standards, the timber cruise procedures and the timber valuation procedures to recognize the special problems associated with decadent stands. This could include appraisal for the stand as a whole, or lump sum bids for stands.

8. Investigate the feasibility of panel-board processes such as an oriented strand board, medium density fibre-board or particle board that would reduce the current surpluses of pulp chips and increase the viability of logging the decadent stands.

To be effective the action required to liquidate the decadent cedar-hemlock stands will require the full cooperation and consultation of the Ministry of Forests and industry. Also, the B.C. Science Council can assist by funding some of the logging and processing research needed so the systems and hardware are in place when a strategy for the decadent stands is implemented.

Unfortunately, this report does not offer any easy solutions to the problem of utilizing the decadent cedar-hemlock stands of the Interior. It is hoped that this report will show the importance of the problem and will clarify the options that are available for its solution. It should be noted that several of the recommendations are similar to those of the Sloan Commission of 1945.

SOMMAIRE

L'objectif de cette étude était d'identifier les méthodes d'exploitation et de transformation qui puissent rentabiliser l'utilisation des peuplements décadents de cèdre-pruche de l'Intérieur de la Colombie-Britanique. Les quatres principales usines de Lumby et l'Unité Publique à Rendement Soutenu (UPRS) Spallumcheen des environs furent choisis pour l'analyse en tant que zone d'approvisionnement typique de l'Intérieur avec une demande en bois de sciage. Malheureusement, il fut impossible d'atteindre l'objectif de l'étude concernant la rentabilité de l'utilisation. Les peuplements décadents de cèdre-pruche sont des peuplements climax qui génèrent principalement des déchets de bois, des billes à pâte ou des copeaux à pâte. Les produits générés par ces peuplements n'ont pas de marché ou ont des prix non-profitables due au surplus de copeaux sur le marché actuel et l'absence de demande pour les déchets de bois et les billes à pâte. L'exploitation de ces peuplements demeurera non rentable à moins d'un changement de la situation, ou que l'on apporte des modifications aux méthodes actuelles d'exploitation ou des mesures incitant à l'utilisation de ces peuplements.

Les coûts d'exploitation augmentent lorsque les opérations forestières se déroulent dans des peuplements décadents. Ceci est attribuable aux données d'inventaire imprécises, aux sites marécageux, au plus grand nombre de bris de billes, à une surveillance accrue et à la plus grande production de billes non-commerciales. Le Tableau S-1 donne un éventail de coûts et de productivité pour l'exploitation de peuplements décadents de cèdre-pruche de qualité meilleure à l'aide des systèmes conventionnels avec débusqueuses. L'utilisation des systèmes d'exploitation par câble augmenterait les coûts d'exploitation de 6 à 8$ par m^3 et ceux-ci pourraient facilement doubler si les peuplements exploités étaient de moindre qualité. Actuellement, l'exploitation est limitée aux peuplements qui ont passé l'âge de maturité de qualité meilleure.

Tableau S-1. Coûts d'exploitation et productivités en peuplements décadents de cèdre-pruche ($/m^3).

	Haut	Bas	Moyenne
Exploitation	$ 15	$ 12	$ 13.50
Transport	8	6	7.00
Autres	9	7	8.00
Total	32	25	28.50

Productivité des exploitations / homme-jour = 25-30 m^3 / homme-jour

Productivité des exploitations / heure-machine = 4.7-5.6 m^3 / heure-machine

Le rendement sciage, la production et les classes produites diminuent lors du sciage des billes défectueuses. La qualité des copeaux diminue due au contenu en pourriture et aux faibles dimensions des copeaux. Les coûts fixes et les coûts d'opération de l'usine de sciage demeurant les mêmes, une rentabilité moindre ou des pertes sont enregistrées, plus particulièrement avec la pruche. Le Tableau S-2 donne des résultats typiques d'une usine de sciage approvisionnée en billes défectueuses de cèdre-pruche de qualité meilleure. Ces résultats sont comparés avec du SPE(*) pour illustrer que le problème est attribuable aux billes de pruche défectueuses et non à celles de cèdre-pruche. Les usines de sciage s'alimentent à présent uniquement avec des billes de cèdre et de pruche de qualité meilleure provenant de peuplements passés l'âge de maturité.

Tableau S-2. Modèle de production pour une usine de sciage alimentée en cèdre-pruche défectueux et en SPE.

	Pruche	Cèdre	SPE
Production (PMP/quart)	125 000	100 000	160 000
Rendement sciage (PMP/m^3)	194	170	222
Coûts d'usinage ($/MPMP)	106.00$	133.15$	92.50$
Coûts d'exploitation ($/MPMP)	146.90$	167.65$	103.60$
Coûts de production ($/MPMP)	252.90$	300.80$	196.10$
Recettes ($/MPMP)	204.90$	365.95$	236.75$
Profit ou (perte)	(48.00$)	65.15$	40.65$

Il y a présentement un surplus de copeaux de plus de 200 000 UPA(**) dans la région où s'alimente l'usine de pâte de Kamloops et une source additionnelle de copeaux provenant des peuplements de cèdre-pruche décadents de Lumby serait difficilement vendable. Il n'y a ni usine ni marché dans la ville de Lumby pour les déchets de bois. En terme de marché de copeaux de la côte ou d'exportation, les coûts de transport jusqu'aux régions côtières sont égal au prix de vente des copeaux de pruche, et les copeaux de cèdre y sont en surplus. Sur le marché d'exportation, les copeaux de SPE ont préférence sur les copeaux de cèdre et de pruche. Rien n'incite à exploiter les peuplements décadents de cèdre-pruche jusqu'à ce qu'il y ait une demande pour ces produits.

L'équilibre entre l'approvisionnement et la demande, à court et à long termes, en arbres à maturité dans l'UPRS de Spallumcheen est donnée au Tableau S-3. Comme on peut le voir sur ce tableau, il y a des déficits en approvisionnement à court et à long terme, le court

(*) SPE = Sapin, pin, épinette

(**) UPA = Unité de poids anhydre = 1.09 tonnes terme étant le plus important. Cependant, les peuplements de cèdre-pruche passés l'âge de maturité, évalués à 5 900 000 m^3, ne sont pas exploités. Si l'accent était mis sur l'exploitation de peuplements décadents, il en résulterait 885 000 m^3 de billes de sciage et les aires de coupe amorceraient un nouveau cycle de croissance plutôt que de continuer à se détériorer. Cependant, les copeaux issus de billes à pâte seraient de qualité médiocre et devraient être ajoutés à l'actuel surplus du Sud de l'Intérieur qui est évalué à 200 000 UPA.

Tableau S-3. Equilibre entre l'approvisionnement et la demande dans l'UPRS de Spallumcheen.

	Long terme	Court terme (20 ans)
Volume net à maturité disponible (m^3)	29 074 000	10 356 000
Capacité des quatres usines de Lumby en double quart (m^3 / année)	1 200 000	1 200 000
Volume net à maturité / capacité par double quart (année)	24	9

Une usine de sciage à coupe optimale munie d'une déchiqueteuse fut étudiée comme solution possible pour surmonter quelques uns des problèmes se rattachant au mesurage, au classement, aux coûts d'usinage et au déchiquetage. Un tel projet ne deviendra cependant rentable que lorsque le prix des copeaux aura atteint 95.00$ par UPA FAB usine. Une usine de panneaux de particules reliée à l'usine de déchiquetage, au coût de 40 - 50$ millions, fut suggérée comme solution mais ne fut pas étudiée en détail parce que c'était au-delà des buts de cette étude.

Les recommendations de l'étude sont:

1. Les peuplements décadents de cèdre-pruche souvelèvent des problèmes à plusieurs facettes lorsque l'on envisage d'augmenter leur utilisation. Par conséquent, une politique d'utilisation graduelle relativement sophistiquée est requise. Celle-ci devrait refléter les variations des conditions économiques engendrées par la variété de sites, un large éventail de qualités de billes et la composition des peuplements de cèdre-pruche passés l'âge de maturité. Ce système varierait entre déclarer une à toutes les espèces comprises dans un peuplement hors-quota. Des mesures devraient également être prises pour que le détenteur d'un permis restaure le site, et la valeur des billes récupérées pourrait aider à défrayer les coûts de restauration. Une approche plus simple serait de désigner hors-quota tous les peuplements décadents de cèdre-pruche mais cette solution fut rejetée puisqu'elle ne touchait pas le problème en entier.

2. Des recherches devraient être entreprises pour évaluer les coûts et la productivité reliés aux techniques de nettoyage de terrains des peuplements les plus endommagés. Les systèmes de débusquage au sol, quoiqu'efficaces, ne sont pas rentables dans les peuplements décadents.

3. Supporter la continuité des recherches entreprises par l'Institut Canadien de Recherches sur les Pâtes et Papier sur le développement d'équipements et de procédés pour réduire le contenu en pourriture et augmenter la qualité et la valeur des copeaux issus de peuplements décadents.

4. Le Ministère des Forêts de la Colombie-Britanique et l'Industrie devraient clairement définir de quoi sont constitués les billes de sciage et les billes à pâte pour la rentabilité d'une usine de sciage afin de modifier les règlements sur le mesurage. Présentement, les définitions n'incitent pas à couper les peuplements décadents.

5. La région de Lumby a présentement une pénurie en bois de sciage et un surplus en copeaux. Ainsi, le gouvernement devrait encourager les propositions d'utilisation faisant usage de plus de fibres de faible qualité et dissuader celles qui utilisent plus de fibres de meilleure qualité.

6. Accorder des permis d'exploitation à long termes pour le surplus de copeaux et de billes à pâte issuent de peuplements décadents.

7. Modifier les normes d'utilisation d'exploitation, les procédures d'inventaire forestier et les procédures d'évaluation forestière afin d'identifier les problèmes spéciaux associés aux peuplements décadents. Ceci pourrait inclure l'évaluation d'un peuplement en entier et une somme globale serait offerte pour le peuplement lors des enchères.

L'entière coopération et consultation de l'Industrie et du Ministère des Forêts seront requises pour rendre efficace la liquidation des peuplements décadents de cèdre-pruche. Le Conseil des Sciences de la Colombie-Britanique peut aussi fournir son assistance en subventionnant certaines recherches sur l'exploitation et la transformation afin que les systèmes et les structures sont en place lorsqu'une stratégie ayant trait aux peuplements décadents est mise à exécution.

Malheureusement, ce rapport n'offre aucune solution facile face à l'utilisation des peuplements décadents de cèdre-pruche de l'Intérieur. Il reste à espérer que ce rapport saura démontrer l'importance du problème et élucider les options susceptibles d'être utilisées comme solutions. Il est à noter que plusiers des recommandations sont semblables à celles de la Commission Sloan de 1945.

INTRODUCTION

In 1981 the Ministry of Forests conducted a field test in a Lumby decadent cedar-hemlock setting that previously had been selectively logged. The field test was to determine the cost and benefits of skidding and decking the remaining non-merchantable logs to the landing and then processing them into a product that was suitable as feedstock for hog fuel or pulp chips. FERIC assisted in these tests and as a result, suggested a further research project to the B.C. Science Council. The project would use a biomass shear, a drum debarker and a roto-drum chipper to determine whether clean, size-acceptable pulp chips, as well as hog fuel, could be made from rotten cedar-hemlock. However, the Science Council preferred an overall economic study into the decadent cedar-hemlock problem prior to starting research on only one potential solution and recommended that FERIC undertake the study. The objective of the study was to determine harvesting and processing methods that would economically utilize the Interior stands of overmature cedar-hemlock and to identify the requirements necessary for greater utilization. The Lumby area was chosen for a case study as it is typical of a logging/saw-milling region containing extensive volumes of these decadent stands.

The decadent cedar-hemlock stands in the Interior wet belt cover an estimated 240 000 ha of potentially productive land. Growth in these stands is zero or negative and extensive heart rot, pocket rot and ring shake makes the timber unattractive for sawlog use relative to fir, pine, spruce and other conifers. The heart rot and pocket rot also make them undesirable for pulp chips. The B.C. Ministry of Forests (MOF) has from time to time through position papers, temporary utilization revisions and studies tried to encourage higher utilization, which could have two obvious benefits:

(1) Any sawlogs recovered would augment normal timber supplies which are in short supply.

(2) The highly productive sites now occupied by decadent stands could be restocked and the allowable cut for the area could be increased.

However, high logging and milling costs, low lumber recovery, grades and prices, lack of a pulp log market and oversupplies of pulp chips and hog fuel have prevented any significant increase in the utilization of the decadent cedar-hemlock stands.

There have been previous studies concerned with Interior decadent cedar-hemlock stands and some are listed in the Bibliography. The harvesting, milling and supply problems noted then are still present but have become more serious. The comments on decadent stands by the Sloan Commission in 1945 illustrate that this is not a new problem: "There are substantial stands of over-mature hemlock in the Interior.... Probably less than 10 percent of this hemlock could be converted into sawn lumber.... It is my opinion that the Crown would be justified in waiving all claims to royalty on over-mature Interior hemlock stands in order to encourage their removal so that new growth of more valuable tree species could come in.... In the long run it would pay the Crown to sell decadent Interior hemlock stands remaining in Crown ownership at a nominal stumpage rate without reservation of royalty, or, perhaps in areas in which white or yellow pine would constitute the greater part of the next crop, to subsidize operators to clear cut those areas."

I. HARVESTING THE RESOURCE

The logging managers of the four major mills were consulted to obtain their suggestions, experiences, productivities and costs when logging in decadent cedar-hemlock stands.

A. Logging Manager's Suggestions

The products of decadent cedar-hemlock stands are primarily pulp chips, pulp logs and hog fuel. At present, these products have limited markets and low prices and until they improve, it will be uneconomic to harvest the stands under existing logging regulations and stumpage charges.

Some of the decadent stands are on steep terrain which will require more costly, cable-logging harvesting systems. Perhaps these stands should be considered inaccessible and be excluded from annual allowable cut calculations.

Most of the suggestions to reduce the costs of logging decadent cedar-hemlock stands included one or more of better planning, closer supervision, and more quality control which, in themselves, increase costs.

Some of the suggestions to reduce costs were:

- selectively log and load out lumber quality logs and then fall, pile and burn the remainder of the timber;

- use the stand as a whole concept when calculating stumpage charges. This would recognize the real losses that occur with hemlock;

- use land-clearing techniques on decadent stands. Stumpage on any merchantable logs recovered would be credited against land clearing costs;

- remove all decadent stands from the annual allowable cut calculation. Stumpage would not be paid on logs removed and the volumes would not be charged against a company's quota; and

- allow companies to bid lump sum payments for stands of timber. This could eliminate the problems with cruising and scaling and reduce MOF and company costs.

B. Logging Experiences

1. Planning and Engineering

Planning and engineering have a significant impact on profitability and long-term development. Much of the data used comes from the operational cruise which is inaccurate in decadent stands and thus the planning and engineering is inadequate.

2. Road Building

Cedar-hemlock species tend to grow on moist sites with silty soils which increases road building costs. Roads usually are built one to three years before logging in order to settle, and this increases investment costs.

3. Falling and Bucking

Experienced fallers are required in decadent stands for safety and timber recovery. Mechanized feller-bunchers cannot be used. Log breakage is high. Bucking is done in the landings but many non-merchantable logs are loaded onto the trucks. Greater quality control supervision of fallers, buckers and loader operators is necessary and higher supervision costs result.

4. Skidding and Loading

The size and amount of equipment used in decadent cedar-hemlock stands is minimized. Contractor rates must be higher to compensate for the non-merchantable logs skidded to the landing. Successful attempts to log decadent cedar-hemlock in the Lumby area have involved either selective logging, experienced and efficient contractors or independent owner-operators, and usually were restricted to better-quality overmature stands.

5. Hauling and Storage

Log hauling contractors are paid by weight and loads have to be checked to ensure that not too many cull logs are being transported. In decadent material the trucks can reach a volume capacity before their weight capacity and they will want a higher rate. Log breakage is high in the millyard.

C. Logging Costs and Productivity

1. Logging Costs

Table I gives a range of logging costs that have been experienced when conventional ground skidding systems were used to log better-quality, decadent cedar-hemlock stands. Logging costs include all costs from falling to loading out. Transportation costs are from the

Sugar Lake area (45 km). "Other costs" include road development, company supervision, road maintenance, stumpage payments and burning and planting. The average total cost of $28.50 per m^3 would increase by approximately $6 to $8 per m^3 if cable systems were used for logging and could easily double in a truly decadent stand.

TABLE I. RANGE OF LOGGING COSTS ($/$m^3$). (BETTER QUALITY STANDS)

	HIGH	LOW	AVERAGE
Logging	$15	$12	$13.50
Transportation	$ 8	$ 6	$ 7.00
Other	$ 9	$ 7	$ 8.00
Total	$32	$25	$28.50

2. Logging Productivity

The productivity objective is 35 m^3 per manday in decadent cedar-hemlock stands. However, the average is probably closer to 25-30 m^3. A general rule is that productivity decreases as the proportion of non-merchantable timber increases.

With conventional ground skidding systems, the balance of equipment and men that would be used in a 20-25 ha cutblock of better-quality, decadent cedar-hemlock with a stand density of 425-475 m^3/ha is:

DAILY COST	EQUIPMENT & MEN
$1 376	4 rubber-tired skidders
546	1 crawler tractor for trailmaking & skidding
466	1 front-end loader
423	2 fallers
244	1 bucker
80	2 crew cabs
140	2 pickups (plus firetool, etc. allowance)
$3 275	

Equipment = 6 pieces; Manpower = 9 men.

This combination of men and equipment would be expected to produce 225-270 m^3 or 7-8 truckloads of logs per day and would result in a logging cost of $12.00 to $14.50 per m^3. By comparison the logging cost in a spruce-pine-fir (SPF) stand would average $8.00 per m^3.

3. Logging Conclusions

The decadent stands will not be logged until it becomes economic to do so. This will not occur until there are better prices and markets for the pulp chips, pulp logs and hog fuel that are the main products from decadent stands. Measures such as declaring decadent stands off-quota with no stumpage may act as an incentive by increasing the mills' effective quota and reducing the costs of logging.

It would be difficult to improve on the present method used to harvest better-quality decadent stands which combines ground skidding systems with selective logging methods. However, for the poorer-quality stands it would be worthwhile to determine the costs of using land clearing methods to remove the timber. Research should begin in this area.

II. MILLING THE RESOURCE

The mill managers of the four major Lumby sawmills gave their suggestions, experiences and costs when processing decadent cedar-hemlock.

Flow diagrams of the four mills are given in Appendices I to IV. Riverside Forest Products' mill is a stud and veneer mill and cannot process decadent cedar-hemlock without major modifications. The other three mills can process decadent cedar-hemlock but would probably need changes in their chipping and chip handling facilities to process it efficiently.

A. Mill Manager's Suggestions and Experiences

One suggestion was to build and operate a log bucking, grading, sorting and chipping plant in the Lumby area to process decadent cedar-hemlock. The chipping plant would be designed to process the grades and volumes of material available. The bucking, grading and sorting operation would ensure that more sawlogs go to the sawmills and the pulp logs go to the chipper. The operation could be located at Lumby or in the Sugar Lake area, depending on transportation economics.

From mill experience it is a decadent hemlock problem, not a decadent cedar problem. Sawmills lose money on hemlock but can make a profit on cedar.

Lumber quality, chip quality and lumber recovery decrease and residual waste volumes increase when processing decadent cedar-hemlock. Unit production costs increase because, while operating and overhead costs remain the same, the quality and quantity of lumber diminishes. In addition, the quality of chips is lower because of rot content and poor size distribution. Lumber recovery often drops by 20% and chip recovery by 15%.

Chip supply has exceeded demand since the 1970's in Lumby and the entire southern Interior. The surplus accumulation started when close utilization policies were introduced and increased with the MOF's decision to set chip prices based on kraft pulp prices. At present, the supply of chips for the Kamloops pulp mill is in surplus by over 200 000 BDU. The Kamloops pulp mill does not foresee any increase in demand for 10 years. There is no market for pulp logs in the Lumby area and the nearest potential user is the pulp mill at Castlegar. None of the Lumby sawmills has a hog mill nor use hog fuel for energy. Waste residuals are burned in beehive burners. Thus, the main markets for fiber from low grade stands are non-existent.

The MOF scaling rules are oriented towards fiber recovery. When determining log volumes and grades, stumpage payments and quota charges, they do not take log defects into account that can have a significant effect on lumber recovery and quality. With decadent logs this means that in most cases lumber-quality stumpage charges are paid on pulp-quality logs.

Log quality and volume can be determined most accurately when the logs are bucked into short lengths and the most practical place to do this is at the slasher deck of the sawmill. Unfortunately, the information collected at this location arrives too late to determine whether harvesting and transportation costs are going to be offset by lumber and chip prices.

B. Milling Costs and Returns

Productivities, costs and revenues will vary from sawmill to sawmill because of differences in sawmill design and major breakdown units. However, Table II gives a set of values that are likely to occur when processing better-quality, decadent cedar-hemlock. Lumber recovery factors would be about 50 percent lower than those used in Table II if truly decadent cedar-hemlock was processed.

TABLE II. DECADENT CEDAR-HEMLOCK SAWMILL PRODUCTION MODEL.

	HEMLOCK	CEDAR
Production (FBM/shift)	125 000	100 000
Lumber Recovery Factor (FBM/m^3)	194	170
Consumption (m^3/shift)	644	588
Manufacturing Cost ($/MFBM)		
Sawing	$ 45.00	$ 70.00
Log Yard	9.00	9.00
Kiln	8.50	8.50
Planer	18.00	20.15
Yard/Transportation	9.50	9.50
Shipping	4.00	4.00
Shop	3.00	3.00
Indirect and Administrative	9.00	9.00
	$106.00	$133.15

PRODUCTION OUTTURN

GRADES	HEMLOCK (%)	CEDAR (%)
#1 & 2	50	50
#3	35	40
#4	15	10

LUMBER SIZES	HEMLOCK (%)	CEDAR (%)
2 x 4	35	20
2 x 6	35	25
2 x 8	10	30
2 x 10	20	10
2 x 12	-	15

Chip Recovery (BDU/m^3)	0.13
Sawdust Recovery (BDU/m^3)	0.05

LUMBER PRICES ($ Cdn)

HEMLOCK

SIZES	GRADE #1&2	#3	#4
2 x 4	$225	$185	$85
2 x 6	225	155	85
2 x 8	225	155	85
2 x 10	260	150	85

CEDAR

SIZES	GRADE #1&2	#3	#4
2 x 4	$465	$215	$65
2 x 6	525	215	65
2 x 8	530	215	65
2 x 10	525	215	65
2 x 12	530	215	65

SALES RETURN

HEMLOCK

SIZES	%	$/MFBM	RETURN
2 x 4	35	$190.00	$66.50
2 x 6	35	179.50	62.85
2 x 8	10	179.50	18.00
2 x 10	20	195.25	39.05
Chips	-	-	18.50
		Total	$204.90

CEDAR

SIZES	%	$/MFBM	RETURN
2 x 4	20	$325.00	$ 65.00
2 x 6	25	355.00	88.25
2 x 8	30	357.50	107.25
2 x 10	10	355.00	35.50
2 x 12	15	357.50	53.65
Chips	-	-	15.30
		Total	$364.95

NET PROFIT

	HEMLOCK	CEDAR
Logging Cost	$146.90/MFBM	$167.65/MFBM
Sawmill Cost	106.00/MFBM	133.15/MFBM
	$252.90/MFBM	$300.80/MFBM
Sales Return	204.90/MFBM	365.95/MFBM
Gain or (Loss)	($48.00)/MFBM	$ 65.15/MFBM

Table II illustrates the basic problem of decadent cedar-hemlock. At today's prices, profits can be made in cedar but not in hemlock. MOF stumpage appraisal calculations show negative returns of a similar magnitude. There is no economic incentive to harvest decadent hemlock.

When the hemlock production model is compared with a spruce-pine-fir (SPF) model the problem is evident again (Table III).

TABLE III. SAWMILL PRODUCTION MODEL - DECADENT HEMLOCK AND SPF.

	HEMLOCK	SPF
Production (FBM/shift)	125 000	160 000
Lumber Recovery Factor (FBM/m^3)	194	222
Consumption (m^3/shift)	644	721
Manufacturing Cost ($/MFBM)		
Sawing	$45.00	$34.50
Log Yard	9.00	9.00
Kiln	8.50	8.50
Planer	18.00	15.00
Yard/Transportation	9.50	9.50
Shipping	4.00	4.00
Shop	3.00	3.00
Indirect and Administrative	9.00	9.00
	$106.00	$92.50

PRODUCTION OUTTURN

GRADES	(%) HEMLOCK	SPF
#1 & 2	50	85
#3	35	12
#4	15	3

LUMBER SIZES	(%) HEMLOCK	SPF
2 x 4	35	40
2 x 6	35	40
2 x 8	10	15
2 x 10	20	5

	Hemlock	SPF
Chip Recovery (BDU/m^3)	0.13	0.15

LUMBER PRICES ($ Cdn)

HEMLOCK

SIZES	GRADE #1&2	#3	#4
2 x 4	$225	$185	$85
2 x 6	225	155	85
2 x 8	225	155	85
2 x 10	260	150	85

SPF

SIZES	GRADE #1&2	#3	#4
2 x 4	$225	$185	$85
2 x 6	225	155	85
2 x 8	225	155	85
2 x 10	260	150	85

SALES RETURN

HEMLOCK				SPF			
SIZES	%	$/MFBM	RETURN	SIZES	%	$/MFBM	RETURN
2 x 4	35	$190.00	$66.50	2 x 4	40	$216.00	$86.40
2 x 6	35	179.50	62.85	2 x 6	40	212.50	85.00
2 x 8	10	179.50	18.00	2 x 8	15	212.50	31.90
2 x 10	20	195.25	39.05	2 x 10	5	241.50	12.10
Chips	-	-	18.50	Chips	-	-	21.35
		TOTAL	$204.90			TOTAL	$236.75

NET PROFIT ($/MFBM)

	HEMLOCK	SPF
Logging Cost	$146.90	$103.60*
Sawmill Cost	106.00	92.50
	$252.90	$196.10
Sales Return	204.90	236.75
Gain or (Loss)	($ 48.00)	$ 40.65

* At a logging cost to the millyard of $23.00/m^3.

Again, at today's prices a profit can be made on SPF but not on hemlock. Harvesting and processing hemlock is not economical.

C. Milling Conclusions

The average return on hemlock will have to increase to over $250/MFBM before sawmills can break even when processing better-quality, decadent hemlock. A combination of lower production rates, sales prices, lumber recovery and lumber grades and higher logging costs make hemlock economically unattractive relative to cedar and SPF lumber.

The main markets for the products of decadent stands (chips, pulp logs and hog fuel) are non-existent and not likely to improve for at least 10 years.

The MOF log scaling rules are oriented towards chip recovery rather than lumber recovery. Thus, the volumes and prices charged to the sawmills do not accurately reflect the amount and grade of lumber that will be recovered. This acts as a disincentive to harvesting stands with a significant pulp log content.

The pulp chips presently produced from decadent cedar and hemlock logs are of poor quality because of rot content and size distribution. They will have to be upgraded for the pulp mills to accept them.

III. HOG FUEL AND ENERGY

As world oil prices increased in the late 1970's, many countries placed emphasis on using wood as a source of energy. Pulp mills installed efficient, cogeneration boilers which used gas, oil and hog fuel, and sawmills utilized more wood waste for energy. Most forest products companies stressed energy self-sufficiency to their mill managers. Research proceeded on developing cost-effective systems for harvesting, transporting, processing and converting biomass into energy or chemicals. However, in B.C. this greater emphasis on wood as an energy source was limited. The main reasons were:

1. An ample supply of relatively inexpensive electricity and natural gas is available.

2. When the surplus amounts of electricity normally associated with sawmill cogeneration plants have to be sold to B.C. Hydro, the plants either yield an unattractive rate of return or involve operating constraints that are unacceptable.

Most wood-based energy systems in B.C. have been installed where the mill itself consumes all the energy produced or where natural gas or hydroelectric power are not available.

Recently, some of the American thermal plants built in the 1970's to overcome oil shortages have experienced surplus hog fuel supplies and are cancelling supply contracts. In B.C. one of the cooperators in this study, Western Energy, dismantled and sold its wood pellet plant because of lack of demand. The plant was designed to dry and pelletize hog fuel.

The Lumby mills have inexpensive supplies of natural gas and hydroelectric power and they don't use waste wood as an energy source. At present, none of them have hog mills and all burn their waste in beehive burners.

IV. TIMBER SUPPLY AND DEMAND

The four Lumby Mills obtain most of their logs from the Okanagan TSA. The Ministry of Forests and the sawmill operators all recognize that there are deficits in timber supply in the Okanagan TSA. Unless there is more planting of new trees, more spacing of overstocked stands or more harvesting and planting in the decadent stands, sawmills will close or have to relocate.*

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* An Analysis of Forest Management Options For the Okanagan Timber Supply Area, Kamloops Forest Region - British Columbia Ministry of Forests. Shuswap Okanagan Forest Association.

The Spallumcheen PSYU was used in this study to emphasize the timber supply problems characteristic of sawmill economies with decadent cedar-hemlock stands. The Okanagan TSA was completely analyzed in 1980*. It was hoped the study of a smaller area would focus more sharply on the supply problems.

A. Timber Supply

1. Net Mature Long-term Volume

The MOF inventory records indicate there is a long-term net supply of 29 000 000 m^3 of mature timber in the Spallumcheen PSYU. Table IV summarizes this information and Appendix V gives more detail. Cedar and hemlock account for 26.4% of the total and no predominant timber type exists.

TABLE IV. SPECIES DISTRIBUTION OF SPALLUMCHEEN PSYU - NET MATURE VOLUME AFTER DEDUCTIONS.

SPECIES	VOLUME AFTER DEDUCTIONS (m^3)	%
Pl	3 268 499	11.2
S	6 463 703	22.2
B	5 275 009	18.1
H	3 194 068	11.0
F	3 923 307	13.5
C	4 484 050	15.4
Py	50 132	0.2
Pw	491 538	1.7
L	1 923 217	6.6
TOTAL	29 073 523	100.0

2. Net Mature Short-term Volume

The MOF estimates a net volume of timber available in the short-term (20 years) that takes into account harvesting pattern restrictions (patch logging) and accessibility. The estimate for the Spallumcheen PSYU is given in Table V with more detail in Appendix VI.

*An Analysis of Forest Management Options

TABLE V. SUMMARY OF SHORT-TERM (20 YEAR) VOLUME CALCULATION.

Total Area (ha)	110 136
Area Alienations (ha)	1 080
Area After All Deductions (ha)	109 055
Net Long-term Volume After All Deductions (m^3)	29 073 545
Volume After Harvesting Pattern Allowances (m^3)	10 757 213
Accessibility Deduction	4%
Short-term (20 Year) Net Volume (m^3)	10 356 749

The short-term supply of mature cedar and hemlock was estimated at 1 587 000 m^3 of cedar and 1 136 000 m^3 of hemlock (Appendix VII). On an annual harvesting basis this converts to 136 100 m^3 per year for 20 years.

3. Location of Mature Volumes

The regions and compartments were plotted on a map of the Spallumcheen PSYU (Figure 1). Those areas with a significant proportion of mature cedar-hemlock, relative to total stand volumes, are shaded darker in the figure.

As can be seen in Figure 1, the cedar-hemlock stands are located primarily east and north of Sugar Lake. These stands are further from the Lumby sawmills than other coniferous species in the PSYU. Higher transportation costs are one of the reasons these stands have not been harvested earlier.

4. Overmature Cedar-Hemlock Volumes

The MOF included overmature cedar-hemlock when calculating the short-term and long-term net volumes of timber available for the Spallumcheen. However, the volume of overmature cedar-hemlock included in these calculations is not easily determined or available. Consequently, an estimate had to be made and two different approaches were used to arrive at an average value (Appendix VIII). From the results of the two approaches it is estimated that the Spallumcheen PSYU has 5.9 million m^3 of decadent cedar-hemlock. The volume suitable for sawlogs would be considerably less but the entire volume must be logged to clear the sites for planting a new crop. The stands with a significant decadent cedar-hemlock component occupy the same areas as the mature stands shown in Figure 1.

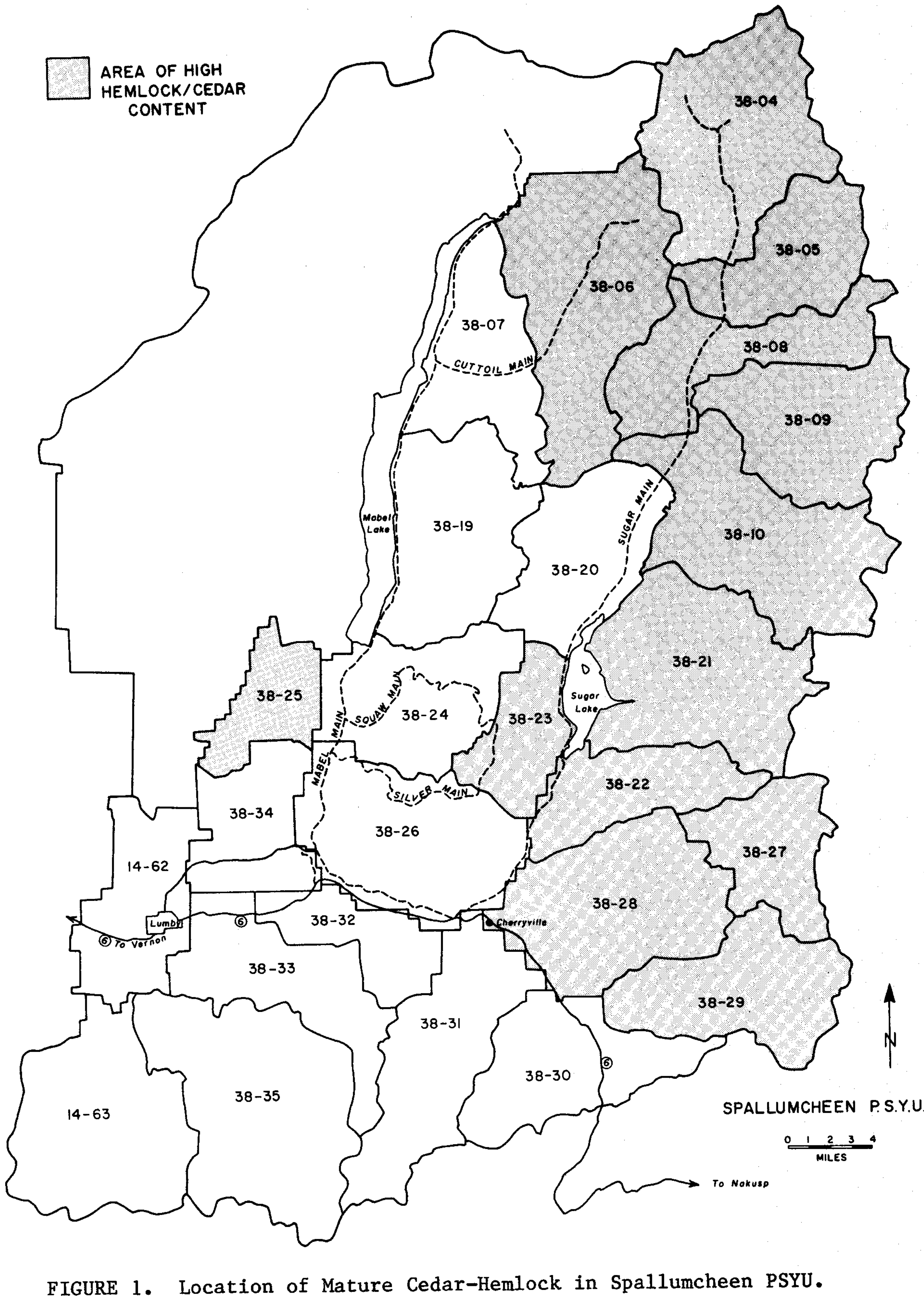

FIGURE 1. Location of Mature Cedar-Hemlock in Spallumcheen PSYU.

5. Comments on Lumby Area Timber Supply

Comments made by MOF officials and the timber operators assist in the interpretation of the foregoing inventory information.

(a) While there are pure stands of overmature cedar-hemlock, the majority of the decadent timber is dispersed throughout the stands. This makes it necessary for intensive quality control when logging.

(b) Although decadent hemlock has little or no market value, it is charged against the mill's quota when it is harvested. This acts as a disincentive to harvest overmature hemlock stands.

(c) The inventory volumes are inaccurate because the volume and decay factors allowed in the MOF inventory cruising manual are not realistic for overmature stands. Both species and volumes recovered vary widely from operational cruise information. This adds to the difficulty of selecting logging areas, planning logging and forecasting costs and volumes.

(d) The ratio of other species and second growth hemlock to overmature hemlock determines profitability rather than total stand volumes.

(e) Timber operators stress that decadent hemlock causes the problem rather than decadent cedar. Careful sawmilling and recovery of secondary products can make utilization of shell cedar economical but little can be done to produce a valuable product from decadent hemlock.

(f) The present MOF utilization standards and scaling rules do not realistically recognize the difference between sawlogs and pulp logs and the quality of the end products they produce.

B. Timber Demands

Each of the four major sawmills (Crown Forest Industries Ltd., Lavington Planer Mills Ltd., Riverside Forest Products Ltd. and Weyerhaeuser Canada Ltd.) can produce in the range of 100 000 - 150 000 board feet of lumber per shift. On an annual basis, this converts to a total requirement of 1 200 000 m^3 for a normal double shift operation.

The four major mills have been harvesting a combined total of 135 000 - 140 000 m^3 per year of mature cedar-hemlock. However, they have not been harvesting decadent cedar-hemlock in any significant amount.

C. Timber Supply and Demand

1. Long-term

A serious deficit exists between supply and mill requirements when the sawmills operate on a double shift basis (Table VI). At present, the deficit is offset by purchasing private timber, harvesting from company holdings and obtaining logs from areas outside the Spallumcheen PSYU. Since other areas of the Okanagan TSA are overcommitted and the Lumby area private holdings have an estimated 10-year life, this is a short-term solution to a long-term problem.

TABLE VI. NET LONG-TERM SUPPLY VERSUS DEMAND.

Net Long-term Mature Volume (m^3)	29 074 000
Double Shift Cutting Capacity (m^3/year)	1 200 000
Volume/Double Shift Capacity (years)	24

2. Short-term (20 years)

The short-term timber supply takes into account cutting patterns, temporary timber reserves and accessibility. Table VII shows the balance between the short-term supply of 10 356 000 m^3 and the demands. Again, there are serious deficits.

TABLE VII. NET SHORT-TERM SUPPLY VERSUS DEMAND.

Net Short-term (20 years) Mature Volume (m^3)	10 356 000
Double Shift Cutting Capacity (m^3/year)	1 200 000
Volume/Double Shift Capacity (years)	9

3. Supply and Demand Conclusions

There is a supply deficit both in the short- and long-term in the Spallumcheen PSYU with the short-term deficit more serious. The sawmills are cutting mature cedar-hemlock in balance with short-term supplies but the overmature cedar-hemlock, which has an estimated net volume of 5 900 000 m^3, is not being cut in any significant amount.

There is an opportunity to offset timber supply deficits by logging more of the overmature cedar-hemlock stands. The overmature stands with their negative growth factors would be put back into production and positive increment would be added to the Spallumcheen PSYU and offset some of the future supply problems. For example, one forester estimated that harvesting and rehabilitating only 700 hectares of the overmature stands would add approximately 2000 m^3 of annual increment. There are over 21 000 hectares of overmature cedar-hemlock stands in the Spallumcheen PSYU.

With modifications to their chipping and chip handling facilities, three of the four Lumby mills can process decadent cedar-hemlock. However, the fourth sawmill would require major modifications because it is a stud and veneer mill. None of the mills could survive on a steady diet of decadent hemlock.

Although decadent hemlock has little or no market value, it is charged against the mill's quota when harvested. This acts as a disincentive to harvest stands with an overmature hemlock component.

V. PROPOSED CHIPPING PLANT

Previous studies on low quality fibre have been conducted by FERIC and ENFOR in British Columbia using the Nicholson biomass shear, waste wood drum debarkers, debris separators and waste wood hog mills and chippers. These studies have shown that it is essential to recover as much of the higher value products as possible from each piece of wood in order to make the system economically viable.

A. Economics of a Chip Plant

In this study we examined the economics of constructing a cooperatively supported log merchandising and chipping plant. The low quality logs would be trucked to a central location where they would be bucked and sorted. The upgraded sawlogs would be sold to the sawmill best able to utilize them. The lower grade logs would be chipped. The estimated capital and operating costs for the chipping option are shown in Appendix IX. This proposed plant would require pulp chip prices of about $95.00 per BDU FOB Lumby to be economically viable. As the current price for chips FOB Lumby is $25.00 per BDU this potential solution was not pursued further.

B. Conclusions on Chip Plant

Until the chip demand increases there is no reason to consider the testing of a shear, drum debarker or other machines that produce pulp chips as originally proposed by FERIC to the Science Council, nor to pursue the suggestion of a merchandising-chipping plant. However, research work should be started on examining the feasibility of alternatives to the pulp mill as a consumer of lower grade fibre (OSB, MDF, and particle board plants) and on the methods of upgrading the quality of fibre produced from low grade cedar-hemlock logs.

VI. RECOMMENDATIONS

1. Decadent cedar-hemlock presents a many-faceted, difficult problem when considering methods to increase its utilization. Consequently, a relatively sophisticated, graduated utilization policy is needed. It should reflect the variation in economic opportunity offered by the variety of terrain and wide range of log quality and stand composition of the overmature cedar-hemlock types. This system would range from declaring one to all species in a stand off-quota. Provision should also be made for rehabilitation of the site by the licensee whereby any log values recovered would help offset rehabilitation costs. A more simplistic recommendation of declaring all decadent cedar-hemlock stands off-quota was considered but was discarded because it did not address the entire problem.

2. Research should be undertaken to determine the costs and productivity of applying land clearing techniques to the poorer decadent stands. Ground skidding systems, although efficient, are not cost effective in decadent stands.

3. Encourage continuation of research by the Pulp and Paper Research Institute of Canada to develop equipment and processes to reduce the rot content and increase the quality and value of chips produced from decadent stands.

4. The MOF and industry should clearly define what constitutes a sawlog and a pulplog in a sawmill economy and change the scaling rules accordingly. Present definitions are a disincentive to harvesting decadent stands.

5. The Lumby area has a timber shortage and a chip surplus. Therefore, the government should encourage utilization proposals that use more low quality fibre and discourage proposals that use more timber quality fibre.

6. Grant long-term export permits for additional chips and pulp logs produced from decadent stands.

7. Modify the logging utilization standards, the timber cruise procedures and the timber valuation procedures to recognize the special problems associated with the decadent cedar-hemlock stands. This could include appraisal for the stand as a whole, or lump sum bids for stands.

8. Investigate the feasibility of panel board processes, such as OSB, MDF and particle board, that would reduce the current surplus of pulp chips and increase the viability of logging the decadent stands.

The action required to make these recommended changes must come from the Ministry of Forests. However, both the problem and the solutions seriously affect not only the government, but also industry and the community and therefore full consultation and cooperation is desirable before changes are made.

Unfortunately, this report does not offer any easy solutions to the problem of utilizing the decadent cedar-hemlock stands of the Interior. It is hoped that this report will show the importance of the problem and will clarify the options that are available for its solution. It should be noted that several of the recommendations are similar to those of the Sloan Commission of 1945.

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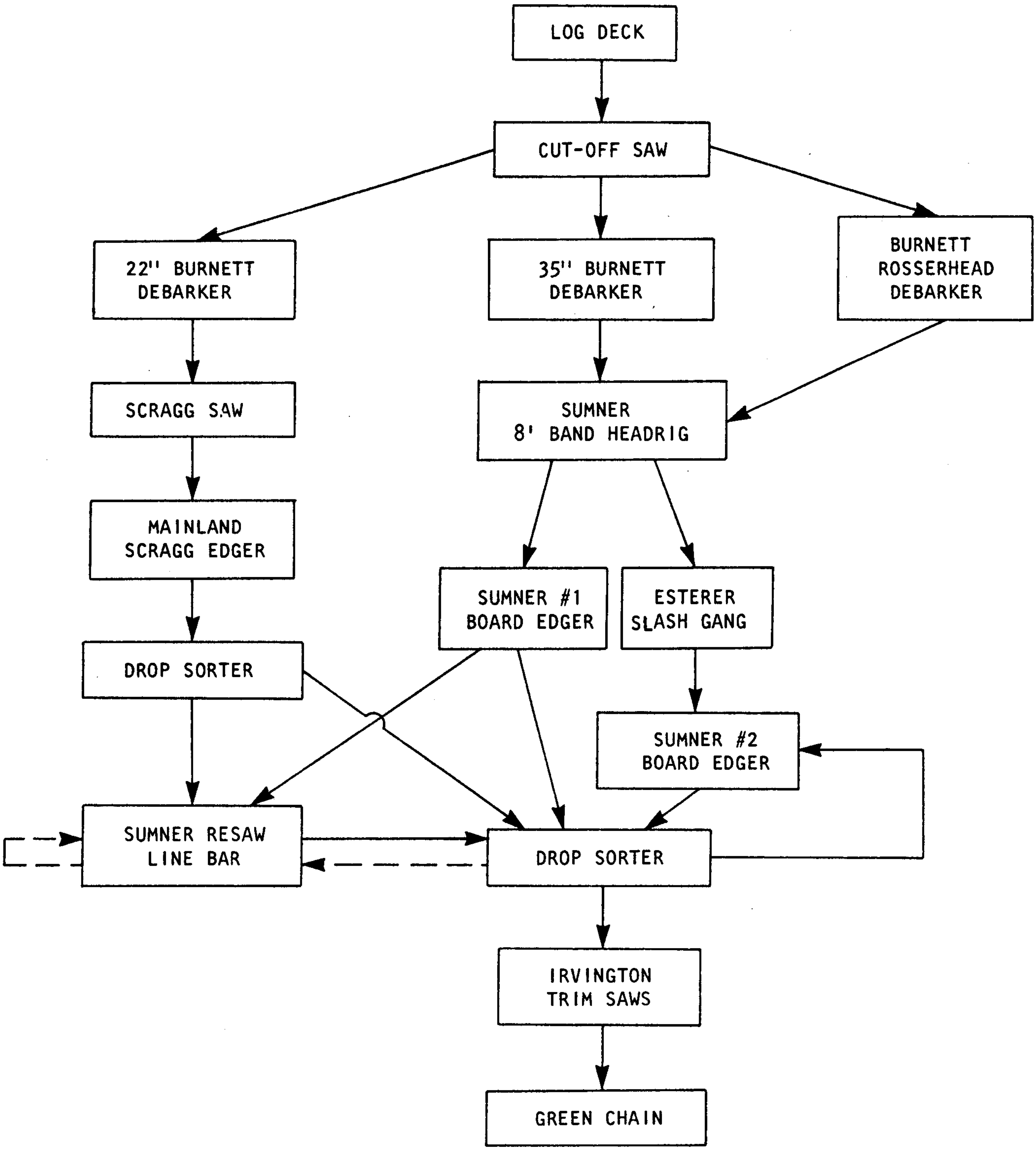
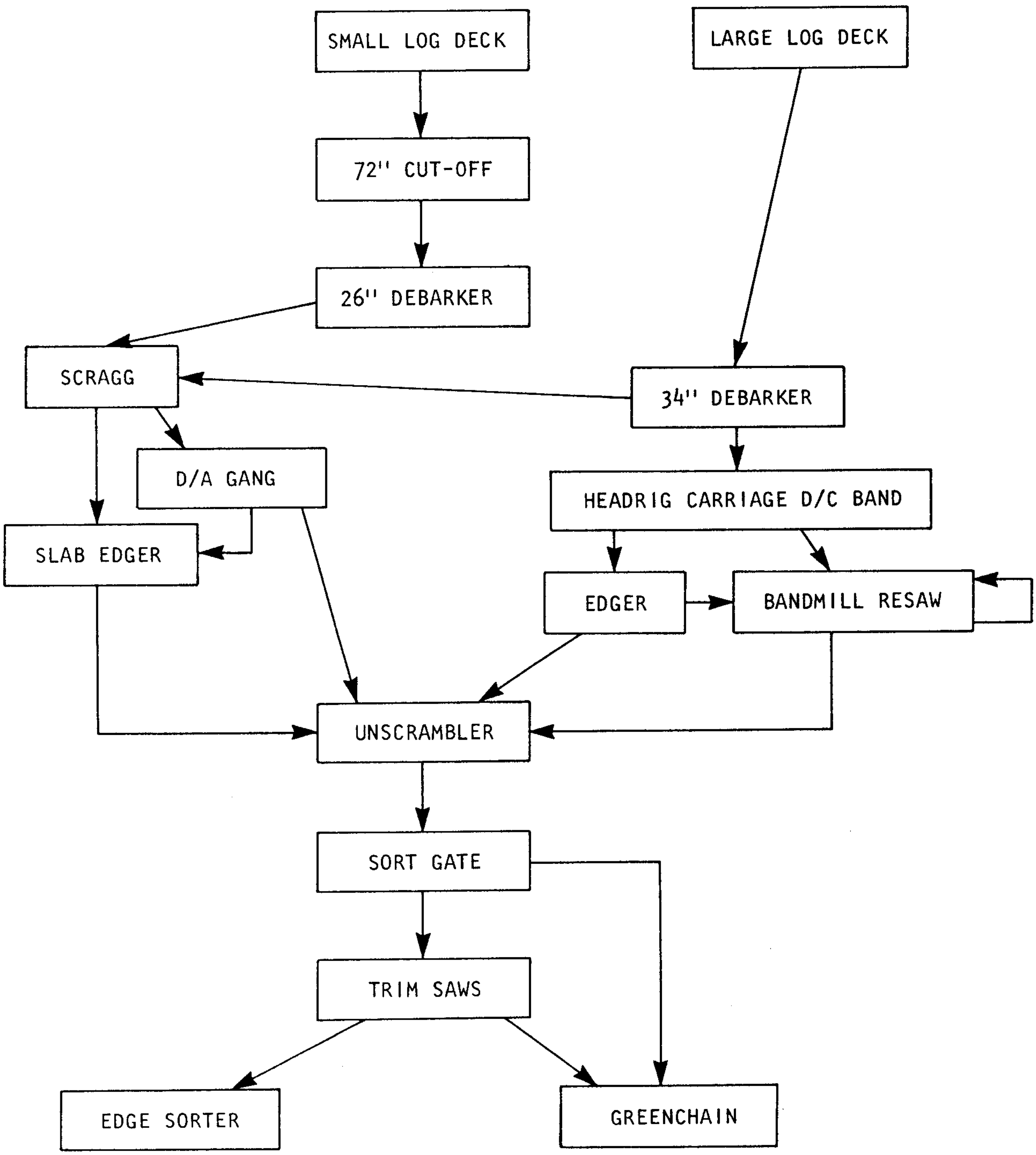
APPENDIX I

CROWN FOREST INDUSTRIES LTD.



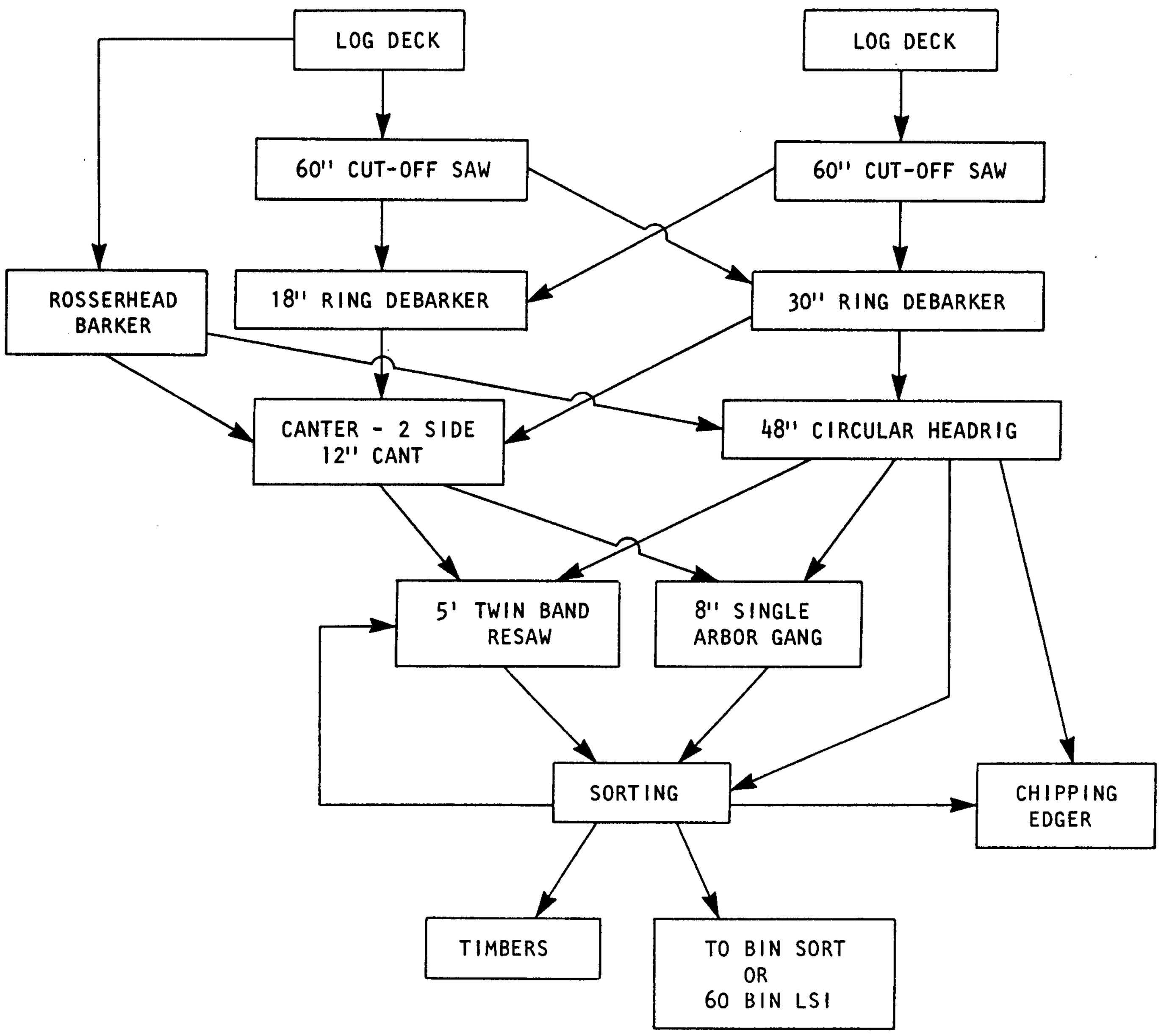
APPENDIX II

WEYERHAEUSER CANADA LTD.



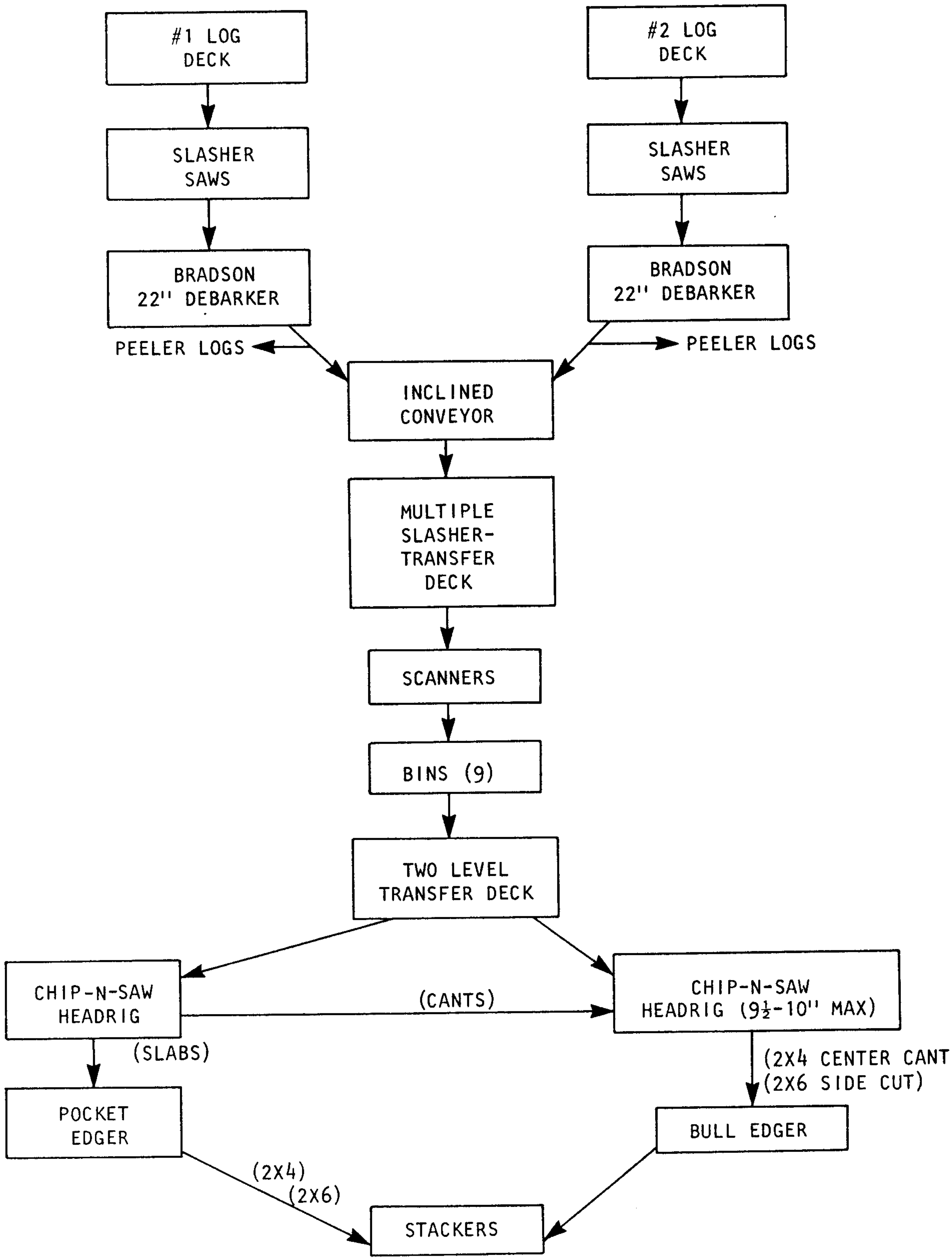
APPENDIX III

LAVINGTON PLANER MILLS LTD.



APPENDIX IV

RIVERSIDE FOREST PRODUCTS LTD.



APPENDIX V

NET VOLUME* OF TIMBER BY SPECIES IN SPALLUMCHEEN PSYU (OSB5)

REGION-COMPARTMENT	PL	S	B	H	F	C	PY	PW	L	TOTAL
14062	63 802	9 571	3 190	3 190	133 984	31 901	3 190	3 190	66 992	319 010
14063	661 140	556 749	313 171	17 398	121 789	34 797	-	-	34 797	1 739 841
38004	-	139 726	124 201	87 975	15 525	134 551	-	10 350	5 175	517 503
38005	7 429	111 438	66 863	193 159	66 863	260 021	-	29 716	7 429	742 918
38006	16 491	461 752	461 752	313 332	98 947	247 367	-	32 982	16 491	1 649 114
38007	66 279	248 547	231 977	248 547	414 245	198 838	-	33 141	215 407	1 656 981
38008	-	464 620	252 222	252 222	66 374	252 222	-	26 550	13 275	1 327 485
38009	9 556	238 911	105 121	219 798	47 782	315 364	-	19 113	-	955 645
38010	19 619	264 863	147 146	166 766	49 049	294 292	-	29 429	9 810	980 974
38019	187 013	748 049	480 889	133 580	534 321	240 444	-	26 716	320 593	2 671 605
38020	11 370	477 538	329 729	56 850	102 330	113 700	-	34 109	11 370	1 136 996
38021	19 841	198 413	198 413	158 731	109 128	267 859	-	19 841	19 841	992 067
38022	46 096	147 506	193 602	175 164	101 411	221 260	-	18 438	18 438	921 915
38023	6 802	68 016	74 818	197 247	88 421	183 643	-	13 603	47 611	680 161
38024	31 049	186 295	155 245	113 847	248 393	124 197	-	31 049	144 896	1 034 971
38025	29 912	39 882	14 956	69 794	104 691	159 529	-	9 970	69 794	498 528
38026	99 464	223 793	161 628	198 927	261 092	136 762	12 433	24 866	124 330	1 243 295
38027	-	180 460	210 536	200 511	40 102	330 843	-	20 051	20 051	1 002 554
38028	91 275	182 550	208 628	195 589	260 786	260 786	13 039	39 118	52 157	1 303 928
38029	69 089	230 295	195 751	126 662	80 603	403 017	-	23 029	23 029	1 151 475
38030	464 260	183 260	146 608	24 435	268 782	36 652	-	12 217	85 522	1 221 736
38031	635 668	459 094	317 834	-	105 945	52 972	17 637	17 657	158 917	1 765 724
38032	65 165	7 667	-	3 833	180 163	23 000	3 833	3 833	95 832	383 326
38033	329 394	109 798	109 798	9 150	182 997	18 300	-	9 150	146 396	914 983
38034	30 781	6 840	3 420	27 361	143 645	64 982	-	3 420	61 562	342 011
38035	307 004	518 070	767 511	-	95 939	76 751	-	-	153 502	1 918 777
TOTAL	3 268 499	6 463 703	5 275 009	3 194 068	3 923 307	4 484 050	50 132	491 538	1 923 217	29 073 523

SPECIES	VOLUME (m^3)	%
PL	3 268 499	11.2
S	6 463 703	22.2
B	5 275 009	18.1
H	3 194 068	11.0
F	3 923 307	13.5
C	4 484 050	15.4
Py	50 132	0.2
Pw	491 538	1.7
L	1 923 217	6.6
TOTAL	29 073 523	100.0

C, H = 26.4%

*Excludes All O.T.T., TFL & Private Wood.
*Net Volume = Gross volume adjusted to reflect immature, deciduous, overmature, problem types.

APPENDIX VI

MATURE VOLUME AFTER DEDUCTIONS FOR ALIENATIONS, HARVESTING PATTERN AND ACCESSIBILITY

REGION COMPART-MENT	TOTAL AREA (ha)	ALIEN-ATION (ha)	AREA AFTER ALL DEDUCTIONS (ha)	VOLUME AFTER ALL DEDUCTIONS (m^3)	VOL. AFTER HARVESTING PATTERN (m^3)	ACCESS-IBILITY (%)	VOLUME AFTER ACCESS-IBILITY
14062	1 015	10	1 005	319 010	118 034	99	116 853
14063	6 248	61	6 186	1 739 841	643 741	98	630 866
38004	2 327	23	2 304	517 503	191 426	99	189 561
38005	2 866	28	2 838	742 918	274 880	98	269 382
38006	7 598	74	7 524	1 649 114	610 172	95	579 664
38007	6 008	59	5 950	1 656 981	613 083	96	588 560
38008	4 131	40	4 090	1 327 485	491 169	96	471 523
38009	3 450	34	3 416	955 645	353 589	85	300 550
38010	3 535	35	3 500	980 974	362 960	95	344 812
38019	9 655	94	9 560	2 671 605	988 494	97	958 839
38020	4 587	45	4 542	1 136 996	420 689	95	399 654
38021	3 919	38	3 881	992 067	367 065	90	330 358
38022	4 000	39	3 961	921 915	341 109	100	341 109
38023	2 647	26	2 622	680 161	251 660	100	251 660
38024	3 499	34	3 465	1 034 971	382 939	99	379 110
38025	2 075	20	2 055	498 528	184 455	100	184 455
38026	4 649	46	4 603	1 243 295	460 019	100	460 019
38027	3 898	38	3 859	1 002 554	370 945	99	367 236
38028	4 407	43	4 363	1 303 928	482 453	99	477 629
38029	4 813	47	4 766	1 151 477	426 046	90	383 442
38030	4 006	39	3 966	1 221 736	452 042	95	429 440
38031	6 364	62	6 302	1 765 744	653 325	95	620 659
38032	1 393	14	1 380	383 326	141 831	100	141 831
38033	3 246	32	3 214	914 983	338 544	100	338 544
38034	1 301	13	1 289	342 011	126 544	100	126 544
38035	8 500	83	8 416	1 918 777	709 947	95	674 450
TOTAL	110 136	1 077	109 057	29 073 545	10 757 161	96	10 356 749

APPENDIX VII

VOLUMES OF CEDAR AND HEMLOCK AVAILABLE IN SPALLUMCHEEN PSYU (OSB5)

REGION COMPARTMENT	HEMLOCK VOLUME AFTER DEDUCTIONS	HEMLOCK VOLUME AFTER H. PAT.	HEMLOCK VOLUME AFTER ACCESSIBILITY	CEDAR VOLUME AFTER DEDUCTIONS	CEDAR VOLUME AFTER H. PAT.	CEDAR VOLUME AFTER ACCESSIBILITY
14062	3 190	1 180	1 168	31 901	11 803	11 685
14063	17 398	6 437	6 308	34 797	12 875	12 618
38004	87 975	32 551	32 225	134 551	49 784	49 286
38005	193 159	71 469	70 040	260 021	96 208	94 284
38006	313 332	115 933	110 136	247 367	91 526	86 950
38007	248 547	91 962	88 284	198 838	73 570	70 627
38008	252 222	93 322	89 589	252 222	93 322	89 589
38009	219 798	81 325	69 126	315 364	116 685	99 182
38010	166 766	61 703	58 618	294 292	108 888	103 444
38019	133 580	49 425	47 942	240 444	88 964	86 295
38020	56 850	21 035	19 982	113 700	42 069	39 966
38021	158 731	58 730	52 857	267 859	99 108	89 197
38022	175 164	64 811	64 811	221 260	81 866	81 866
38023	197 247	72 981	72 981	183 643	67 948	67 948
38024	113 847	42 123	41 702	124 197	45 953	45 493
38025	69 794	25 824	25 824	159 529	59 026	59 026
38026	198 927	73 603	73 603	136 762	50 602	50 602
38027	200 511	74 189	73 447	330 843	122 412	121 188
38028	195 589	72 368	71 644	260 786	96 491	95 526
38029	126 662	46 865	42 179	403 017	149 116	134 204
38030	24 435	9 041	8 589	36 652	13 561	12 883
38031	-	-	-	52 972	19 600	18 620
38032	3 833	1 418	1 418	23 000	8 510	8 510
38033	9 150	3 386	3 386	18 300	6 771	6 771
38034	27 361	10 124	10 124	64 982	24 043	24 043
38035	-	-	-	76 751	28 398	26 978
TOTAL	3 194 068 (1)	1 181 805 (3)	1 135 983 (5)	4 484 050 (2)	1 659 099 (4)	1 586 781 (6)

(7) Total All Volumes After Deductions 29 073 545 m^3
(8) Total All Volumes After H. Pat. 10 757 211 m^3
(9) Total All Volumes After Accessibility 10 356 750 m^3

% Long-term Hemlock & Cedar $\frac{(1) + (2)}{(7)} = \frac{3\ 194\ 068 + 4\ 484\ 050}{29\ 073\ 545} = 26.4\%$

% Hemlock & Cedar After H.P. Deduction $\frac{(3) + (4)}{(8)} = \frac{1\ 181\ 805 + 1\ 659\ 099}{10\ 757\ 211} = 26.4\%$

% Short-term Hemlock & Cedar $\frac{(5) + (6)}{(9)} = \frac{1\ 135\ 983 + 1\ 586\ 781}{10\ 356\ 750} = 26.3\%$

Short-term Hemlock & Cedar Annual Cut $\frac{1\ 135\ 983 + 1\ 586\ 781}{20} = 136\ 138\ m^3/\text{year}$

$= 48\ 071$ ccf/year

APPENDIX VIII

ESTIMATE OF OVERMATURE CEDAR-HEMLOCK VOLUMES

The first approach calculated the area occupied by stands which were more than 90 percent cedar, hemlock or cedar-hemlock, older than 141 years and taller than 19.4 m. The gross stand densities for these timber types were then multiplied by the areas occupied and a volume was calculated. The gross volume is 9 375 000 m^3 (Table VIII-1). This volume has to be reduced by 42 percent to reflect the differences experienced between inventory cruise volumes and cut volumes. The volume then becomes 5 437 265 m^3.

TABLE VIII-1. ESTIMATE OF NET VOLUME AND AREA OF DECADENT CEDAR AND HEMLOCK IN SPALLUMCHEEN PSYU.

TYPE	LAND CLASS	GROSS AREA (ha)	GROSS VOLUME (m^3)	%
C	Crown	2 608	1 100 576	
	Alienated	144	60 768	
	Total	2 752	1 161 344	12.4
CH	Crown	5 568	2 433 216	
	Alienated	1 553	678 661	
	Total	7 121	3 111 877	33.2
H	Crown	1 112	420 336	
	Alienated	461	174 258	
	Total	1 573	594 594	6.3
HC	Crown	8 336	3 876 240	
	Alienated	1 356	630 540	
	Total	9 692	4 506 780	48.1
	GRAND TOTAL	21 138	9 374 595	100.0
	NET VOLUME = 0.58 x 9 374 595 = 5 437 265 m^3.			

The second approach was to calculate the gross volume of cedar and hemlock species in age classes 190 and 250 years in the MOF's Resource Planning List (Table VIII-2). This approach assumes that any cedar or hemlock older than 190 years will have significant rot. Averaging the results of the two approaches gives an average net volume of 5 900 000 m^3.

TABLE VIII-2. NET VOLUME OF CEDAR & HEMLOCK 190 YEARS AND OLDER IN SPALLUMCHEEN PSYU.

SPECIES	GROSS VOLUME (m^3)		
	190-250 YEARS	250+ YEARS	TOTAL
CEDAR	2 476 613	3 836 529	6 313 142
HEMLOCK	2 197 799	2 462 190	4 659 989
TOTAL	4 674 412	6 298 719	10 973 131
NET VOLUME = 0.58 x 10 973 131 = 6 364 416 m^3.			

APPENDIX IX

MERCHANDISING CHIPPING OPERATION

I. BASIC ASSUMPTIONS AND VOLUMES

Volume of decadent cedar-hemlock	5 900 000 m^3
Annual harvesting rate	500 000 m^3
Sawlog yield (15%)	75 000 m^3
Pulp log yield (45%)	225 000 m^3
Material left in stand (40%)	200 000 m^3
Chips from pulp logs (70%)*	77 000 BDU
Hog fuel from pulp logs (30%)	33 000 BDU

Average log diameter	46 cm
Average log length	13.7 m
Sawlog bucked length	4.9 m

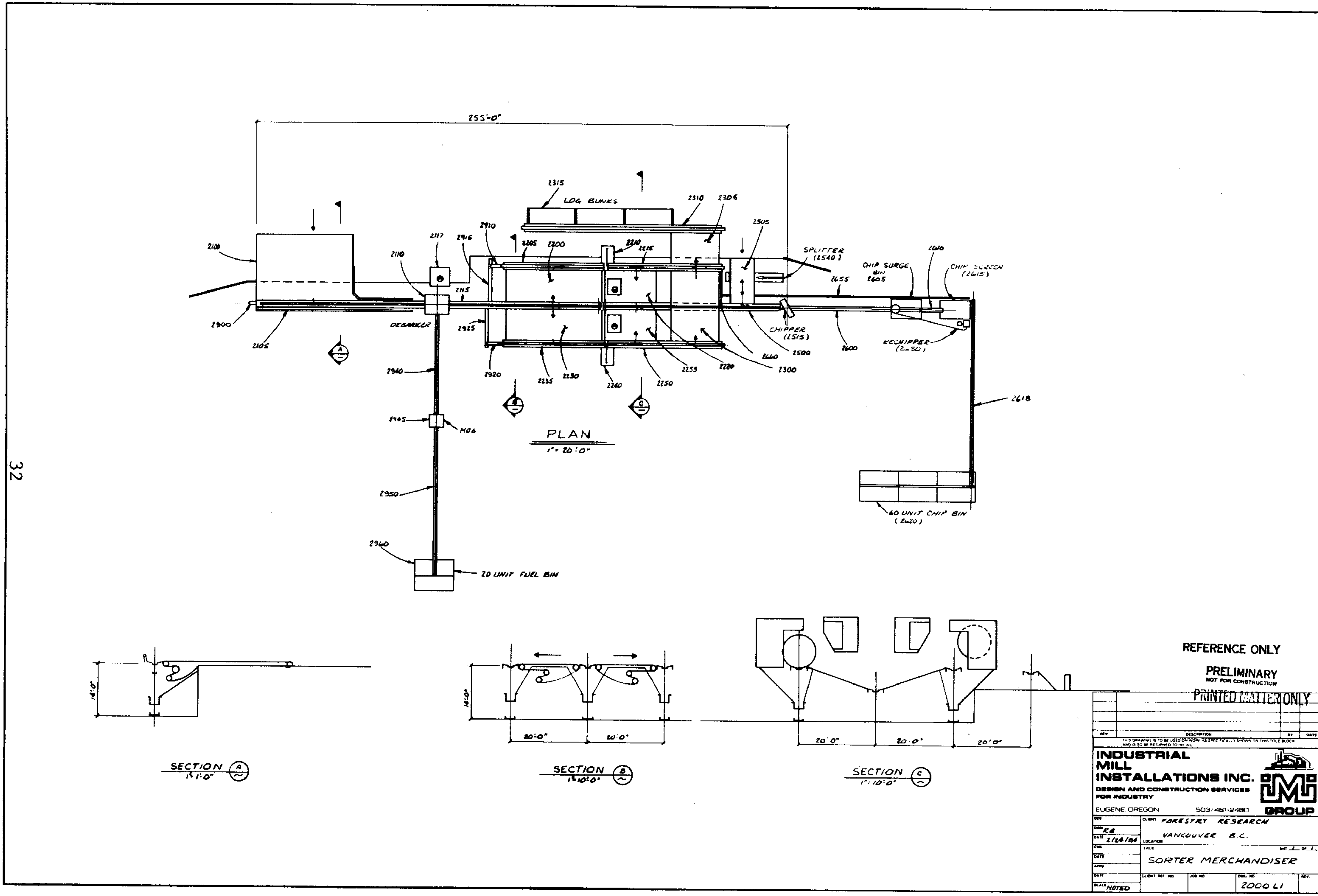
II. ESTIMATED CAPITAL COST - $6 260 000

Industrial Mill Installations put together a preliminary system design (See Figure IX-1) and estimated an installed cost. Carroll Hatch, QED Engineering and Sandwell also offered advice. The installed cost is not of bid quotation quality but rather a reasonable estimate. Similarly, operating costs are an estimate based on the approximate log sizes and volumes available. The merchandising-chipping system includes the following equipment and components:

- 1 x 114 cm diameter ring debarker
- 2 x 274 cm diameter cutoff saws
- 1 log splitter
- 1 x 244 cm diameter whole log chipper
- chip screens
- Hog mill
- 1 x 20 unit fuel bin
- 3 x 20 unit chip bins
- Air compressor
- All motors and drives (1940 kW)
- Merchandiser and sawlog bins
- Foundations and footings
- Walkways, guarding, operator enclosures

Installed cost including engineering:	$4 560 000
Developing a log storage yard and purchasing truck unloading and mobile mill equipment is estimated to cost:	$1 700 000
	$6 260 000

*Based on 2.04 m^3/BDU x 0.70 x 225 000 m^3.



255'-0"
LOG BUNKS
SPLITTER (2540)
CHIP SURGE BIN 2605
CHIP SCREEN (2615)
DEBARKER
CHIPPER (2515)
RECHIPPER (2630)
PLAN
1" = 20'-0"
60 UNIT CHIP BIN (2620)
20 UNIT FUEL BIN
SECTION A
SECTION B
SECTION C
20'-0"
18'-0"
REFERENCE ONLY
PRELIMINARY
NOT FOR CONSTRUCTION
PRINTED MATTER ONLY
INDUSTRIAL MILL INSTALLATIONS INC.
DESIGN AND CONSTRUCTION SERVICES FOR INDUSTRY
EUGENE, OREGON
503/461-2480
IMI GROUP
FORESTRY RESEARCH
VANCOUVER B.C.
SORTER MERCHANDISER
NOTED
2000 LI

Figure IX-1.

A. Annual Capital Cost

1. Depreciation

Merchandising and chipping plant:

Merchandiser - $\frac{\$1\ 710\ 000^*}{20 \text{ years}}$ = \$85 500

Chipping plant - $\frac{\$2\ 850\ 000^*}{20 \text{ years}}$ = \$142 500

Log yard and equipment:

Yard - $\frac{\$500\ 000}{20 \text{ years}}$ = \$25 000

Mobile equipment - $\frac{\$1\ 200\ 000}{10 \text{ years}}$ = \$120 000

2. Insurance

At 1% of average value:

Merchandiser	= \$ 8 55
Chipping plant	= \$ 14 25
Log yard and equipment	= \$ 8 50

B. Annual Interest Costs

Interest costs are calculated at 15% of the average capital investment.

Merchandiser - $\frac{\$1\ 710\ 000}{2} \times \frac{0.15}{20}$ = \$6 400

Chipping plant - $\frac{\$2\ 850\ 000}{2} \times \frac{0.15}{20}$ = \$10 700

Yard - $\frac{\$500\ 000}{2} \times \frac{0.15}{20}$ = \$ 1 875

Mobile equipment - $\frac{\$1\ 200\ 000}{2} \times \frac{0.15}{10}$ = \$ 9 000

*Estimated cost split between merchandiser and chipping plant.

III. ESTIMATED ANNUAL OPERATING COSTS

Repair and maintenance, operating supplies, labour, supervision, fuel, lubricants and electricity. Six operators would be needed for plant and mobile equipment.

Chipping plant	$ 450 000
Merchandising plant	$ 500 000
Log yard	$ 200 000
	$1 150 000

IV. PRODUCT COSTS

A. Sawlog Costs

Costs through the yard and plant are allocated based on volume proportion. Thus, sawlog costs through the yard and merchandiser become:

1. Depreciation

$$\frac{75\ 000}{300\ 000} \times (\$85\ 000 + \$25\ 000 + \$120\ 000) = \$\ 57\ 500$$

2. Insurance

$$\frac{75\ 000}{300\ 000} \times (\$855 + \$850) = \$\ 426$$

3. Interest

$$\frac{75\ 000}{300\ 000} \times (\$6\ 400 + \$9\ 000 + \$1\ 075) = \$4\ 320$$

4. Operating Costs

$$\frac{75\ 000}{300\ 000} \times (\$500\ 000 + \$200\ 000) = \$175\ 000$$

5. Total Plant Costs

$= \$237\ 250/\text{year}$ or $= \$3.16/m^3$

6. Logging Costs

Logging costs (at the average cost used in the study) are $\$28.50/m^3$.

7. Sawlog Costs

$$\begin{array}{r} \$28.50 \\ +\ \ 3.16 \\ \hline \$31.66/m^3 \end{array}$$

B. Chipping Costs

Again, yard and plant costs are allocated on the proportion of the volume of the product. Thus, chip costs become:

1. Depreciation

$$\frac{225\ 000}{300\ 000} \times (\$85\ 500 + \$142\ 500 + \$25\ 000 + \$120\ 000)$$

$$= \$279\ 750$$

2. Insurance

$$\frac{225\ 000}{300\ 000} \times (\$855 + \$1\ 425 + \$850) = \$2\ 347$$

3. Interest

$$\frac{225\ 000}{300\ 000} \times (\$6\ 400 + \$10\ 700 + \$1\ 875 + \$9\ 000) = \$20\ 980$$

4. Operating Costs

$$\frac{225\ 000}{300\ 000} \times (\$450\ 000 + \$500\ 000 + \$200\ 000) = \$862\ 500$$

5. Total Plant Costs

$$= \$\ 1\ 165\ 580/\text{year} \quad \text{or} = \$5.18/m^3$$

6. Logging Costs

Logging costs (at the average cost in the study) are $\$28.50/m^3$.

7. Pulp Log Costs

$$\begin{array}{r} \$28.50 \\ +\ \ 5.18 \\ \hline \$33.68/m^3 \end{array}$$

C. Chip and Hog Fuel Costs and Revenues

1. Costs

The 225 000 m^3 of pulp logs will generate 77 000 BDU of chips and 33 000 BDU of hog fuel. Obviously, the mill cannot hope to recover full logging and mill costs out of hog fuel which has a sales value of \$1 to \$3/tonne. If the traditional hogging costs of \$7-\$9/tonne are used, then the portion of costs the pulp chips have to carry can be determined. The mill will still lose money on hog fuel. The estimated costs of the two products are:

Estimated hogging cost = \$8.00/tonne

$$\text{Tonnes of hog fuel} = 33\ 000 \text{ BDU} \times \frac{2\ 400 \text{ lbs}}{\text{BDU}} \times \frac{\text{tonne}}{2\ 205 \text{ lbs}}$$

$$= 36\ 000 \text{ tonnes}$$

$$\text{Cost of hog fuel} = 36\ 000 \text{ tonnes} \times \$8.00/\text{tonne}$$

$$= \$288\ 000$$

$$\text{Total cost of chipping and hogging} = 225\ 000 \text{ m}^3 \times \$33.68/\text{m}^3$$

$$= \$7\ 578\ 000$$

$$\text{Total cost of chipping} = \$7\ 578\ 000 - \$288\ 000$$

$$= \$7\ 290\ 000$$

$$\text{Cost of chipping/BDU} = \frac{\$7\ 290\ 000}{77\ 000}$$

$$= \$94.68/\text{BDU}$$

2. Revenues

On hog fuel, the plant will lose an average of \$6.00 per tonne as the average selling price FOB the mill is \$2.00 per tonne (if a market existed) and production costs are approximately \$8.00 per tonne.

On chips, the mill will need \$95.00 per BDU to recover costs. However, the Kamloops pulp mill is paying \$25-\$30 per BDU for chips in Lumby. Transportation costs are paid by the pulp mill which adds another \$20-\$25 per BDU for the trip from Lumby to Kamloops. However, the present surplus in the drawing area of the pulp mill (200 km radius) is in excess of 200 000 BDU. This surplus has existed since 1975 when interior chip prices were based on a percentage of kraft pulp prices. If chip prices rose to \$95.00 per BDU, then the sawmills that supply the pulp mill would likely increase their output of chips and compete with the chip plant.

Interior hemlock chips transported to the Coast sell for \$50-\$55 per BDU on the Coast. However, rail transportation and handling adds \$50 per BDU to costs. There is a surplus of cedar chips and thus little demand for interior cedar chips.