TIMBER SUPPLY
INFORMATION PACKAGE

REVELSTOKE COMMUNITY FOREST CORPORATION

TFL 56
MANAGEMENT PLAN #3

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Revised July 10, 2000
Revisions are shaded in grey

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INFORMATION PACKAGE

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INFORMATION PACKAGE
for
Revelstoke Community Forest Corporation
TFL 56
Management Plan #3

1. INTRODUCTION

Revelstoke Community Forest Corporation (RCFC), the holder of TFL 56, is currently producing Management Plan #3. One of the more important functions of the Management Plan process is to set the annual cut levels for the next five-year period. This document – the Timber Supply Analysis Information Package -- will indicate the process, and information to be used, in these cut calculations. Additionally, it will:

- Provide a detailed account of the factors related to timber supply and how these factors will be applied in the timber supply analysis.
- Provide a means for communication between RCFC, Forest Service and BC Environment staff.
- Provide Forest Service staff with the opportunity to review data that will be used in the timber supply analysis.
- Ensure that all relevant information is accounted for in the analysis to a standard acceptable to Forest Service staff.
- Reduce the risk of having an analysis rejected because assumptions were not agreed upon in advance.

RCFC has a challenging TFL to work with. A high proportion of low value wood, high harvesting and management costs, difficult terrain, and an assortment of conflicting resource values combined ensure that without good planning a profitable future and thriving well-managed forest will not be possible. To ensure good planning and a profitable future, RCFC has invested heavily in many advanced planning tools and inventories.

These tools and inventories (discussed in the SMOOP document) have allowed us to begin the data package process with completion of an area-based plan to achieve forest cover objectives. This plan is much like the landscape unit plans discussed in Forest Practices Code documents; however it technically is not a landscape unit plan because it has not been produced via a multi-agency planning team under the auspices of the Forest Service. This plan is simply an RCFC plan to achieve all of the forest cover goals specified for the landscape units within TFL 56. Throughout this document it will be termed the *RCFC 1999 Caribou, Biodiversity and Ungulate Analysis.* It is used as a tool to geographically fix areas to meet biodiversity, caribou and ungulate winter range management goals. This geographic information will be used to formulate the initial "runs" with the spatial model we are using for the timber supply analysis. The spatial analysis will link the annual cut directly to the specific locations on the TFL where the cut is to come from at any point in time.

2. PROCESS

The Management Plan process is long and involved. This current process began in November 1998 and will be completed by May 2001. On a timeline, compilation of this data package is about midway through the process.

Long before we began work on this Management Plan, work was progressing on as yet unofficial higher level plans such as the *Kootenay Boundary Land Use Plan* (KBLUP). The completion of KBLUP led to formulation of a more locally relevant plan entitled *Revelstoke and Area Land Use Planning Final Recommendations* (often deemed the "MAC" plan).

Although this MAC plan is not yet approved as a higher-level plan, we have used the draft recommendations extensively throughout our Management Plan process.

The MAC plan is an extremely influential document for forest management on the TFL 56 land base. It designates zones for special biodiversity, caribou and ungulate winter range management which in turn profoundly influence forest management. To ensure that we are managing these zones correctly, RCFC undertook to do a detailed landscape unit plan over the entire TFL land base. This plan, entitled *RCFC 1999 Caribou, Biodiversity and Ungulate Analysis*, designates special management areas for retention and recruitment of older age classes, and quantifies the age class present and planned structure in each of the management units in the TFL. This plan has a 1:20,000 map component, and a table component.

With completion of the 1999 Caribou, Biodiversity And Ungulate Analysis, many of the deductions to the forested land base that are required for management of other resources, become apparent.

2.1 Growth and Yield

Detailed growth and yield information can be found in section 8 of this report. The general strategy for predicting net stand yields is as follows:

Naturally regenerated stands in TFL 56 are defined for MP#3 as any stand established prior to 1980. Net yields for these stands will be provided by the Variable Density Yield Prediction model (VDYP) [BC MoF, winVDYP v1.1). Like stands are grouped by site index, inventory type group, and age such that a single yield curve can be applied to each group. The VDYP inputs were derived using area-weighted averages from forest cover inventory information (FIP files).

Managed stands in TFL 56 are defined for MP#3 as any stand established on or after 1980. Net yields for these stands will be provided by the Table Interpolation Program for Stand Yields (TIPSY) [BC MoF, TIPSY v2.1e]. Like

stands will be grouped by site index and species groupings such that a single yield curve can be applied to the group. TIPSY inputs were derived using area-weighted averages from forest cover silviculture information and RCFC's current regeneration practices.

2.2 Missing Data

The following information is currently not included in this data package:

- Additional sensitivity analyses or options that may arise during the analysis phase. These will be included in the final timber supply analysis report.

3. TIMBER SUPPLY FORECASTS

3.1 Base Case

The base case has been designed to reflect current practice on TFL 56 and is summarized below:

- New (1999) operability line;
- Approved (1999) inventory database with minor revision for surveyed site indices and NSR areas;
- Timber harvesting land base as defined in section 6;
- Yield curves as defined in section 7 and 8;
- Unsalvaged losses of 1776m^3 /year;
- Integrated resource management guidelines as defined by the MAC strategy dated October 1999 (section 10);
- Partial cutting strategy implemented in:
    - Compartment 280,
    - Compartment 270 over 1000 meters in elevation,
    - Any blocks with >50% high or very high avalanche likelihood following harvesting,
    - Any blocks over 1500 meters in elevation with plantability concerns identified by ESA1's;
- Forested "Mature Forest Retention Areas" identified in RCFC's landscape unit plan will be deemed to meet the criteria necessary for MAC forest cover requirements; and
- Initial harvest level of 100,000 m^3/yr (current AAC).

The base case will utilize the MAC strategy as the last two Forest Development Plans have followed the draft MAC recommendations and thus is considered current practice. The designation of the final MAC strategy as a Higher Level Plan under the Forest Practices Code is currently pending regulatory approval.

3.2 Sensitivity Analyses

Uncertainly around the base case data and assumptions will be investigated using sensitivity analyses. In order to isolate the effects of a given constraint, only one variable will be altered in each analysis. Table 1 indicates the various sensitivity analyses planned. During preparation of the timber supply analysis, additional sensitivity analyses may become required and will be presented in the final timber supply analysis report.

Table 1. Sensitivity Analyses

Issue	Sensitivity Analysis	Magnitude of Change	Expected pressure
Old growth site indexes	Apply OGSI – spruce	OGSI spruce equation	Slight upward
Old growth site indexes	Apply OGSI – all species	As per OGSI equations	Slight upward
Min harvest ages	Adjust min harvest ages	+/- 20 years	Upward/downward
Natural stand volumes	Adjust yield curves	+/- 10%	Upward/downward
Managed stand volumes	Adjust yield curves	+/- 10%	Upward/downward
Provincial biodiversity	Implement 10/45/45 policy in place of MAC biodiversity	Apply weighted averages by landscape unit and BEC variant.	Upward/downward
Aerial Hw Blocks	Smaller operable land base	Remove hemlock blocks (>38% Hw/Hm) with aerial harvest method. (1171 ha)	Downward
Harvest Priorities	Use an oldest first priority instead of closest to the mill.	N/A	None
The accuracy of inventory age classes 8 & 9 are suspect	Use 200 years as the definition of old in NDT 1	Change forest cover "old" requirement to 200.	None or upward
Spatial distribution of harvest	Request a different harvest pattern	Change harvest priorities in model	No change expected
Use of age class 6 & 7 for "old and mature" requirement	Have age class 6 to 9 qualify for "mature and old" requirement	N/A	Upward

3.3 Alternate Harvest Flows Over Time

For any given scenario, there are many potential harvest flows that can occur because of differing short and long-term priorities. In order to demonstrate the short and long term implications of various harvest flows through time, alternative flows will be provided for the base case. Examples of theoretically possible flow regimes are described below:

- **Unconstrained** (harvest everything available in each time period)
- **Base Case** (maintain the current AAC as long as possible while ensuring there is no more than a 10% change in harvest per period and the harvest level does not drop more than 15% below the long term harvest level (LTHL)).

- **No Trough** (Initial harvest level will be set to ensure that there is no more than a 10% change in harvest per period and the harvest level does not drop below **LTHL**.
- **Current AAC with One Drop to LTHL**
- **Max Long Term** (Immediately drop to **LTHL** harvest level)
- **Max Short Term** (Highest starting level allowing no more than **10%** drops per period to **LTHL** harvest level).

The options that will be presented in the final timber supply analysis will depend on the characteristics of the timber harvesting landbase. Flow regimes that demonstrate the full range of possibilities will be included for the base case.

3.4 Other Options

As an alternative to the base case, a proposed management option will be presented that represents RCFC's vision of the most likely outcome for management in the future. This option is simply the base case with an adjustment for old growth site indices (OGSI sensitivity analysis outlined in section 3.2).

Table 2. Options Analyses

Option Title	Issue to be Tested	Proposed Sensitivity Analysis	
		Title	Range to be tested
Proposed Management	Base case + OGSI	OGSI	Apply OSGI equations

4. MODEL

Forest Planning Studio (previously called *Atlas)* will be used to provide timber supply forecasts. It is a spatially explicit, forest-level simulation model that was developed by Dr. John Nelson at the University of British Columbia. Forest disturbances (e.g. harvesting, succession) and growth are applied to individual polygons and polygons are grouped to form larger areas over which constraints are applied. Overlapping constraints are easily applied by allowing polygons to belong to several groups.

Forest cover polygons and RCFC's landscape level plan (Total Chance Plan harvest blocks and Mature Forest Retention Areas) form the basic building blocks for the model's polygons. The line work for these polygons was merged along with any management zone line work (e.g. Landscape Units, Caribou Habitat, Biodiversity Zone, Ungulates Range). This results in many small polygons but each one falls entirely within a single forest cover polygon, harvest block, and combination of management zones – making the evaluation of management zone constraints straight forward.

Harvesting will be implemented by grouping polygons to form blocks similar to RCFC's landscape unit plan / total chance plan. This will ensure that proposed harvest units are as realistic as possible. Patch size distribution goals will be addressed through a priority zoning system that is described in Section 10.3.4.

Modeling will be completed by Cameron Brown R.P.F. of Silvatech Consulting Limited.

5. CURRENT FOREST COVER INVENTORY

The current forest cover inventory was thoroughly updated in 1999 (current to July 24 1998) using 1:20,000 digital orthophotos. This digital data was submitted to the Ministry of Forests Resources Inventory Branch in mid-1999 and has been approved as of January 2000. The use of digital orthophotos made possible a thorough correction of old errors in block and road locations. Time zero for the timber supply analysis will be January 1, 1999 as the openings from July 24, 1998 to Jan 1999 have been included in the model database.

The inventory, prior to the update, was the subject of a Resources Inventory Branch audit in February 1999. The purpose of the audit was to assess the overall accuracy of the current inventory. Three components were tested, mature volumes (stands over 60 years), immature site index (free growing to 60 years), and non-forested classification.

Audit results for the mature component found "that the inventory is statistically acceptable"[1]. **Inventory volumes in mature stands were found to be close to audited volumes. Subsequent analysis of post-stratified data also shows a similar level of acceptability in the operable forested area.**

Audit results for the immature site index suggest that the site index may not be accurate. Again this confirms RCFC observations. We have found that the site index estimates have been too conservative. We have begun a long-term project of obtaining site index estimates from on-site measurements (Growth intercept method during free-growing surveys). These results are being input into the forest inventory database as the surveys are completed. Currently, only a small proportion of the stands have been converted to the new site indices. Table 3 indicates the openings for which these corrections have been applied. Timber supply projections using the old site indices will result in a conservative long-term harvest projection. With the age class structure in the TFL being heavily-weighted towards mature and older stands – and harvest over the next several decades coming from these stands – the short and medium term harvest projections will not be affected by site indices on younger stands.

[1] Page 4, TFL 56 Inventory Audit (Appendix 1)

Table 3. Site Index Modifications

Opening		Survey	Hectares	Growth intercept.		Previous
C.P.-Block	Strata	Year		site index	Species	FIP SI[2]
688-4	A	1998	34.5	23	Fd	17
688-4	B	1998	10.1	25	Fd	17
690-17	A	1999	32.0	30	Fd	17
690-2	A	1998	50.4	27	Fd	17
690-300	A	1999	18.3	21	Cw	10
690-9	A	1999	22.3	21	Sx	15
692-103	A	1998	58.1	25	Fd	10
692-107	A	1999	3.6	26	Fd	--
698-6	A	1999	14.1	24	Sx	15
698-6	B	1999	4.5	28	Sx	15
700-4	A	1999	8.7	27	Sx	10
700-5	A	1999	13.8	25	Sx	15
724-101	A	1997	3.0	18	Hw	18
724-103	A	1997	5.5	20	Fd	--
724-1A	A	1997	7.8	17	Hw	19
724-1A	A	1999	7.8	19	Hw	19
724-2A	A	1998	64.6	21	Sx	19
724-3	A	1997	40.7	26	Se	19
724-301	C	1999	15.5	21	Sx	19
724-302	A	1997	174.4	16	Hw	18
724-304	B	1999	35.0	18	Cw	19
726-10	A	1997	68.8	22	Se	20
726-17	A	1999	34.8	16	Bl	11
726-2	A	1999	42.2	27	Sx	--
726-21	A	1997	31.0	29	Fd	--
726-21	B	1997	12.2	28	Se	--
726-6A	A	1997	34.4	20	Se	15
726-8	A	1997	21.6	25	Se	18
726-9	A	1998	23.6	18	Sx	19
728-200	A	1999	40.4	20	Cw	13
Total			933.7	Avg. = 22[3]		Avg. = 16

The audit assessment of the non-forest classification suggests that it did not meet provincial standards. However this is unlikely to create a problem in the data package because the problems were "due to alpine areas being delineated broadly by current standards and some environmentally sensitive areas were described as non-productive forest."[4] Alpine areas and environmentally sensitive areas are, for the most part, not included in the harvestable landbase.

RCFC had been required, in the approval of Management Plan #2, to complete a "comprehensive inventory". In light of the favourable audit results and RCFC's favourable experience in using the inventory data, RCFC requested an exemption from the need for a comprehensive inventory. This exemption was approved on February 21, 2000 and the letter of approval is enclosed in Appendix 1.

[2] The previous FIP site index is left blank where there are several polygons with differing site indices present on the stand in question.
[3] A spreadsheet indicating calculations is included in Appendix 1.
[4] Page 4, TFL 56 Inventory Audit (Appendix 1)

RCFC has reviewed all polygons listed as NSR and found that some with "NF Descriptors" listed as NSR are actually satisfactorily restocked (SR). Polygons with suitable survey data have been changed to SR. These are listed in Appendix 4. As well, some polygons had not had the most recent survey data for "well spaced stems" inserted. This has now been input and the polygons are listed in Appendix 4 as well.

The only other revision to the approved inventory files was the correction of a missing type line on the Keystone face. A Cw Hw stand (31.8 ha) was included with a large deciduous polygon (82M039-45) instead of the adjacent Cw Hw polygon (82M039-26). A new polygon was created and given the attributes of 82M039-26.

Recent work that RCFC has done indicates that there is more forested area in TFL 56 than the inventory suggests. 913 hectares of additional forested area was found when the landscape level plan was created. Forest cover mapping showed areas of non-forest where the orthophoto showed forested areas (i.e. islands in slide chutes). The refinement of the line work around non-forested openings resulted in both increases and decreases of forested area but the result was a 913 ha increase in forested area. This refined line work was not used in MP #3 because it was not approved – the intent is to incorporate it into a future forest cover update.

6. DESCRIPTION OF LAND BASE

TFL 56 covers an area of 119,748 hectares and is situated north of Revelstoke. It is bounded on the west by the Lake Revelstoke reservoir, on the east by the height-of-land of the Selkirk Mountains, on the north by the Goldstream River and on the south by the Downie-Carnes height-of-land. The nearest settlement is Revelstoke, 40 kilometres to the south.

The land is extremely rugged and dominated by two roughly east-west valleys – those of Downie Creek and Goldstream River – and one north-south valley, that of the Columbia River (Lake Revelstoke Reservoir). Elevation ranges from 573 metres at reservoir level to 3050 meters at Carnes Peak.

The forested land base is a relatively small proportion of total area and the timber harvesting land base is even a smaller proportion still. Most harvesting is confined to valley sidewalls and valley bottoms. The remaining "high country" is too rugged or does not support marketable timber.

The ruggedness has minimized human use, hence there are no settlements, little private land, and until recently little recreation use. One highway (Hwy 23N) traverses the TFL. Traffic is light and dominated by logging and other industrial traffic. Recreation use has increased in recent years and is dominated by three major groups. The first group consists of sport fishers and hunters. The second group consists of helicopter skiers and the third major group is composed of snowmobile recreationists. A fourth user group composed of self-propelled backcountry users, is increasing as the area becomes more widely known and nearby parks become increasingly crowded.

Wildlife use the TFL area extensively. Grizzly bears, black bears, moose, deer, and caribou are common. Caribou have become a management issue because they have been extirpated over much of their former range.

6.1 Timber Harvesting Landbase Determination

TFL 56 is composed almost entirely of Schedule B land (provincial land in TFL) but also contains two small Timber Licences (schedule A land) totalling 754 hectares. Due to the small area in Timber Licences, the TFL net down summary below does not differentiate between the two ownership classes.

Table 4. Timber Harvesting Land Base Determination

	Area (ha)[5]			Coniferous m3 [6]
	Operable 99	Inoperable	TFL 56	TFL 56
TOTAL	42778.7	76968.9	119747.6	16,616,361
Non Productive/ Non Forest	4472.2	55307.0	59779.2	0
Productive Forest	38306.5	21661.9	59975.8	16,616,361
Less				
Inoperable		21661.9	21661.9	5,526,325
Non Classified Roads	957.8		957.8	141,487
Keystone LRUP Reserve	1745.1		1745.1	443,078
Unstable Terrain	1979.2		1979.2	777,280
Low Sites	298.7		298.7	62,359
Problem Forest Types	247.6		247.6	44,271
Deciduous Forest Types	837.0		837.0	0
Riparian Reserves	1049.8		1049.8	373,887
Low stocking level (<300 ws sph)	223.1		223.1	0
Wildlife Tree Patches	266.0		266.0	79,800
Timber Harvesting Land Base	30702.2	0.0	30702.2	9,167,874
Less Long Term Removals				
Future Roads	963.0		963.0	305,790
Mature Forest Retention Areas	9073.7		9073.7	3,437,132
Long Term THLB	20665.5	0.0	20665.6	5,424,952

6.2 Total Area

The total area of TFL 56 is 119,748 hectares. This includes small areas of water such as Downie Creek, one half of Goldstream River and various small lakes and streams.

6.3 Non-Forest

Non-forest includes all areas in the forest cover inventory file with a non-forest descriptor (water, ice, rock, alpine, roads, mining areas, etc.).

In TFL 56, these areas are predominately in high elevations (>1800m) and consist of alpine tundra, alpine parkland, rock, and glaciers. Below 1800m in elevation there is a much lower proportion of non-forest land and it consists of avalanche tracks, water, swamps, mines, and roads.

[5] The areas presented above do not include any overlap between classifications. Deductions were made in the order presented above such that overlapping classifications are removed by the net down occurring first on the list.

[6] Volumes are coniferous net volumes based on minimum 17.5 cm dbh utilization standard.

Hydropower development has resulted in the previous loss of the reservoir lands and a significant area in power line corridors.

Table 5. Non-Forest Area

Description	Total Area (ha)
Alpine	37540.2
Rock	5003.7
Water/Swamp	948.3
Developed/Urban (e.g. mines, power lines, Hwy 23)	840.1
Other (Not typed in inventory, meadow)	329.0
Total	44661.3

6.4 Non-Productive Forest

Non-productive land is defined as land that is potentially productive, but is not currently supporting commercial forests. These areas are described below.

Table 6. Non-Productive Forest

Description	Total Area (ha)	Net down Area (ha)
Non Productive	3521.7	3521.7
Non-Productive Brush	11138.5	11138.5
Non-Productive Burn	422.2	422.2
Non-Commercial Brush	35.6	35.6
Total	15118	15118

6.5 Inoperable Forest

A thorough treatise on this subject is contained in Appendix 2. In brief, large areas of forestland in TFL 56 are unavailable for harvest because they are physically or economically inaccessible. During the MP#2 preparation in 1994, an operability line was determined. Ten thousand cubic meters annually were to be cut from above this 1994 operability line. Since then, RCFC has far exceeded this quota – in essence, RCFC has proven operability on a large area above the 1994 operability line. This proven performance was used in the field to determine a new operability line (1999 operability line). Please see Appendix 2 for a review of harvesting performance above the 1994 operability line. A related review of aerial harvesting is contained in the same appendix as an attachment to the *Operability Rationale*.

Table 7. Inoperable Land Base

Criteria	Total area (ha)
Forested land above 1999 Operability Line	21661.9
Non-Forested land above 1999 Operability Line	55307.0
Total Inoperable:	76968.9

6.6 Roads, Trails and Landings

The purpose of this section is to quantify the proportion of the TFL that has, or will be, converted to roads, trails and landings. These areas are expected to remain non-productive unless they are permanently deactivated. RCFC does not plan to do significant amounts of road deactivation. RCFC generally considers roads to be an investment in the land base and will be protected like any other forest investment until the next entry.

6.6.1 Classified Roads, Trails, and Landings

Classified roads, trails and landings are those that are captured in the inventory database. Their areas are not reported here because the TFL 56 inventory file has them lumped into NP code 54 (Urban) along with power lines and mine areas (Table 5).

These areas were removed from the land base along with the other non-forested polygons. It should be noted that the highway and power line polygons are very precise because they were updated during the last inventory update using digital orthophotos with 1-metre pixels.

6.6.2 Unclassified Roads, Trails, and Landings

Unclassified roads, trails and landings are those that exist on the land base, but were too narrow, indistinct or insignificant to create an inventory polygon for. These are quantified electronically by "buffering" the roads to a preset width and calculating the areas through a geographic information system. No deactivation is planned. Two classes of road are recognized here, the two mainlines – Goldstream and Downie – will use average road widths of 20 metres. The remaining roads will have a width applied that will represent the productive area lost to roads, trails and landings. The average road width, obtained by sampling road widths within the TFL (see Appendix 4), was increased by an amount that represents the area in trails and landings. Table 8 summarizes road width data.

Table 8. Unclassified Roads, Trails, And Landings

Road Type	Width (m)	Length (km)	Gross Area (ha)	Net down Area (ha)
Primary logging roads (Goldstream FSR 0-40 km, Downie FSR 0-36 km)	20	76	152.0	127.9
Secondary logging roads (all roads except those mentioned above)	15.9			
Additive for landings (0.14 ha every 500 metres = 2.8 metres extra road width)	2.8			
Additive for skid trails (0.5% occupancy * 9000 ha logged = 45ha/492 km of road = 0.8m extra width)	0.8			
Total secondary road width to use in buffering	19.5	492	959.4	829.9
Total		568	1111.4	957.8

6.6.3 Future Roads, Trails, and Landings

Future roads, trails and landings are, as the name implies, those that will be built to harvest undeveloped timber. The current inventory database contains 31,745 ha of undeveloped timber below the operability line, of which 13,956 will be used for active forest management. Roads in these areas will be similar to the existing roads and will not be deactivated. To estimate the site occupancy of these structures, samples of existing roads and landings as well as a sample of Silviculture Prescriptions (SP's) completed in the last three years was taken. Statistics for road width, road percent occupancy, landing size, landing percent occupancy, skid trail width, and skid trail percent occupancy were compiled. The complete sampling is available in Appendix 4 and a summary is shown below.

Table 9. Determination Of Site Degradation

Category	Avg. amount	%
Average landing size	0.14 hectares	
Average road width	15.9 metres	
Average road site occupancy:		5.0%
Average landing site occupancy:		1.4%
Average permanent skid trail width:	4.0 metres	
Average permanent skid trail site occupancy:		0.5%
Average total site degradation		6.9%

Table 10. Future Roads, Trails, And Landings

Reduction Type	Total area (ha)
Roads	698
Trails	70
Landings	195
Total	963

Future permanent access structures are accounted for through a reduction in yield curves because of timing. To include the volume (area) associated with the new roads and landings when a polygon is harvested for the first time, an area reduction for future PAS would have to occur after the first harvest. This is difficult to achieve in ATLAS. The strategy is to allow the polygon to receive the full volume on the first harvest (natural stand curves) and subsequent harvests will use a managed stand yield curve that has been reduced by 6.9% to account for the reduction in productive area.

Note that the area reduction shown in the table above serves only to provide an estimate of the long term THLB in table 4. Modeling will utilize managed stand yield curves that have been reduced by 6.9% for any polygon that will require future permanent access construction (roads, landings, trails).

6.7 Exclusion Of Specific Geographically Defined Areas

The purpose of this section is to quantify the location and areas to be excluded from the timber harvesting land base to account for any area-specific exclusion. Only one area-specific landbase deduction is necessary – the deduction for the wilderness portion of the Keystone LRUP.

Table 11. Exclusion Of Specific Geographically Defined Areas

Description of area	Reason or exclusion	Operable Forested Area (ha)
Keystone Standard Basin Local Resource Use Plan Area.	The LRUP specifies a wilderness area that is exempted from harvesting activities. While most of the wilderness area is in alpine parkland, some is within the 1999 operable forest.	1745.1

6.8 Unstable Terrain and ESA's

Some forestlands are environmentally sensitive or particularly valuable for other resource values. These areas are identified on the forest inventory as "ESA's". The ESA system uses the following categories: soil (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), wildlife (Ew), water (Eh), and fisheries (Ef). Only ESA1's (high environmental sensitivity) are considered for land base net downs. .

"Es" These polygons are identified in the inventory data because of concern for **terrain stability or erosion potential**. RCFC has also completed TSIL 'D' mapping for the TFL that identified terrain likely to be "unstable". This mapping is viewed as better information than the Es polygons. However, not all polygons identified as "unstable" preclude the practice of forestry – the label is meant to raise a warning flag for closer scrutiny in the field. In order to estimate the actual area that will be excluded from harvesting due to soils concerns, a map was created showing TSIL D "unstable" polygons and where there was overlap with Es polygons. All of the overlap areas were

removed from the land base and the remaining TSIL D "unstable" polygons were reviewed by RCFC based on past road building experience, harvesting experience, more detailed field assessments (TSIL A), and possibilities for alternative harvest systems. The total chance planning that had been completed had already removed many areas because they were deemed too risky for harvest. The end result was 2203 hectares or 49% of TSIL "D" unstable areas in the forested operable land base being removed. Please see Appendix 4 for further details. **Note that using only ESA polygons would have resulted in 1538 hectares of net down – our more conservative and realistic method has resulted in 1979 hectares of net down.**

"Ep" areas are identified on the Forest Cover maps and are environmentally sensitive due to likely **forest regeneration problems**. Although Ep areas are identified on RCFC forest cover maps, RCFC has experienced no problems in regenerating any sites since purchasing the TFL. Most Ep areas are in high elevation ESSF areas where RCFC now uses group selection silvicultural systems to provide shelter to seedlings. As well, use of *Abies lasiocarpa* and *Tsuga mertensiana* in concert with *Picea engelmannii* reduces past regeneration problems associated with planting pure Picea. No net-downs are attributed to Ep areas as group selection is applied to these areas in the model.

"Ea" areas are identified on the Forest Cover maps and are environmentally sensitive due to **snow avalanche problems**. RCFC has not used the existing Ea mapping but has obtained *avalanche likelihood mapping* that rates the likelihood of an avalanche occurring if forest cover is removed. This mapping is considered to be better information than Ea mapping and divides the landscape into categories from Low to Very High. In discussions with the experts who produced the maps, it was determined that if group selection silviculture systems are used to limit the down-slope exposure distances, areas should not have to be excluded from harvesting based solely on avalanche hazard. Thus, areas with greater than 50% high or very high avalanche likelihood are assigned to group selection harvest systems within the model. Recent forest practices in avalanche areas have been to leave narrow strips of trees along avalanche tracks to help confine avalanche activity. As well, tall stumps and in-block reserves have been used to reduce risk within blocks.

"Er" areas would be identified on the Forest Cover maps due to conflicting **forest recreation activities**. However, Er areas are not identified in TFL 56 inventory mapping.

"Ew" areas are identified on the Forest Cover maps and are environmentally sensitive due to **sensitive wildlife areas**. While these exist on the TFL, no deductions have been made because MAC guidelines for deer, moose, caribou and bear supersede the overview mapping for "Ew" areas.

"Eh" areas would be identified on Forest Cover maps due to **sensitive water sources**. There are no "Eh" areas indicated in the TFL 56 forest cover mapping.

"Ef" areas, which are considered environmentally sensitive due to presence of **sensitive fisheries areas,** are not identified on RCFC Forest Cover maps. Forest Practices Code riparian guidelines are being modelled and will adequately address fisheries concerns

Table 12. Area Reductions For ESA's

ESA Category	ESA Description	Gross Area (Operable ha)	% Reduc-tion	Comments	Net down Area (ha)
Es	This includes forested areas labelled as both "unstable" on the TSIL "D" mapping and as Es (ESA1) on the Forest Cover mapping	Total Es 1538 TSIL D Overlap 279	100% of overlap	Remainder of Es areas ignored as better information was used.	279 (gross) 277 (net)
TSIL "D" Unstable	This includes all other forested areas labelled as "unstable" on the TSIL "D" mapping	4376	46%		2024 (gross) 1701 (net)
	Total Terrain Stability Net-down:	4655	49%	ESA overlap plus 46% of the remaining TSIL D Unstable polygons.	2303 (gross) 1979 (net)
Ea		0	0%	Better information used	0
Avalanche Likelihood mapping	Areas designated as high or very high likelihood on *Avalanche Likelihood Mapping*	3932	0%	These areas have been identified for silvicultural systems other than clearcut or clearcut with reserves.	0
Ep	Regeneration	470	0%	Silvicultural systems changes and use of alternate species has eliminated high elevation regeneration concerns.	0
Er	Recreation	0	0%	Does not occur in the TFL.	0
Ew	Wildlife	0	0%	No special deductions. MAC guidelines will be used.	0
Eh	Water	0	0%	Does not occur in the TFL. FPC riparian guidelines will be modelled	0
Ef	Fisheries	0	0%	Does not occur in the TFL. FPC riparian guidelines will be modeled	0
Total		9057			2303

6.9 Low Sites

The purpose of this section is to describe and document the area in TFL 56 that is not suitable for harvest due to poor timber growing potential. TFL 56 generally has very good growing conditions so there are few areas that are not "suitable for harvest" due to low site quality.

Low site thresholds have been set independently for aerial harvest polygons and non-aerial harvest polygons due to the higher rate of return required for aerial harvesting. Aerial harvest polygons with a SI_{50} from 0 to 8 (SI_{50} is

projected height in metres at age 50) are removed from the land base. Non-aerial harvest polygons with an SI_{50} from 0 to 7 are also removed from the land base.

RCFC staff have reviewed each low site area and have visited several in the field. Based on these site visits, RCFC staff are confident that the SI_{50} 7 and 8 are logical and manageable thresholds for forest management on TFL 56.

Table 13. Low Site

Harvest System	Site Indices to be Removed	Gross Operable Area (ha)	Net down Area (ha)	Volume Removed (m3)
Aerial	0-8	179.1	140.4	36,810
Non-Aerial	0-7	1397.7	158.3	25,517
	Total		298.8	62,327

6.10 Problem Forest Types and Deciduous Forest Types

In the Management Plan #2 process, a number of problem forest types were identified. However, in the years that have elapsed since approval of MP #2, RCFC has been harvesting the profile of the existing timber. In other words, although there were deductions for problem forest types, RCFC logged all of these types in the proportion in which they exist on the land base. RCFC therefore will make no deductions for problem forest types except for those minor deductions listed in Table 14. For further information, please see the report in Appendix 2 entitled *RCFC TFL 56 Current Harvest Practices: A review of Management Plan #2 Harvest Requirements and the 1999 Operability Line.*

In areas designated for aerial harvest, there has been considerable thought given to the need for deductions for problem forest types. Because RCFC recently carried out a thorough total chance planning process, the need for deductions has been virtually eliminated. Each proposed aerial block has been individually reviewed – many were removed because it was felt they were uneconomic. Those that were removed were placed outside the operable landbase when the 1999 operability line was established. A thorough review of RCFC's aerial harvesting accomplishments and the proposed aerial landbase is contained in the report entitled *Aerial harvesting History in TFL 56* (Appendix 2).

Table 14. Problem Forest Types

Inventory type group	Characteristics					
	Age class	Height class	Stocking class	Reduction %	Total Area (ha)	Net down Area (ha)
All	>6	<2	0,1	100%	2128.0	195.4
All	all	all	≥2	100%	1291.1	52.2
Deciduous leading	all	all	all	100%	1387.2	970.1
Totals					4806.3	1217.7

6.11 Riparian Reserve Areas

RCFC's management of riparian reserve zones follows the practice outlined in the Forest Practices Code. Practices within management zones are modified versions of the FPC recommended practices.

Riparian classifications were applied to all TRIM water features based on the "Lake, Wetland, and Stream Classification" mapping dated 1998. This mapping used size to classify lakes/wetlands. Sampling information and gradient were used to provide stream riparian classes (S1-S6) or categories (S1-S4, S5-S6). Areas without a specific class were assigned one through a rule set devised specifically for TFL 56. The rule set was as follows (applied in order):

- Where a riparian class is known, use it;
- All other double line TRIM streams are S2;
- All remaining fish bearing streams (gradient < 20%) that are direct tributaries to Downie, Goldstream, or Lake Revelstoke are S3 for the first 2 reaches;
- All remaining fish bearing streams are S4;
- Any non-fish bearing streams (gradient >20%) that are direct tributaries to Downie, Goldstream, or Lake Revelstoke are S5 for the first 2 reaches;
- All remaining non-fish bearing streams are S6.

Table 15. Riparian Reserve Zones – Streams

Location	Riparian Class	Stream length (km)	Reserve width (m)	Management zone width RMZ (m)	Removal % in RMZ	Net reserve width (each side)	Buffer area (ha)	Net down area (ha)
S1 streams	S1	12.1	50	20	50%	60	219.2	74.2
S2 streams	S2	44.9	30	20	50%	40	542.6	183.6
S3 streams	S3	92.2	20	20	50%	30	834.6	272.4
S4 streams	S4	107.4	0	30	50%	15	486.1	154.5
S5 streams	S5	56.7	0	30	83%	5	85.5	28.9
S6 streams	S6	2187.2	0	20	95%	1	659.8	202.9
Sorcerer Crk	S5	In S5	0	30	50%	15	In S5	In S5
Brewster Crk	S5	In S5	10	20	50%	15	In S5	In S5
						Stream Totals	2827.9	916.5

RCFC's management of lake and wetland riparian reserve zones follows the practice outlined in the Forest Practices Code. Practices within management zones are modified versions of the FPC recommended practices. These modifications reserve at least to the magnitude specified in the recommended "best practices" specified in the *Riparian Management Area Guidebook*.

Table 16. Riparian Reserve Zones -- Lakes And Wetlands

Location	Riparian Class	Reserve width (m)	Management zone width (m)	Removal % in RMZ	Net Width (m)	Gross Area (ha)	Netdown Area (ha)
Wetlands							
W1 wetlands	W1	10	40	75%	20	570.1	74.1
W3 wetlands	W3	0	30	66%	10		
W5 wetland complexes	W5	10	40	75%	20		
Lakes							
Lake Revelstoke	L1 >1000 ha	0	20	0%	20	334.1	59.2
L3 lakes	L3	0	30	50%	15		

6.12 Backlog NSR

When RCFC purchased the TFL, an aggressive plan to eliminate the entire backlog NSR area within the TFL was instituted. All backlog areas in the TFL were surveyed and had prescriptions formulated. Most were planted or brushed to bring them up to standard. Some were accepted at lower stocking standards or had no practical treatments that could bring them up to sufficient stocking levels. There are now no areas classified as "backlog NSR" although there are some areas with low stocking of conifers. Table 17 summarizes these areas. A full summary of NSR areas within TFL 56 can be found in section 8.9.2.

Table 17. Deductions For Stands With Low Stocking Levels

Description of area	Reason or exclusion	Excluded area (ha)
Stands with <300 well spaced stems/ha (not current NSR)	Area not likely to provide coniferous timber within a reasonable time frame – no treatment planned.	223.1

6.13 Wildlife Tree patches

Wildlife tree patches (WTP's) were removed from the land base where existing reserves or forested net-downs were unable to meet the spacing requirements. All forested areas not part of the THLB were buffered by 250m in order to identify areas in the THLB that do not meet the 500m spacing rule for WTP's. Any areas not covered by the buffer (4433 ha) are assumed to require WTP's totalling an average of 6%. This should be considered to be an overestimate of the actual amount required in WTP's as the percentage in forested reserve is well in excess of 6% for each BEC variant in each landscape unit. An amount less than 6% retention would likely be considered acceptable to meet the spacing requirements.

. This WTP proportion was calculated using the February 2000 update of the *Landscape Unit Planning Guide*. The calculations are displayed in Appendix 4.

Table 18. WTP deductions

Description of area	Reason or exclusion	Excluded area (ha)
Wildlife tree patches	Additional areas required to maintain 500m spacing.	266.0

6.14Cultural Heritage Resource Deductions

There has been only one area of significant cultural heritage value found within the present boundaries of TFL 56. This is the historic Keystone Standard Basin trail. Most of the known remaining trail bed has been protected by the *Keystone Standard Basin Local resource Use Plan* for which land base deductions occur elsewhere in this document. A small portion of the known trail exists in the operable forest outside of the protected LRUP area. This portion of the trail is within a Mature Timber Retention Zone in which no harvest is planned therefore no special deductions are necessary to protect it.

RCFC has carried out several archaeological impact assessments on areas judged to have a high likelihood of historic aboriginal use, but have found no traces of past use. Aboriginal people used the TFL 56 area very little and it is likely that the Revelstoke Dam has flooded most areas of actual use.

6.15 Other Sensitive Site Deductions

There are no "other" sensitive site reductions necessary.

6.16 Wildlife Habitat Deductions

Wildlife habitat deductions are addressed through forest cover constraints. The cover constraints are dealt with by maintaining MFRA's. and are noted in Tables 36a and 36b.

6.17 Area Additions

The area of low stocking level stands (Table 17) removed from the land base will not be reintroduced into the model for this analysis. This area has been written off because it is not currently reasonable to rehabilitate these areas and thus there is no expectation for productive forests in the short or mid term.

Potential areas for landbase additions include the Goldstream mine area and the power line corridor to the mine. It is likely that these areas will cease to be used for the mining activities and will again grow forest. However, with the lack of a definite closure schedule, these areas will not be returned to the landbase in this modelling exercise. There is a potential "upward pressure" on the landbase of conservatively 90 hectares should these areas be returned.

7. INVENTORY AGGREGATION

7.1 Management Zones

The FPS spatial timber supply model allows polygons to belong to an unlimited number of management zones simultaneously and therefore permits the use of overlapping constraints. Within the model, each management zone is defined separately and has constraints applied specifically for that management zone. For example, a polygon may belong to a local caribou zone, an ungulate winter range zone, and an intermediate biodiversity zone. In order for the polygon to be harvested, no constraints can be violated in any of the zones it belongs to.

The management zones to be used in this analysis are derived from two sources – the MAC recommendations and the Keystone Local Resource Use Plan. These MAC zones cover issues relating to wildlife habitat and biodiversity in each of the two landscape units. The Keystone LRUP zones identify areas of no harvesting (Wilderness and Zone A), caribou management (Zone B), visual quality management (Zone C), and normal harvesting practices (Zone D). Zone B and C will not be specifically delineated in the model as they are covered by the MAC caribou zone which will satisfy the constraints of these two zones. Each zone to be modeled is outlined in Table 19.

Table 19. Management Zones

Mgmt Zone	Criteria Used to Delineate Zone			1999 Operable Area		
	Landscape Unit	Manage for:	BEC	Gross (ha)	Forested (ha)	THLB (ha)
1	R12	Primary caribou	ICH below 94 Op.	5053	4587	2592
2	R12	Primary caribou	ICH above 94 Op.	250	243	77
3	R12	Primary caribou	ESSF below 94 Op.	2081	1999	1192
4	R12	Primary caribou	ESSF above 94 Op.	1058	1029	100
5	R12	Recruitment caribou	ICH	2962	2604	1140
6	R12	Recruitment caribou	ESSF	1003	972	429
7	R12	Intermediate Caribou	ICH	3325	2718	1706
8	R12	Intermediate Caribou	ESSF	2096	2031	653
9	R12	Ungulate Deer		2165.1	1703	985
10	R12	Ungulate Moose		5486.9	4318	2497
11	R12	Low Biodiversity	ICH wk1	4442	4152	2226
12	R12	Low Biodiversity	ICH vk1	3734	3187	2255
13	R12	Low Biodiversity	ICH mw3	276	235	131
14	R12	Low Biodiversity	ESSFvc	7397	7136	3220
15	R12	Intermediate Biodiversity	ICH wk1	3216	2917	1561
16	R12	Intermediate Biodiversity	ICH vk1	5140	3780	2245
17	R12	Intermediate Biodiversity	ICH mw3	2108	1712	1043
18	R12	Intermediate Biodiversity	ESSFvc	187	150	78
19	R19	Primary caribou	ICH below 94 Op	1346	1144	738
20	R19	Primary caribou	ESSF below 94 Op.	758	734	590
21	R19	Primary caribou	ESSF above 94 Op. Line	489	438	92
22	R19	Recruitment caribou	ICH	2948	2643	1586
23	R19	Recruitment caribou	ESSF	63	55	41
24	R19	Intermediate Caribou	ESSF	154	124	57
25	R19	Ungulate Moose		5108	4144	2425
26	R19	Low Biodiversity	ICH wk1	2357	2117	1377
27	R19	Low Biodiversity	ICH vk1	5260	4403	3127
28	R19	Low Biodiversity	ESSFvc	3654	3356	2357
29	R19	Intermediate Biodiversity	ICH wk1	1159	892	527
30	R19	Intermediate Biodiversity	ICH vk1	3661	2971	1661
31	R19	Intermediate Biodiversity	ESSFvc	195	147	97

7.2 Stand Groups (Analysis Units)

In order to reduce the complexity and size of the model, like stands are grouped based on management regime, species, age, and site index. Each stand group is assigned a yield curve, minimum/maximum harvest age, and a subsequent yield curve to follow after treatment.

Three main sets of stand groups have been created for the purposes of timber supply modeling:

- Managed stands,
- Natural stands ≤140 years of age,
- Natural stands over 140 years of age.

Natural vs. managed stands are differentiated because different growth models are used to produce their yield curves. Natural stands are defined as those that regenerated naturally after a disturbance with no assistance in achieving the potential of the site. For the purposes of this management plan, any stand established more than 20 years ago (before 1980) will be treated as a natural stand and will use the Variable Density Yield Prediction (VDYP) model to supply the yield curves. Managed stands are defined as those established less than 20 years ago and will use yield curves supplied by the Table Interpolation Program for Stand Yields (TIPSY).

The natural stands are further subdivided into two age categories (≤140 and >140 years). This is required in order to apply Old Growth Site Index adjustments during sensitivity analyses. Only site indexes for stands in excess of 140 years of age are eligible for the adjustments.

The stands managed with a group selection silviculture system (i.e. Lookout Mountain, avalanche prone slopes, Ep areas, high elevation ESSF) will utilize the same set of stand groups (curves) as stands managed with a clearcut silviculture system (**but with a volume reduction of 5%**). This is possible because the areas where group selection is to be applied are explicitly identified on the landbase and have been broken up into approximately one-hectare patches. Thus, when a polygon is eligible to be harvested, it will be harvested in its entirety. The spatial distribution of harvest within the group selection areas will be managed by the model using adjacency constraints.

Group Selection areas are indicated on map (Map 1) and described on Table 35.

Table 20. Stand groups

Stand Group ID	Stand Group Name	Age Range	Species	Inv Type Groups	Site Class	SI Range	G&Y Model
Existing Managed Stands							
1	Low stocking (300-700 ws sph)	Any	Any	Any	M	7+	TIPSY
2	Exist-Man-CwHw-G	Existing <20	CwHw	9-17	G	18+	TIPSY
3	Exist-Man-CwHw-M				M	<18	TIPSY
4	Exist-Man-Fd	Existing <20	Fd Leading	1-8, 27-34	All	>7	TIPSY
5	Exist-Man-SxBl-G	Existing <20	SeBl	18-26	G	18+	TIPSY
6	Exist-Man-SxBl-M				M	<18	TIPSY
Existing Natural Stands							
10	Nat-Fd-G	20+	Fd leading	1-8,27,28	G	>21	VDYP
11	Nat-Fd-M				M	16-21	VDYP
12	Nat-Fd-P				P	<16	VDYP
20	Nat-Mat-Bl-G	20-140	Bl leading	18-20	G	14+	VDYP
21	Nat-Mat-Bl-M				M	<14	VDYP
30	Nat-Mat-Cw-G	20-140	Cw leading	9-11	G	>18	VDYP
31	Nat-Mat-Cw-M				M	14-18	VDYP
32	Nat-Mat-Cw-P				P	<14	VDYP
40	Nat-Mat-Hw-G	20-140	H leading	12-17	G	>16	VDYP
41	Nat-Mat-Hw-M				M	13-16	VDYP
42	Nat-Mat-Hw-P				P	<13	VDYP
50	Nat-Mat-Sx-G	20-140	Sx leading	21-26	G	>21	VDYP
51	Nat-Mat-Sx-M				M	15-21	VDYP
52	Nat-Mat-Sx-P				P	<15	VDYP
25	Nat-Old-Bl-G	>140	Bl leading	18-20	M	14+	VDYP
26	Nat-Old-Bl-M				P	<14	VDYP
35	Nat-Old-Cw-G	>140	Cw leading	9-11	G	>18	VDYP
36	Nat-Old-Cw-M				M	14-18	VDYP
37	Nat-Old-Cw-P				P	<14	VDYP
45	Nat-Old-Hw-G	>140	H leading	12-17	G	>16	VDYP
46	Nat-Old-Hw-M				M	13-16	VDYP
47	Nat-Old-Hw-P				P	<13	VDYP
55	Nat-Old-Sx-G	>140	Sx leading	21-26	G	>21	VDYP
56	Nat-Old-Sx-M				M	15-21	VDYP
57	Nat-Old-Sx-P				P	<15	VDYP
Future Managed Stands							
100	Man-Fd-G	Regen	Fd leading	1-8,27,28	G	>21	TIPSY
110	Man-Fd-M				M	16-21	TIPSY
120	Man-Fd-P				P	<16	TIPSY
200	Man-Bl-G	Regen	Bl leading	18-20	G	14+	TIPSY
210	Man-Bl-M				M	<14	TIPSY
300	Man-Cw-G	Regen	Cw leading	9-11	G	>18	TIPSY
310	Man-Cw-M				M	14-18	TIPSY
320	Man-Cw-P				P	<14	TIPSY
400	Man-H-G	Regen	H leading	12-17	G	>16	TIPSY
410	Man-H-M				M	13-16	TIPSY
420	Man-H-P				P	<13	TIPSY
500	Man-Sx-G	Regen	Sx leading	21-26	G	>21	TIPSY
510	Man-Sx-M				M	15-21	TIPSY
520	Man-Sx-P				P	<15	TIPSY

7.3 Detailed Land Base Information Requirements

The net down process was completed using ARCINFO and used numerous coverages representing various types of data. Where required, coverages were created for each of the net down classifications (riparian buffers, road buffers, unstable polygons, etc) and aligned with the base forest cover data. Once completed, all of the relevant line work was merged into a single coverage that contained many polygons but every polygon belonged entirely to at least one net down category and management zone. The data is currently in an MS Access 97 database and has been queried to provide the information in the preceding sections.

A CD with this database is included in the map pocket in this binder. Additional copies can be obtained through RCFC or Silvatech Consulting Ltd.

8. GROWTH AND YIELD

8.1 Site Index Assignments

Site indexes from the recently approved FIP files were used for all polygons except those mentioned in Section 5, Table 3. These polygons were assigned a new site index based on recent silviculture surveys that included the estimation of site index using the growth intercept method (total of 933.7 ha). The site indexes in the FIP file were determined by the MoF Inventory Branch using their curves for natural stands and the age/height information in FIP files.

Site indexes will be altered during the sensitivity analysis to look at the uncertainty around old growth site indexes. Two sensitivity analyses using the equations developed by the Old Growth Site Index (OGSI) project will be run:

Spruce OGSI:

This projection will adjust the site index of old growth spruce stands (>140 years of age) once they have been clearcut harvested. The adjustment will only be applied to polygons within the old growth site index range that was sampled in the paired plot study (5.7 - 25.4m at breast height age 50). The following formula from the paired plot study will be used to determine the new site index:

$$\text{New SI} = 17.46 + 0.1948 * SI_{OG}$$

The new site indexes for each polygon will be used to produce a new weighted average site index that will be used to create a new set of managed stands curves for spruce. This new set of curves will replace the curves used in the base case.

All OGSI

This projection will adjust the site index of all old growth stands (>140 years of age) once they have been clearcut harvested. Only the species shown below exist as old growth within TFL 56. The adjustments will only be applied to polygons within the old growth site index range indicated below, and will have the following formulas applied:

Table 21. OGSI Formulae

Species	Source Study	Equation	SI_{OG} Range
Sx	Paired Plot	New SI = 17.46 + 0.1948 * SI_{OG}	5.7 - 25.4
Cw	None*[7]	New SI = SI_{OG} + 4	7 – 18
Bl	Veteran Trees	New SI = 8.824 + 0.5682 * SI_{OG}	4.5 - 22.0
Hw	Veteran Trees	New SI = 11.42 + 0.5430 * SI_{OG}	4.7 - 17.5

[7] The veteran trees' equation for Cw was considered to be unrepresentative, as all SI's between 11.6 and 23.2 would be adjusted to 20.7. A conservative and more realistic adjustment is to increase old growth site indexes at the low end of the range (7-18) by a nominal 4m. Average gain in the veteran study was 5m for Cw, with much larger gains occurring below SI_{OG} 15.7.

The new site indexes for each polygon will be used to produce a new weighted average site index that will allow a revised set of managed stand curves to be created. This new set of curves will replace the curves used in the base case.

8.2 Utilization Level

The table below documents the utilization level by species that will be used in the development of the yield tables. The indicated level for conifers is the utilization level applied operationally. RCFC is somewhat new to deciduous harvest and has no proven performance. It is the intention of RCFC to utilize hardwoods in the MP #3 period, however since there is no proven performance, hardwood utilization will not be considered in the yield analysis.

Table 22. Minimum Utilisation Standards

Species	Utilisation			
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)	Firmwood standard (%)
Western red cedar >140 years	17.5	30	15	50%
Lodgepole pine	12.5	30	10	50%
Other coniferous species and cedar ≤ 140 years	17.5	30	10	50%
Deciduous species	Currently not utilized			

8.3 Decay Waste and Breakage for Managed Stands

Decay, waste, and breakage factors are applied to unmanaged stand yield tables to obtain net volumes per hectare. In all cases, the default values within VDYP associated with Forest Inventory Zone G and Public Sustained Yield Unit 481 were used.

8.4 Operational Adjustment Factors for Managed Stands

All managed stands (< 20 yrs old in database) were modelled in TIPSY and had operational adjustment factors (OAF's) applied. Provincial average OAF values were used in the absence local data.

OAF1 of 15%: a constant % reduction to account for incomplete site occupancy such as holes in the stand;

OAF2 of 5%: an increasing reduction that represents losses toward maturity, such as decay that increase with stand age. This factor also accounts for waste and breakage when a stand is logged.

8.5 Volume Deductions

For existing natural stands (VDYP curves), volume reductions have been applied to remove any deciduous volume from coniferous leading stands in the following manner:

1. Area weighted species percentages were derived for each of the natural stand groups (analysis units).
2. All coniferous species were totalled and then new percentages were recalculated using the coniferous total. These coniferous percentages totalling 100% were used in VDYP to derive the curves.
3. The original deciduous species percentage was used to reduce the curve volume. For example, if 8% of the stand group was deciduous, an 8% volume reduction was applied to the VDYP curve.

Table 23. Volume Reductions

Stand Group	Stand Group Description	Problem species	Percent Reduction
10	Natural-Fd-G	Deciduous component of mixed stands	1
11	Natural-Fd-M	Deciduous component of mixed stands	3
12	Natural-Fd-P	Deciduous component of mixed stands	24
20	Natural-Mat-Bl-G	Deciduous component of mixed stands	0
21	Natural-Mature-Bl-M	Deciduous component of mixed stands	0
30	Natural-Mature-Cw-G	Deciduous component of mixed stands	4
31	Natural-Mature-Cw-M	Deciduous component of mixed stands	2
32	Natural-Mature-Cw-P	Deciduous component of mixed stands	4
40	Natural-Mature-Hw-G	Deciduous component of mixed stands	0
41	Natural-Mature-Hw-M	Deciduous component of mixed stands	5
42	Natural-Mature-Hw-P	Deciduous component of mixed stands	1
50	Natural-Mature-Sx-G	Deciduous component of mixed stands	7
51	Natural-Mature-Sx-M	Deciduous component of mixed stands	2
52	Natural-Mature-Sx-P	Deciduous component of mixed stands	0
25	Natural-Old-Bl-G	Deciduous component of mixed stands	0
26	Natural-Old-Bl-M	Deciduous component of mixed stands	0
35	Natural-Old-Cw-G	Deciduous component of mixed stands	0
36	Natural-Old-Cw-M	Deciduous component of mixed stands	0
37	Natural-Old-Cw-P	Deciduous component of mixed stands	0
45	Natural-Old-Hw-G	Deciduous component of mixed stands	0
46	Natural-Old-Hw-M	Deciduous component of mixed stands	0
47	Natural-Old-Hw-P	Deciduous component of mixed stands	0
55	Natural-Old-Sx-G	Deciduous component of mixed stands	0
56	Natural-Old-Sx-M	Deciduous component of mixed stands	0
57	Natural-Old-Sx-P	Deciduous component of mixed stands	0

For existing and future managed stands (TIPSY curves), the removal of the deciduous component is assumed to be dealt with through the application of provincial average OAF values.

8.6 Yield Table Development

This section describes the methods used to develop the yield curves used in the timber supply analysis.

Normally, all stands within the THLB area would be used to derive the yield tables but in RCFC's case, landscape unit Mature Forest retention Areas (MFRA's) have been delineated within the THLB in order to address non-timber issues such as wildlife habitat and biodiversity. These MFRA's will not be harvested in the base case or most of the sensitivity analyses so they have been removed from the area used to derive the yield tables. The total area that the yield curves were based on is 21907.8 hectares.

8.6.1 Base Yield Tables

The base yield tables provided polygon specific volumes for all existing stands. This information is contained in the FIP files and is generated using the FIPUpdate option of VDYPBatch. The MoF Inventory Branch completed this process during the recent approval of the updated inventory files (1999).

8.6.2 Aggregated Yield Tables

In order to simplify the timber supply modeling process, all forest cover polygons are initially assigned to one of 31 stand groups, each with an associated yield curve. An additional 14 yield curves were also created to model future stands regeneration after harvesting (total of 45 curves).

Stands groups fit into three categories: existing natural stands (25 curves), existing managed stands (6 curves), and future managed stands (14 curves). A description of these stand groups can be found in Section 7.2.

8.7 Yield Tables for Unmanaged Stands

Yield tables for natural stands have been developed using the Ministry of Forests Variable Density Yield Predictor (winVDYP ver 1.1). Stand groups (analysis units) were created to reflect differences in Inventory Type Groups, site classes, and age. The attributes of each stand group were aggregated using area-weighted averages and then these values were used in VDYP to generate a curve for each stand group. These values can be found in Table 24 below. Refer to section 8.5 for an explanation of how the species percentages were altered to account for the removal of deciduous volumes.

Table 24. VDYP Input Parameters [8]

Curve ID	Age range	Leading species	Inv type groups	Site classes		Site index (m @ BHA)			Crown closure wt avg	Species 1		Species 2		Species 3		Species 4		Species 5		Species 6		Area	% of THLB
				Site class	SI range	FIP min	FIP max	Area wt avg		SP	%	SP	%	SP	%	SP	%	SP	%	SP	%		
10	20+	Fd	1-8,27,28	G	>21	21.1	27.1	24.9	69.6	FD	63	HW	26	CW	5	S	3	Dec	1	PW	1	488.7	2%
11				M	16-21	16.8	20.8	19.0	71.7	FD	57	HW	21	CW	10	S	7	PW	3	Dec	3	452.8	2%
12				P	<16	12.0	15.5	12.8	76.6	FD	68	Dec	24	HW	8	S	1	PW	0	B	0	350.8	2%
20	20-140	Bl	18-20	G	14+	14.7	24.2	15.9	36.8	B	47	S	35	BL	14	HW	2	HM	1	CW	1	516.2	2%
21				M	<14	11.0	13.9	11.4	37.0	BL	31	HW	20	B	18	SE	16	S	8	CW	6	39.3	0%
30	20-140	Cw	9-11	G	>18	18.4	29.0	20.0	52.6	CW	52	HW	22	SE	11	FD	8	Dec	4	PW	2	1144.1	5%
31				M	14-18	14.6	18.0	17.6	64.5	CW	51	HW	35	FD	8	Dec	2	S	2	PW	1	189.2	1%
32				P	<14	11.3	13.4	12.9	55.8	CW	61	HW	24	FD	6	Dec	4	S	4	PW	1	85.2	0%
40	20-140	H	12-17	G	>16	16.1	26.9	19.1	56.6	HW	58	CW	20	FD	8	SE	10	PW	2	BL	2	1450.3	7%
41				M	13-16	13.1	16.0	14.9	69.1	HW	61	CW	12	SE	11	Dec	5	B	7	FD	4	248.5	1%
42				P	<13	7.7	12.7	11.1	48.7	HW	55	CW	26	SE	10	FD	4	BL	4	Dec	1	157.8	1%
50	20-140	Sx	21-26	G	>21	21.3	33.2	25.4	66.4	S	47	CW	20	HW	20	Dec	6	FD	4	BL	2	361.8	2%
51				M	15-21	15.0	21.0	18.0	47.8	SE	60	CW	13	HW	10	B	9	FD	4	PW	2	402.3	2%
52				P	<15	10.0	14.7	12.6	60.9	SE	28	S	25	CW	20	BL	12	HW	9	B	6	111.0	1%
25	>140	Bl	18-20	M	14+	14.8	14.8	14.8	40.1	B	60	S	40	BL	0	CW	0	FD	0	HM	0	153.7	1%
26				P	<14	10.3	13.7	12.0	47.6	B	64	S	23	HW	8	SE	5	CW	0	Dec	0	357.6	2%
35	>140	Cw	9-11	G	>18	18.2	21.6	20.7	67.6	CW	68	HW	27	S	4	SE	0	B	0	FD	0	1137.5	5%
36				M	14-18	14.6	17.9	15.9	61.3	CW	70	HW	22	S	5	SE	2	B	0	FD	0	2015.4	9%
37				P	<14	10.7	13.8	13.0	61.1	CW	77	HW	14	S	7	SE	2	Dec	0	B	0	420.5	2%
45	>140	H	12-17	G	>16	16.6	19.9	18.8	65.8	HW	63	CW	32	S	3	B	1	FD	1	SE	0	831.0	4%
46				M	13-16	13.0	15.7	14.8	66.5	HW	67	CW	23	S	7	B	2	SE	1	FD	0	2296.4	10%
47				P	<13	8.4	12.8	11.2	56.7	HW	63	CW	23	S	12	B	1	PW	0	SE	0	1068.9	5%
55	>140	Sx	21-26	G	>21	21.3	34.3	24.0	49.0	S	66	B	17	CW	10	SE	5	HW	3	BL	0	577.6	3%
56				M	15-21	15.0	16.5	15.1	53.6	S	56	B	26	SE	10	CW	5	HW	3	Dec	0	345.6	2%
57				P	<15	8.0	14.4	11.5	51.3	S	59	B	27	HW	8	CW	3	SE	3	Dec	0	2008.7	9%
																						17211.2	79%

[8] Species percentages put into VDYP were altered to remove deciduous (i.e. 100% conifer) and then yields were reduced by the percent deciduous.

Figure 1. Existing Natural Stand Curves (Fd, Bl)

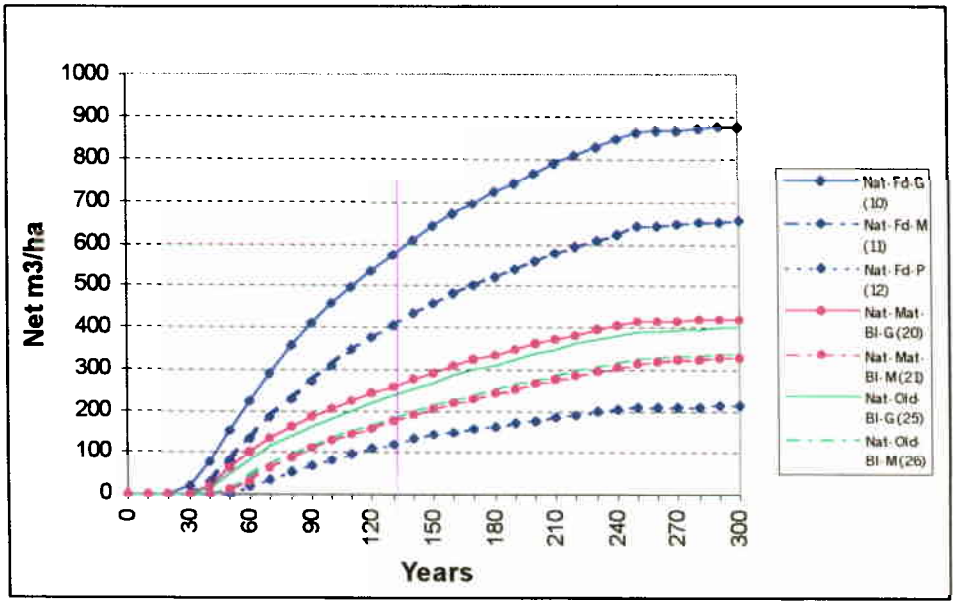


Figure 2. Existing Natural Stand Curves (Cw)

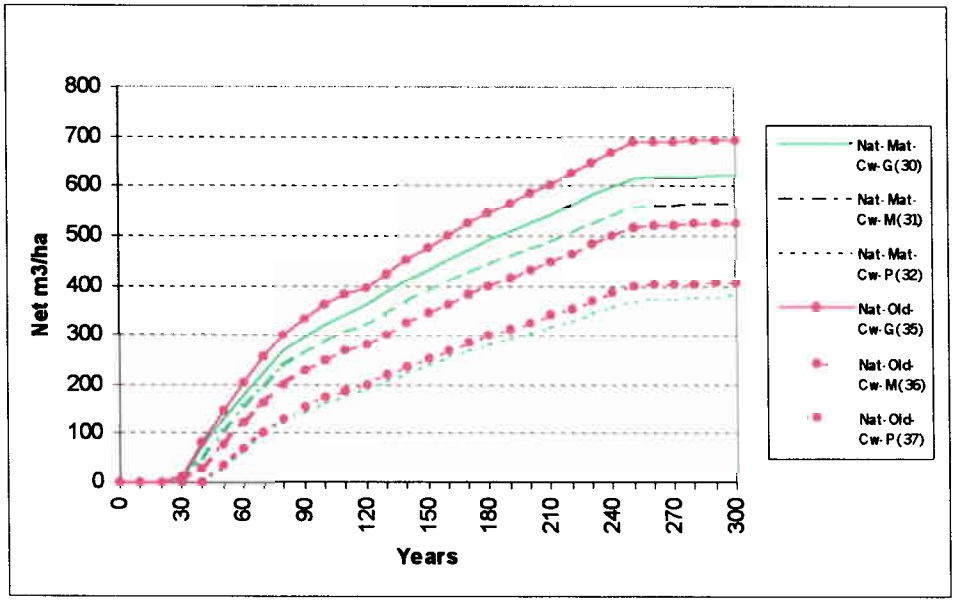


Figure 3. Existing Natural Stand Curves (Hw)

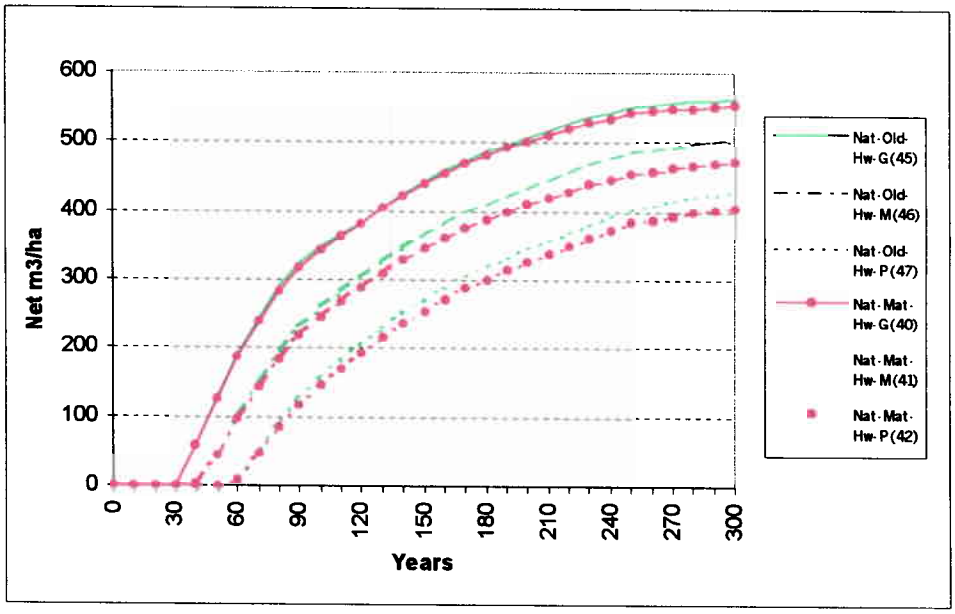
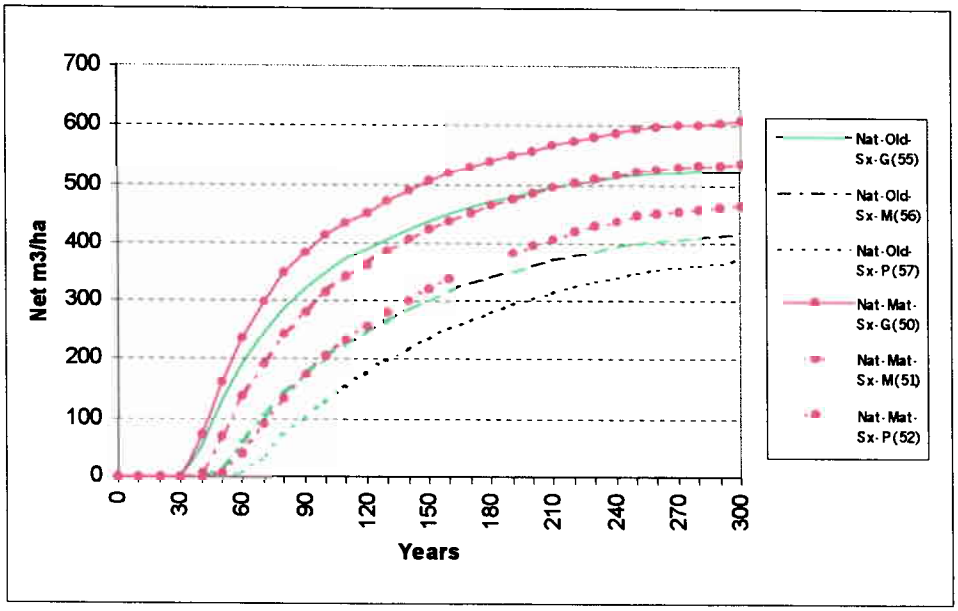


Figure 4. Existing Natural Stand Curves (Sx)

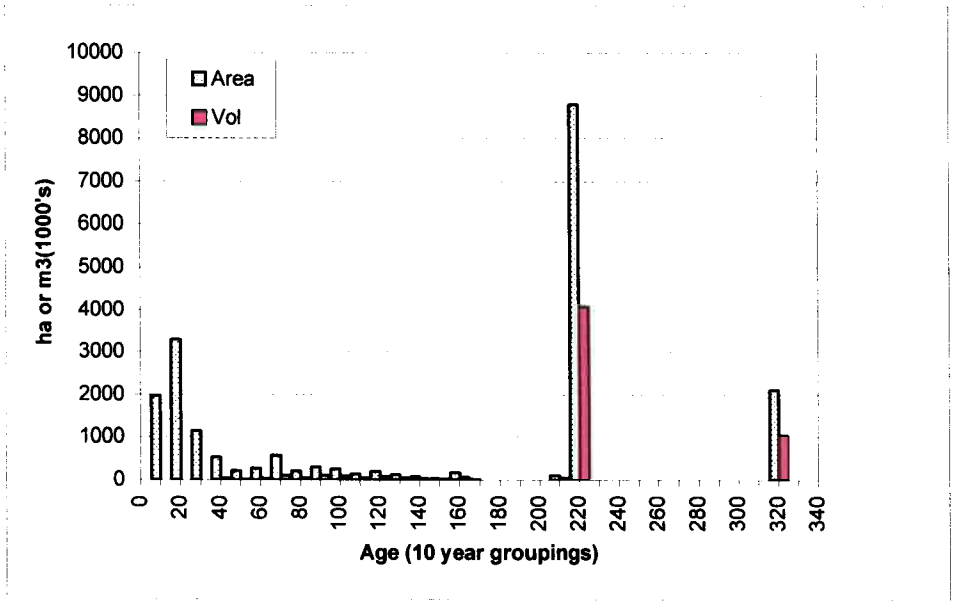


8.7.1 Existing Mature Timber Volumes

Existing mature timber volumes were obtained from the polygon information in the recently approved inventory files and can be found in Section 6.1, Table 3.

The graph below shows volumes broken down by age class for the THLB and illustrates the concentration of polygons in the 220 and 320-year age classes. This is a result of the difficulties associated with age estimations in the original data capture process and does not accurately represent what occurs on the ground. Older age classes are generally spread out around these two classes and many areas are older than 320 years. The area/volume distribution shown is only for the stands in the THLB that will be harvested (i.e. landscape unit reserves not included).

Figure 5. Area / Volume summary (1999 Inventory data)



8.7.2 Yield Tables for Unmanaged Immature Stands

All natural stands (>20 years old as of 1999) were modeled in one of two age groups (20-140 or 140+). The 20-140 year old curves contain mature and immature stands and were modeled in VDYP with the parameters found in Table 24. These curves are shown in Figures 1-4 and are referred to as "mature" (i.e. Nat-Mat-Hw-G).

8.7.3 Existing Timber Volume Check

In order to validate the aggregation process, a volume check has been performed that compares the volumes in the inventory files (polygon specific) to the volumes generated for each of the stand groups using the yield curves. There are some large variations in volume estimates for stand groups with small areas, but overall the stand group volume is within 3% of the inventory volume.

Table 25. Existing Timber Volume Check

Stand Group	Area	Curve Volume (1000 m^3)	Inventory Volume (1000 m^3)	% Difference from Inventory
10	488.7	145.86	133.36	9%
11	452.8	88.33	94.91	-7%
12	350.8	8.14	6.39	27%
20	516.2	22.69	26.53	-14%
21	39.3	0.86	1.13	-24%
25	153.7	55.53	56.30	-1%
26	357.6	105.94	113.94	-7%
30	1144.1	78.26	78.58	0%
31	189.2	31.56	28.53	11%
32	85.2	2.57	2.22	16%
35	1137.5	718.40	716.44	0%
36	2015.4	989.50	1009.45	-2%
37	420.5	166.23	172.88	-4%
40	1450.3	96.26	95.62	1%
41	248.5	29.14	31.98	-9%
42	157.8	1.72	3.17	-46%
45	831.0	436.76	488.82	-11%
46	2296.4	1049.35	1117.92	-6%
47	1068.9	425.57	410.67	4%
50	361.8	67.28	60.09	12%
51	402.3	41.62	38.60	8%
52	111.0	4.69	4.42	6%
55	577.6	290.67	311.62	-7%
56	345.6	129.76	139.50	-7%
57	2008.7	649.52	694.91	-7%
All	17211.2	5636.2	5838.0	-3%

The volumes projected by the yield curves predict 3% less existing volume over the area in which harvesting will occur. A portion of the difference can be explained by the application of the yield curves using 10-year age classes. There was a cluster of inventory ages at 225 and 325 years and these would have been rounded down to 220 and 320 respectively. Thus, the projected volumes for any old stand curves (shaded above) should have been slightly higher as the rounded ages that were used were generally lower than those in the inventory file. This will not occur in the model, as actual ages will be used to evaluate volume.

8.8 Yield Tables for Managed Stands

Yield tables for managed stands have been developed using the Ministry of Forests' Table Interpolation Program for Stand Yields (TIPSY v2.1e) model. One set of curves was developed for existing managed stands and another set was developed for future managed stands. The future managed stand curves will be assigned to natural stand polygons once they harvested and are reduced to reflect losses from permanent access structures. For example, when any polygon with a natural cedar stand curve with a medium site class (curve 31 or 36) is harvested, it would be assigned to the managed cedar stand curve with a medium site class (curve 310). TIPSY inputs for these future curves are taken from the natural stand curves they are associated with and RCFC's current regeneration species practices. The attributes for all managed stand curves can be found in Table 26 below.

Existing managed stand curves derived their site index from an area-weighted average of the polygons in the inventory file. These values were then used in TIPSY to generate a curve for each stand group and can be found in Table 26 below. Where a species did not exist in TIPSY (i.e. Bl), the species percentages were adjusted or another similar species was used.

Table 26. TIPSY Input Parameters

Curve ID	Age Range	Group Name	Inv Type Groups	Site Class	Range	SI m @ bha 50	Regen Delay	OAF 1	OAF 2	Regen Method	Species Mix	Intial Density
1	ALL	NSR Bklog 300-700 ws sph	Any	M	7+	16.4	5	25	5	Natural 100%	$Se_3\ Cw_3\ Hw_3\ Fd_1$	450
2	Existing <20	CwHw	9-17	G	18+	19.7	2	15	5	100% Planted	$Cw_5\ Sx_3\ Hw_2$	1400
3				M	<18	14.3	2	15	5	100% Planted	$Cw_4\ Hw_4\ Sx_2$	1400
4	Existing <20	Fd Leading	1-8, 27-34	All	>7	22.8	2	15	5	100% Planted	$Fd_5\ Cw_2\ Hw_2\ Pw_1$	1400
5	Existing <20	SeBl	18-26	G	18+	21.6	2	15	5	100% Planted	$Sx_7\ Bl_1\ Hw_1\ Cw_1$	1400
6				M	<18	14.6	2	15	5	100% Planted	$Sx_6\ Bl_2\ Hw_1\ Cw_1$	1400
100	Regen	Fd leading	1-8, 27,28	G	>21	24.9	2	15	5	100% Planted	$Fd_4\ Se_3\ Cw_1\ Hw_1\ Pw_1$	1400
110				M	16-21	19.0	2	15	5	100% Planted	$Fd_4\ Se_3\ Cw_1\ Hw_1\ Pw_1$	1400
120				P	<16	12.8	2	15	5	100% Planted	$Fd_4\ Hw_3\ Sx_2Cw_1$	1400
200	Regen	Bl leading	18-20	G	14+	15.7	2	15	5	100% Planted	$Sx_5\ Bl_3\ Hw_2$	1400
210				M	<14	12.0	2	15	5	100% Planted	$Sx_5\ Bl_3\ Hw_2$	1400
300	Regen	Cw leading	9-11	G	>18	20.3	2	15	5	100% Planted	$Cw_6\ Sx_3\ Hw_1$	1400
310				M	14-18	16.0	2	15	5	100% Planted	$Cw_6\ Sx_3\ Hw_1$	1400
320				P	<14	13.0	2	15	5	100% Planted	$Cw_5\ Sx_3\ Hw_2$	1400
400	Regen	H leading	12-17	G	>16	19.0	2	15	5	100% Planted	$Cw_3\ Sx_3\ Bl_2\ Hw_2$	1400
410				M	13-16	14.8	2	15	5	100% Planted	$Cw_3\ Sx_3\ Bl_2\ Hw_2$	1400
420				P	<13	11.2	2	15	5	100% Planted	$Cw_3\ Sx_3\ Bl_2\ Hw_2$	1400
500	Regen	Sx leading	21-26	G	>21	24.5	2	15	5	100% Planted	$Sx_4\ Bl_2\ Hw_2\ Cw_2$	1400
510				M	15-21	16.6	2	15	5	100% Planted	$Sx_4\ Bl_2\ Hw_2\ Cw_2$	1400
520				P	<15	11.5	2	15	5	100% Planted	$Sx_4\ Bl_3\ Hw_3$	1400

Figure 6. Existing Managed Stand Curves

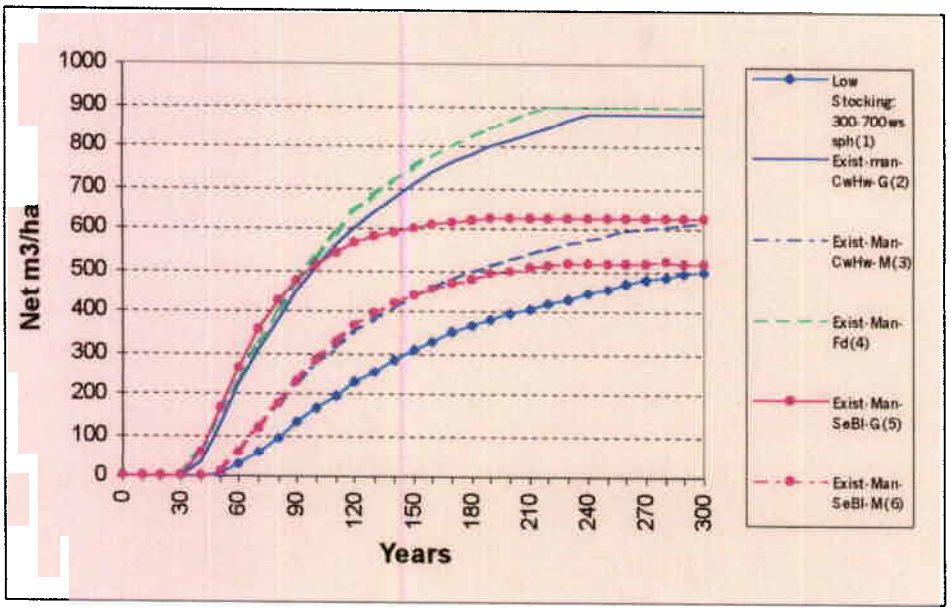


Figure 7. Future Managed Stand Curves (Fd, Bl)

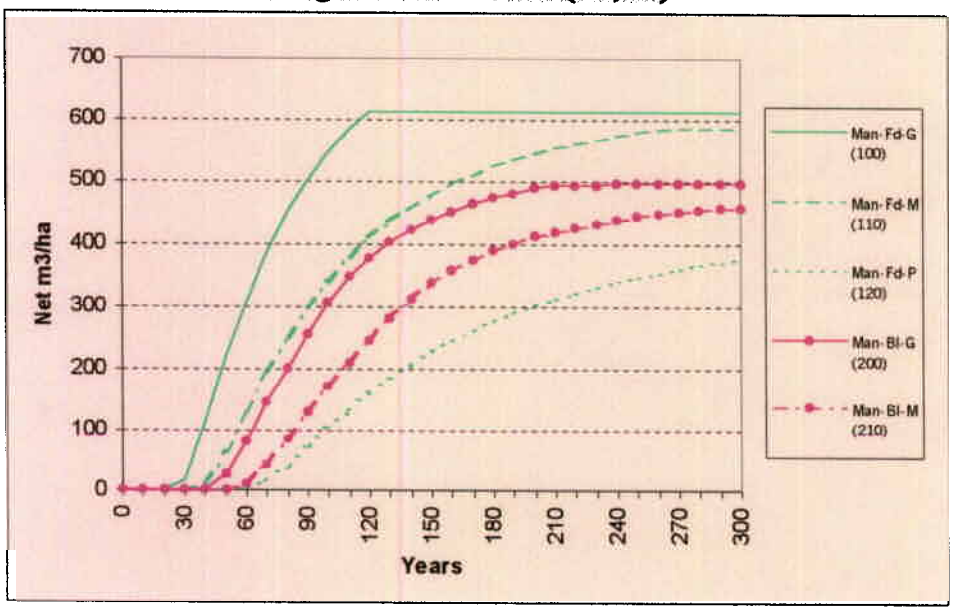


Figure 8. Future Managed Stand Curves (Cw, Hw)

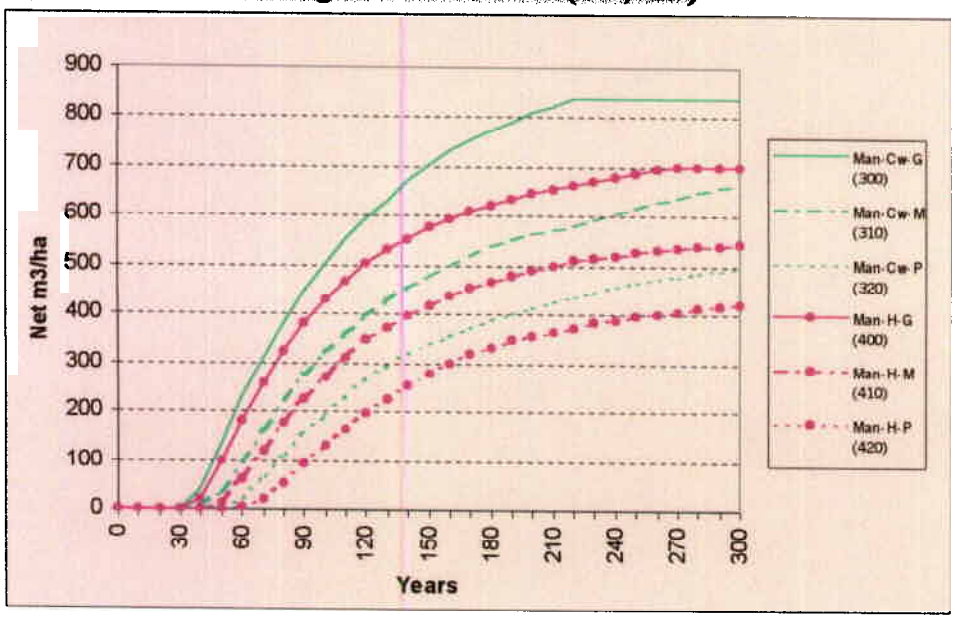
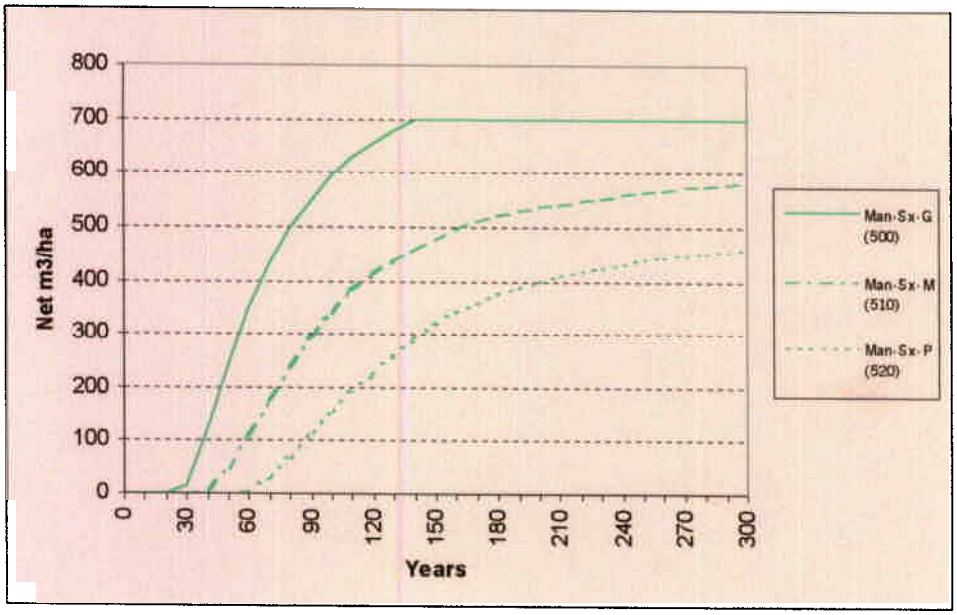


Figure 9. Future Managed Stand Curves (Sx)



8.8.1 Silvicultural Management Regimes

Two silvicultural management regimes will be modeled in the timber supply analysis. This section describes how each will be modeled using the identified stand groups.

Clear Cutting:

The yield curves discussed above are applied to areas as they are harvested. The curves assume basic silviculture obligation will be met and no intensive management is applied.

Group Selection:

Areas to be managed using group selection have been explicitly defined on the land base. In order to model this silviculture system within these areas, polygons were split to ensure that polygons were approximately one hectare in size. Harvesting will be modeled on a polygon specific basis where entire polygons are harvested and the rate and distribution of harvest is controlled using explicit adjacency/green-up rules within each group select "block". **A 5% reduction will be applied to account for the "edge effect" shading on growth potential. Currently mature stands will have a 5% area reduction; currently clearcut stands will have second generation yield curves reduced by 5%.**

8.8.2 Aggregated Yield tables

No further aggregation of managed stand yield curves is necessary.

8.8.3 Regeneration Delay

The RCFC regeneration delay policy has undergone some change since the last Management Plan. At that time, trees would be ordered after harvest. Trees are now ordered prior to harvest so that they arrive as soon as possible after harvest. Regeneration delay has been calculated as 2.1 years from time of harvest commencement or 1.8 years from harvest completion. Calculation details are shown in Appendix 3. A regeneration delay of 2 year has been used as an input into TIPSY when deriving the managed stand curves.

8.8.4 Regeneration Assumptions

When a natural stand group is cut, it is assigned to a managed stand group as described below in Table 27. Managed stands cycle back onto themselves after harvesting. The only exception to this rule is the low stocking curve – its will move onto a regular managed stand curve (510).

Table 27. Regeneration After Harvesting

Natural Stand Group	Moves to	Regenerated Stand Group after Harvest of Natural Stand
10	→	100 - Man-Fd-G
11	→	110 - Man-Fd-M
12	→	120 - Man-Fd-P
20, 25	→	200 - Man-Bl-G
21, 26	→	210 - Man-Bl-M
30, 35	→	300 - Man-Cw-G
31, 36	→	310 - Man-Cw-M
32, 37	→	320 - Man-Cw-P
40, 45	→	400 - Man-H-G
41, 46	→	410 - Man-H-M
42, 47	→	420 - Man-H-P
50, 55	→	500 - Man-Sx-G
51, 56	→	510 - Man-Sx-M
52, 57	→	520 - Man-Sx-P

8.8.5 Species Conversion

No species conversion will be modelled.

8.9 Silvicultural History

8.9.1 Existing Managed Immature

Stands established less than 20 years ago have had effective planting, stocking control and competition control and so are considered managed stands in this timber supply analysis. Yields for stands established prior to 1980 are determined using natural stand curves. Table 28 below provides the areas for existing managed stands by stand groups. The definition of managed stands used means that they are less than 20 years old and have all been planted.

Table 28. Existing Managed Stand Areas By Stand Group

Curve ID	Group Name	Area	% of THLB[9]
1	Low stocking 300-700 ws sph	217.4	1%
2	CwHw	881.1	4%
3		440.1	2%
4	Fd Leading	458.6	2%
5	SeBl	1718.8	8%
6		980.7	4%
	Totals	4696.7	21 %

The methodology for deriving the yield curves for this set of stand groups is described in Section 8.8.

8.9.2 Backlog NSR and Current Non-Stocked Areas

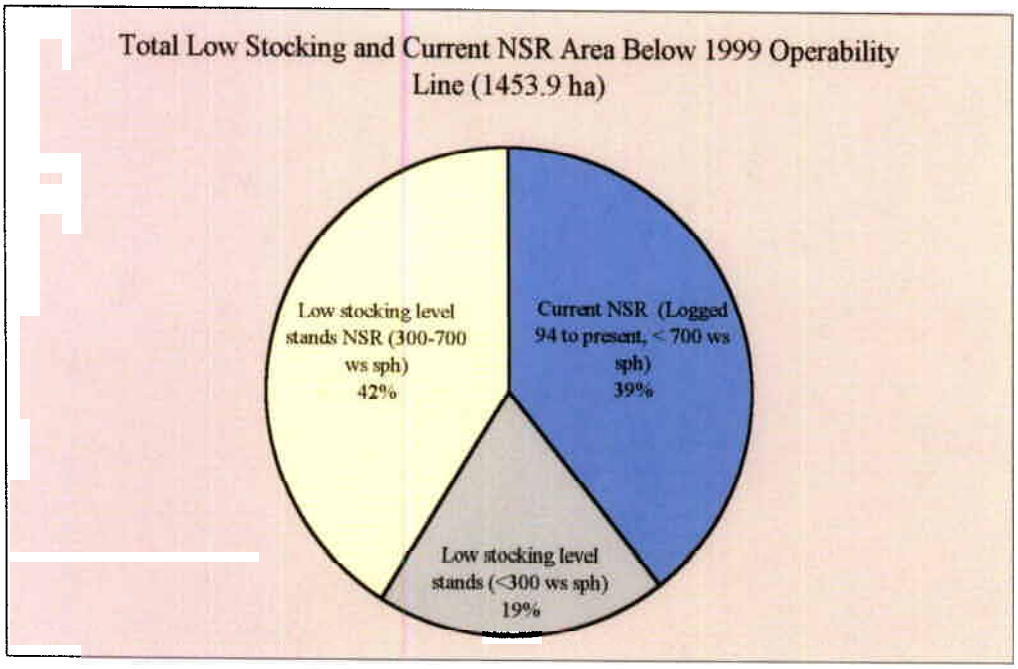
TFL 56 has worked hard to eliminate all Backlog NSR sites within TFL 56. As of 1999, all backlog areas have been brought up to standard or have been accepted at lower stocking levels because there was no practical treatment that would result in full stocking. This effectively eliminated all areas from the Backlog NSR classification.

Areas with long term low stocking levels have been divided into two groups. Areas logged prior to 1994 that currently do not have a stocking level of at least 300 well-spaced stems per hectare were removed from the THLB and will not be brought back into the landbase during this analysis. Areas harvested prior to 1994 with 300-700 well-spaced stems per hectare were assigned to a Low Stocking yield curve (Stand Group 1).

Figure 10 illustrates a breakdown of all NSR area below the 1999 operability line. Further information is presented in Table 29 below

[9] THLB does not include reserves for the purposes of yield curve determinations.

Figure 10. Low Stocking Level Stands and NSR (1999 Operable Area)



An area summary of NSR in the THLB can be found in Table 29. Any NSR logged before 1994 that does not currently have 300 well-spaced sph will not be included in the table as this area was removed from the THLB (net area of 223.8 ha).

Table 29. Old and Current NSR (THLB)

Stand Group	Low stocking 94		THLB
	Old	Current	NSR
1 – Low stocking	217.4	0.0	217.4
2 - CwHw -G	0.0	162.7	162.7
3 - CwHw -M	0.0	299.0	299.0
5 - SeBl-G	0.0	13.4	13.4
6 - SeBl-M	0.0	26.5	26.5
Total hectares:	217.4	501.7	719.0
Proportion:	30%	70%	

Areas on the low stocking curve have a longer regeneration delay (5 years) and a lower initial stocking (450 sph). Areas classified as current NSR will have the standard curves applied – these assume full stocking and the regular regeneration delay (2 years).

9. UNSALVAGED LOSSES

In this section, unsalvaged losses due to natural causes are quantified. This includes epidemic losses to insects and disease (pests) and losses to fire and windthrow. Endemic pest losses are dealt with through factors applied in the growth and yield models as noted below:

TIPSY: The OAF2 of 5% reduces gross volumes to account for losses toward maturity such as decay, and endemic forest health issues like minor infestations.
VDYP: The model predicts actual average yields from appropriate inventory plots. Endemic losses are inherently recognized in the averages.

Losses have been calculated for the TFL area as a whole and are summarized in Table 30. Appendix 1 contains the data and further explanation of methodology.

Table 30. Unsalvaged Losses

Description	Gross losses (m^3/year)	Annual unsalvaged volume (m^3/year)
Fire losses (20 year average)	2309 m^3	452 m^3
Windthrow (5 year average)	852 m^3	136 m^3
Pest (epidemics only, 7 year average.)	2506 m^3	367 m^3
Other	0 m^3	0 m^3
Total	5667 m^3	955 m^3

It should be noted that the pest losses include a looper event that is typically on a 10 to 15 year cycle, yet the period of observation is only 7 years. The result is that the numbers presented above for pest losses are likely quite conservative and actual losses may in fact be considerably lower.

10. INTEGRATED RESOURCE MANAGEMENT

10.1 Forest Resource Inventories

This section describes the present status of resource inventories and related information for the TFL 56 area.

Table 31. Forest Resource Inventories

Inventory	Date completed or updated	Comments
Aerial Photo-graphy	July 1998	1:50,000 aerial photography was completed on TFL 56. This photography was digitally ortho-rectified to create 1:20,000 mapsheets. Essentially these are maps that look like photos and are invaluable planning and inventory tools. They exist digitally as a "layer" in RCFC's digital base map and physically as mapsheets in our map cabinet. **Approval:** Not required.
Large Scale Contour Mapping	1997	Mapping at a 1:5,000 scale and at a 5 metre contour interval has been completed for timbered portions of the TFL. **Approval**: Not required.
Total Chance Inventory	November 1998	Total chance harvest planning has been carried out in the entire TFL. This essentially provides an inventory of all timber that is currently deemed "practical" to harvest and suggests methods for access and harvest. **Approval:** Not required.
Forest Cover	July 1999	▪ A major update using the above-mentioned orthophotos was completed. Spatial positions of all existing roads and cut blocks were checked and corrected if necessary using these orthophotos. ▪ A Ministry of Forests audit was completed and generally found the inventory data within acceptable tolerances. ▪ RCFC will use this updated inventory information – further updated with GPS data for harvesting completed since July 1998 – for the timber supply analysis. **Approval:** approved in late 1999.
Terrain Stability	April 1997	Terrain stability (TSIL D) mapping was completed for the entire TFL. **Approval:** Not required.
Recreation	December 1992	RCFC presently uses recreation mapping completed by the previous tenure holder. This will be updated and digitized to ministry standards **Approval:** Not submitted yet
Caribou habitat	February 1996	Caribou Habitat Suitability mapping has been completed for key areas of the TFL **Approval**: Not required.
Stream and Wetlands	February 1998	Stream and wetland classification has been done for the entire TFL. The information used is field-based for most streams in the Downie Valley and Front Face areas of the TFL. Limited field data was available for the Goldstream area. However fieldwork is being completed in 1999 for the Goldstream watershed. **Approval:** February 1998 Columbia Forest District.
Avalanche Likelihood	September 1998	Avalanches have become an issue as harvesting progresses on steeper slopes, higher elevations, and further back in narrow valleys. This mapping has been completed for the entire TFL and provides avalanche hazard by polygon. **Approval:** Not required.
Cultural Heritage Resources	Ongoing	Cultural heritage inventories will be completed on a site-specific basis when specific concerns are brought forward or if any signs of cultural heritage resources are noted during the other on-site assessments that take place. RCFC has to-date completed three archaeological impact assessments where concerns were noted during the Forest Development Plan process. No archaeological sites were discovered. **Approval**: Ongoing.

10.2 Forest Cover Requirements

There are a number of very specific forest cover requirements for TFL 56. The Revelstoke Minister's Advisory Committee (MAC) plan has identified areas for management of low and intermediate biodiversity, moose winter range, deer winter range, and caribou habitat. These management areas are further subdivided by biogeoclimatic (BEC) sub zones, landscape units, and other geographic criteria.

TFL 56 has two landscape units: R12 and R19. R12 is completely within TFL 56 and comprises the Downie valley and a portion of the "Columbia face". Landscape unit R19 comprises the Goldstream Valley and a portion of the Columbia face. This unit is shared with TFL 55. However, by agreement with the local Forest Service and Ministry of Environment staff, the portion of R19 within TFL 56 is managed independently of the TFL 55 portion.

There are two biogeoclimatic zones in the forested portion of TFL 56, the ICH and ESSF. The ICH has three sub zones: ICHwk1, ICHvk1, and ICHmw3. There are two ESSF sub zones: the ESSFvc and the ESSFvcp. The ESSFvcp is the "parkland" portion of the ESSF, and as such is not within the forested land base.

The Keystone Standard Basin Local Resource Use Plan (LRUP) also specifies forest cover requirements but is generally covered off by the MAC plan, as it is more restrictive.

In total there are 31 zones requiring forest cover constraints, many of which are overlapping. Each of the zones is defined in Section 7.1, Table 19 while the forest cover requirements to be applied are described below in Table 32. TFL 56 is primarily within natural disturbance type one (NDT 1), however the ICHmw3 biogeoclimatic sub zone is NDT 3. The NDT 3 area comprises about 2000 hectares of forested area in two portions – near Mars Creek and Downie Resort.

Table 32. Forest Cover Requirements –TFL 56

Requirement to Manage for:	Mgt Zones Applied	Forest Cover Requirements Applied within the Zone
Primary Caribou	1, 3, 19, 20	**Below 1994 operability:** At least 40% (slopes <80%) older than 140 years with at least 10% older than 250 years. To be met on the forested portion of each BEC zone in each landscape unit.
	2, 4, 21	**Above 1994 operability** As an interim strategy, at least 70% of the productive area between the 1994 operability line and parkland forest[10] must be >140 years. To be met in each landscape unit.
Intermediate Caribou	7, 8, 24	Manage as per intermediate biodiversity. These zones will be modeled independently from the intermediate biodiversity zones.
Recruitment Caribou	5, 6, 22, 23	Recruitment plan must be in place to achieve the cover requirements set out in primary caribou over time. To be met in each BEC zone and landscape unit.
ICH Low Biodiversity (NDT 1)	11, 12, 26, 27,	**Green-up:** n/a (Target of 1/3 of area in each patch size group: 0-40, 40-80, 80-250) **Early seral:** n/a **Old and mature**: Not applicable[1] **Old**: More than 13% older than 250[2] To be met on the forested portion of each BEC variant in each landscape unit.
ESSF Low Biodiveristy (NDT 1)	14, 28	**Green-up:** n/a (Target of 1/3 of area in each patch size group: 0-40, 40-80, 80-250) **Early seral:** n/a **Old and mature**: Not applicable[1] **Old**: More than 19% older than 250 years[2] To be met on the forested portion of each BEC variant in each landscape unit.
ICH Intermediate Biodiversity (NDT 1)	15, 16, 29, 30	**Green-up:** n/a (Target of 1/3 of area in each patch size group: 0-40, 40-80, 80-250) **Early seral:** n/a **Old and mature**: More than 34% older than 100 years **Old**: More than 13% older than 250 years To be met on the forested portion of each BEC variant in each landscape unit.
ICH Low Biodiversity NDT 3	13	**Green-up:** n/a (Target of 1/3 of area in each patch size group: 0-40, 40-80, 80-250) **Early seral:** n/a **Old and mature**: Not applicable[1] **Old**: More than 14% older than 140 years To be met on the forested portion of each BEC variant in each landscape unit.
ICH Intermediate Biodiversity NDT 3	17	**Green-up:** n/a (Target of 1/3 of area in each patch size group: 0-40, 40-80, 80-250) **Early seral:** n/a **Old and mature**: More than 23% older than 100 years **Old**: More than 14% older than 140 years To be met on the forested portion of each BEC variant in each landscape unit.
ESSF Intermediate Biodiversity	18, 31	**Green-up:** n/a (Patch size distribution) **Early seral:** n/a **Old and mature**: More than 36% older than 120 years **Old**: More than 19% older than 250 years To be met on the forested portion of each BEC variant in each landscape unit.
Ungulate Deer	9	**Mature:** At least 40% cover older than 120 years. Retained forest cover must be greater than 20 ha in size and provide >60% crown closure every 250 ha.
Ungulate moose	10, 25	**Mature:** At least 34% cover older than 100 years. Retained forest cover area must be greater than 20 ha in size and provide >70% crown closure every 500 ha.

[1] There are no mature requirements in low biodiversity emphasis areas in TFL 56.

[2] One third of the old requirement is initially required in low biodiversity emphasis areas. The old requirement will increase linearly to its full value at 210 years.

The landscape unit plan completed for the TFL area specifically addresses the forest cover requirements mentioned above. Mature Forest Retention Areas (MFRA's) were designated such that they contributed toward meeting forest cover requirements while addressing connectivity and minimizing the impact on the THLB. The MFRA's are spatially explicit and are kept as a "layer" in our

[10] Parkland forest is defined as open subalpine forest with tree islands and alpine meadow vegetation. This line was determined in a joint meeting with Bob Brade, Forest Ecosystem Specialist, Del Williams, RCFC Forester and Ministry of Forest Staff on June 26, 2000.

geographic Information System. The designation of these areas replaces the need for the model to select mature/old retention areas and ensures a more logical, operationally feasible plan. These areas are not meant to be permanently reserved from harvest but should be considered "portable" and may be moved around the management zone over time as other areas mature. They may, over time, be enlarged or reduced if forest cover requirements change – they may also contribute to Old Growth Management Areas (OGMA's). For the purposes of the timber supply model, the reserve areas are not replaced or moved over time.

The report entitled *Revelstoke Community Forest Corporation 1999 Caribou, Biodiversity and Ungulate Analysis* (Appendix 5) has details on the MFRA's. A map -- *TFL 56 Harvest and Reserve Thematic Map* – shows the location of all of the MFRA's (Map 1).

Several of the zones do not currently meet the forest cover requirements described above due to past harvesting events or stand disturbances. **Where this occurs in caribou areas, the model will lock out harvesting from the entire zone so that the forest cover requirements are met as soon as possible in the zone.**

All forest cover requirements are evaluated at the mid point of each period in the model. Polygons are aged to the midpoint of the period prior to evaluating any cover constraints. If ages are distributed evenly within the 10-year period, half of the stands that could reach a critical age in the middle of the period would become eligible, while the other half must wait until the next period.

All areas within the THLB are tracked within the model on a polygon (forest cover or smaller) basis and any forested area within a management zone can contribute toward seral goals applied to the zone. Areas outside/adjacent to a zone have no influence on seral goals within the zone.

10.2.1 Forest Cover Objectives – Rationale

Visual Quality Objectives: The Keystone LRUP's Zone C is the only area in which VQO's have been established within the TFL. Partial retention is specified. This VQO area lies largely within a primary caribou zone with a small portion within a caribou recruitment zone. As well, MFRA's cover the majority of the area so the partial retention objective can be met easily without modelling any special constraints.

Although no VQO's have been set for the remainder of the TFL, RCFC continues to engineer new harvesting areas with basic visual principles in mind. These principles involve shape and configuration of cutblocks but

not the overall percentage of viewscapes that may be modified. Therefore the overall AAC will not be affected. This strategy is consistent with the Draft MAC Plan and the *Lake Revelstoke Reservoir Integrated Recreation Plan*.

Adjacent Cutblock Green-up: RCFC will not be modelling adjacent cutblock green-up explicitly, but will be modelling a transition to the patch-size distribution suggested for the appropriate natural disturbance type in the *Landscape Unit Planning Guidebook*. It describes the desired future condition for the managed landscape as follows:

	NDT 1	
Small patches	(0-40 ha)	30-40% of landbase
Medium patches	(40-80 ha)	30-40% of landbase
Large patches	(80-250 ha)	20-40% of landbase
	NDT 3 (with Douglas-fir)	
Small patches	(0-40 ha)	20-30% of landbase
Medium patches	(40-80 ha)	25-40% of landbase
Large patches	(80-250 ha)	30-50% of landbase

The modeling process will strive to move the current patch size distribution toward the desired future condition of one third of the managed landbase in each of the patch sizes shown above (NDT 1 and 2). This strategy will only be applied where it makes ecological sense within the unique landscapes found in TFL 56. Very large patches will generally be avoided in steep narrow valleys with frequent slide chutes, but will be prominent on rounded landforms where fires naturally would create large openings. This ecological rationale will be given higher priority than meeting the generic patch size distribution numbers given above.

Caribou habitat – managed to guidelines (Primary caribou): These zones currently contain good caribou habitat and will be managed under the most restrictive caribou guidelines. The model will apply the mature and old seral constraints as written above. RCFC's landscape plan MFRA's will be used to satisfy these constraints.

Caribou habitat – seral stands (Recruitment caribou): This area is considered good *potential* habitat but currently is occupied by (young) seral stands that do not contain large quantities of arboreal lichens that the caribou favour. By definition, the *recruitment caribou* zones are lacking sufficient mature and old forest to meet the *primary caribou* requirements. The same management rules as primary caribou are to be applied but because of the lack of older stands, they cannot be met immediately. A recruitment strategy that meets the guidelines in a reasonable length of time

is necessary. To this end, RCFC has created MFRA's to provide the forest cover requirements. Over time, these MFRA's will result in enough mature and old forest to meet primary caribou habitat requirements. The model will use the reserves identified by RCFC during their landscape unit planning process to fulfill the requirements.

Caribou habitat – managed as intermediate biodiversity (Secondary caribou): This area contains a smaller population of caribou and will be managed under the *intermediate biodiversity emphasis* rules. For purposes of the analysis, these areas will be amalgamated with the intermediate biodiversity areas and evaluated as such.

Ungulates – Deer /Moose: The Goldstream LU (R19) winter range is for moose and the Downie LU (R12) winter range has areas of both moose and deer. Only the mature seral constraints shown in Table 32 will be modeled. The model will not check for crown closure or the 20 ha minimum reserve size because the stands reserved by the LU plan are assumed to provide the best compromise for all values.

Biodiversity Emphasis Areas: Biodiversity emphasis zones within TFL 56 are treated substantially different than the standard provincial methodology. Instead of BEO by LU, corridors of intermediate biodiversity emphasis exist within the valley bottoms and the remaining operable portion of each landscape unit is designated as low biodiversity emphasis. Forest cover constraints must be met entirely from within these areas. This results in no contribution from inoperable land - only forested net downs or reserves below the operability line are able to reduce the impact on the THLB.

MAC states that the mature and old percentages must be met on both the operable land base and the crown forested landbase. The percentage requirements on the crown forested area will be modelled as a check on the assumption that *"meeting the percentage requirements on the operable landbase will assure that they are met on the crown forested landbase"*.

Identified Wildlife: The following "identified wildlife", are designated for the Nelson Region, Columbia District:

Fish	*Mammals*
Bull trout	Fisher
Birds	Grizzly bear
American bittern	Mountain goat
Northern Goshawk	Bighorn sheep
Long-billed Curlew	

Although some of these species exist in TFL 56, no Wildlife Habitat Areas (WHA) have been established and therefore there are no General Wildlife Measures (GWM) to adhere to. Species known to exist in the TFL are considered during RCFC's planning and are addressed though existing management guidelines such as riparian management areas and old/mature forest retention.

Riparian Management Zones: Riparian management zones were determined explicitly by buffering all TRIM streams based on their riparian class. The buffered areas were then removed from the landbase. See Tables 15 and 16 in Section 6.11 for the methodology.

Wildlife Tree Patches: The percentage of each BEC variant in forested reserve exceeds the amount required for WTP's in all cases. However, in order to meet the 500m minimum spacing rule for WTP's, specific polygons will still have a portion of their area reserved for WTP's. This will reduce the volume associated with harvesting the polygons by the % reserved. See Table 18 in Section 6.13 for additional information.

10.3 Timber Harvesting

This section discusses issues related to harvesting and describes how the model allocates stands for harvest in a given period.

10.3.1 Minimum Harvestable Age/Merchantability Standards

Minimum harvestable age was set using a combination of rules and professional judgement for each curve. The following table indicates some of the statistics used and the resultant minimum harvest ages. The "rules" used were:

1. The stand must achieve a volume of at least $150m^3$/ha.
2. The stand must be at least 80 years old.
3. The stand is to be under the age of MAI maximization.

4. The stand should achieve an average diameter of 25 cm dbh. However if age of maximization of MAI is less than age to achieve 25 cm dbh, then the minimum harvest age may be reduced by up to 30 years below achievement age of 25 cm dbh.

The application of these rules provides a "window" of possible minimum harvest ages. Professional judgement was applied to set the minimum harvest age within this window.

Table 33. Minimum Harvest Ages

Curve	Description	Maximization of MAI			Age to achieve 25 cm dbh	Age to achieve 150 m3/ha.	Age to achieve 250 m3/ha.	Min Harvest Year
		Max MAI m3/ha/yr	Age	Volume m3/ha.				
1	Low stocking	2.06	160	329	80	100	130	120
2	Exist-Man-CwHw-G	5.09	110	560	80	54	65	80
3	Exist-Man-CwHw-M	2.93	130	381	120	75	95	120
4	Exist-Man-Fd	5.31	120	637	80	50	60	80
5	Exist-Man-SxBl-G	5.28	80	423	70	50	60	80
6	Exist-Man-SxBl-M	3.06	120	368	115	75	95	110
100	Man-Fd-G	6.04	80	484	65	45	52	80
110	Man-Fd-M	3.67	110	404	90	60	75	90
120	Man-Fd-P	1.66	170	282	200	110	155	140
200	Man-Bl-G	3.39	110	373	105	70	85	110
210	Man-Bl-M	2.24	150	363	140	95	120	140
300	Man-Cw-G	5.42	100	542	75	50	60	80
310	Man-Cw-M	3.51	120	421	105	70	83	110
320	Man-Cw-P	2.46	140	344	140	90	110	130
400	Man-H-G	4.61	100	461	80	55	65	90
410	Man-H-M	3.10	120	372	115	75	91	110
420	Man-H-P	2.01	160	322	170	105	135	150
500	Man-Sx-G	6.67	80	533	60	45	49	80
510	Man-Sx-M	3.69	110	406	100	65	79	100
520	Man-Sx-P	2.29	160	366	150	100	122	150
10	Nat-Fd-G	4.82	102	472.3	75	50	65	80
11	Nat-Fd-M	3.43	119	384.4	90	65	85	100
12	Nat-Fd-P	1.28	146	181.1	120	125	215	130
20	Nat-Mat-Bl-G	2.19	113	230.9	85	80	125	100
21	Nat-Mat-Bl-M	1.51	155	212.1	115	115	185	130
30	Nat-Mat-Cw-G	3.71	107	351.4	70	55	75	80
31	Nat-Mat-Cw-M	3.27	111	315.6	80	60	83	90
32	Nat-Mat-Cw-P	2.02	140	233.3	115	90	150	120
40	Nat-Mat-Hw-G	3.71	94	327.6	80	55	74	80
41	Nat-Mat-Hw-M	2.85	120	303.1	100	70	97	100
42	Nat-Mat-Hw-P	1.97	157	269.0	120	100	145	130
50	Nat-Mat-Sx-G	4.80	84	390.1	75	50	59	80
51	Nat-Mat-Sx-M	3.36	104	331.9	85	65	81	90
52	Nat-Mat-Sx-P	2.37	136	293.1	120	85	118	120
25	Nat-Old-Bl-G	1.97	124	226.1	90	85	139	110
26	Nat-Old-Bl-M	1.56	153	217.8	115	110	178	120
35	Nat-Old-Cw-G	4.05	109	378.2	70	50	70	80
36	Nat-Old-Cw-M	2.86	126	292.6	90	70	100	100
37	Nat-Old-Cw-P	2.09	146	246.4	120	90	149	130
45	Nat-Old-Hw-G	3.83	96	339.0	80	55	72	90
46	Nat-Old-Hw-M	2.90	122	306.9	100	70	98	110
47	Nat-Old-Hw-P	2.08	153	277.3	120	100	140	130
55	Nat-Old-Sx-G	3.69	86	309.1	70	55	72	80
56	Nat-Old-Sx-M	2.19	125	257.5	100	85	120	110
57	Nat-Old-Sx-P	1.68	158	248.9	125	110	160	130

10.3.2 Operability

The operable land base rationale is included in Appendix 2.

Table 34. Operability Approval

Date approved	Approved by:
May 25, 2000	David Raven, R.P.F.

10.3.3 Initial Harvest Rate

Initial harvest levels will generally be set at the current AAC (100,000 m3/year). Alternative initial harvest levels will be explored for the base case as described in Section 2.3.

10.3.4 Harvest Rules

Harvest priorities will be assigned to provide a spatial distribution of harvest and to provide operationally realistic harvest scenarios. Four to five abstract "zones" will be identified across the TFL so that each of the dispersed "zones" effectively represents a single pass in a multi pass harvest scenario. Block sizes will be designed to help the current patch size distribution move toward the desired future condition. These "zones" are assigned a harvest priority so that all 1st pass areas have priority over all other areas, all 2nd pass areas have priority over 3rd, 4th and 5th pass areas, and so on. This enables a spatial distribution of harvest to be realized without applying a hard constraint such as adjacency/green-up.

Within these pass priorities, harvesting is prioritized based on distance to the mill. Of all eligible stands in the 1st priority "zone", stands closest to the mill will be harvested first in order to ensure that road development is projected in a logical manner. The only circumstance where the model would require a road to be built to the back end of an undeveloped valley would be if no closer stand were eligible.

A sensitivity analysis will be run to look at the impact of harvesting oldest stands first within the pass priorities. Refer to Section 2.2.

10.3.5 Harvest Profile

The harvest profile will not be modeled explicitly as it is partially addressed in the multi pass zoning exercise. A mixture of forest types and harvest systems are placed into each pass so that no one type or harvest system dominates.

10.3.6 Silvicultural Systems

The clearcut silviculture system will continue to be the most commonly applied system in TFL 56. However group selection and single-tree selection will also play an important part in forest management. There are several specific areas where these systems will be applied and some more generic rules for broader applications. These are listed in Table 35.

Group selection is now frequently used on TFL 56. As practiced on TFL 56, it involves use of a 3-pass system and openings of 1/4 to 1 hectare in size. Group selection is used for several reasons including wildlife habitat enhancement or protection, visual resource protection, avalanche likelihood reduction, and at higher elevations, regeneration enhancement.

Single tree selection is just beginning to be used on the TFL. Because this method has received little use to date, it is not specifically modelled.

Table 35. Silviculture Systems

Silviculture system	Eligible analysis units or locations	Area (ha)*	Area (not in MFRA) (ha)**	% retention	# of entries	Time between entries
Clearcut	All areas not listed below	26474	17493	0	1	–
Group selection (4180 ha)	Compt. 280	1209	1209	66%	3	35 years
	Compt 270 (>1000m elev.)	1533	1533	66%	3	35 years
	ESSF areas that are also "Ep" and avalanche-prone areas	1438	1438	66%	3	50 years
Single tree selection	No areas are to be modelled for single tree selection	0	0	–	–	–

**Areas are "long term" THLB areas. * Areas are THLB areas

Refer to section 8.8.1 for growth and yield curve information.

10.3.7 Harvest Flow Objectives

The general harvest flow objective will be to maintain the current AAC for as long as possible without compromising long-term

sustainability or causing the rate of decline to exceed a reasonable level. This will be accomplished using the following rules:

- Limit any harvest declines to no more than a **10%** per period;
- Harvest levels cannot drop more than 20% below **LTHL**.

The intent is to use the current AAC until it must be reduced down to the LTHL level, ideally with no drop below LTHL. A constant AAC harvest flow scenario (always try to harvest AAC) will also be run for each option/sensitivity analysis. This will provide additional understanding of the volume of timber available in the short term.

10.4 Other

While compiling this information package, the authors noted some areas where the information was likely to result in an upward or downward "pressure" on the model's results. These pressures are summarized on the following table.

Table 36. Expected Pressures

Description	Trend
While digitizing the forested landbase from the orthophotos, it was noted that the forested landbase indicated on the forest cover maps was conservative. The forest cover polygons missed many forested areas adjacent to avalanche paths and other NP brush areas.	There are 913 hectares more operable forest area detected using higher level mapping of forested area than is shown in the FIP database. This translates into a direct upward pressure of 913 hectares or 2.4% of the operable productive forest.
RCFC has noted that where actual site index measurements are taken, they are consistently higher than the FIP database site indices. This is documented in Appendix 1 where new site indices and old FIP indices are displayed.	Average site index from on-site measurements: 21.9m @ age 50 Average previous FIP site index for the same areas: 16.0 m @ age 50 Difference: 36.3% increase This may indicate an upward pressure of 36.3% on growth of new forests. This increase in site index would apply only to those stands that have already been logged (i.e. OGSI does not apply) and have not had a new site index assigned through SIBEC or Growth Intercept methods. It assumes that these managed stands are still using the old growth site index value. The increase applies to approximately 6693 ha (32%) of the THLB [7454 ha of THLB logged less 761 ha with updated SI's].
Pest loss statistics do not span the entire return period of our most destructive pest – the hemlock looper. Our statistics span 7 years while the average return period is about double, yet we include in our statistics an epidemic.	Loss due to looper calculated with 7 year span: $280m^3/ha/yr$ Loss if return period were to be the usual +- 14 years: $140m^3/ha/yr$ Potential upward pressure: $140m^3/ha/yr$

11. OPTION ASSUMPTIONS

This analysis does not propose alternative options to the base case. The proposed management option is simply the base case with OGSI included (Refer to Sensitivity Analyses found in Table 2).