

Summary Report of Mountain Caribou Recovery Plan

Timber Supply Risk Assessment

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Ministry of
Forests and Range

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Introduction:

The following presents a summary of the timber supply risk assessment undertaken for the Mountain Caribou Recovery Plan. This summary provides information to decision makers to help them to understand the overall fibre supply risk at the management unit level associated with potential reductions in timber supply arising out of the Caribou recovery plan.

Timber Supply Risk Assessment Approach:

The risk assessment is based on an analysis of log input utilization within a timber supply scale area over the period 2001-2007. Log input utilization was measured by net (inflow – outflow) scale data from the Harvest Billing System. The analysis is carried out at a species level to help identify species specific requirements that may exist.

By examining the actual, species specific volumes, used by mills over time it is possible to profile log input utilization and gain insights into critical timber supply requirements for all mills operating within the area bounded by a TSA.¹ The log utilization is based on scaled log volumes in the management unit and identifies the volume and type of species firms have actually used in their operations over the last business cycle.² By examining the scale data we can develop an estimate of how firms have adjusted log input requirements to meet changes in market demand for their products.

Two indicators of how firms have adjusted their log input requirements have been developed:

- The Average Absolute Deviation (AAD)
- Minimum scaled volume.

The Average Absolute Deviation measures how far on average capacity, as measured by log inputs, was adjusted up and down, over a business cycle, as firms responded to market price and demand signals. The AAD can therefore be interpreted as a measure of the resiliency or adaptability of firms to remain in business.

¹ The overall risk assessment approach was reviewed by Dr Harry Nelson of the Faculty of Forestry at UBC, and was found to be able to assess the sector timber supply risk at the management unit area level. Dr Nelson was in agreement that a process should be established whereby firm specific timber utilization concerns should be able to be self identified by impacted firms. The ability of firms to identify operation specific information to the decision makers has been incorporated in the second stage of the overall assessment process outlined above.

² Due to transportation and handling costs it is assumed that for the overwhelming majority of cases once a log is scaled in a mill it is used there. There are some logs that are moved after scaling and this is not captured in the analysis. However because we are looking at the overall net log flow in the management unit, inter-firm and intra-firm swaps should be captured although scale before log movements are not.

A further measure of operability is obtained by determining the minimum level of scale over the period. The minimum scale volume reflects the lowest aggregate input requirement that arose in the period. Because this measure reflects the lowest log input requirement experienced over the business cycle it is assumed that this level reflects a point after which firms either take extended curtailment or shut down operations.

Using these two indicators and an estimate of the potential impact of the mountain caribou recovery on timber supply it is possible to map out the overall TSA area risk of potential timber supply reductions across all firms. The assessment of timber supply risk is done by first examining how the individual management unit timber supply reductions are distributed among the units. This involves examining the net timber flows between management units to determine management unit specific impacts by species.

Once the species net flow impacts have been determined these values are then compared to the Average Absolute Deviation and Minimum Scale Volume by forming the following ratios:

$$\text{Net Timber Supply Impact} \div \text{Average Absolute Deviation} = \text{Risk to Level A}$$

The interpretation of this ratio is that as the value becomes closer to 1 the potential risk to firms in the TSA area increases.

The net impact is also compared to the Minimum Scaled Volume by forming the ratio:

$$\text{Net Timber Supply Impact} \div (\text{Average Scale Volume} - \text{Minimum Scale Volume}) = \text{Risk to Level B}$$

The interpretation of this ratio is if the value is greater than 1 we assume absolute risk. By this we mean firms will not be able to operate without some reduction to capacity in the medium or long term.

As can be seen the size of the estimated timber supply impact is a critical value in determining the level of risk. The approach and assumptions used in determining the timber supply estimates are outlined in the report attached as Appendix 1 of this document.

Summary Tables:

Summary tables of the net timber supply impacts are presented below. The tables outline risk assessment thresholds and corresponding risk levels for the 12 timber supply areas by species categories. Rows highlighted in red identify impact ratios greater than one and suggests that the potential risk for sector impacts is high. Rows highlighted in pink indicate ratios near one and risk levels may be increasing.

An all species assessment is presented first to examine concerns over general supply conditions, however species specific assessments were also undertaken to examine the potential for supply impacts for critical species.

TSA Scale Area Timber Supply Risk Assessment

All Species

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	825,204	620,658	134,006	204,545	34,219	0.2554	0.1673
Boundary	1,668,562	1,190,041	197,416	478,520	33,749	0.1710	0.0705
Golden	429,776	357,549	26,060	72,227	7,814	0.2998	0.1082
Revelstoke	593,076	501,081	66,963	91,996	55,779	0.8330	0.6063
Robson Valley	415,694	69,612	117,509	346,083	10,401	0.0885	0.0301
Cranbrook	1,062,267	932,631	92,910	129,636	16,899	0.1819	0.1304
Invermere	1,061,142	927,767	56,598	133,375	7,418	0.1311	0.0556
Kamloops	3,035,725	2,867,087	94,504	168,638	16,564	0.1753	0.0982
Kootenay Lake	413,421	355,177	44,892	58,244	30,226	0.6733	0.5190
Prince George	13,139,506	10,417,421	1,431,650	2,722,085	19,320	0.0135	0.0071
Quesnel	4,170,646	3,592,301	290,878	578,345	4,444	0.0153	0.0077
Williams Lake	4,394,858	3,619,991	432,061	774,867	139,189	0.3222	0.1796

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

Cedar

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	139,107	109,701	19,567	29,406	5,619	0.2872	0.1911
Boundary	91,979	58,478	22,858	33,501	3,130	0.1370	0.0934
Golden	21,802	8,719	9,655	13,083	552	0.0572	0.0422
Revelstoke	283,613	231,652	22,413	51,961	16,740	0.7469	0.3222
Robson Valley	37,605	17,440	7,752	20,165	849	0.1095	0.0421
Cranbrook	4,297	1,992	942	2,305	137	0.1454	0.0594
Invermere	1,881	810	673	1,071	20	0.0292	0.0184
Kamloops	144,316	105,908	30,190	38,408	5,838	0.1934	0.1520
Kootenay Lake	46,373	17,603	17,871	28,770	3,942	0.2206	0.1370
Prince George	1,312	190	1,545	1,123	27	0.0172	0.0236
Quesnel	184	1	185	183	2	0.0090	0.0091
Williams Lake	6,442	238	3,964	6,205	25,587	6.4547	4.1239

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

TSA Scale Area Timber Supply Risk Assessment Con't

Douglas Fir

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	187,197	148,516	22,548	38,681	5,508	0.2443	0.1424
Boundary	361,432	199,158	72,837	162,274	5,270	0.0724	0.0325
Golden	88,157	70,245	10,279	17,912	440	0.0428	0.0246
Revelstoke	55,719	39,499	14,885	16,220	1,099	0.0738	0.0677
Robson Valley	67,313	3,824	33,738	63,489	587	0.0174	0.0092
Cranbrook	91,452	44,981	26,286	46,471	497	0.0189	0.0107
Invermere	104,569	44,857	37,204	59,711	40	0.0011	0.0007
Kamloops	872,944	417,721	177,950	455,223	585	0.0033	0.0013
Kootenay Lake	111,286	45,511	34,886	65,775	3,960	0.1135	0.0602
Prince George	246,133	150,426	57,279	95,708	95	0.0017	0.0010
Quesnel	436,278	138,802	167,033	297,477	927	0.0056	0.0031
Williams Lake	303,939	196,036	57,761	107,903	6,146	0.1064	0.0570

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

Balsam

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	10,780	19	12,354	10,761	16	0.0013	0.0015
Boundary	40,543	3,229	37,013	37,314	511	0.0138	0.0137
Golden	11,778	1	12,310	11,777	2,197	0.1785	0.1866
Revelstoke	13,122	98	18,718	13,024	6,925	0.3700	0.5317
Robson Valley	2,756	412	1,840	2,344	263	0.1429	0.1122
Cranbrook	15,724	-1,349	18,143	17,072	15,201	0.8379	0.8904
Invermere	28,249	185	9,937	28,063	2,400	0.2415	0.0855
Kamloops	59,036	716	47,819	58,320	4,633	0.0969	0.0794
Kootenay Lake	1,448	0	1,820	1,448	3,935	2.1628	2.7183
Prince George	641,941	166,288	199,993	475,653	12,830	0.0642	0.0270
Quesnel	56,508	4,122	33,915	52,387	878	0.0259	0.0168
Williams Lake	55,313	2,267	32,573	53,046	27,595	0.8472	0.5202

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

TSA Scale Area Timber Supply Risk Assessment Con't

Hemlock

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	181,654	96,950	45,918	84,704	11,281	0.2457	0.1332
Boundary	264,029	177,584	44,349	86,445	11,356	0.2561	0.1314
Golden	31,466	10,777	11,493	20,689	1,104	0.0960	0.0533
Revelstoke	148,316	109,964	34,598	38,352	16,143	0.4666	0.4209
Robson Valley	32,856	305	22,792	32,551	1,075	0.0472	0.0330
Cranbrook	33,249	477	25,670	32,772	911	0.0355	0.0278
Invermere	19,196	2,598	15,960	16,598	102	0.0064	0.0061
Kamloops	184,217	92,513	54,191	91,704	4,818	0.0889	0.0525
Kootenay Lake	63,151	54,360	6,087	8,791	6,801	1.1173	0.7737
Prince George	137,421	34,149	93,271	103,273	118	0.0013	0.0011
Quesnel	44,696	122	32,630	44,574	59	0.0018	0.0013
Williams Lake	14,149	-73	11,574	14,222	15,308	1.3226	1.0763

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

Lodgepole Pine

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	139,314	79,823	42,423	59,491	765	0.0180	0.0129
Boundary	466,272	279,532	142,068	186,740	815	0.0057	0.0044
Golden	150,425	107,748	20,443	42,676	0	0.0000	0.0000
Revelstoke	4,967	743	3,805	4,224	0	0.0000	0.0000
Robson Valley	158,090	9,957	78,155	148,133	11	0.0001	0.0001
Cranbrook	732,353	678,395	43,330	53,958	2,589	0.0598	0.0480
Invermere	691,569	536,179	122,119	155,390	1,153	0.0094	0.0074
Kamloops	1,127,968	831,858	206,316	296,110	196	0.0009	0.0007
Kootenay Lake	99,007	55,651	30,024	43,355	1,096	0.0365	0.0253
Prince George	8,679,271	5,510,089	1,336,675	3,169,182	61	0.0000	0.0000
Quesnel	2,992,771	2,532,400	269,696	460,371	55	0.0002	0.0001
Williams Lake	3,381,793	2,681,672	318,928	700,121	478	0.0015	0.0007

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

TSA Scale Area Timber Supply Risk Assessment Con't

Spruce

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	65,953	45,392	13,447	20,561	4,544	0.3380	0.2210
Boundary	252,224	158,911	41,158	93,313	7,494	0.1821	0.0803
Golden	121,425	98,500	10,497	22,925	2,945	0.2805	0.1284
Revelstoke	78,901	57,825	18,427	21,076	18,904	1.0259	0.8970
Robson Valley	113,291	9,174	45,611	104,117	4,039	0.0886	0.0388
Cranbrook	103,790	74,726	17,129	29,064	3,982	0.2324	0.1370
Invermere	160,959	106,177	29,605	54,782	2,764	0.0934	0.0505
Kamloops	600,844	505,908	46,022	94,937	8,487	0.1844	0.0894
Kootenay Lake	61,249	42,566	11,628	18,683	8,086	0.6954	0.4328
Prince George	3,404,525	2,825,764	343,389	578,760	10,436	0.0304	0.0180
Quesnel	615,783	537,400	48,995	78,383	1,657	0.0338	0.0211
Williams Lake	630,877	425,995	117,167	204,882	42,531	0.3630	0.2076

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

Other Species

Scale Areas	Average Scaled Volume over 2001 - 07	Minimum Scaled Volume over 2001 - 07	A - Average absolute deviation of total scaled volume	B - Average scaled volume less minimum scaled volume	Impact to the District - Average Scenario	Risk Level to A	Risk Level to B
Arrow	101,198	81,608	13,048	19,591	2,804	0.2149	0.1431
Boundary	192,082	132,296	29,401	59,786	2,325	0.0791	0.0389
Golden	4,724	3,124	1,104	1,600	18	0.0164	0.0113
Revelstoke	8,439	3,637	3,239	4,802	94	0.0291	0.0196
Robson Valley	3,782	138	2,934	3,644	12	0.0041	0.0033
Cranbrook	81,402	62,273	11,662	19,129	669	0.0574	0.0350
Invermere	54,720	39,606	12,806	15,114	154	0.0120	0.0102
Kamloops	46,401	29,471	7,841	16,930	68	0.0086	0.0040
Kootenay Lake	30,908	19,881	6,581	11,028	1,288	0.1958	0.1168
Prince George	28,901	6,157	14,416	22,745	12	0.0008	0.0005
Quesnel	24,426	776	23,250	23,651	2	0.0001	0.0001
Williams Lake	2,344	17	1,880	2,327	22	0.0115	0.0093

Total Scaled Volume are all timbers scaled in the district from all land types with waste and reject volume excluded.

Highlights of Findings:

All Species:

- No significant risk (risk level > 1) was found when considering total supply to the sector (i.e., all species). However, Revelstoke and Kootenay Lake timber supply areas are approaching increased risk levels with risk levels greater than 0.5.
- The largest timber supply impact in terms of volume is forecast in the Williams Lake TSA, but the volume remains substantially below identified risk thresholds. There is a potential concern that risk in this area will increase as more operations are shifted to the eastern supply blocks.
- Specific mills may be at greater risk if their dependence on the area's fibre flows is higher than the area's averages.

Species Specific:

- Revelstoke is most vulnerable to potential reductions to the volume of spruce. The risk level was greater than 1 suggesting a high risk level.
- Reductions in the volume of cedar flowing to Revelstoke are approaching, but do not exceed risk thresholds.
- For the Kootenay Lake, there is high risk associated with caribou related reductions to hemlock and balsam, although these reductions combined account for just over 10,000 cubic metres.
- Reductions in the volume of spruce flowing to Kootenay Lake are approaching, but do not exceed risk thresholds.

Additional Considerations:

- Capacity differences between large and small mills suggest that regardless of a change in timber supply, smaller mills operating well below capacity may be at risk to small timber supply reductions.
- Transport and other operating costs not captured through appraisal mitigation resulting from shifting chart areas may lead to higher risk for some mills regardless of the volume change.

Overall Risk Assessment Process:

Although the timber supply risk assessment provides insights into the broad sector impacts it is not able to assess the impacts that may arise for individual firms. In order to overcome this limitation the overall risk assessment has been structured to incorporate an opportunity for licensees and operators to provide firm specific information. By incorporating both the broader sector impacts with firm specific information the decision makers will be better able to understand the scope of the potential impacts.

The details of the firm specific reporting process are in the final stages of development and should allow for individuals to self identify concerns over specific timber impacts and costs.

Appendix 1

Timber Supply Implications of Mountain Caribou Recovery Plan Incremental Habitat – Inputs to Economic Risk Assessment

Prepared by Jeff Stone, RPF, Regional Timber Supply Analyst, Southern Interior Forest Region, May 7, 2008.

Introduction

This report updates the March 17, 2008 report “Timber supply implications of Mountain caribou recovery plan incremental habitat – inputs to economic risk assessment”. It is a draft working document describing input provided for the economic risk assessment that is being prepared by the Economics and Trade Branch of the Ministry of Forests and Range.

Several previous reports provide timber supply or timber harvesting land base implications of the Mountain caribou recovery plan. These include Valdal et al. 2007, Valdal 2008, Stone 2008a, Stone 2008b and Stone 2008c. Previous reports provided timber supply implications based on an assessment of a variety of data and information including identified incremental THLB impacts, species volume estimates, and characteristics of recent timber supply analyses.

This report, as did Stone 2008c, provides estimates of an impact based on distributing over a specified time period, an estimate of the current merchantable inventory of the timber harvesting land base that would be made unavailable due to the proposed recovery plan. The volumes in this report update the estimates of the volumes per hectare and incremental timber harvesting land base impacts found in Stone 2008c. Further, these volumes are now assumed distributed over a 50 year period for input into the economic risk assessment.

This report does not provide a “timber supply” impact estimate in the sense of looking at harvest flows over time as might be determined from forest estate models. Timber supply is dependent on the interaction of existing inventory, growth and yield, and forest management and social objectives. Nevertheless, the identification of the merchantable volume made unavailable is a significant factor that can influence short-term timber supply.

The actual timber supply made available to licensees in the short-term is dependent on a number of decisions including the chief forester’s allowable annual cut decision and contractual obligations. This document does not indicate allowable annual cut decisions. Allowable annual cut decisions are a determination made by the chief forester in consideration of timber supply information, environmental, social, and economic information.

The impact on timber supply due to a change such as caribou management is not a simple calculation. The determination of an impact is dependent on a number of factors including the choice of how such an impact is “spread through time”. Above we noted that we are assuming for the economic risk assessment that the impact of the “loss” of existing merchantable volume will be spread over a 50 year period. The choice of 50 years was arbitrarily made, though it corresponds approximately to a point where management units would be transitioning from the harvest of existing stands to the harvest of stands that had previously been harvested.

General Methods

This document provides estimates of inventory volume made unavailable due to the proposed mountain caribou recovery plan.

The mountain caribou recovery plan proposal does not enable directly determining the inventory volume made unavailable. The recovery plan developed by 4 planning teams as well as the current legal or recognized requirements varies among the mountain caribou planning units. As such determining the inventory volume made unavailable is not a straightforward inventory volume summary.

For this report, the inventory volume made unavailable was determined by multiplying an estimate of the merchantable volume per hectare within the incremental caribou zone by an estimate of the equivalent timber harvesting land base (THLB) made unavailable due to the recovery proposal. In the case where the caribou strategy was simply the application of a no-harvest zone over an existing harvestable zone with only integrated resource management requirements, the volume in the caribou no-harvest zone would be considered to be the product of the average volume by the incremental THLB.

The merchantable volume per hectare was summarized from the most recently available inventory data that had been coarsely updated to 2007 for depletions. Volumes were determined only for the timber harvesting land base within the proposed incremental mountain caribou management areas. Volume per hectare estimates were stratified by management unit and caribou planning unit. Volumes were based on a 12.5+ cm dbh utilization level of lodgepole pine and a 17.5+ cm dbh for all other species. This work was completed by MFR SIFR geomatics group. The first draft of this work is described in MacGregor et al. 2008, however, all summaries were updated to May 8, 2008 and includes information from tree farm licences and refined mountain caribou recovery plan areas.

Several sources of estimates for incremental timber harvesting land bases impacts were available. The sources for estimates included estimates provided by the planning tables based on their assessments, estimates calculated by MFR SIFR geomatics group, and estimates derived from planning tools. The sources of these estimates and the reasons for the choices that I made are described in Appendix A where the specifics around the methodology used in each caribou planning unit are noted

Results

Table 1 identifies the annual inventory volume that would be assumed to be unavailable over a 50 year period for each forest management unit. Table 2 provides the same information by forest district. Table 3 identifies by management unit the assumed incremental timber harvesting land base impact and the volumes per hectare used. Background on these estimates for individual units are discussed in Appendix A.

Discussion

Volume impact over a 50 year period is a simplistic statistic to use as a surrogate for the short term timber supply impact of the proposed mountain caribou recovery plan.

The statistic is an easy to understand value that enables stakeholders to hypothesize the implications of different assumptions (e.g., different levels of impact, length impact distributed). Further the derivation of this statistic as the product of the average volume per hectare and the estimate of an equivalent timber harvesting land base impact provides simple understandable factors.

Each of the 3 components (volume per hectare, equivalent timber harvesting land base, and distribution decision) contain varying levels of uncertainty and potential biases. This analysis provides a reasoned attempt at quantifying these factors based on available information and opinions. The results from this analysis will not provide a definitive timber supply impact about the Mountain caribou recovery proposal. It will provide a relative understanding of the impacts of the strategy within a management unit which then can be used within the ministry's model for understanding potential economic risk based on scaled volumes.

Users of the information in this report and the economic risk assessment need to be critical of the methods and results. These results, where necessary, should lead to further investigation of the impacts, using more refined methods to address specific questions.

Table 1. Average annual volume (cubic metres per year) by species for forest management unit expected to be removed from the current inventory over a 50 year period. The volumes are calculated by multiplying (a) the identified equivalent timber harvesting land base that is to be made unavailable due to the mountain caribou recovery plan over existing management and (b) an estimate of the species volume per hectare found within the recovery plan area.

Management Units	Average Volume Impact (cubic metres per year)								Total
	Lodgepole Pine	Red Cedar	Spruce	True Fir	Hemlock	Douglas Fir	Larch	Other	
Arrow TSA	847	2005	4369	4060	5783	5803	1862	489	25217
Cranbrook TSA	1889	2	1370	1089	24	10	69	267	4720
Golden TSA	0	1830	1488	429	1188	165	0	1	5101
Invermere TSA	413	0	1152	474	0	4	13	57	2114
Kamloops TSA	379	1153	11017	8437	936	316	0	71	22308
Kootenay Lake TSA	3010	9348	16922	14859	18880	8126	725	2754	74623
Okanagan TSA	0	1159	4159	5360	670	750	0	111	12210
Prince George TSA	61	99	7507	7469	0	0	0	35	15171
Quesnel TSA	29	4	870	386	1	13	0	1	1304
Revelstoke TSA	0	9103	15838	5458	10823	961	0	71	42254
Robson Valley TSA	11	1494	5172	3993	1409	704	0	37	12819
Williams Lake TSA	508	37805	48162	32071	27532	7964	0	148	154190
100 Mile House TSA	13	1	341	137	0	2	0	0	494
TFL 14	15	0	994	1066	0	0	0	13	2088
TFL 23	353	3381	3332	2158	6836	1751	744	351	18907
TFL 33	0	0	117	127	0	0	0	0	244
TFL 52	31	0	821	546	0	0	0	0	1399
TFL 55	0	122	1349	622	359	2	0	0	2454
TFL 56	0	2600	3013	1035	4320	195	0	0	11164

Table 2. Average annual volume (cubic metres per year) by species for forest district expected to be removed from the current inventory over a 50 year period. The volumes are calculated by multiplying (a) the identified equivalent timber harvesting land base that is to be made unavailable due to the mountain caribou recovery plan over existing management and (b) an estimate of the species volume per hectare found within the recovery plan area.

Forest District	Average Volume Impact (cubic metres per year)								Total
	Lodgepole Pine	Red Cedar	Spruce	True Fir	Hemlock	Douglas Fir	Larch	Other	
Arrow Boundary	1200	5386	7701	6218	12619	7554	2606	841	44124
Central Cariboo	508	37805	48162	32071	27532	7964	0	148	154190
Columbia	0	13654	21688	7545	16691	1323	0	72	60973
Headwaters	390	2646	16189	12430	2345	1020	0	108	35128
Kootenay Lake	3010	9348	16922	14859	18880	8126	725	2754	74623
Okanagan Shuswap	0	1159	4276	5487	670	750	0	111	12453
Prince George	61	99	7507	7469	0	0	0	35	15171
Quesnel	60	4	1691	931	1	13	0	2	2702
Rocky Mountain	2316	2	3516	2629	24	15	82	337	8921
100 Mile House	13	1	341	137	0	2	0	0	494

Table 3. Incremental timber harvesting land base impacts and species volume per hectare estimates by management unit and caribou planning unit.

Forest District Mgmt Unit / Planning Unit		Incremental THLB (ha)	Average volume (cubic metres per hectare) over proposed caribou management zone								Total
			Douglas Fir	Hemlock	Larch	Lodgepole Pine	Other	Red Cedar	Spruce	True Fir	
<u>Arrow Boundary FD</u>											
Arrow TSA	2b	5061	53.2	53.0	16.3	5.0	3.1	18.1	31.1	28.6	208
	1a	1011	20.7	20.9	10.4	16.7	8.8	8.7	60.1	57.7	204
TFL 23	2b	6413	13.7	53.3	5.8	2.7	2.7	26.4	26.0	16.8	147
<u>Central Caribou FD</u>											
Williams Lake TSA	5b	25108	15.9	54.8	0.0	1.0	0.3	75.3	95.9	63.9	307
<u>Columbia FD</u>											
Golden TSA	3a	730	11.3	81.4	0.0	0.0	0.0	125.3	101.9	29.4	349
Revelstoke TSA	3a	5075	9.5	106.6	0.0	0.0	0.7	89.7	156.0	53.8	416
TFL 55	3a	336	0.3	53.4	0.0	0.0	0.0	18.1	200.8	92.5	365
TFL 56	3a	1356	7.2	159.3	0.0	0.0	0.0	95.9	111.1	38.2	412
<u>Headwaters FD</u>											
Kamloops TSA	3a	60	0.0	0.4	0.0	0.0	0.0	0.2	83.6	203.8	288
	4a	6000	2.6	7.8	0.0	3.2	0.6	9.6	91.0	68.3	183
Robson Valley TSA	3a	441	77.6	122.7	0.0	0.0	3.5	119.9	90.1	9.7	424
	4a	39	1.2	25.3	0.0	11.2	4.1	26.4	132.3	93.7	294
	5a	782	0.0	1.3	0.0	0.2	0.2	0.2	128.6	136.4	267
	6	948	1.0	15.1	0.0	0.0	0.0	21.7	119.3	89.8	247

Table 3 (continued).

Forest District Mgmt Unit / Planning Unit	Incremental THLB (ha)	Average volume (cubic metres per hectare) over proposed caribou management zone									Total
		Douglas Fir	Hemlock	Larch	Lodgepole Pine	Other	Red Cedar	Spruce	True Fir		
<u>Kootenay Lake FD</u>											
Kootenay Lake TSA	2b	8404	46.5	84.3	0.0	5.5	11.8	46.6	47.6	21.0	263
	1a	1822	3.5	13.8	3.5	3.9	3.1	6.9	70.8	69.5	175
	1b	5694	1.6	37.0	5.3	17.0	5.7	11.0	55.7	77.2	211
<u>100 Mile House FD</u>											
100 Mile House TSA	5b	104	0.9	0.0	0.0	6.2	0.1	0.7	163.8	65.9	238
<u>Okanagan Shuswap FD</u>											
Okanagan TSA	3a	1996	18.8	16.8	0.0	0.0	2.8	29.0	104.2	134.3	306
TFL 33	3a	81	0.0	0.0	0.0	0.0	0.0	0.0	71.9	78.4	150
<u>Prince George FD</u>											
Prince George TSA	5a	0	1.7	1.3	0.0	0.4	0.0	3.6	111.6	109.0	228
	6	3579				0.9	0.5	1.4	104.9	104.3	212
TFL 30	6	804	0.0	6.6	0.0	0.0	0.1	0.1	119.6	89.9	216
<u>Quesnel FD</u>											
Quesnel TSA	5b	218	2.9	0.2	0.0	6.6	0.3	1.0	199.6	88.5	299
TFL 52	5b	288	0.0	0.0	0.0	5.4	0.1	0.0	142.5	94.7	243
<u>Rocky Mountain FD</u>											
Cranbrook TSA	1b	1227	0.4	1.0	2.8	77.0	10.9	0.1	55.8	44.4	192
Invermere TSA	1b	426	0.5	0.0	1.6	48.5	6.7	0.0	135.2	55.6	248
TFL 14	2b	644	0.0	0.0	0.0	1.1	1.0	0.0	77.2	82.8	162

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Appendix A – Comments on methods for individual planning units

Revelstoke/Shuswap (3-A) Caribou Planning Unit

Volume per hectare

Volume estimates were based on average species estimates derived from the timber harvesting land base from within the identified incremental no-harvest zones. Volumes were obtained from the most recently available inventory coverage and timber harvesting land base definition. Utilization levels were 12.5+ cm dbh for lodgepole pine and 17.5+ cm dbh for other species.

One exception to using the most recent inventory was for TFL 33. An oversight resulted in inventory and THLB information from TFL 33 was not included in the data set. For volume estimates of TFL 33, inventory estimates from the Okanagan TSA that overlapped slightly with TFL 33 and its incremental caribou zone was used. As the incremental THLB impact to TFL 33 is expected to only be 80 ha, further work was not pursued.

Incremental THLB

Incremental no-harvest zones were spatially identified in this unit. Estimates of the increment were based upon incremental timber harvesting land base estimates identified by the Revelstoke/Shuswap Caribou Habitat Team (February 22, 2008). These estimates are based upon the “analysis” data set of the herd biologists.

Other bases for estimating the impact suggest a lower incremental THLB impact. For example, the herd biologist’s summary suggests a 10,075 ha THLB impact in planning unit 3-A. An analysis on the SaRCO base, for which the budget was derived, suggests a 9105 ha THLB impact for the whole planning unit. The analysis by MFR SIFR geomatics group, suggests for the Columbia Forest District an impact of only 6323 ha THLB as compared to 7497 ha in the herd biologist estimate.

The herd biologist estimate of timber harvesting land base was used as it has considered reasoned estimates. For example, based on his data set there were approximately 245 ha of incremental THLB outside of the THLB (mainly in TFL 55 and 56). Licensees had indicated that these areas would likely be harvested even if they were not described as THLB. As such, a decision was made to include these areas as incremental.

This assessment does not consider further work to map an additional 1000 ha of age class 2 habitat. This habitat is not expected to have significant, if any, merchantable volume that would contribute to short-term impact. This additional habitat will have mid-term and long-term impacts in the range of 2,000 to 3,000 cubic metres per annum.

Distribution of Impact

In terms of the distribution of inventory impacts, the transition between existing and managed stands occurs 6-7 decades in the future for all 4 management units. This suggests that the distribution of the impacts across 5 decades is feasible.

Wells Gray-Thompson Planning Unit (4-A)

Volume per hectare

The volume per hectare determined for this unit was based upon the timber harvesting landbase found within the proposed no-harvest area. Information from the attribute management zones was not included. Volumes were obtained from the most recently available inventory coverages and timber harvesting land base definition in the Kamloops and Robson Valley TSAs. Utilization levels were 12.5+ cm dbh for lodgepole pine and 17.5+ cm dbh for other species.

Volume estimates for the attribute management zone was not used to calculate the average volumes per hectare. If this area differs substantially from the no harvest polygons a potential bias exists when applying the average across all incremental THLB impacts.

Incremental THLB

In Wells Gray-Thompson planning Unit (4-A), the conceptual agreement (as well as other options) identify a 6000 ha incremental THLB impact as a no-harvest zone and an attribute management zone.

In this volume impact analysis, I assume that the total required suitable habitat in the attribute management zone is all considered incremental impact. Alternative assumptions around the ability to “move” the suitable habitat would result in lower incremental impacts. For this analysis, I decided to assume that the full target in the attribute management zone is considered an incremental impact.

Incremental THLB in the Wells Gray-Thompson planning unit is the increment above a 2007 licensee proposal (Kamloops TSA Licensees 2007) that was accepted by SaRCO. The current legal requirement is based upon the Kamloops LRMP Appendix 10. Impact above the current legal requirements would be greater than above the accepted licensee proposal.

Distribution of Impact

In terms of the distribution of inventory impacts, the transition between existing and managed stands occurs 3-4 decades in the future for the Kamloops TSA. The use of a 5 decade average thus may underestimate the timber supply implications.

Quesnel Highland (5-B)

Volume per hectare

The volume per hectare determined for this unit was based upon the timber harvesting landbase found within the proposed no-harvest and no harvest zones. Information from the corridor or modified harvest management zones was not included. Volumes were obtained from the most recently available inventory coverages and timber harvesting land base definition in the Williams Lake, Quesnel, and 100 Mile House TSAs and TFL 52. Utilization levels were 12.5+ cm dbh for lodgepole pine and 17.5+ cm dbh for other species.

Volume estimates for the corridor or modified management zones were not used to calculate the average volumes per hectare. If this area differs substantially from the no harvest polygons a potential bias may exist when applying the average across all incremental THLB impacts.

Incremental THLB

The Cariboo-Chilcotin Caribou Strategy Committee identified a total of 25290 net hectares of incremental habitat protection for the Quesnel Highland planning unit (CCCSC 2007). As the proposed plan builds upon the mountain caribou strategy of the Cariboo-Chilcotin Land Use Plan, specific conversion factors were used to identify, where necessary, the impact from a previous land use value to the proposed.

The degree of correspondence of the conversion factors to actual timber supply, short-term inventory unavailability, or equivalent timber harvesting land base is not certain. The accounting of THLB impact used is very simplistic. It does not necessarily consider the effects of the spatial and temporal distribution of habitat requirements and growth across the land base. In general, it is feasible that a management objective on a specific area could have no impact on timber supply or alternatively in the short-term the objective could have a larger impact.

The distribution of impacts across the 4 management units (Williams Lake TSA, Quesnel TSA, TFL 52, and 100 Mile House TSA) was not reported in CCCSC 2007. SIFR geomatics staff based on files and the conversion factors provided by CCCSC identified

Distribution of Impact

The transition between existing and managed stands occurs in decades 7-8 in timber supply analysis for pre-Mountain pine beetle infestation conditions in the management units of this caribou planning unit. However, given the large pine component of the management units this transition time period though will be shortened. Additionally, as harvest in the short-term is focused outside of the caribou no harvest zones, the impact might be considered more concentrated in the mid-term. As such, the use of a 5 decade average may underestimate the timber supply implications.

Hart Ranges (6) and Upper Fraser (5-A)

Volume per hectare

The volume per hectare determined for this unit was based upon the timber harvesting landbase found within the proposed core habitat (existing and incremental) zones. Information from the corridor habitat zones was not included. Volumes were obtained from the most recently available inventory coverages and timber harvesting land base definition in the Prince George TSA, TFL 30 and Robson Valley TSA. Utilization levels were 12.5+ cm dbh for lodgepole pine and 17.5+ cm dbh for other species.

The incremental THLB impacts are the result of removal of both the creation of no harvest zones and the removal of area from existing caribou management constraints and modelled assumptions around the contribution to the impact of the proposed and previous management objectives. As such, while the volume estimates simply from the proposed core habitat provide a reasonable estimate of the proposed no-harvest, there is uncertainty in the volume estimates of the impact given that we have not compared volumes of areas no longer contributing to the impact.

Incremental THLB

The Prince George Habitat Planning Team have identified proposed habitat protection zones for the Hart Ranges (6) and the Upper Fraser (5-A) planning units (PGHT 2008). Based on methodology similar to the SaRCO budget estimate methodology they calculated a total impact between the original caribou management requirements and the current proposal of 7966 ha. This estimate that is 1834 ha over budget included an accounting for area that was believed to be isolated by the strategy in the Robson Valley TSA.

As management zone specific impacts were not provided in PGHT 2008, SIFR geomatics staff compared the proposed management strategy to the current ungulate winter range order. The PGHT(2008) methodology was used except the area thought to be isolated was not included. It is now believed that this isolation is not present. This summary, which is in agreement with the habitat team's assessment, identifies a total incremental impact of 6007 ha THLB distributed between the 3 management units.

The accounting of THLB impact used above is very simplistic. It does not consider the effects of the spatial and temporal distribution of habitat requirements and growth across the land base. In general, it is feasible that a management objective could have no impact on timber supply or alternatively in the short-term the objective could have a larger impact.

Distribution of Impact

In terms of the distribution of inventory impacts, the transition between existing and managed stands occurs in decades 8-13 in the base cases for pre-Mountain pine beetle infestation timber supply analysis in management units within this planning unit. This time period will be shortened given the pine component of these management units. However, the use of 5 decades to distribute the impact for this assessment appears feasible.

Kootenay Planning Units (1-A, 1-B, and 2-B)

Volume per hectare

The volume per hectare determined for this unit was based upon the timber harvesting landbase recommended as a no-harvest zone. Volumes were obtained from the most recently available inventory coverages and timber harvesting land base definition in the Invermere TSA, Cranbrook TSA, Kootenay Lake TSA, Arrow TSA, TFL 14 and TFL 23. Separate estimates of volume per hectare were obtained for each management unit. Utilization levels were 12.5+ cm dbh for lodgepole pine and 17.5+ cm dbh for other species.

Incremental THLB

The existing caribou management under the order for the Kootenay Boundary Higher Level Plan is based upon aspatial management objectives. District staff had concerns that simple methods that quantified the impact of a management objectives (e.g., using 70% for a 70% must be greater than 100 years) may overestimate the THLB implications. In order to determine an incremental THLB impact staff from Arrow-Boundary forest district and ILMB Kootenay Sub-region provided an analysis using “the Fretwell table” approach. This approach does an accounting to ensure that sufficient suitable habitat is removed from the land base but also addresses some of the distribution concerns by prioritizing requirements first on non-THLB.

While the “Fretwell” approach in the short-term considers the distribution, it does not reflect dynamics of aging where currently non-suitable stands move into a condition of suitability (and potentially enables harvest of stands in the THLB that are currently used to meet targets). Further, the Fretwell method considers only the age characteristic of the THLB and non-THLB for suitability. It is likely that some non-THLB would not be suitable. As such it is important to recognize that the methods used focuses on short-term timber availability rather than looking at timber supply dynamics (i.e., increased mid-term availability can influence short-term availability)

Distribution of Impact

In terms of the distribution of inventory impacts, the transition between existing and managed stands occurs in decades 4 to 8 in analysis for pre-Mountain pine beetle

infestation conditions in management units within this planning unit. This time period will be shortened given some pine component within these management units. For the management units with short-transitions (TFL 23 and Invermere TSA), the use of a 5 decade average thus may underestimate the timber supply implications.