

# Kamloops TSA Forest For Tomorrow Prioritization of Survey Efforts (A Multiple Accounts Approach)

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Version 1.0

***Prepared for:***

Forests for Tomorrow  
Ministry of Forest, Forest Practices Branch  
727 Fisgard St.  
Victoria, BC  
Contact: Alanya Smith



***Prepared by:***

Forsite  
330 42<sup>nd</sup> St NW  
Salmon Arm, BC  
Contact: Cam Brown, RPF



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## 1. Introduction

The Forests For Tomorrow (FFT) program was established by the BC Ministry of Forests and Range in an effort to ensure that stewardship issues associated with disturbed forest land without any regeneration obligations, are addressed. The program's key objective is to reduce the amount of Not Satisfactorily Restocked (NSR) Crown forest land in BC that lies outside industry obligations, in an effort to improve future timber supply, while also reducing risks to biodiversity, water, fish, wildlife, and habitat<sup>1</sup>.

A Multiple Accounts Decision Analysis (MADA) framework was developed in 2007/08<sup>2</sup> to help prioritize areas for FFT investigation (e.g. survey, recce, etc). This project adapted and applied this framework to the Kamloops TSA in support of the recipient holder to prioritize areas of the TSA for further investigation. Input layers used to build the GIS resultant for this project can be found in Appendix A. Changes were made to the original MADA framework's design in order to align with the datasets available in the Kamloops TSA and scoring was adjusted in order to reflect local circumstances. Rationale is provided where assumptions differ from the original MADA document. These differences were regarded as not universal enough to warrant changing the original MADA document.

## 2. Objective

The primary objective of this project was to provide a product that directs FFT survey efforts toward viable opportunities that maximizes the benefits realized by FFT reforestation investments. Forsite currently holds the recipient agreement for the FFT program in the Kamloops TSA. The intent is to weave the results of this project into the already established 2008 survey program during this fiscal year and then build the 2009 survey program based on project results.

## 3. Area of Interest

The Kamloops TSA is located in the Southern Interior Forest Region ( Figure 1) and represents approximately 2,233,580 ha Crown land<sup>3</sup>. The northern half overlaps a portion of the Headwaters Forest District while the southern half consists of the entire Kamloops Forest District. TFL's 18 and 35 occur within the same geographic area but are not considered part of the TSA area.

About 65% of the TSA landbase is considered Crown Forested Land Base (CFLB). Of this, about 72% is considered available for harvesting. Douglas-fir and pine leading stands dominate the landscape (33% and 27%, respectively) with spruce and balsam leading stands (19% and 11%, respectively) making up the majority of the rest of the landscape (Figure 2).

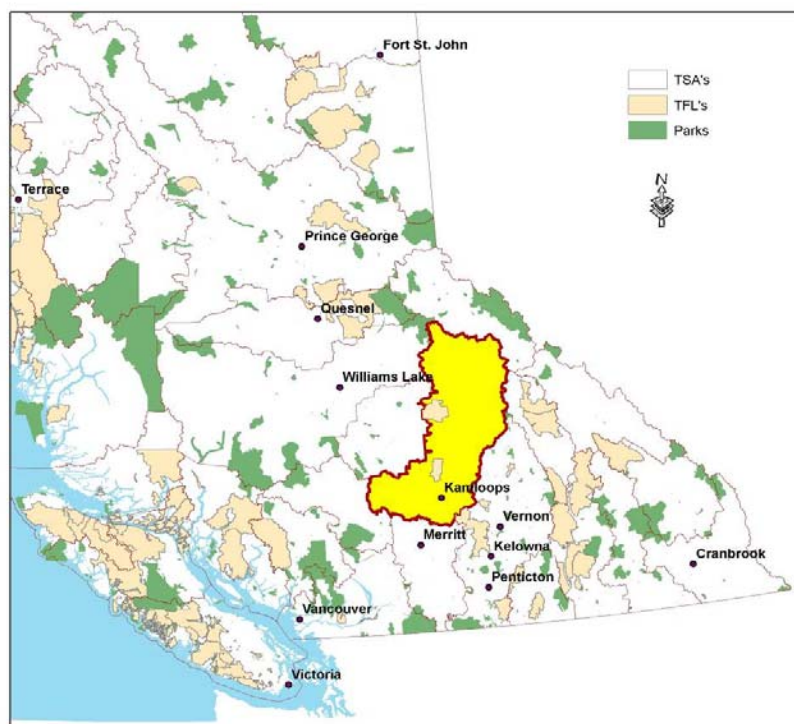


Figure 1. Location map for the Kamloops TSA

<sup>1</sup> FFT Program Management Plan 2007. [http://www.for.gov.bc.ca/hfp/fft/FFT\\_Mgt\\_Plan\\_2007.pdf](http://www.for.gov.bc.ca/hfp/fft/FFT_Mgt_Plan_2007.pdf)

<sup>2</sup> Integrating Timber and Non Timber Values into FFT Silviculture Investment Decisions (Forsite, March 2008)

<sup>3</sup> Excludes parks and protected areas (Wells Gray park)

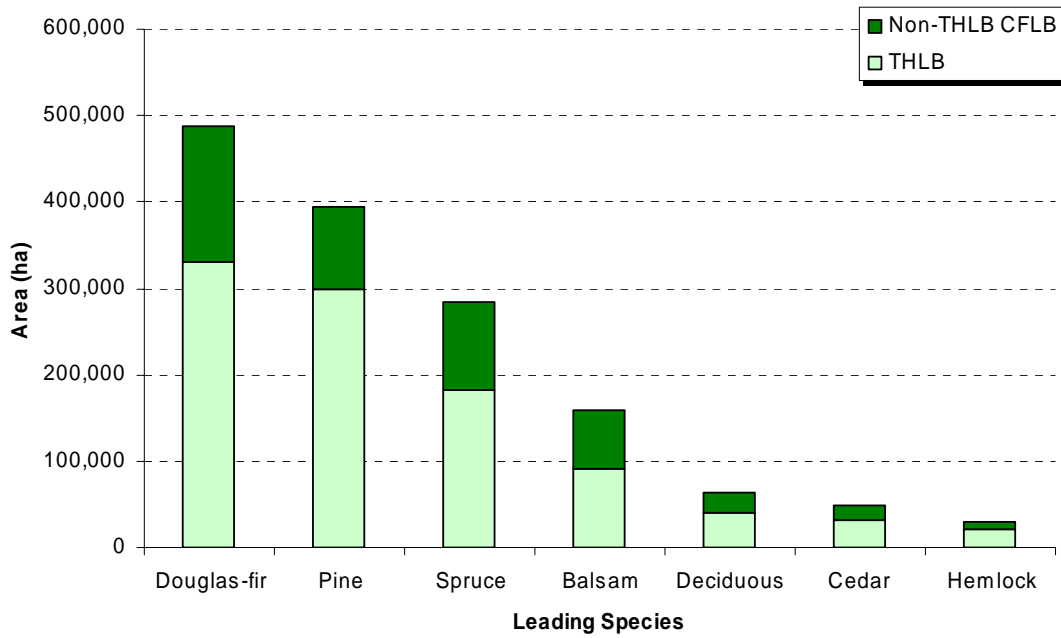


Figure 2. THLB and forested Non-THLB area by leading species in the Kamloops TSA.

Figure 3 shows the Timber Harvesting Land Base (THLB), the location of community watersheds, as well as recent fires (2003 onwards) in the Kamloops TSA.

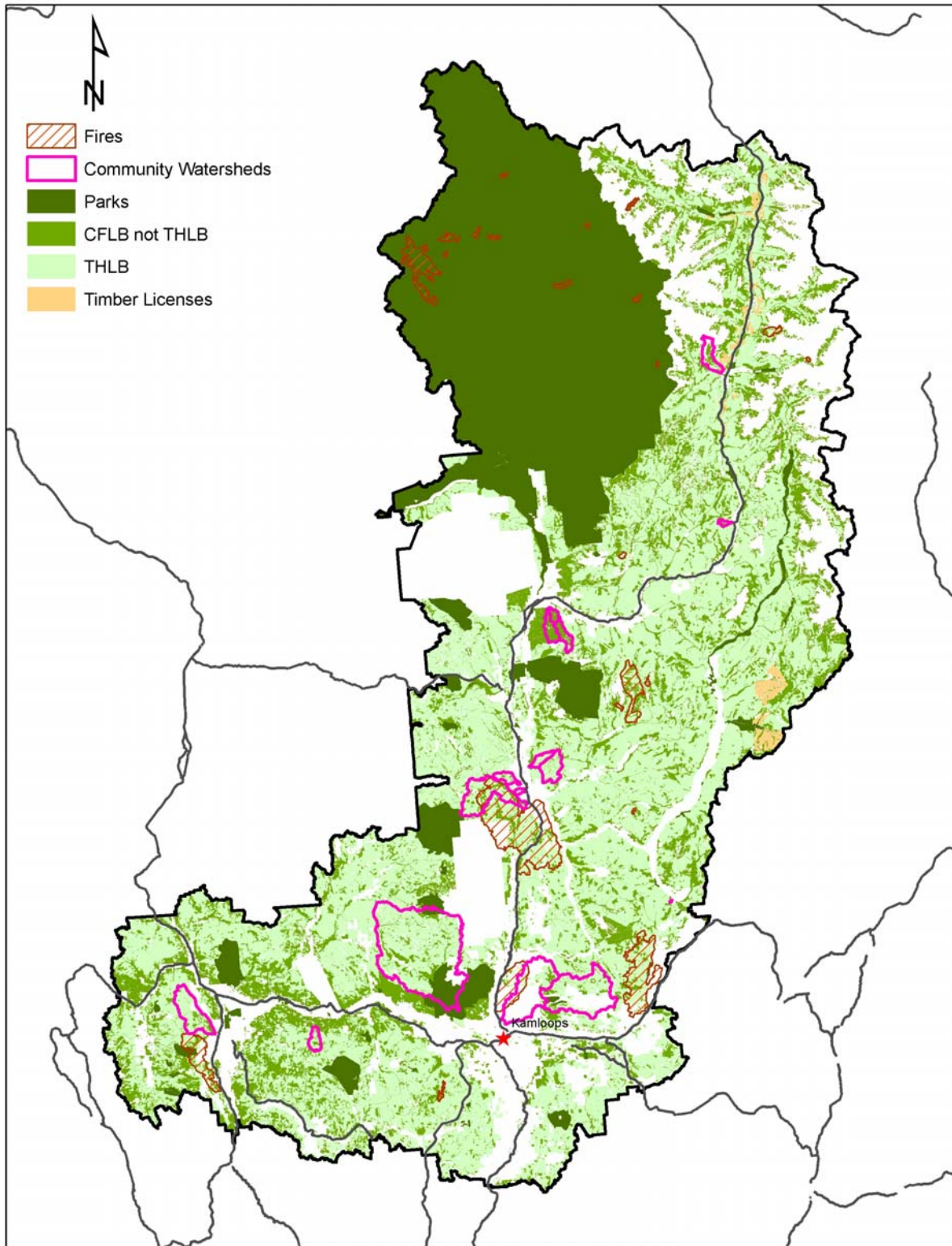


Figure 3. Timber harvesting land base, Community watersheds, and fires in the Kamloops TSA

## 4. FFT Footprint

The area where the FFT program has a mandate to operate is referred to as the FFT Footprint. This footprint is made up of areas that have been impacted by fires/pests/disease that now require reforestation investments to be made by the crown because no other tenure holder has reforestation obligations. This footprint area can be separated into three broad stratum: areas impacted by fires, immature areas impacted by forest pests/disease, and mature areas impacted by forest pests/disease. This later group is currently difficult to identify because of the potential for commercial interests to salvage areas and then incur the silviculture obligations for the site.

FFT silviculture investments are almost entirely limited to the Timber Harvesting Land Base, so this acts as another broad filter for the FFT footprint, whether it is filtered out entirely or assigned scoring that reflects its priority for investment. Treatments outside the THLB may still take place with appropriate approvals. The non-THLB was filtered out for the Kamloops TSA by the recipient in this case.

A complete list of factors used to define the Footprint areas in Kamloops TSA, along with rationalization, is provided in Table 1.

Table 1. Kamloops FFT netdown factors, rationale, and data source

Factor	Description / Rationale	Data Source
<b>Timber Harvesting Landbase</b>	The THLB definition from TSR4 (Timberline) was used to limit the FFT footprint to areas where future harvesting is expected. Currently, there is no reason to prioritize non-THLB areas for surveys as there are very limited opportunities to treat these areas with FFT dollars.	Timberlines TSR4 Resultant
<b>Silviculture Obligations</b>	Ensures that areas that have been logged and have silviculture obligations were not included in the population. Also ensured non-FG Pre-87 blocks are included as there are no obligations on these areas	RESULTS data queries Recent Licensee logged blocks
<b>Impacted by fires</b>	Any fires that have occurred since 1998 were included	Consolidated FAIB fire dataset
<b>Impacted by pests/disease with low salvage opportunity</b>	Any immature areas (<80yrs old) with IBM, IBS, or IBD <sup>4</sup> attack (trace to very severe) in the consolidated 2004-2007 health overview mapping were included. Mature impacted stands (>=80 yrs old) with a low salvage priority were included as defined by: <ul style="list-style-type: none"> <li>• Forest Health Overview Mapping of IBM, IBS, IBD attack</li> <li>• no current plans to log (Licensees and FTA data)</li> <li>• &gt;=50% PI + Mod, Severe or V Severe attack in last 4 yrs + (SI &lt;15 or vol/ha&lt;150 or piece size &lt;0.3)</li> <li>• any sites SI &lt; 17 with Mod-V Severe attack in 2004 and still not harvested.</li> </ul>	Consolidated forest health overview flights (2004-2007)  Consolidated FTA and licensee data Licensee planned blocks  Forest Inventory data
<b>Past FFT treatment</b>	Forsite FFT database was used to remove areas that have already been surveyed and/or classified as a "walk-away" because of access or costs.	Internal Forsite FFT tracking database
<b>Terrain</b>	Inaccessible areas (slopes >80%) were removed for treatment feasibility	DEM - already built for FFT last year
<b>First Nations / public interest areas</b>	No available data to identify areas where FFT treatments were not desired. <sup>5</sup>	Notdata obtained.
<b>SARCO Caribou Reserves</b>	SARCO Caribou reserves (100% reserves) were removed from potential treatment... Note: In future analyses they may be left in the population and regarded similarly to the OGMAs, where they may be treated if supported by MOE and will benefit from reforestation activities.	Caribou 'No Harvest' areas from Land use Coordination Office

Figure 4 depicts the approximate areas associated with each of the aforementioned categories as a result of applying the assumptions in Table 1 to the Kamloops TSA. These areas more or less represent the subset of the landbase where FFT treatments could potentially be applied.

<sup>4</sup> Codes representing mountain pine beetle, spruce bark beetle, and Douglas-fir bark beetle.

<sup>5</sup> No available dataset exists and feedback from MFR FN liaison staff and FFT staff indicated it was unlikely to be feasible to create within the timeframe of this project. The goal is to ensure it is included in update completed next year

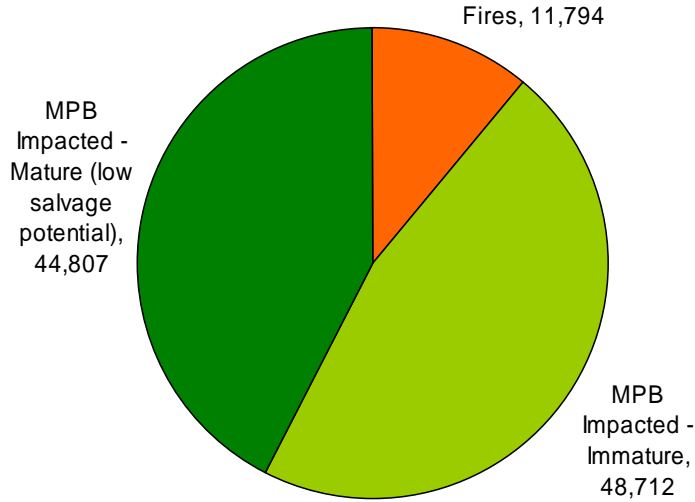


Figure 4. FFT Footprint estimated for the Kamloops TSA in 2008

## 5. Priority Scoring Methodology

### 5.1 Timber Prioritization / Scoring

The scoring and associated rationales for determining relative Timber Value across the Kamloops TSA FFT footprint area are detailed in Table 2. Detailed explanations and rationalization for departures from or additions to the original MADA approach are provided below the table. A general preference for areas impacted by fires or immature stands impacted by MPB is maintained.

Table 2. Relative Timber Values Scoring and Rationale applied to the Kamloops TSA.

Issue	Subgroups	Score	Data Source	Scoring Rationale
<b>Fire</b>	All impacted stands	50	Consolidated FAIB fire dataset	Fire areas are of high priority for treatment
<b>Immature MPB (&lt;80 yrs old)</b>	>70% PI, S or VS Attack	50	Veg inventory, consolidated forest health overview flights (2004-2007). Assume low end of the stand profile will not be salvaged (low SI, low m <sup>3</sup> /ha, cable logging, etc.)	Stands with higher levels of mortality will be higher priority for treatment. Below 50% PI, treatments are unlikely to be feasible because of green volume on site (low IRR).
	>70% PI, Mod Attack	40		
	>70% PI, Trace or Low Attack	30		
	50-70% PI, S or VS Attack	20		
	50-70% PI, Mod Attack	15		
	50-70% PI, Trace or Low Attack	10		
All others	0			
<b>Mature MPB (&gt;=80yrs old)</b>	>70% PI, Low Salvage Potential	30	Veg. inventory, consolidated forest health overview flights (2004-2007). Assume the low end of the stand profile will not be salvaged (Low SI, low m <sup>3</sup> /ha, cable logging, etc)	FFT does not want to invest in areas that are likely to be salvaged so only sites with a lower probability of salvage occurring get points. The higher the percent pine, the more likely the stand will be viable for treatment / will need treatment. Sites most likely to have low salvage potential are cable ground sites (>40% slope, < 200m <sup>3</sup> /ha) and low volume conventional ground (<40% slope, <150 m <sup>3</sup> /ha).
	>70% PI, Mod Salvage Potential	10		
	>70% PI, High Salvage Potential	0		
	50-70% PI, Low Salvage Potential	10		
	50-70% PI, Mod Salvage Potential	5		
	50-70% PI, High Salvage Potential	0		
	All others	0		
<b>Probability of Nat. Regen</b>	Low	0	Timberline Type 2 Analysis (applied Arbourtech natural regeneration probability model)	Sites with natural regen are less likely to require treatment and/or have lower IRRs because the volume gains associated with treatment are smaller.
	Moderate	-5		
	High	-25		

Issue	Subgroups	Score	Data Source	Scoring Rationale
Site Index	>=20	5	Veg. Inventory – no adjusted SI's available.	Assuming equal treatment costs, higher productivity areas will yield the highest IRRs. Don't want to visit poor sites so negative & exponentially larger below SI 15. (eg, SI 8 gets -81)
	15-20	3		
	<15	$-(17-SI)^2$		
Proximity to roads	<300m	2	Buffered Existing Roads data (Consolidated TRIM and Forest Tenure Roads)	Sites within existing access are better candidates for treatment due to lower treatment costs.
	300-1000m	1		
	>1000m	-1		
Past Silviculture (Spaced, pruned, or fertilized)	Yes	1	RESULTS data queries linked to veg. inventory.	Sites with previous investment are likely to be good sites with reasonable access.
Stand Level Economics	Uneconomic (<4)	-10	Timberline Silviculture Type 2 (applied Arbourtech Merch. Model)	Sites with higher net economic value at harvest are preferred. Merchantability considers stand value and all costs associated with harvesting the stand.
	Marginally Economic (4 - 6)	0		
	Economic (>6-7)	1		
	Highly Economic (>7)	2		

### 5.1.1 Rationalization for Changes to Timber Scoring

The following changes were made relative to the published MADA framework (Forsite 2008):

- The use of the THLB score (100) was not applied because only THLB stands were considered suitable candidates for priority survey work.
- The score values associated with 'Probability of Natural Regeneration' were reduced because of a lack of faith in the datasets ability to predict natural regen on the ground. It was felt that it did capture some broad trends and was better than nothing but applying extreme penalties based on this dataset was not warranted.

### 5.2 Non Timber Prioritization / Scoring

The scoring and associated rationales for determining relative Non Timber Value across the Kamloops TSA FFT footprint area are detailed in Table 3. Detailed explanations and rationalization for departures from or additions to original MADA approach are provided below the table.

Table 3. Relative Non Timber Values Scoring and Rationale

Issue	Subgroups	Score	Data Source	Scoring Rationale
Watershed	Community Watershed	5	CWS and DWS (LRDW)	Reforestation efforts will have a significant hydrological benefit that will be realized in a short timeframe relative to wildlife cover habitat benefits. Watershed health is a critical social and environmental issue. Post MPB watershed hazard is used in order to capture both existing disturbance levels in the watershed and the expected impacts from loss of PI. Treatments above H60 line are preferred.
	Domestic Watershed	5		
	Site is above H60 or H40 in watershed	1	H40 line for interior Plateau, H60 for rest. Derived during the "Risk-based watershed screening" <sup>6</sup> project	
	Moderate Risk Watershed (30-45 points)	0.5	Results from "Risk-based watershed screening" project completed by Forsite for MoE and KTSA Licensees. Risk is based on post MPB hazard ratings and watershed specific consequences (values at risk).	
	High Risk Watershed (45-70 points)	1		
	Very High Risk Watershed (>70 points)	2		
VQO with Disturbance	Preservation VQO with >5% under 20 yrs	1	VQO polygons and established VQO ratings. The % under 20 yrs was calculated for each VQO polygon from forest cover age.	Reforestation will help restore visual quality promptly. Only those VQO areas where disturbance is above acceptable levels warrant prioritization
	Retention VQO with > 10% under 20 yrs	1		
	Partial Retention VQO with > 15% under 20 yrs	1		
Fire Risk (Interface)	Within 10 km of a community	1	Buffered towns, villages, municipalities, cities, in BC Gazetteer.	Treatments within this zone can help to reduce fuels and provide an immediate reduction in risk. Only some prescriptions will actually result in reduced risk.

<sup>6</sup> Forsite et al. 2007. "A Risk-Based Watershed Screening Procedure for the Kamloops Timber Supply Area"

Issue	Subgroups	Score	Data Source	Scoring Rationale
Recreation	Within 1 km of mapped recreation sites or trails	1	Buffered recreation sites/trails on LRDW	Reforestation will help improve recreation values in a short timeframe.
Species at Risk	Mapped red and blue listed species areas (WHAs)	-10	Buffered WHAs from BC MoE	Without detailed knowledge of impacts and issues - best to avoid these areas.
Biodiversity (OGMAs)	OGMAs in high BEO's	1	SIR FTP	Areas of high BEO designation are the highest priority for biodiversity protection. Reforestation of OGMAs will help to re-establish old growth conditions ASAP (long term benefit).
	OGMAs in Intermediate BEO's	0.5		
	OGMAs in Low BEO's	0.25		
Terrestrial Wildlife Values	Deer Winter Range - Deep Snow	1	ILBM. Snowpack defined by BEC variants unique to each TSA. For example – BG, PP, IDFx are shallow, etc.	Reforestation activities will help provide cover habitat in the long term.
	Deer Winter Range - Moderate Snow	0.75		
	Deer Winter Range - Shallow Snow	0.5		
	Moose Winter Range	0.5	ILMB - moose habitat mapping.	Area impacted by MPB next to wetlands would benefit from cover re-establishment (long term benefit)
	SARCO Caribou attribute management zone	1	Land Use Coordination Office.	Reforestation will help to provide cover habitat in the long term.
	SARCO Caribou Managed Corridor	1	Land Use Coordination Office.	Reforestation will help to provide cover habitat in the long term.

### 5.2.1 Rationalization for Changes to Non Timber Scoring

The following changes were made relative to the published MADA framework (Forsite 2008):

- The MADA document uses post MPB Equivalent Clearcut Area (ECA) calculations as a surrogate for watershed risk. For the Kamloops TSA, a more detailed and robust indicator of watershed risk (Forsite et. al., 2007) was available and was therefore used in place of post MPB ECA calculations.
- Known priority areas for First Nations and Public were dropped because no available dataset existed and feedback from MoF FN liaison staff and FFT staff indicated it was unlikely to be feasible to create within the timeframe of this project. The goal is to ensure it is included in update completed next year.
- Open Range and Open Forest scoring was dropped because a suitable dataset did not exist for the Kamloops TSA.
- Grizzly bear scoring was dropped because detailed habitat mapping was not available.
- Scoring was adjusted to reflect priorities in the Kamloops TSA. Community watersheds and the H60/H40 line were elevated in importance.

### 5.3 Multiple Account Scoring:

Once scoring for timber and non-timber values was completed and each was standardized out of 10, multiple account scoring was determined using the 75% timber, 25% non timber weighting specified in the MADA framework document. The flowchart shown below (Figure 5) provides an overview of the scoring process.

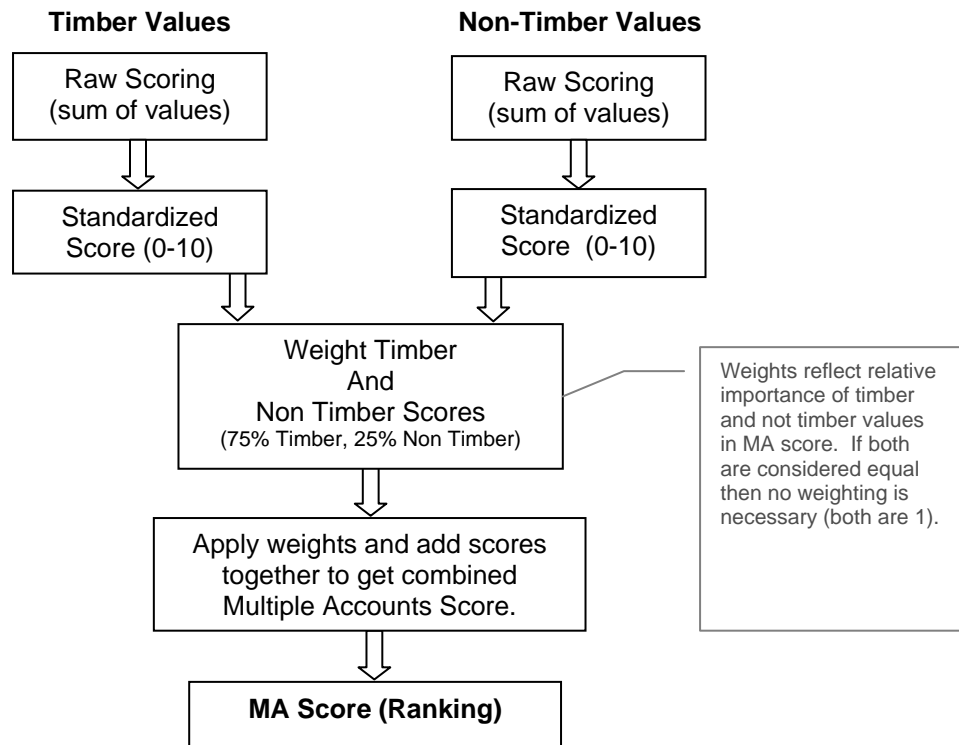


Figure 5. Flow Chart of process to derive the Multiple Account Score

## 6. Results

### 6.1 Multiple Account Scoring Results

The quartile results of the final multiple accounts scores for the candidate FFT survey areas is shown in Figure 6 by candidate stratum. This figure shows that the fires areas were heavily skewed toward 1<sup>st</sup> quartile rankings, while areas in the Mature MPB impacted stratum were skewed away from 1<sup>st</sup> quartile. This is a direct reflection of the scoring approach that de-emphasized mature MPB stands and only put a portion of the immature MPB stands (>70% PI + significant attack) on the same level as fires.

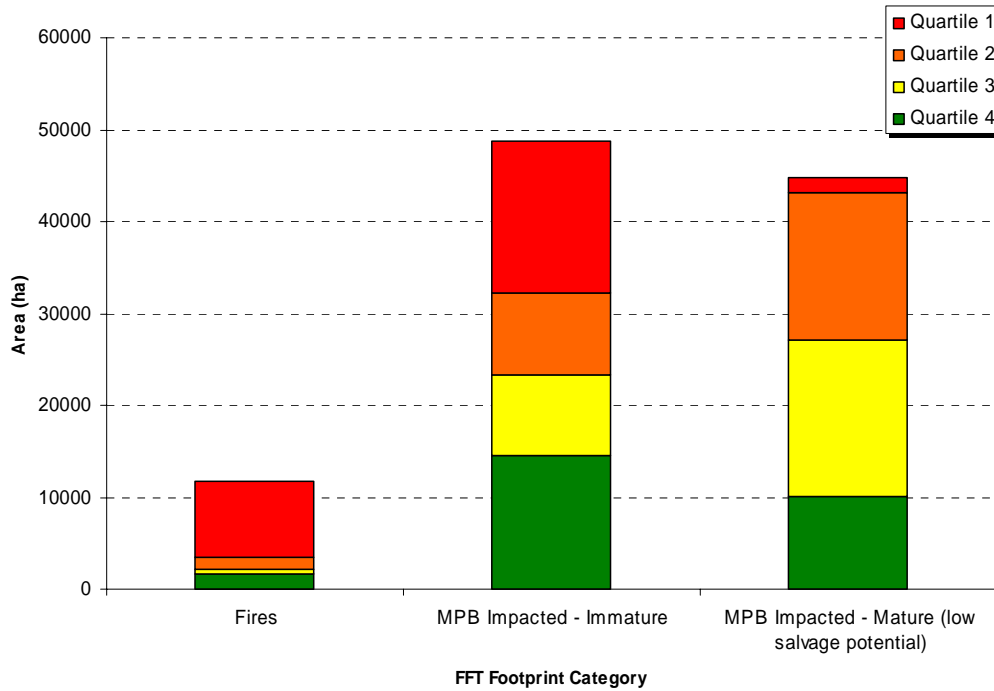


Figure 6. Kamloops FFT Multiple Accounts Footprint by Stratum Type and Priority Quartile.

The sites that had the highest multiple accounts scores, were those that scored well from both a timber and non timber perspective (win-win sites). To understand what these sites looked like in the Kamloops TSA, the timber and non timber scores of top quartiles candidates were examined. The best **timber** scores came from areas with high site indices, were close to roads (<100m), had good stand level economics, and were either within the fire or immature MPB impacted candidate stratum. The best **non timber** scores typically came from areas within community watersheds that were ranked as high risk that also overlapped with community fire interface zones, and highly restrictive VQOs. Occasionally wildlife related issues were also present in the top candidates.

The spatial distribution of the quartile ranking for the timber, non timber, and multiple account scores are shown in Figure 7.

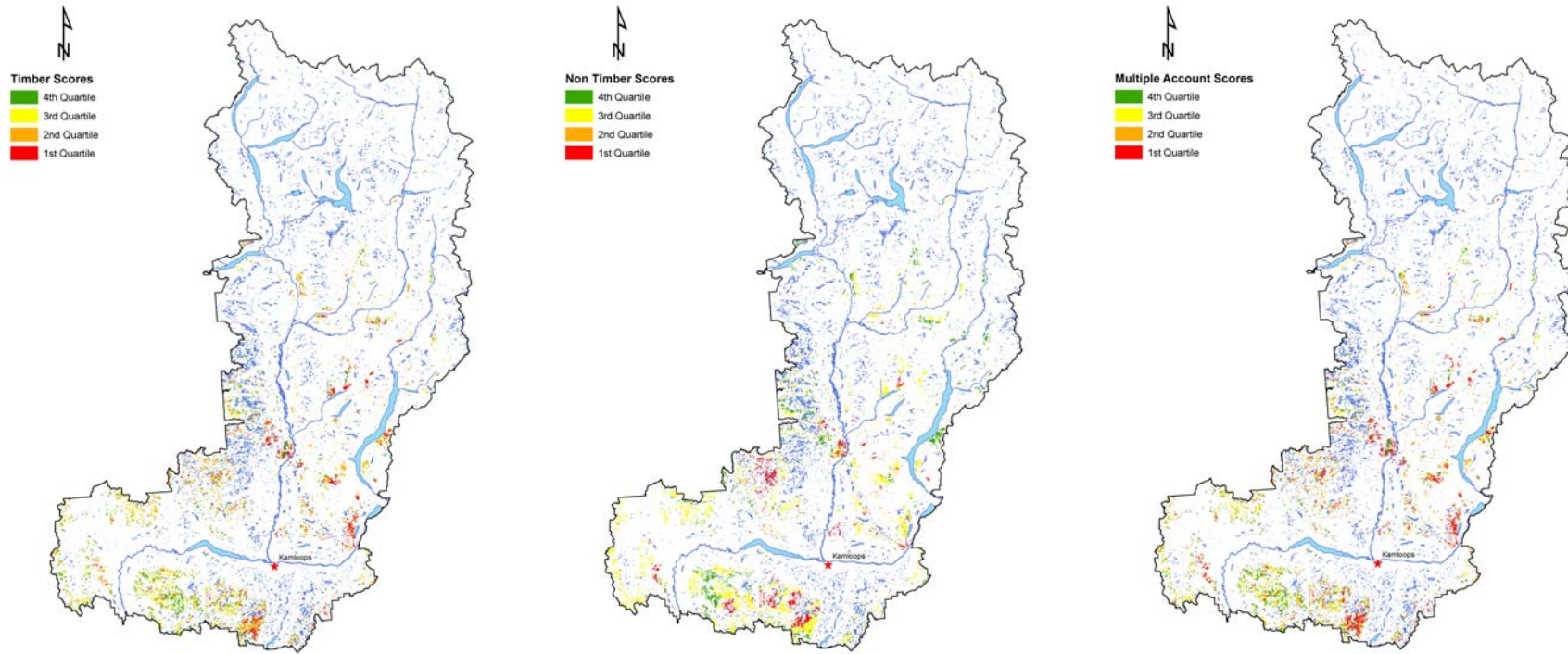


Figure 7. FFT priority areas by candidate stratum and quartile ranking for Timber, Non Timber, and Multiple Account scores

## 6.2 Profiling of Multiple Accounts Results

This section attempts to characterize the results of the multiple account scoring by showing the likelihood of finding a particular stand attribute within a given quartile.

### 6.2.1 Timber

Stands that received the highest timber scores were entirely within the 1<sup>st</sup> quartile of the multiple account score (Figure 8). This result occurs because of the emphasis placed on timber scores when calculating the multiple account score (75% timber, 25% non timber). The remainder of the site (not best timber scores) are evenly distributed throughout the other quartiles as expected.

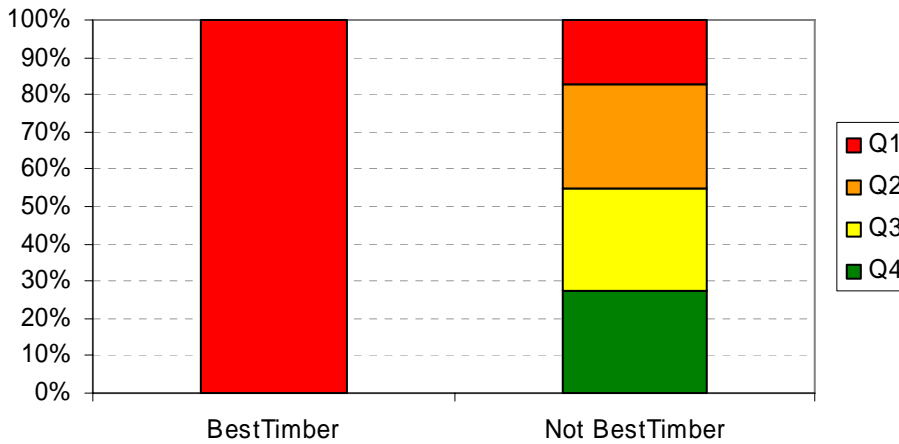


Figure 8. Likelihood of areas with high timber scores falling within Multiple Account quartiles

### 6.2.2 Non Timber

Stands that received the highest non-timber scores had a 48% chance of being within the 1<sup>st</sup> quartile and a 79% chance of being in the top 2 quartiles of the multiple account scores, while the remainder of the landbase had much lower representation in the top quartiles. This result shows that best non timber sites are favored in the multiple account rankings but not to the degree that the better timber sites are. Approximately 15% of the best non timber sites fall into the bottom quartile because they have poor timber scores. For example, high risk community watersheds contain areas of low productivity that are far from roads, etc.

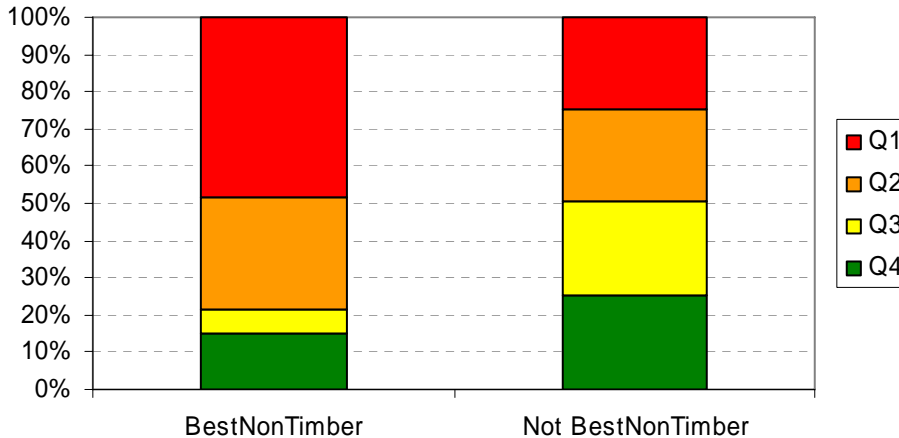


Figure 9. Likelihood of areas with high Non Timber scores falling within Multiple Account quartiles.

### 6.2.3 Community Watershed

Stands falling inside CWS's were more likely to fall in the top 2 quartiles than stands outside of CWS's (62% vs 49%).

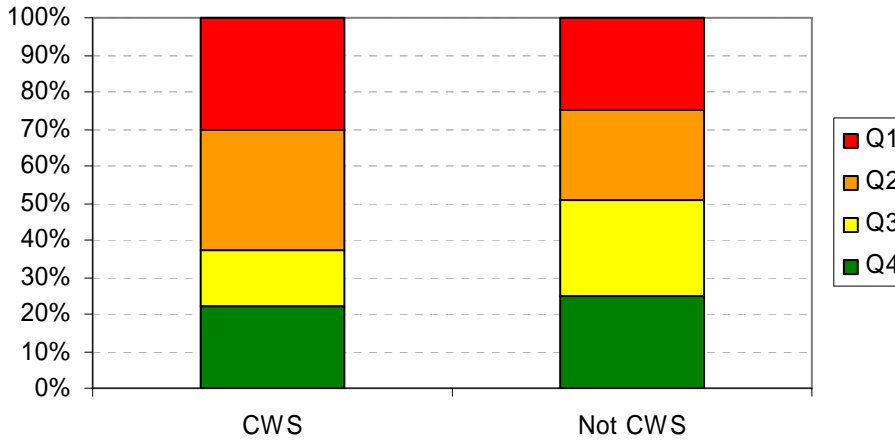


Figure 10. Likelihood of Community Watershed (CWSs) falling within Multiple Account quartiles.

### 6.2.4 High Risk Watershed

Stands falling inside high risk watersheds were less likely to be in the top quartile but slightly more likely to fall in the top 2 quartiles than stands outside of high risk watersheds (51% vs 48%). This occurs because of the this factor non timber values only contribute 25% of the total score and the high risk status makes up only a portion of the non timber score – however there is a slight preference for these stands and the areas with good timber values (win-wins) are still rising to the top.

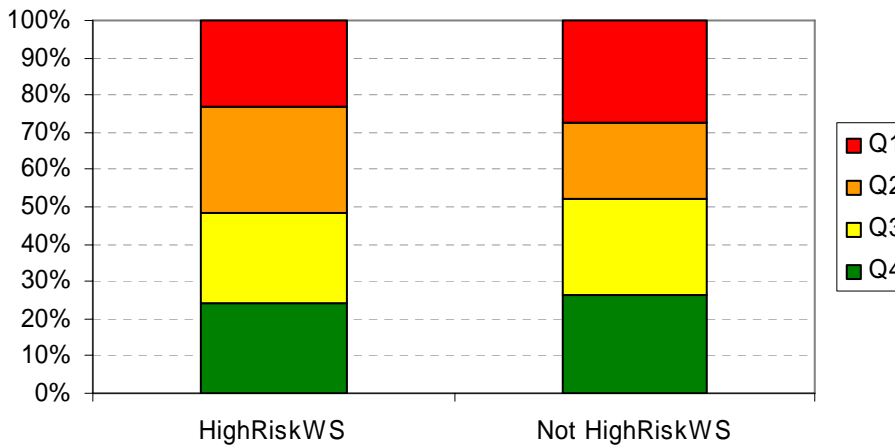


Figure 11. Likelihood of High Risk Watersheds falling within Multiple Account quartiles.

### 6.2.5 Visuals

Impacted visual areas are heavily skewed toward top quartile rankings when compared with non impacted visual areas. This cannot be attributed to scoring because of low points so it is likely that there is a correlation with these sites and good timber values.

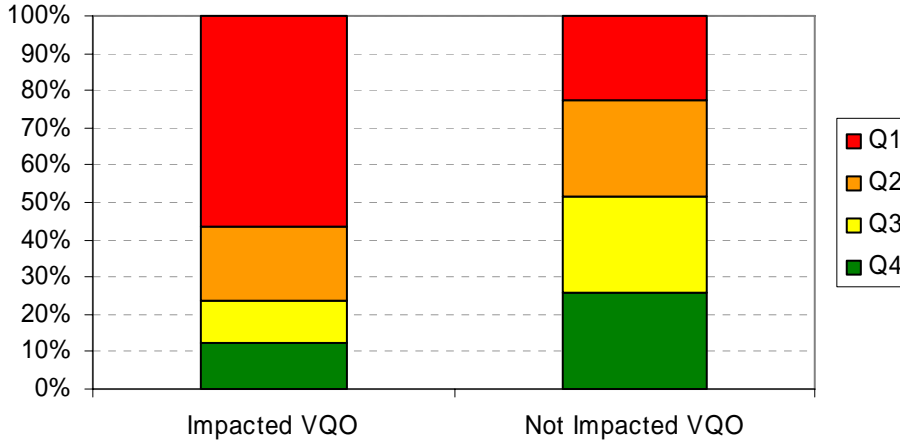


Figure 12. Likelihood of Impacted Visual areas falling within Multiple Account quartiles.

### 6.2.6 Deer

Again, deer winter range areas are heavily skewed toward top quartile rankings when compared with non deer winter range areas and the difference cannot be explained by point scores awarded to deer. It is likely that there is a correlation with these sites and good timber values because they tend to be valley bottom, easy access timber sites.

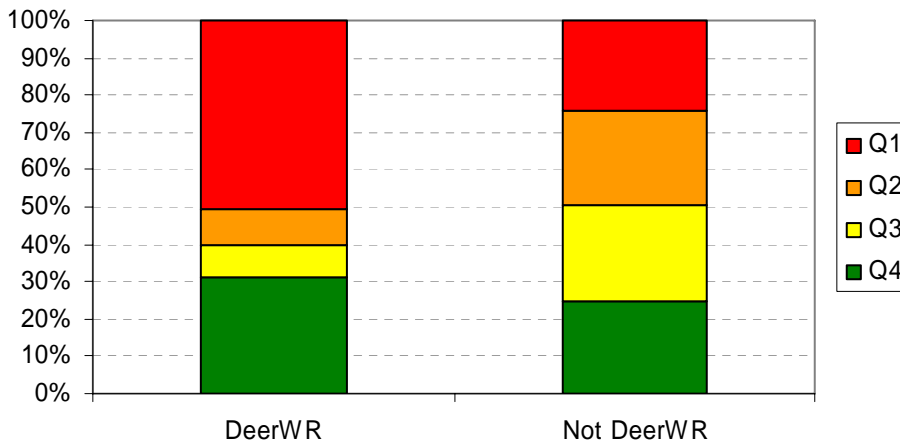


Figure 13. Likelihood of Deer Winter Range area falling within Multiple Account quartiles.

## 7. Discussion

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Analysis of the Multiple Account results show that the intent behind the scoring worked as planned and the stands that floated to the top had good timber and non timber scores. This product can improve the efficiency of the FFT survey program and ensure resources are directed towards sites that maximize benefits for timber and non timber values (win-win situations).

The intent is now to integrate the results with the operational FFT program over the course of 2008. Existing candidates scheduled for survey this year will be prioritized using the results of this project, while the development of 2009 candidates will rely more fully on this approach. Further consideration of whether FFT can access mature stands will be required at that time.

## References and Citations

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Forsite, 2008. Integrating Timber and Non Timber Values into FFT Silviculture Investment Decisions (Multiple Accounts Decision Analysis). March 21, 2008

Forsite, Grainger and Associates Consulting Ltd., M.J. Milne & Associates Ltd., Key Forest Resources. 2007. A Risk-Based Watershed Screening Procedure for the Kamloops Timber Supply Area. Version 4.0 May 22, 2007. Prepared for Kamloops TSA Licensees and BC Ministry of Environment.

Timberline, 2007. Developing A Multiple Accounts Decision Analysis Process For Effective Silviculture Investment Decisions. March 31, 2007

## Appendix 4. Data sources used to build the Kamloops FFT multiple accounts database

Issue	Source	Comments
Landbase definition (THLB, CFLB)	Timberline TSR4	July 2007 Vintage
Parks, private lands, woodlots, etc	LRDW	
Silvicultural Status	RESULTS (June 2007 extract)	ID logging, free growing status, and previous spacing or pruning.
Forest Cover	LRDW VRI Forest vegetation composite polygons	Provides SI, ages, %PI, etc
Recent Fires (1998-2007)	MFR Forest Analysis and Inventory Branch	Major fire include: McLure, Vermelin Creek, McGillvray, Strawberry Hill, Chewels Mtn, and Venables.
2004-2007 Insect attack levels	Consolidated forest health overview flights (2004-2007)	Limited to IBM, IBS, and IBD attack areas – classified into nil, trace, low, mod, severe, very severe attack.
Likelihood of Natural Regeneration	Timberline Type 2	Based on Arbourtech's model that uses ecosystems, aspect, %PI, age, and crown closure.
Existing Roads	TRIM/LRDW	These were buffered to ID areas within 300m and 1km of roads.
Stand Merchantability	Timberline Type 2	Based on Arbourtech's merchantability model. Stands are assigned a net value based on historical lumber/chip values and appraisal costs.
Community Watersheds	LRDW	
Visual Quality Objectives	SIR FTP	Contains both Headwaters District and Kamloops district VQOs
BC Gazetteer (population centers)	LRDW	Towns, villages, municipalities, and communities were used.
FN / Public Areas of Interest	Not used.	No available mapping.
OGMAs	SIR FTP	
Landscape Units and Biodiversity Emphasis Areas	SIR FTP	
Recreation Trails and Sites	LRDW	Points, lines (trails) and polygons (sites) were obtained.
Wildlife Habitat Areas (WHA's)	<a href="http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html">http://www.env.gov.bc.ca/wld/frpa/iwms/wha.html</a>	
Deer Winter Range	SIR FTP	Shallow snowpack (PP, BG, IDFx_), Mod Snowpack (IDF, MS, ICHx_/d_), Deep ICH other, ESSF.
Moose Winter Range	SIR FTP	
Caribou Habitat	<a href="ftp://gis.luco.gov.bc.ca/pub/outgoing/sarco/">ftp://gis.luco.gov.bc.ca/pub/outgoing/sarco/</a>	Indicates no harvest areas and caribou corridors
High Value Grizzly Habitat	n/a	No mapping available.
High Value Fish Habitat	n/a	No mapping available.
OR and OP Ecosystems	n/a	Designations in forest cover mapping were not suitable as they are considered non forested areas.
H60 and H40	Forsite Derived	Represents the upper, sensitive portion of watersheds
Harvest Depletions	Consolidated Licensee block data	Data collected from licensees for Kamloops operating area project

<b>Issue</b>	<b>Source</b>	<b>Comments</b>
Watershed Risk	Forsite derived for watershed risk rating procedure project.(Forsite et. al, 2007)	Watershed Risk Rating procedure
FFT Field Visited Area	Forsite Derived Dataset (recipient agreement holder)	Identifies were survey have already been conducted.
Biogeoclimatic Ecosystem Classification	LRDW	