Williams Lake Timber Supply Area
Forest Health Strategy
2016/2017

BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

Endorsed By:

Harold Stolar
District Manager
Cariboo-Chilcotin Natural Resource District

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Prepared by Kristine Wilker, RPF

Foreword

The purpose of the Williams Lake TSA Forest Health Strategy 2016/2017 is to inform operational planners, reviewing agencies and approval authorities of forest health risks, issues and best management practices.

Updates of Note 2016/17:

- Beetle Management Unit Maps with Corresponding Strategies.
- Priority and ranking of *Forest Health Factors in the Williams Lake TSA (Table 2)*.
- Reducing the impacts of climate change.
- Non-recoverable losses.
- Description of key TSR issues.
- Emergency Bark Beetle Management Area (EBBMA) was rescinded July 3, 2014. Blanket Salvage permit direction provided (Appendix 3).

Forest Health Factors to note for the coming field season are:

- Douglas-fir bark beetle – Concerns about the growing population prompted the Douglas-fir bark beetle specific Strategic Management Plan and Implementation Plan for the Cariboo Region. The strategy map also contains a "suppression=High" category to aid in directing resources.
- Western spruce budworm – Predictive sampling indicated a general collapse of the sustained outbreak the region has been experiencing so this is the first year since 1997 that an aerial treatment program will not be conducted as. Detailed western spruce budworm monitoring will be conducted on all sites with higher predicted populations to track larval development, population levels and tree defoliation.
- The 2015 Aerial Overview Survey mapped 8,290 hectares of drought damage in lodgepole pine stands in the western Chilcotin (Tatla Lake to One Eye Lake). A subsample of these mapped polygons will be monitored by regional specialists to examine impacts.

For more information on pests and diseases in the Williams Lake TSA review the *2015 Overview of Forest Health Conditions in Southern British Columbia* at:
http://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/aerial-overview-survey-documents/2015_sifr_fh_overview.pdf

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1. Introduction

This strategy recommends actions to address forest health issues in the Williams Lake Timber Supply Area (WLTSA) also known as the Cariboo-Chilcotin Natural Resource District. It is one of the largest Timber Supply Areas (TSAs) in the province, covering approximately 4.93 million hectares. There are three general landscape types: the Chilcotin Plateau, the central portion of the TSA and the eastern portion of the TSA. The Chilcotin Plateau, located west of the Fraser River, is characterized by a drier climate with extensive lodgepole pine forests and some Douglas-fir. The central portion of the TSA, located both east and west of the Fraser River, has mixed-species forests primarily Douglas-fir and lodgepole pine as well as a large portion of drybelt Douglas-fir stands. The eastern portion of the TSA increases in elevation to forests of spruce, pine, western redcedar, western hemlock and subalpine fir.

The intent of this document is to provide guidance and information to operational planners, reviewing agencies and approval authorities on forest health risks, issues and best management practices. It outlines the current status of forest health factors and key strategies and actions to minimize losses from damaging agents. The objective is to enhance ecosystem health by improving forest resiliency and sustainability. By providing acceptable approaches to forest health management this document attempts to simplify the planning and approval process for forest health treatments.

2. Guiding Principles

The WLTSA strategy and Forest Professionals[1] are to be consistent with all relevant legislation and planning guidance including:

- Cariboo-Chilcotin Land Use Plan (CCLUP), Government Actions Regulation (GAR) Orders pertaining to Ungulate Winter Range (#U-5-001, U-5-002 and U-5-003), and associated strategies;
  Order for Shallow/Moderate Snowpack MDWRs
  Order for Transition/Deep Snowpack MDWRs
- Chief Forester guidance in the Williams Lake TSA Rational for Allowable Annual Cut (AAC) Determination (February 25, 2015);
- CCLUP Regional Biodiversity Conservation Strategy and Updates;
- Chief Forester Guidance on Landscape- and Stand-level Structural Retention in Large-Scale Mountain Pine Beetle Salvage Operations (December 2005); and
- FRPA bulletins.

[1] Forest Professionals are Registered Professional Foresters, Registered Forest Technologists, Special Permit and Limited License Holders, Accredited Timber Cruisers, Accredited Timber Evaluators and Silvicultural Accredited Surveyors. Forest professionals ensure that the forests are managed sustainably. (http://abcfp.ca/)

The Provincial Forest Health Strategy (2013-2016) provides an overview of forest health direction by the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) in British Columbia. The three key strategic forest health objectives are to:

1. Protect forest resources from pest damage by direct actions when operationally possible and justified;
2. Implement stand establishment activities to minimize the expected impact of known forest pests; and
3. Assess pest impacts on forest values to improve estimates of timber yield from British Columbia's forests and prioritize management interventions.

The Cariboo Region Forest Health Strategy (2013-2016) is a guiding document for forest health management within the Cariboo Forest Region. The purpose of this document is to:

1. Provide guidance to forest managers on the best forest health management strategies in the Cariboo Region;
2. Outline the legal and government policy framework for forest health management in the Cariboo Region;
3. Provide a rationale for practising proactive forest health management in the Cariboo Region;
4. Outline the current knowledge with regards to the impact of forest health factors on timber supply; and
5. Identify knowledge gaps when it comes to forest health management in the Cariboo Region.

3. Forest Health Objectives

- Identify beetle management strategies (Suppression, Salvage and Monitor). The 2016 Beetle Management Unit (BMU) strategy maps are located in Appendix 2.
- Provide updated strategic guidance for the ongoing forest health management in the WLTSA.
- Identify treatment strategies for forest health management.
- Facilitate co-operative planning between agencies and licensees.
- Establish short- and long-term harvest guidelines to best address opportunities, given the current pest incidences and infestation levels.
- Facilitate the development of scientifically and ecologically sound operational plans and practices.
- In conjunction with the various licensees and MFLNRO identify areas of responsibility for beetle management. This includes where there may be opportunities for small tenure holders to assist in salvage/suppression efforts.

4. Roles and Responsibilities

- Licensees and FLNRO will collaboratively undertake implementation of this strategy primarily through the WLTSA Forest Health Committee.
- Meetings of this committee will be held on an as-needed basis to discuss the implementation and effectiveness of this strategy. An outline of meeting topics, dates and actions are shown in Table 1.
- Bark beetle treatment planning (detailed aerial surveys, probing, pheromone placement, single tree removal/disposal, trap tree placement/removal and larger scale treatments such as sanitation harvesting) is an iterative process involving the collaborative effort of licensees and FLNRO in WLTSA Forest Health Committee.
- Specific roles for monitoring, reporting and consolidation of information will be determined via the Forest Health Committee meetings.

Table 1: Implementation schedule for Forest Health Committee meetings

Topic	Meeting Dates	Actions
Planning	June - October	• Aerial overview and detailed flight information • Updated BMU strategies and boundaries • Identify areas of responsibility and planned activities based on infestation levels and capability • FLNRO report on IBD treatments and monitoring evaluations from 2015-2016
Implementation	September-March	• Discussion of planned and implemented beetle treatments • Update on spruce budworm treatments of the previous year (if applicable), and eggmass sampling and treatment strategy • Stand Development Monitoring (SDM) monitoring results • WLTSA Forest Health Strategy in Draft

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Monitoring & Evaluation	January – June	• Licensee submission of IBD treatment type, location and volume removed • Evaluation of treatments and monitoring results with recommendations for future planning • Overwinter mortality sampling results for Douglas-fir bark beetle • Update on western spruce budworm treatment plans and target areas • Final version of WLTSA Forest Health Strategy endorsed and released

5. Priority Forest Health Factors in the WLTSA

The priority status of forest health agents is derived from the FLNRO annual aerial overview survey, from regional forest health specialists, district and branch forest health staff, and reports from licensees.

Within the WLTSA pest species are ranked according to:

- distribution of pest and current incidence levels,
- available susceptible host species,
- landscape level hazard and risk information,
- known or suspected impacts on forest resource values,
- availability of operational detection and treatment methods, and
- costs and benefits of applying detailed detection and treatment activities.

Table 2: Priority of the Forest Health Factors within the WLTSA

High	Moderate	Low
Wildfire	Armillaria Root Disease	Mountain Pine Beetle
Douglas-fir Bark Beetle	Tomentosus Root Disease	Western Balsam Bark Beetle
Western Spruce Budworm	Laminated Root Disease	Douglas-fir Tussock Moth
Drought Damage	Western Gall Rust	Forest Tent Caterpillar
Spruce Bark Beetle	Commandra Rust	Aspen Serpentine Leaf Miner
Gypsy Moth	Lodgepole Pine Dwarf Mistletoe	Black Army Cutworm
	Post-wildfire Damage	Terminal Weevil

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High	Moderate	Low
	Elytroderma Needle Cast	Warren's Root Collar Weevil
	Spruce Weevil	Stalactiform Rust
	Two Year Cycle Budworm	Atropellis Canker
	Hemlock Looper	Lophodermella Needle Cast
		Windthrow
		Pine Needle Sheathminer
		Flood Damage
		Bear Damage
		Winter Desiccation

6. Forest Health Factors and Management Directions

Definitions

The following definitions, from the *Provincial Bark Beetle Management Technical Implementation Guidelines, Spring 2003*, are used for the purposes of this document regardless of any changes that may be made to the provincial definitions.

Emergency Bark Beetle Management Area (EBBMA): is a planning and reporting unit that enables aggressive action in expanded outbreak areas where implementation of emergency harvesting measures is reasonably expected to suppress bark beetle populations, or hold them static. All designations under the Emergency Bark Beetle Management Regulation have been rescinded. See Section 9 and Appendix 3 for more details.

Beetle Management Unit (BMU): is a planning and reporting unit for operational beetle management. Its purpose is to facilitate the implementation of beetle management activities.

The following are strategies that may be employed within BMUs. An assigned strategy is based on the level of outbreak in an area and the estimated effectiveness of selected treatments in achieving stated objectives.

Suppression: This is the most aggressive Strategy. It is selected when the infestation status is such that aggressive direct control actions are expected to keep an area at endemic population levels. Areas are lightly infested, and resources for direct control or harvesting and milling capacities equal or exceed the amount of the infestation. The intent of the strategy is to reduce or keep the outbreak to a size and distribution that can be handled within "normal resource capability".

Objective: To reduce populations and maintain them at a relatively low level. Target is to treat 80 to 100% of the known infestation sites. All

harvest and treatment is directed at currently attacked trees. The intent is to "control" outbreak in that area and stop spread.

Holding: The intent of this strategy is to maintain an existing outbreak at a relatively static level. It is a delaying strategy until adequate resources are available, or access is created to allow for a more aggressive approach, or to reduce overall loss while waiting for a killing climatic event. This is appropriate in areas with chronic beetle infestations that are too large to deal with using single tree treatments or where access is poorly developed for directed harvesting.

Objective: To maintain the infestation to a relatively static level by treating ~50 – 70% of the known infestation sites. The level of harvest and/or treatment is equal to the rate of infestation expansion. Harvesting should be concentrated in green attacked trees.

Monitor: This strategy is applied to areas where there are low population levels, where management efforts would be ineffective in substantially reducing the beetle population and subsequent levels of damage, or where there is no short term (less than 5 years) possibility of salvaging dead timber. This may be due to management constraints such as wilderness area, Parks or ecological reserve, or because access cannot be put in place before substantial merchantable degradation of the dead material occurs.

Objective: To record the change in attack level with no action required beyond monitoring and recording. This objective is appropriate in parks, ecological reserves and inoperable areas where the outbreak has peaked, salvage is not possible, and there is no current opportunity for any mitigation of further loss.

Salvage: This strategy is applied to areas where management efforts would be ineffective in substantially reducing beetle populations and subsequent levels of damage. Such areas have extensive outbreaks covering a large proportion of susceptible stands. The objective in this case is to salvage affected stands and minimize value loss.

Objective: To salvage timber previously attacked to minimize value loss. Indications are that holding the infestation static will fail due to influx of populations from heavily infested BMUs in proximity. Emphasis is more to retrieve values at risk and maximize Crown revenues by directing harvest towards killed stands prior to significant degradation. Treat <50% of the currently infested sites. This objective is appropriate in areas where suppression and holding actions are no longer appropriate or feasible.

Bark Beetles

Douglas-fir Beetle *(Dendroctonus pseudotsugae)*
Priority = High, area impacted increased to 26,650 ha in patches and 1,790 spot infestations.

Douglas-fir beetle is causing significant damage to forests in the WLTSA and is currently reaching outbreak levels. During outbreaks Douglas-fir beetle can kill large numbers of healthy trees over extensive areas. Outbreaks can have extremely negative impacts on ungulate winter range (MDWR), preservation of Old Growth Management Areas (OGMAs), watershed management and recreation and aesthetic values.

Detailed helicopter-GPS surveys have been conducted annually for heavily impacted areas of the WLTSA that are good candidates for operational treatments. This detailed survey provides accurate GPS coordinates of infestation centres (fading to red stage) and when infestations are continuous using polygons. In August of 2015 the detailed flight identified 2373 spot infestations with an approximate area of 593 hectares and 55 polygon infestations with an approximate area of 11698 hectares. These polygons have a Douglas-fir beetle infestation level of 11-30%.

In the past year the Forest Health Committee was tasked by the District Manager to address Douglas-fir beetle (IBD) infestations in the central portion of the district on either side of the Fraser River. These areas are labelled Suppression=High. Within the Suppression=High areas licensees identified specific working areas and signed a map to indicate their intention to address IBD. Cooperation among licensees to effectively treat entire BMUs is critical in order to maximize control efforts.

Through this process a Strategic Douglas-fir Bark Beetle Management Plan and Douglas-fir Bark Beetle Implementation Plan and supporting maps and documents were created to specifically address IBD infestations. The Interim Modification to Biodiversity Update #7b was reviewed and updated through a collaborative process between the Forest Health Committee and the Biodiversity Committee. Emphasis was put on the requirement for monitoring and reporting stand and landscape level Douglas-fir beetle treatments.

Stand management for “Suppression” of Douglas-fir beetle:

- Identify areas with beetle activity from overview flight provided by FLNRO.
- Use the overview flight information to direct detailed aerial and ground surveys to confirm and refine infestation site information.
- Prescribe treatments for all identified sites based on beetle activity level anticipating that control activities continue for more than one year. Where direct treatment is not possible (due to operability, economics, constraints on the landbase, etc.) prioritize actions based on the most effective use of the forest management capacity while protecting all forest resources.
- Propose trap tree programs in areas with low to moderate infestations.

- Limit harvesting activity to unconstrained or modified harvest areas except where consistent with other guidance.
- Prioritize sanitation harvesting (removal of currently infested trees including trap trees) over salvage harvesting (removal of dead trees). Salvage harvesting requires exemptions for MDWR and is not permissible in OGMAs.
- Propose sanitation harvest areas within constrained areas (OGMAs, RRZs, etc…) only if all the conditions outlined in Biodiversity Update #7b and Interim Modifications to Biodiversity Update #7b can be achieved (i.e., landscape level conditions, treatment targets, harvesting conditions). These are ecologically sensitive areas and it is imperative that any activity in these areas is consistent with current biodiversity guidance and special care and attention is given to the harvesting practices.
- Hauling of trap trees should not occur before September 1st.
- Provide MFLNRO with complete site information indicating site, location, treatment type and volume removed.
- Monitor and report the 2015-2016 Douglas-fir beetle treatments by site and BMU.

WLTSA Strategy: "Suppression" for most Douglas-fir dominated areas (see Appendix 2 for specifics).

Spruce Beetle (*Dendroctonus rufipennis*)
Priority = High, area impacted increased to 2,565 ha.

Spruce stands are generally located in moist to wet ecosystems which result in faster decay and a short "shelf-life" of one to three years. Many spruce-leading stands have a high site index and if these stands are not harvested and re-forested promptly it could result in significant long-term losses in productivity. High site index stands should be prioritized for salvage of dead trees and suppression of infestation centres with an aim to balance forest health and mid-term timber supply. Wind felled spruce is an excellent habitat to spruce beetles and blowdown centres should be carefully monitored to ensure populations are dealt with before they start increasing and attacking standing healthy spruce.
Spruce beetle is difficult to detect in overview surveys but is useful in identifying general trends in beetle levels. The areas to watch are Quesnel Lake in the east and Big Creek and Churn Creek in the south.

Spruce beetle continues to be a species of great concern due to rapid spread, high attack ratios, and short "shelf-life" due to ecotypes where the beetle is located. The main treatments for spruce beetle are trap tree deployment and salvage harvest. Poor access, steep ground and other economic challenges have led to very little harvesting of infested spruce.

WLTSA Strategy: "Monitor" due to lack of activity in spruce dominated stands.

Mountain Pine Beetle *(Dendroctonus ponderosae)*
Priority = Low, area impacted dropped to 1,880 ha.

In the AAC Rationale for Williams Lake TSA the Chief Forester directs licensees "to continue to focus harvesting as much as possible on mountain pine beetle-impacted pine-leading stands in the Williams Lake TSA; and to harvest no more than their share of the AAC partition attributable to live tree volume." This strategy should be followed while managing current and future forest values in context of sustainability.

Overall Objective: Salvage affected pine stands in a manner that will:

- maximize the economic value obtained from the killed trees,
- extend the salvage term (i.e. harvest those stands with the most dead wood), and
- expedite the restoration of impacted stands to the harvesting land base.

High Priority for Salvage (Unconstrained Landbase)

- Stands with at least 70 percent pine with high percentages of beetle-infested or killed stems
- Stands located west of the Fraser River
- Low volume stands (<100 cubic metres/ha)
- Pure pine stands with little or no advanced regeneration (especially high site index) to expedite stand recovery. (i.e. Ideal candidate areas for stand rehabilitation)
- Areas where shelf-life is considered short (i.e. wetter BEC zones)

Moderate Priority Salvage (Unconstrained Landbase):

- Areas where shelf-life is considered short
- >50% Pine by Volume
- >30% beetle attack (Red green and gray combined)
- High/Moderate Susceptibility

Low Priority Salvage (Unconstrained and constrained areas)

- Mixed Stands (< 50% pine)
- Maximize harvest of infested pine through selective harvest.
- Prescriptions should target pine removal rather than clearcut, where residual stands can be maintained in a wind firm condition to target the maximum volume of infested pine and to encourage natural regeneration of non-pine (climax) species especially where advanced regen exists in understory. Where more than one beetle species has infested mixed stand, then the rational should be explicit.
- OGMA's, MDWR's, Riparian and other constrained areas in accordance with higher level plan guidelines, Land Use Orders and GAR orders.

- High amount of advanced regeneration
- Stands with suitable secondary structure (see Appendix 4 for definition)

The following table provides guidance to the placement of salvage areas on the landbase. It serves as guidance for salvage planning, but other values as listed above, should also be considered and rationalized in harvesting proposals.

Table 3: Priority for pine salvage based on stand characteristics and level of beetle kill (Modified from McLennan 2003) (Eng 2004.).

	Percentage of pine killed (Green, Red and Grey attack)				
Percentage of stand volume that is pine	<30%	30-50%	51-70%	>70% West of the Fraser River	>70% East of the Fraser River
<30%	No	No	No	No	No
30-50%	No	No	No	Low	Low
51-70%	Low	Low	Low	High	Moderate
>70%	Low	Moderate	Moderate	High	Moderate

WLTSA Strategy: All BMUs within the WLTSA have been identified as "salvage" strategy (Appendix 2) for Mountain Pine Beetle.

Western Balsam Bark Beetle (*Dryocetes confuses)*
Priority = Low, area impacted increased to 28,240 ha with most infestations rating trace or light.

WLTSA Strategy: "Monitor" with no treatments planned.

Defoliators

Defoliators, such as the western spruce budworm and 2-year cycle budworm, impact all age classes of their preferred hosts and can substantially impact growth and productivity and wood quality. Severe defoliation by these insects can result in mortality, especially in younger age classes, and have negative impacts on other stewardship values on the land base (e.g., ungulate ranges).

Western spruce budworm *(Choristoneura occidentalis)*
Priority = High, area impacted decreased to a 15-year low of 3,755 ha.

Western spruce budworm populations have decreased suggesting that this last >15 year outbreak is ending. Previous tree mortality caused by repeated western spruce budworm continues to have lasting impacts. Severe defoliation of mature stands does not typically result in mortality but stresses the trees reducing wood quality and quantity, and predisposes Douglas-fir to attack by Douglas-fir bark beetle. When a mature stand is infested, understory mortality can be very significant. As a result of this

understory mortality and Douglas-fir bark beetle mortality NSR stands are being created within the WLTSA. Many of these stands are located in Mule Deer Winter Range and OGMA's which puts constraints on possible treatments.

FLNRO has been conducting aerial treatments of moderate to severe western spruce budworm populations using *Bacillus thuringiensis* var. *kurstaki* (B.t.k.) annually to protect the most valuable stands at risk. 2016-17 is the first year since 1997 that the aerial treatment is not happening due to the population crash of this insect. Detailed monitoring will be conducted during this year to determine if populations are continuing to decrease, signalling an end to this sustained outbreak.

This pest is of high significance as it not only has the potential to cause mortality and growth loss in the current growing stock, but also stresses the trees, increasing future vulnerability to bark beetle attack and furthering potential losses to mid-term timber supply.

Silviculture strategies:

- Plant higher densities to increase resilience in stands decreasing the overall susceptibility to sever and sustained Western Spruce Budworm defoliation events.

WLTSA Strategy: "Monitor" with no treatments planned. Detailed monitoring at the "moderate" egg mass sites in order to track larval development and populations levels and tree defoliation will be conducted.

Gypsy moth *(Lymantria dispar)*
Priority = High

Gypsy moth is an invasive non-native species which has not become established in the WLTSA. This insect defoliates deciduous trees and has over 300 known hosts. Introduction to an area could occur from recreational and other vehicles traveling in or from infested areas carrying pupae or eggs.

WLTSA Strategy: "Monitor" through the use of a trapping program in conjunction with District and Regional staff and the Canadian Forest Service. Early detection of this defoliator is critical for eradication treatments.

Two Year Cycle Budworm *(Choristoneura biennis)*
Priority = Moderate, area impacted decreased to 105 ha.

In the interior wet belt two year budworm defoliates true firs and spruce species during "on" years (in the WL TSA this occurs during even years). This pest has the potential to create significant damage in the eastern portion of the WLTSA, with infestations covering over a million hectares recorded for the Cariboo during previous outbreaks. Potentially, plantations could suffer significant damage from this insect, and severe defoliation may predispose trees to attack by western balsam bark beetle or spruce beetle.

WLTSA Strategy: "Monitor" with no treatments planned.

Western Hemlock Looper *(Lambdina fiscellaria lugubrosa)*
Priority = Moderate, area impacted was not recorded in 2015.

The western hemlock looper is a very destructive insect that defoliates western hemlock, western red cedar, Douglas-fir and spruce species. Untreated, it can lead to high levels of mortality during its two to four year outbreaks. In severe cases, previously damaged stands may require stand rehabilitation. Generally this insect has an eight year cycle between high population levels. Historically outbreaks have been restricted to around Quesnel Lake. The last time populations were high in this region was 2012, so would not expect populations to increase again until 2020.

WLTSA Strategy: "Monitor" with no treatments planned.

Forest tent caterpillar *(Malacosoma disstria Hubner)*
Priority = Low, area impacted has increased to 8,012 ha.

One or more years of severe defoliation may result in top-kill, branch mortality, reduced

radial growth and if the infestation persists, occasional mortality. Many of the infested stands were also infested with aspen serpentine leaf miner.

WLTSA Strategy: “Monitor” with no treatments planned.

Aspen Serpentine Leaf Miner *(Phyllocynistis populiella)*
Priority = Low, area impacted has decreased to 59,848 ha.

Leaf miners tunnel between the epidermal layer of the leaf, reducing the leaf’s photosynthetic capacity. Outbreaks of this pest are fairly common in western North America. Short (1 or 2 year) outbreaks do not normally have major long term impacts on tree growth, however this insect has been active for several years areas around the Williams Lake TSA.

WLTSA Strategy: “Monitor” with no treatments planned.

Pine Needle Sheathminer *(Zelleria haimbachi(Bsk.))*
Priority = Low, area impacted has increased to 1917 ha.

The Pine needle sheathminer generally attacks juvenile to immature pine stands. Up to 100% of the new growth may be destroyed resulting in growth reduction.

WLTSA Strategy: “Monitor” with no treatments planned.

Weevils

Spruce weevil: Priority = Moderate
Lodgepole Pine Terminal weevil and Warren’s Root Collar weevil: Priority =Low

Spruce weevil and lodgepole pine terminal weevil can cause significant forking damage in young stands. Most of the mortality occurs in the first 10 years. The ICH and parts of the SBSdw1 are at high risk for spruce weevil. Warren’s Root Collar weevil can cause scattered mortality in young stands.

Silviculture strategies:

- Plant alternate species or species mixes.
- Leave non-target species; for example do not brush aspen.
- Plant higher densities.
- Plant genetically resistant stock for terminal weevil.

WLTSA Strategy: “Monitor” individual affected stands.

Diseases

Root Diseases

Armillaria (*Armillaria ostoyae*)
Priority = Moderate
Armillaria root disease causes mortality in a wide range of conifers and deciduous trees and may increase the susceptibility of infected trees to bark beetles and other pests. Douglas-fir, true firs, and western hemlock are highly susceptible to Armillaria root disease, spruce exhibits medium to high susceptibility, pines are moderately susceptible, and western red cedar and deciduous species have a lower susceptibility. Western larch also appears to be less susceptible to Armillaria after age twenty to forty.

Tomentosus (*Innonotus tomentosus*)
Priority = Moderate
Spruce is the primary host for Tomentosus root disease and lodgepole pine exhibits medium to high susceptibility. Infection can occur via spores, or from root to root contact between trees or trees and stumps. Tomentosus root disease often goes undetected and can cause considerable growth loss in mature spruce stands.

Laminated root rot (*Phellinus weirii*)
Priority = Moderate
Laminated root rot is primarily a disease of Douglas-fir. It is most prevalent on warm south facing slopesin the ICH and SBSdw1. It forms discrete root rot centres or openings with associated windthrown and dead standing trees. Windthrown trees generally have characteristic root balls with laminated decay and typically fall in all directions.

WLTSA Strategy: "Monitor" and treat detected infestation areas in accordance with Provincial guidebooks.
Harvest system:

- Partial harvest systems are generally not recommended.
- Stumping can be an effective method of reducing losses from Armillaria prior to planting.

Silviculture strategy:

- Plant less susceptible species for Armillaria such as pines or western red cedar where appropriate.
- For Tomentosus avoidance plant (no spruce within 5m of an infected stump) or plant less susceptible species.
- Free-growing assessments should be conducted after age 12 in high hazard root rot BEC zones. Root diseases are often not detectable before age 12.

Stem Rusts of Pine
Priority = Moderate
Comandra blister rust (*Cronartium comandrae*), **stalactiform blister rust** (*Cronartium coleosporioides*) and **western gall rust** (*Endocronartium harknessii*) all occur within the

WLTSA. These pests are particularly important in young pine stands (<25 years of age). Comandra and stalactiform rust can only infect lodgepole pine from spores produced on the alternate host plant. These spores are typically only transmitted over short distances. The frequency of alternate plant hosts present on a site is likely an important risk factor for the Cronartium stem rusts. Western gall rust is the most common forest health factor affecting young lodgepole pine stands.

WLTSA Strategy: "Monitor" young stands (esp. pure pine stands).
Silviculture strategy:

- Where pine is a preferred species, minimum stocking should be increased to 2000sph to offset mortality due to rust.
- Plant alternate species where possible to minimize the risk of losses.
- Before considering spacing it is important to conduct pest surveys and to consider the impact of forest pests on final stocking levels. In some instances it may be wise to delay spacing until the final impact of forest pests can be more accurately assessed.
- Free-growing assessments should be conducted after age 12 in high hazard root rot BEC zones. Rusts are often not detectable before age 12.

Dwarf Mistletoe (*Arceuthobium americanum*)
Priority = Moderate
There are high incidences of lodgepole pine dwarf mistletoe in the SBPSxc where lodgepole pine is the only preferred species. The disease is caused by a parasitic plant and spread occurs from infected residual trees. Preliminary results of a study in the Chilcotin indicate that dwarf mistletoe severity will likely increase in the SBPSxc as a result of scattered small diameter residual pine (<20cm dbh) which survived the Mountain Pine Beetle outbreak. Dwarf Mistletoe sanitation treatments are one of the best ways of controlling the spread of the disease.

WLTSA Strategy: "Monitor" young pine stands.
Harvest systems:

- Design large cut blocks with smooth edges.
- Maintain dwarf mistletoe free boundaries and natural barriers whenever possible(e.g. roads, non lodgepole pine timber type, water bodies, etc.).
- Avoid leaving wildlife tree patches and leave strips infected with dwarf mistletoe within or adjacent to the block whenever possible especially along road right of ways.
- Stands or portions of stands which are infested should be treated following harvest by removal of all residual lodgepole pine over 0.5m in height. Residuals will generally have dwarf mistletoe plants unless they were shaded prior to harvesting. On average it takes four years between infection and the first

appearance of plants. A trial is being set up to measure the effectiveness of sanitation treatments using heights of 0.3m, 1.0m, 3.0m and no treatment.

Elytroderma Needle Cast *(Elytroderma deformans)*
Priority = Moderate
Elytroderma needle cast is easily recognized and well documented on Ponderosa pine but often goes misdiagnosed on Lodgepole pine. It is unique from other foliage disease in its ability to infect and persist in shoots where it can cause severe stunting and brooming. Elytroderma displays similar symptoms to Lophodermella but it can be distinguished by the fruiting bodies and stunting that it causes. Elytroderma is widespread in the IDF and SBPS. Low lying areas adjacent to wet are and swamps generally have a higher incidence. Severe stunting has been observed in some stands but information is lacking on the extent and impact of this disease within the Williams Lake TSA.

WLTSA Strategy: "Monitor" and document the extent of damage through stand density monitoring surveys. Increase general awareness of the disease in young pine stands. Retain Douglas-fir in pine salvage blocks. The residual Douglas-fir will act as seed trees that will increase diversity in the stand to mitigate the impact of climate change.

Silviculture Strategy:

- Increase regeneration densities to 2000sph offset potential losses and damage from Elytroderma.
- Plant alternate species where appropriate for the site.
- Dwarf mistletoe sanitation treatments can effectively remove infected advanced regen.

Lophodermella Needle Cast *(Lophodrmella concolor)*
Priority = Low
When conditions are optimal (wet springs and summers), needle cast can infect large tracts of pine forest, particularly plantations. The long-term impact of this foliar disease is not completely understood, although permanent sample plots in affected plantations show significant growth reduction and mortality. This agent should be closely monitored, mapped, and the impact on plantations carefully recorded (esp. in the IDF & SBPS).

WLTSA Strategy: "Monitor"

Abiotic Injuries

Wildfire Damage and Post-Wildfire Mortality

Wildfire damage: Priority = High, area impacted has increased to 9,892 ha.
Post-Wildfire mortality: Priority=Moderate, area impacted has decreased to 116 ha.

Recently killed trees in moderate severity burns and felled trees along fire guards are susceptible to Douglas-fir beetle attack immediately following a fire. When these beetles emerge the following year, they attack fire stressed trees inside the fire and eventually, if beetle population become high enough, spill over into the surrounding healthy stand.

WLTSA Strategy: "Monitor" and treat affected areas for Douglas-fir beetle. Promote sanitation harvesting (removal of currently infested trees), fire salvage, trap trees, MCH and fall and burn where appropriate to minimize the build-up of Douglas-fir beetle populations.

Drought Damage

Priority = Moderate, area impacted has increased to 8,287 ha.

The majority of the drought damage occurred in the rain shadow of the Coast Mountains in the western Chilcotin and were mapped exclusively in lodgepole pine. Sites mapped for drought should be monitored closely when they are detected because the trees become stressed making them more susceptible to bark beetle infestations. Areas of drought should therefore be subject to ground checks if they are located in suppression zones.

WLTSA Strategy: "Monitor" with no treatments planned. If damage occurs in susceptible Douglas-fir stands then stressed trees should be protected with MCH, other appropriate strategies include trap trees or fall and burn.

Windthrow

Priority = Low, area impacted has remained static at 3.2 ha.

The area of windthrow recorded during the overview survey was 4 ha. The occurrence of windthrow can contribute to the maintenance and build-up of local spruce and Douglas-fir bark beetle populations.

Windthrow patches of Douglas-fir and spruce should be addressed promptly to minimize the expansion of beetle populations. It may be appropriate in some areas to leave blown-down trees on the ground until after the beetle flight and utilize them as trap trees. Windthrown trees should be removed prior to the beetle flight of the following year so that attacked blowdown does not contribute to increases in beetle attack.

WLTSA Strategy: Allow windthrow to act as trap trees through summer and harvest before April 1st to prevent bark beetle population build-up. Alternative strategies are to use MCH, trap trees and/or fall and burn.

Flooding Damage
Priority = Low, area impacted has remained static at 3.2 ha.

Sites mapped for flooding should be monitored closely when they are detected because the trees become stressed making them more susceptible to bark beetle infestations. Areas of flooding should therefore be subject to ground checks if they are located in suppression zones.

WLTSA Strategy: "Monitor" with no treatments planned. Strategies are to use MCH, trap trees or fall and burn.

Bear Damage
Priority = Low, area impacted has decrease to 670 ha causing trace to light levels of mortality.

This damage is done to lodgepole pine plantations in the eastern Cariboo and has been going on for several years.

WLTSA Strategy: "Monitor" with no treatments planned.

7. Bark Beetle Management

The Aerial Overview Survey (AOS) is conducted annually over 80-90% of the province provides a way to track changes in various visible forest health agents. The graphs in Appendix 1 are based on AOS data from 1999-2015 showing the total area impacted by each bark beetle.

Infestation Prioritization

Treatment prescriptions are based on beetle activity levels, which are broken into three main components, to determine what hazards the spread of the infestation could create, and the associated risk. Bark beetle hazard maps identify stands that are highly susceptible to bark beetle because of their stand characteristics.

1. Size of infestation.
    - Area of infestation.
    - Percent of infestation in a given polygon (area)
    - Number of trees with visible colour change (Time of year reported)
    - Number of "green attack": this year's attack (fading to yellow depending on time of year and weather)

- Number of “red attack”: last year’s attack
- Number of visible “grey Attack”: previous year’s mortality (> 2years).

2. Population Dynamics of Pest and Host including site factors.
    - Pest
    - Green to red ratio giving population growth rates from last year’s attack.
    - Known information from population sampling of other sites in the area.
    - On site information: Number of last year’s infected trees to this year’s. Present stage of growth and variability. Number of gallery starts over a given sample area. Length of galleries, number of egg groups. Number of live larva versus dead. Visible predators or pathogens. Presence of other secondary bark beetles and sawyer beetles.
    - Host
    - Known information from report and information/ mapping systems: stand composition, average age, height, diameter, wood quality attributes, biogeoclimatic zone, and susceptibility.
    - Site inspection and reports: sub-zone, slope (position and percent), topography, aspect, soils, and stand structure. More detailed information of attacked trees, overall health including other forest health factors and available present and future host trees. Possible direction of spread.
3. Location
    - Proximity to resource values. Use susceptibility maps and overlays of MDWR, OGMAs, Parks, private land, visually sensitive area and other information tools to determine what values are potentially at risk if the infestation spreads and what values are already affected.
    - Determine the viability of possible treatments and approximate costs in resources and manpower.

Taking into consideration the points above the highest priority for treatment is the unconstrained landbase and MDWR where “suppression” actions are being undertaken:

- Follow up treatments from previous year.
- Areas that impact public safety (eg. Areas of high interface wildfire risk, recreation areas, parks, roads etc…).
- Areas where severe windthrow events have occurred, compounding the susceptibility of the stand to further attack.
- High susceptibility areas adjacent to identified high-value or constrained landbase (eg. parks, OGMA’s, Modified Cariboo Harvest in accordance with recommendations from the biodiversity committee and Government Action Regulations (GAR orders and Land Use Orders)).
- High susceptibility areas in other unconstrained areas.

Suppression of infested areas inside constrained areas (OGMA, Riparian, etc.) is considered secondary to the above, and must be consistent with the Regional

Biodiversity Conservation Strategy, and "Update Notes". Consultation may also be required, where guidance is not available through the Biodiversity Guidelines and Updates.

Treatment Options for Bark Beetles

A variety of treatment options are presently available. Most are used in combinations or in phases lasting up to several years. Wherever possible the utilization of tree fibre in conjunction with beetle population reduction is the preferred treatment. More expensive and labour intensive options are generally chosen only to augment other treatments and/or as part of an overall plan which requires multiple options to protect the congruency of the project. The following list identifies the common treatments in the WLTSA, however other options may be considered. *The Bark Beetle Management Guidebook* contains a more comprehensive list of possible treatments.

No Control: tactic used in areas of low risk and low hazard when expenditures of time, resources and money would exceed expected benefits.

Monitor: (used in conjunction with no control) to track and or delay action where populations are decreasing or inaccessible low risk sites (Detailed aerial flights, ground probing and other detection methods).

Sanitation Harvesting: the removal of infested timber through operational harvesting by licensees, BCTS and small scale salvage. From clear-cuts to single tree removal utilising ground based machines, cable or helicopter logging.

Trap Trees: is the process of mimicking natural blow-down disturbances that are the endemic beetle's habitat and are applicable to Spruce and Douglas-fir. Trap trees can be from a District wide systematic placement to individual spot use. Prefalling roads and right of ways before beetle flight prior to harvest after beetle flight can be an effective use of trap trees.

Pheromone Baiting: for holding bark beetles close to original infestation sites and or concentrating populations in specific location.

Anti-aggregation Pheromone Baits: for beetle dispersal and single tree protection such as MCH (methylcyclohexeneone). Effective to disperse beetles from small infestation centres (max. 10 currently infested trees). Also used in conjunction with other treatments, including after harvest dispersal of infested stumps and debris.

DO NOT apply near or in areas frequented by small children and companion animals (e.g., residential lots, parks, camping sites, resorts and scenic vistas).

Fall and burn or single tree disposal: The felling of infested trees and burning of the infested sections (including debarking), also including burning of groups of trap trees. Used in situations where removal of infested trees is impractical or counter to mandated management practices.

Funnel trapping: the use of Lindgren funnels with pheromone lures traps in groups or grid patterns, for monitoring of beetle flight activity and in mass trapping patterns, where feasible (labour intensive). For Douglas-fir beetle funnel traps

should be a minimum of 100 m away from live Douglas-fir trees or used in conjunction with MCH.

All forest health activities should have follow up work done in the area which would be determined by the infestation intensity in the surrounding area.

Table 4: Possible follow up options for different treatment types

Treatment 1 (year 1)	Follow up on treatment 1	Treatment 2 (year 2)	Follow up on treatment 2
Harvest	Trap tree; or MCH/Fall & Burn	MCH/ Fall & Burn monitor	monitor
Trap Tree	Reduced number of trap trees; or MCH/ Fall & Burn	MCH/ Fall & Burn monitor	monitor
Fall and Burn	MCH/ Fall & Burn	Monitor	
MCH	Trap tree; or monitor	Monitor	

Trap Tree Guidelines

The following guidelines should be followed for the planning and execution of trap tree programs for spruce and Douglas-fir beetle management. Consult the *Bark Beetle Management Guidebook*, *1995* for more general guidance on trap tree placement.

- Trap trees are best suited for areas of high beetle susceptibility and low occurrence of current beetle infestations.
- Trap Trees should be located as close as possible to the current attack and no farther than 200 m from infestation centre
- A ratio of 1 trap tree to every 4 infested trees should be felled
- Ideally trees should be felled immediately prior to beetle flight, in shaded areas with existing access which will allow prompt recovery of attacked trap trees prior to the next beetle flight. Do not buck or limb trap trees.
- Do not place trap trees in riparian reserves.
- Identify opportunities for smaller operators (small-scale salvage) to assist in carrying out suppression activities.
- Avoid placing trap trees near large Douglas-fir vets
- Avoid placement of trap trees in constrained MDWRs or OGMAs wherever possible. If appropriate management requires the use of trap trees in these areas, the following tactics should be followed:

Mule Deer Winter Range (MDWR) and Bark Beetles

Follow Government Actions Regulation (GAR) orders pertaining to ungulate winter range (#U-5-001, U-5-002, and U-5003):

- http://www.env.gov.bc.ca/wld/documents/wha/Amendment_ShallowModerate_Feb07_Ord.pdf

- http://www.env.gov.bc.ca/wld/documents/wha/Amendment_TransDeep_Feb07_ord.pdf

    - Use existing access only.
    - Trees selected for trap trees should be ones that would be harvested in a regular MDWR entry
    - Trap trees should not be located on ridge lines or topographic breaks.
    - Trap trees should be marked to cut and fallers should be instructed clearly as to what the goals are and should be supervised appropriately.
    - Trap tree sites must be accurately mapped with trees removed prior to next beetle flight without damage to the surrounding stand.
    - Trap tree sites in MDWRs would be followed up with a second treatment (eg., trap trees, anti-aggregation pheromone baiting (MCH))
    - All infested Douglas-fir trees, stumps, and debris associated with sanitation harvest must be treated and/or removed from the site prior to beetle flight.

Old Growth Management Areas (OGMAs) and Bark Beetles

In many areas, OGMAs contain the only representation of old forests in a given landscape/BEC zone. The qualities present in the OGMAs (large old trees) are also attractive for bark beetle. To minimize the impact on OGMAs the following precautions will be taken.

- Be consistent with the Land Use Objectives for the Cariboo-Chilcotin Land Use Plan, Biodiversity Updates, and Interim Modification to Biodiversity Update #7b
- Identify OGMAs of major concern for annual bark beetle monitoring
- Susceptible stands outside OGMAs will aid in prioritizing OGMA treatments
- Where infestations occur inside OGMAs, if appropriate, locate an intensive trap tree program outside the boundary to draw beetles out of the OGMA
- Consider using MCH on Douglas-fir where it could be of benefit to protect healthy stands inside OGMAs which may be provided and/or placed by FLNRO
- All infested Douglas-fir trees, stumps, and debris associated with sanitation harvest must be treated and/or removed from the site prior to beetle flight.

Hydrology Strategy for Bark Beetles

Insect infestations and subsequent related disturbances can affect watershed and hydrological processes by affecting water yield, magnitude and timing of peak flows, erosion processes, and sedimentation. The impacts involve complex interactions between harvest levels, road densities, understory vegetation, geography, and local and regional climate.

Forest planners and practitioners are encouraged to implement these recommendations where practicable:

- Hydrologic Sensitivity of Watersheds to MPB Infestation in the BC Interior, includes planning guidance for consideration
- AAC Rationale for Williams Lake TSA (p.25) – Hydrologic Considerations

General recommendations pertaining to watershed planning:
(http://www.for.gov.bc.ca/hfp/mountain%5Fpine%5Fbeetle/stewardship/hydrology/)

- salvage harvest in stages by using a variety of cutting intensities and retention strategies, distributed over the landscape, to desynchronize runoff,
- avoid sensitive terrain and soil types and develop erosion control plans where necessary,
- minimize harvesting within riparian areas,
- maintain a diversity of cover types and minimize post-salvage reforestation delays through single tree or patch retention to protect advanced regeneration as well as non-coniferous forest vegetation,
- leave fine and coarse woody debris in openings where possible to delay surface runoff,
- develop watershed management strategies that will maintain other forest resource values,
- construct, inspect, and maintain roads to ensure natural surface and shallow subsurface drainage remain intact, and
- upgrade drainage networks on permanent roads prior to salvage logging as necessary to accommodate expected increases in peak flows.

Preferentially retain stands:

- where less than 70 percent of the overstory is dead or vulnerable,
- that contain healthy advanced regeneration, and
- that are above the H60 in watersheds where there are known to be high riparian values and where Equivalent Clearcut Areas due to canopy mortality and harvesting could potentially exceed 50 percent.

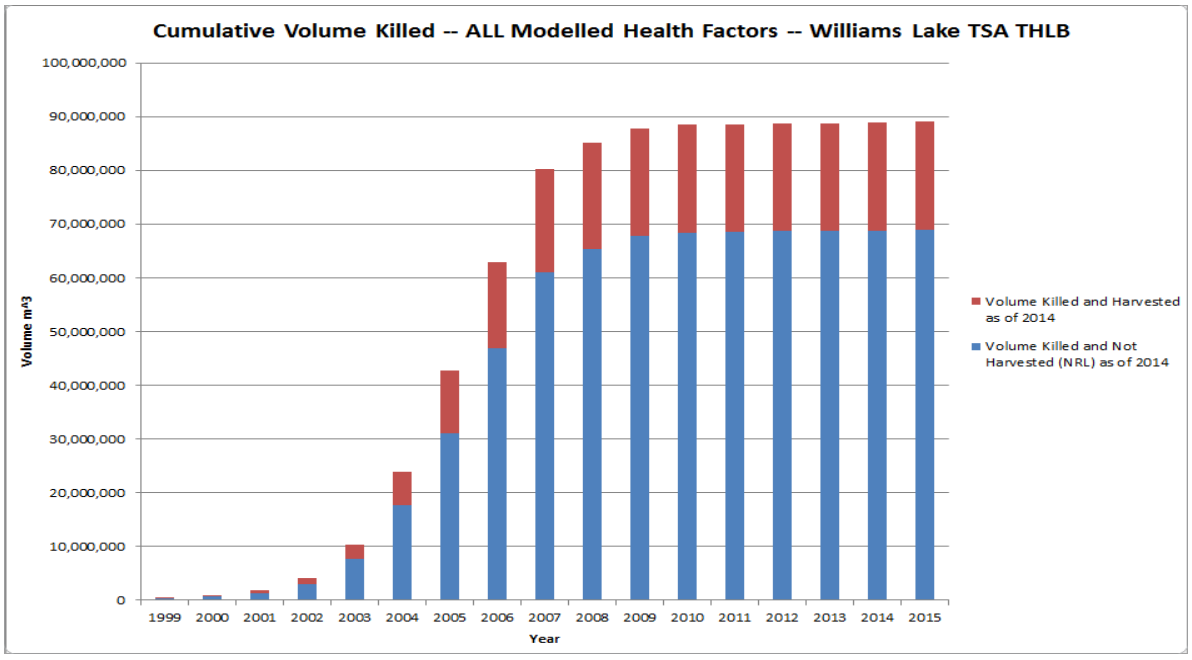
8. Non-Recoverable Losses

Non-recoverable losses account for the average volume lost each year due to natural causes, such as pests, fire and wind, that are not recovered or salvaged. The WLTSA Rationale for AAC Determination assumed a total of 149,553 cubic metres per year. Since this time a new tool for estimating NRL has been developed using the provincial aerial overview survey data. The salvage areas are netted out of the mapped mortality resulting in a rough estimate of unsalvaged volumes. This spreadsheet is posted on the FTP site at https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/NRLs/ The most recent NRL estimates for the WLTSA are provided in Table 5. The salvaged areas were not available for 2015 at the time of this Strategy being written.

Table 5: Summary of estimated non-recoverable losses (unsalvaged) by damaging agent 2009-2014

Year	Douglas-fir beetle (m3/yr)	Drought (m3/yr)	Fire (m3/yr)	Flooding (m3/yr)	Mountain Pine Beetle (m3/yr)	Spruce beetle (m3/yr)	Western Balsam Bark Beetle (m3/yr)	Total (m3/yr)
2009	148749	0	506976	0	1600667	169084	1049	2426525
2010	5154	0	389525	87	123842	124845	5261	648714
2011	6748	0	192	182	33757	24583	6223	71685
2012	34037	0	12656	4730	25006	81517	15026	172972
2013	3667	0	629	3667	5832	13885	3185	30865
2014	60030	343	9918	13228	6289	3248	3883	96939

Chart 1: Cumulative Volume Killed – All Modelled Forest Health Factors 2009-2014



9. Emergency Bark Beetle Management Regulation

As of July 3, 2014, all designations under the Emergency Bark Beetle Management Regulation have been rescinded. Appendix 3 is a memorandum that provides direction on the appropriate use of blanket salvage permits. A blanket salvage permit is a cutting permit issued to major licensees who have an existing tenure and is a tool that can be effective in reacting quickly in order to salvage smaller dispersed patches of dead or damaged timber.

Operations under the blanket salvage cutting permit for forest health concerns are to occur in accordance with the memo mentioned above and the following direction from the district:

- This authority is limited to the removal of fir bark beetle infested timber, spruce bark beetle infested timber, windthrown timber, fire killed timber and timber that must be harvested to facilitate the harvesting of the infested or windthrown or fire killed timber.
- Required to submit maps and or a report of sanitized sites.

Look for the updated Blanket Salvage Permit – District Guidelines this coming year. This document will amalgamate provincial and district blanket salvage permit requirements and provide consistent administration.

10. Reducing the Impacts of Climate Change

There is a growing body of evidence that global climate change has contributed to increased incidence and severity of a number of forest health factors (Woods et al., 2010). Therefore, adapting natural resource management to climate change is necessary to ensure forests are productive and ecosystems are resilient. The Cariboo Region Forest Health Strategy (2013-2016) contains valuable information, and supporting research, about the landscape-level hazard rating by forest health factor for biogeoclimatic subzones.

The Forest Stewardship Action Plan for Climate Change Adaptation 2012-2017 was released with three main goals to encourage adaptations to deal with climate change:

1. Foster Resilient Forests
2. Maintain Future Options and Benefits
3. Build Adaptive Capacity.

The Cariboo Region Extension Note on Adapting Natural Resource Management to Climate Change includes climate change projections; projected impacts of climate change to ecosystems; and adaptation strategies for natural resource management.

Website for Climate Change and Adaptation in B.C. Forests:
http://www.for.gov.bc.ca/het/climate/index.htm

The choice of silviculture strategies and/or harvesting systems can be an important consideration in establishing a healthy future stand. These strategies need to be considered in the context of integrated resource management.

Some silvicultural strategies and harvesting systems are listed below to help minimize the impact from forest pests and mitigate the risks associated with climate change:

- Adopt the Cariboo enhanced stocking standards for pine. For many of these BECs there is a management option for pine or mixed species. When managing for pine ensure high densities of pine are regenerated and/or a mix species with a low density of pine overstory. Increased densities of pine will help mitigate losses due to forest health factors such as stem rusts, atropellis and terminal weevil. When managing for mixed species, planting alternate species is often best done during initial stand establishment. Trying to fill plant later with pest resistant species after a pest problem occurs can be both costly and difficult. Where a stand is known to be at high risk from a host specific pest, planting alternate species or mixtures of host and non-host species is potentially a good strategy. In general, planting a mixture of species will reduce the impact of most pests and may have other beneficial effects such as increasing biodiversity and mitigating climate change impacts.
- Treat the site prior to planting. For obligate parasites that have short distance spread (dwarf mistletoes) or site specific pests (some root rots), site treatment such as sanitation spacing or stumping can be an effective method of reducing losses from disease.
- Planting within two years of slash burning may increase the risk of black army cut worm or Rhizina root disease in certain areas.
- Before considering spacing it is important to conduct pest surveys and to consider the impact of forest pests on final stocking levels. In some instances it is preferable to delay spacing until the final impact of forest pests can be more accurately assessed.
- Facilitate migration of seed sources and extend the natural range of trees species. The Ministry of Forests Lands and Natural Resource Operations has modified their seed transfer guidelines and provided assisted species migration guidance (http://www.for.gov.bc.ca/hti/spar/chronologySZ.htm). These policies

will help ensure that trees are more adapted to changes in climate and more resistant forest health agents.

- Partial harvest systems are generally not recommended in stands with root disease or dwarf mistletoe but may be beneficial for regenerating well stocked stands with greater structural and species diversity and may provide some mitigation against growing season frosts and other weather events.

11. Key TSR Issues

In February 2015 a new Annual Allowable Cut Determination for the WLTSA was published. In this document FLNRO staff, other agencies and licensees (as appropriate) are directed by the Chief Forester to undertake or support specific tasks and studies. The key tasks and studies that relate to this strategy are noted below. These projects are important to help reduce the risk and uncertainty associated with factors that affect the timber supply in the Williams Lake TSA.

Short-term considerations:

1. Licensees are to continue to focus harvesting as much as possible on mountain pine beetle-impacted pine-leading stands in the Williams Lake TSA; and to harvest no more than their share of the AAC partition attributable to live tree volume.
2. District staff are to monitor the following and report semi-annually to the chief forester:
    a. harvest performance within MPB-killed pine-leading stands and the volume attributable to live trees within those stands; and
    b. harvest contribution from non-pine leading stands.

Mid-term timber supply considerations:

1. *Low productivity sites*: Staff are to explore opportunities (eg., rehabilitation and bioenergy) for the use of some of the low productivity sites before the next determination
2. *Mule deer winter range*: Staff are to address MDWR issues including meeting minimum basal area targets relative to current or projected stand conditions; incentives for non-clearcut harvesting approaches given higher administrative and planning costs; and addressing poor forest health conditions that may be exacerbated by lack of management before the next determination so that this factor can be better considered. There is also a need for a standard Cariboo

region-wide approach to modelling winter range requirements stemming from an order under the Government Actions Regulation.

3. *Douglas-fir stands*: Staff are to explore innovative ways (such as use of LiDAR) to improve the inventory, including growth and yield, of Interior Douglas-fir stands given their contribution to mid-term timber supply.

Other considerations:

1. *Climate change*: Staff are to try and understand projected climate change impacts in the TSA so that this important consideration can be factored into the next determination.

12. Web Links for Resources

Cariboo-Chilcotin Resource District Resources

Douglas-fir Bark Beetle Documents, including:

- BMU priority areas,
- DCC IBD Operating Areas
- Strategic Douglas-fir Bark Beetle Management Plan Cariboo Region,
- signed Douglas-fir Bark Beetle Implementation Plan Cariboo-Chilcotin Resource District, and
- signed Interim Modifications to Biodiversity Update #7b
  https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Douglas-fir%20Bark%20Beetle%20Documents/

Cariboo Region Forest Health Strategies and Data

Strategic Douglas-fir Bark Beetle Management Plan - Cariboo Region
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Douglas-fir%20Beetle%20Strategy/

Interim Modifications to Biodiversity Update #7b August 2015 *Expires October 31, 2016*
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/

Detailed helicopter-GPS Douglas-fir bark beetle survey data (2015)
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Detailed%20BB%20Heli-flight%20Data/2015%20Detailed%20IBD%20Data/

Bark beetle hazard rating maps (2014)
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Bark%20Beetle%20Hazard%20Maps/2014/

Beetle Management Unit Boundaries – BMUs (Spring 2015)
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Beetle%20Management%20Unit%20Boundaries/Spring%202015/

Guide to Identifying Douglas-fir beetle attack from ground assessments
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Forest%20Health%20Presentations/Douglas-fir_beetle_signs.pdf

2015 updated Seral Analysis. This analysis is based on the 2015 VRI data.
Report:
ftp://ftp.geobc.gov.bc.ca/publish/Regional/WilliamsLake/forest/seral/seral_2015/report/
Maps:
ftp://ftp.geobc.gov.bc.ca/publish/Regional/WilliamsLake/forest/seral/seral_2015/maps/

Root Rot shape files
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/

Biodiversity Committee Updates

Cariboo-Chilcotin Land Use Plan. 2006. An Integrated Strategy for Management of Biodiversity and Bark Beetles in Douglas-fir and Spruce Stands. Update Note #7b.
https://www.for.gov.bc.ca/tasb/slrp/lrmp/williamslake/cariboo_chilcotin/plan/biodiv/biodiv_update7b_dec_11_2006.pdf

Land Use Order
Objectives for wildlife tree retention, OGMAs, Critical Fish Habitat, Lakes, Riparian Reserve Zones, Grasslands, High Value Moose Wetlands, Grizzly Bear.
ftp://ftp.geobc.gov.bc.ca/publish/Regional/WilliamsLake/Cariboo-Chilcotin_LUOR_Order/legal_order_document/CaribooChilcotinLUO_May2011.pdf

MDWR Management Strategies
Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin Part 1a:
Management Plan for Shallow and Moderate Snowpack Zones. 2007. R.J. Dawson, H.M. Armleder, B. Bings, and D. Peel.

Management Strategy for Mule Deer Winter Ranges in the Cariboo-Chilcotin Part 1b:
Management Plan for Transition and Deep Snowpack Zones. 2006. R.J. Dawson, H.M. Armleder, B. Bings, and D. Peel.

General Wildlife Measures

Order for Shallow/Moderate Snowpack MDWRs:
http://www.env.gov.bc.ca/wld/documents/wha/Amendment_ShallowModerate_Feb07_Ord.pdf

Order for Transition/Deep Snowpack MDWRs:
http://www.env.gov.bc.ca/wld/documents/wha/Amendment_TransDeep_Feb07_ord.pdf

Individual MDWR Long-term Objectives Maps, Overview TSA MDWR maps, Snowpack Zones map:
http://www.env.gov.bc.ca/esd/distdata/ecosystems/mdwr/

Information Notes:

Mule Deer Winter Range Strategy Committee. 2014. Regional mule deer winter range strategy. Information Note #1. Guidance for fire damaged stands.
https://www.for.gov.bc.ca/tasb/slrp/lrmp/williamslake/cariboo_chilcotin/plan/biodiv/2014_June_Final_Information_Note1.pdf

Mule Deer Winter Range Strategy Committee. 2014. Regional mule deer winter range strategy. Information Note #2. Guidance for MDWR General Wildlife Measure Exemption Requests for Salvage of Insect-killed Douglas-fir.
https://www.for.gov.bc.ca/tasb/slrp/lrmp/williamslake/cariboo_chilcotin/plan/biodiv/2014_June_Final_Information_Note2.pdf

Frost Hazard Guide and Extension Note

Steen, O.A.S., R. Stathers, and R. Coupé. 1990. Identification and management of summer frost prone sites in the Cariboo Forest Region. For. Can. and B.C. Min. For., Victoria, B.C. FRDA Rep. 157. 23 pp.
http://www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr157.htm
https://www.for.gov.bc.ca/rsi/research/cextnotes/extnot05.pdf

Ecora Resource Group Ltd. 2012. Drought risk and frost hazard mapping for the Williams Lake TSA. And Frost Hazard Workbook (Excel). (maps available upon request).
https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Frost%20Hazard/Report%20and%20tools/

General Forest Health Information

Provincial Aerial Overview Survey
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

RESULTS Incidence Maps
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/RESULTS%20incidence%20maps/

12. References

Eng, M. 2004 Forest Stewardship in the Context of Large-scale Salvage Operations: An Interpretation Paper, B.C. Ministry of Forests Forest Science Program Technical Report 019

Heineman, J.L. et al. 2010 Investigating the influence of climate, site, location, and treatment factors on damage to young lodgepole pine in southern British Columbia. Can J. For. Res. 40: 1109-1127

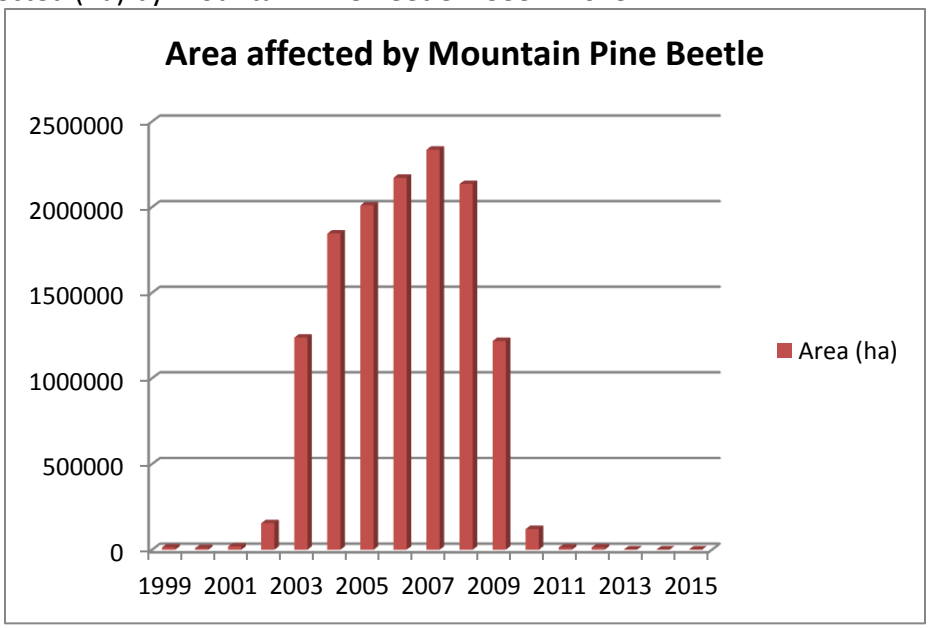
McLennan, D. 2003. Ecosystem restoration recommendations in areas aff ected by major salvage harvesting. British Columbia Ministry of Water, Land and Air Protection. Terrestrial Ecosystem Restoration Program, Victoria, B.C. Review draft .

Westfall J. & Brooks, J. 2001 Cariboo Forest Region Pests of Young Pine Stands: Incidence and Impact 1996-1999. B.C. Min. of For.

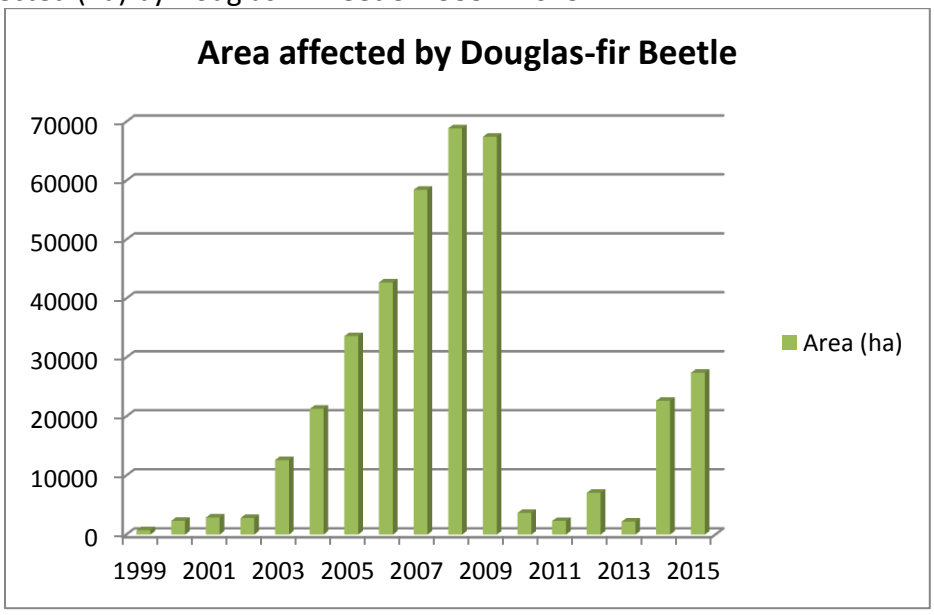
Woods, A.J. et al. 2010. Forest health and climate change: a British Columbia perspective. Forestry Chronicle 86(4): 412-417.

Appendix 1: Bark Beetle Population Trends 1999-2015

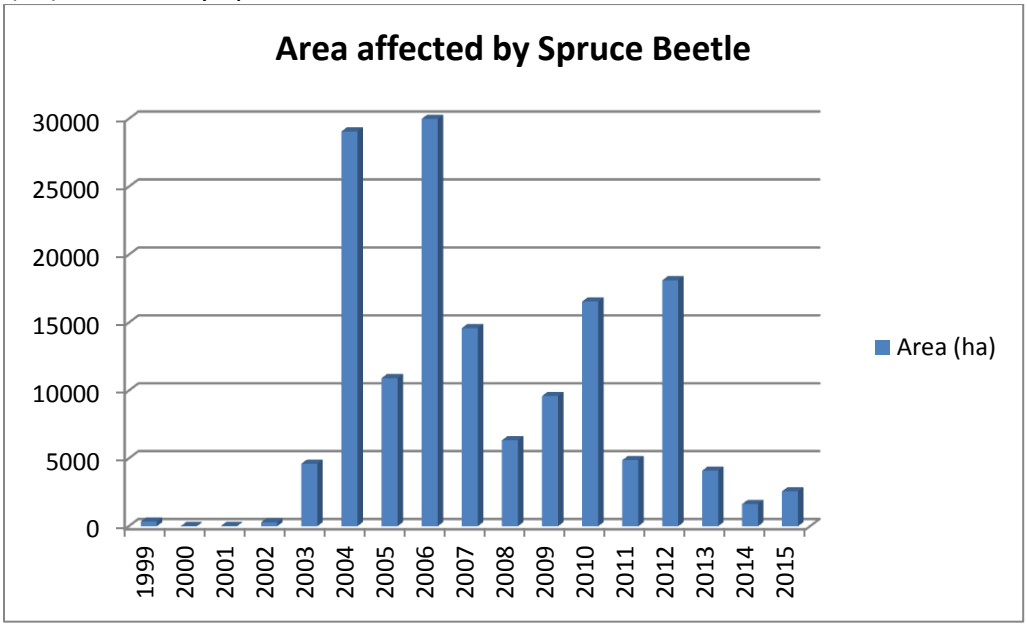
Area affected (ha) by Mountain Pine Beetle: 1999 – 2015



Area affected (ha) by Douglas-fir Beetle: 1999 – 2015



Area (ha) affected by Spruce Beetle: 1999 – 2015



Appendix 2:

Beetle Management Units and WLTSA Strategies

Douglas-fir
Bark Beetle (IBD)
Strategy
Beetle Management Unit
Strategy (IBD)
Monitor
Salvage
Suppression
Suppression = HIGH PRIORITY
Upper Dean
Beeftrail
Christenson Creek
Tusulko
Corkscrew
Hotnarko
Telegraph
Holtry
Nimpo
Atnarko
McLinchy
Alplands
Clearwater
Big Stick
Colwell
Kilnaklini
Westbranch
Middle Lake
Crazy Creek
Hickson
Tiedemann
Nude Creek
Doran Creek
Nostetuko
Ottarasko
Cheshi Stikelan
Chilko
Franklyn
Downton
Punky Moore
Palmer/Jorgenson
Puntzi
Chilanko
Tatla/Little Eagle
Bidwell/Lava
Upper Tatlayoko
Brittany
Nemiah
Rainbow
Gunn Valley
Beece Creek
Edmond
Lord River
Taseko
Tchaikazan
Clusko
Punky Moore
Olsbako
Nazko
Sisters
Alexis
Pyper
Swash
Tautri East
Proposed FNWL Anaham 1
Anaham
Proposed FNWL Anaham 2
Proposed FNWL Anaham 3
Proposed FNWL Stone
Minton
Haines
Tete Angela
Nuntzi Elkin
Bambrick
Nadlia
Upper Big Creek
Big Creek
BCTS-Gaspard-Churn-Big Creek
Gaspard
Farwell
Churn
Dash
BCTS Dash
Upper Churn
Koster/Lone Cabin
Dog Creek
Alkali West
Alkali CF
Alkali East
Riske
Chimney
Military Reserve
Meldrum
BCTS-Mackin
Mackin
BCTS-Twan
BCTS-Hawks Creek
Hawks Creek
Big Lake
Beaver Valley
Polley
Likely CF
Kangaroo
Likely
Waska/Lynx
BCTS-Quesnel Lake
AFRF-Gavin Lake
WLCF-Potato Mountain
Horsefly
McKay
Black Creek
McKinley
McKusky
Moffat
BCTS-McIntosh
WLCF-Flat Rock
Williams Lake
AFRF-Knife Creek
Keys Lake
BCTS-Caribou Lake
Little River
Mitchell Lake
Penfold
Niagara
East Arm
Eastside
Westside
0
15
30
60
Kilometers
Ministry of Forests, Lands and Natural Resource Operations
Last updated: 07/12/2015
Updated by: camahood

Mountain Pine Beetle (IBM) Strategy
Beetle Management Unit Strategy (IBM)
Salvage
0 15 30 60
Kilometers
Ministry of Forests, Lands and Natural Resource Operations
Last updated: 07/12/2016
Updated by: camahood
Upper Dean
Beeftrail
Christenson Creek
Tusulko
Hotnarko
Telegraph
Atnarko
Alplands
McLinchy
Clearwater
Big Stick
Colwell
Kilnaklini
Westbranch
Middle Lake
Crazy Creek
Hickson
Tiedemann
Nude Creek
Doran Creek
Nostetuko
Ottarasko
Cheshi/Stikelan
Chilko
Franklyn
Edmond
Lord River
Tchaikazan
Taseko
Corkscrew
Hoitry
Nimpo
Palmer/Jorgenson
Puntzi
Chilanko
Tatla/Little Eagle
Bidwell/Lava
Upper Tatlayoko
Downton
Punky Moore
Clusko
Otsbako
Nazko
Sisters
Alexis
Pyper
Siwash
Brittany
Nemian
Rainbow
Gunn Valley
Tete Angela
Nuntzi Elkin
Haines
Bambrick
Beece Creek
Nadlla
Big Creek
Upper Big Creek
Tautri East
Proposed FNWL Anaham 1
Anaham
Proposed FNWL Anaham 2
Proposed FNWL Stone
Minton
Proposed FNWL Anaham 3
Mackin
BCTS-Twan
BCTS-Mackin
Meldrum
Military Reserve
Riske
BCTS-Gaspard-Churn-Big Creek
Gaspard
Dash
BCTS-Dash
Upper Churn
Churn
Koster/Lone Cabin
Farwell
Alkali West
Alkali CF
Alkali East
Chimney
Dog Creek
Hawks Creek
BCTS-Hawks Creek
Big Lake
Beaver Valley
Likely CF
Polley
Kangaroo
Likely
Keys Lake
BCTS-Caribou Lake
Little River
Penfold
Niagara
Mitchell Lake
East Arm
Eastside
Westside
Wasko/Lynx
BCTS-Quesnel Lake
AFRF-Gavin Lake
WLCF-Potato Mountain
Horsefly
McKay
Black Creek
McKinley
McKusky
Moffat
BCTS-McIntosh
Williams Lake
WLCF-Flat Rock
AFRF-Knife Creek

Spruce Bark Beetle (IBS) Strategy

Beetle Management Unit Strategy (IBS)

Monitor

0 15 30 60
Kilometers

Ministry of Forests, Lands and Natural Resource Operations

Last updated: 07/12/2015
Updated by: camahood

Appendix 3:

Emergency Bark Beetle Management Area
And
Blanket Salvage Cutting Permits

File: 18810-04/EBBMA
Ref: 206915

July 3, 2014

To: FLNR REGIONAL EXECUTIVE DIRECTORS
FLRN PROVINCIAL EXECUTIVE DIRECTORS
FLNR DISTRICT MANAGERS

From: Lorne Bedford
Acting Director
Resource Practices Branch

Re: Emergency Bark Beetle Management Area

The emergency situation associated with the mountain pine beetle (MPB) epidemic that led to the establishment of an Emergency Bark Beetle Management Area (EBBMA) and Emergency Management Units (EMUs) has long since passed.

Over the winter in 2011/12, we initiated discussions with the Operational Issues Forums regarding our intent to repeal the EBBMA and return to managing bark beetles as part of normal operations rather than as an emergency situation. We received wide scale support that the emergency was over, but there was a need to have the tenure and pricing tools afforded by the EBBMA continue to be available to manage bark beetles effectively. Specifically, there was concern over the availability of blanket salvage permits (BSPs). Over the past year and a half, we have worked with Tenures and Pricing staff to revise policies so that blanket salvage permits remain a viable tool.

On June 1, 2014 amendment no. 5 to the Interior Appraisal Manual (IAM) included changes to pricing and eligibility criteria for blanket salvage permits including the requirement to be consistent with the District Forest Health Strategy. The method through which management units are assigned an emergency bark beetle unit strategy (aggressive, containment or salvage) remains unchanged; simply the document within which the information resides has changed. The current BMU strategies will be referenced in the locally maintained District Forest Health Strategy. This strategy will allow local knowledge and priorities to inform the decision process.

With the beetle epidemic over, there is no longer a need for the EBBMA or EMUs and they are repealed in the attached Order. The provisions for the EBBMA were carried over from the Bark Beetle Regulation under the Forest Planning and Practices Regulation 109(1) and 109(2). Both sections will soon be repealed by OIC and future scenarios similar to the wide-scale mountain pine beetle outbreak will be managed as a "Forest Health Emergency" under s.27 of the *Forest and Range Practices Act.*

In addition to the changes in the IAM there will be an updated memo from the Deputy Minister to replace the "Bark Beetle Salvage Cutting Permits memo" dated March 22, 2005, that currently resides in the Cutting Permit and Road Tenure Administrative Manual.

The changes in the IAM, in combination with the memo, will provide district managers both the tools and consistent direction to effectively manage bark beetles and other forest health damage according to local priorities and to protect local resources values.

If you have any questions or concerns please contact Tim Ebata at (250) 387-8739.

L Bedford

Lorne Bedford
Acting Director
Resource Practices Branch

Attachment - Order for Disestablishment of Emergency Bark Beetle Management Area and Units

pc: Richard Grieve, Director, Strategic Initiatives and Legislation Branch
Albert Nussbaum, Director, Forest Analysis and Inventory Branch
Murray Stech, Director, Timber Pricing Branch
Doug Stewart, Director, Forest Tenures Branch
Grant Loeb, Manager, Timber Pricing Branch
Jim Hackett, Interior Lumber Manufacturers' Association
Less Kiss, Coast Forest Products Association
Archie Macdonald, Council of Forest Industries
Doug Routledge, Council of Forest Industries
Jennifer Burleigh, Provincial Forest Entomologist, Resource Practices Branch
Tim Ebata, Forest Health Officer, Resource Practices Branch

File: 280-20
Ref: 207020

BY EMAIL

To: Interior Regional Executive Directors
Interior District Managers

From: Tim Sheldan
Deputy Minister

Re: Blanket Salvage Cutting Permits

As of July 3, 2014, all designations under the Emergency Bark Beetle Management Regulation have been rescinded. The purpose of this memo is to provide direction on the appropriate use of blanket salvage permits going forward now that the emergency of the mountain pine beetle epidemic has passed. This memo replaces all previous direction given for blanket salvage permits.

A blanket salvage permit is a cutting permit issued to major licensees who have an existing tenure. Cut blocks that meet the criteria specified below may be amended into the cutting permit if approved by the district manager prior to commencement of harvesting.

This tenure tool can be effective in reacting quickly in order to salvage smaller dispersed patches of dead or damaged timber[1]. Caution must be exercised to ensure that inappropriate application of this tool is avoided. The overarching intent of this provision is to facilitate the recovery of otherwise unrecoverable losses to both available timber supply and Crown revenue from dead or damaged timber. At the same time the tool will minimize the amount of undamaged timber that is necessary to harvest in order to salvage the timber. Appropriate use of this tool is critical to protect the mid-term timber supply.

Blanket Salvage Permits will only be used in the following circumstances:

- Sanitation harvesting for the management of insect infestations in a manner that is consistent with the districts' forest health strategy, or

- Harvesting dead or damaged timber that is a high priority for the district and must be addressed quickly and cannot wait for the planning of a larger cutting permit development in the area, or

[1] Refer to section 6.4(3) of the Interior Appraisal Manual for the definition of damaged timber.

Interior Executive Directors

- Harvesting dead or damaged timber where the district is satisfied that the timber is isolated such that it cannot be logically added to an approved or potentially planned harvest opportunity.

Cut blocks that are amended into existing or future blanket salvage permits must meet the following criteria:

1. No more than 5000 cubic metres may be harvested under an individual opening. An opening must not exceed 15 hectares, excluding the volume harvested from any road clearing that is necessary to facilitate the removal of the dead or damaged timber.

2. In instances of harvesting for the purposes of insect sanitation, supporting documentation detailing the results of probe surveys must be submitted with the amendment prior to harvest.

3. The district manager is satisfied that the amount of undamaged timber that needs to be harvested will be minimised.

4. Calculation of the stumpage rates for these cutting permits is as prescribed in the *Interior Appraisal Manual*.

The district manager must ensure that these permits do not overlap other existing cutting authorities, and that a plan is in place to ensure the correct marking of timber and to verify that only approved cut blocks are harvested.

Each district may have its own more specific requirements as long as they are consistent with this direction. It is my expectation that Regional Executive Directors maintain a reasonable level of consistency between districts and across regions. Operational results will be reviewed going forward and will inform decisions as to any further changes that may be required.

Tim Sheldan
Deputy Minister

pc: Archie Macdonald, Council of Forest Industries
Jim Hackett, Interior Lumber Manufacturers Association
Chris Armanini, Tolko Industries Ltd.
Tom Jensen, Assistant Deputy Minister, Timber Operations, Pricing and First Nations Division
Dave Peterson. Assistant Deputy Minister, Tenures, Competitiveness and Innovation Division
Rick Manwaring, Assistant Deputy Minister, Regional Operations Division – South Area
Kevin Kriese, Assistant Deputy Minister, Regional Operations Division - North Area
Susanna Laaksonen - Craig, Executive Director, Timber Operations, Pricing and First Nations Division
Murray Stech, Director, Timber Pricing Branch
Keith Tudor, A/Director, Timber Pricing Branch
Grant Loeb, Manager, Timber Pricing Branch
Lorne Bedford, A/Director, Resource Stewardship Division

Appendix 4:

Suitable Secondary Structure

BRITISH COLUMBIA

District Policy
Central Cariboo and Chilcotin Forest Districts
Williams Lake Timber Supply Area (TSA)

Interpretations on the Definition of "Suitable Secondary Structure" within the Forest Planning and Practices Regulation (FPPR)

June 24, 2013

Purpose

In order to assist in protecting mid-term timber within the Williams Lake TSA, the protection of secondary stand structure needs to be conducted during harvest planning and development. Due to the lack of additional species in pine leading stands, there is varying interpretations on the definition of "suitable secondary structure" within the FPPR; therefore, it is appropriate to provide a district interpretation.

The section of the definition that requires interpretation is:
(a) *likely to survive an attack from mountain pine beetle*. The opposing positions on this interpretation are: does it include lodgepole pine or just other species, especially if the pine has recently survived the latest mountain pine beetle (MPB) epidemic. There is logical reasoning that a mature pine is still susceptible to a MPB attack.

Scope

This interpretation focuses the emphasis on protecting the younger pine stands which have a greater likelihood to contribute to the mid-term inventory. This also confirms the ability to harvest mature pine types that meet the salvage definition but do have a green mature pine component.

Additional monitoring on the sequence of harvesting within the TSA must be conducted. If mature green pine leading stands are being harvested prior to merchantable MPB killed stands this policy will be at risk and may require further direction or refinement.

Policy

To ensure there is a pine component that is protected as secondary stand structure, the district's interpretation is that west of the Fraser River within the Williams Lake TSA targeted pine leading stands age Class 4 or less (</= 80 years of age) will be considered likely to survive an attack from MPB for the purpose of the "suitable secondary structure" definition. The forest cover labels will be used to identify age class or other methods acceptable to the district.

Ministry of Forests, Lands and Natural Resource Operations

Address:
200 - 640 Borland Street
Williams Lake, British Columbia
V2G 4T1

Tel: 250-398-4345
Fax: 250-398-4790
Website: www.gov.bc.ca/for

BRITISH COLUMBIA

Review Schedule

This Policy will be reviewed on an annual basis or as issues arise within the Williams Lake TSA.

Approval

Michael C. Pedersen, R.P.F.
District Manager
Central Cariboo and Chilcotin Forest Districts