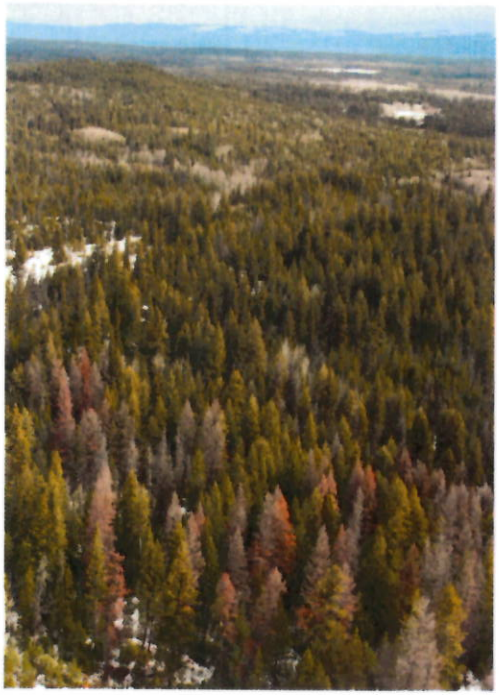
Quesnel Natural Resource District
Forest Health Strategy
2019/2020



Covering: Quesnel Natural Resource District, Quesnel Timber Supply Area, TFL 52, Woodlots, and Cascadia Timber Supply Area

Updated by: _____ Date: 28-02-20

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Table of Contents

Table of Contents i

Introduction 1

Guiding Principles 2

Forest Health Objectives 3

Roles and Responsibilities 3

Strategies and Tactics for Specific Forest Health Agents 6

Bark Beetles *6*

Strategy for Douglas-fir beetle (*Dendroctonus pseudotsugae*) 15

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/update_note_7b.pdf 16

Strategy for Mountain pine beetle (*Dendroctonus ponderosae*) 16

Strategy for Western balsam bark beetle (*Dryocoetes confusus*) 16

Defoliators *17*

Western spruce budworm (*Choristoneura freemani* Razowski) 17

Two-year-cycle budworm (*Choristoneura biennis*) 17

Gypsy moth (*Lymantria dispar*) 17

Forest Health Agents of Young Stands *18*

Reporting and Tracking 19

Hard pine stem rusts 19

Dwarf Mistletoe on Lodgepole pine (*Arceuthobium americanum*) 20

Root Disease *20*

Armillaria (*Armillaria ostoyae*) 20

Tomentosus (*Inonotus tomentosus*) 20

Abiotic Injuries *21*

Weather Related Forest Health 22

Windthrow 22

Reducing the Impacts of Climate Change 24

Management of Douglas-fir Beetle around Other Resources 24

Map Links 25

Reference Material 32

Biodiversity Conservation Strategy Committee 2006. An Integrated Strategy for Management of Biodiversity and Bark Beetles in Douglas-fir and Spruce Stands update 7b. Interagency (ILMB) Cariboo Manager's Committee (CCLUP). Williams Lake B.C. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-

resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/update_note_7b.pdf 32

Introduction

This strategy recommends actions to address forest health issues in the Quesnel Natural Resource District including the Quesnel Timber Supply Area, TFL 52, Woodlots, and that part of the Cascadia TSA contained within the Quesnel Natural Resource District. It outlines the current status of forest health, as well as, key tactics and forest management actions that can help address forest health issues. The intent of this strategy is to provide useful guidance to forest professionals, operational planners, reviewing agencies, and approval authorities regarding forest health agents within the Quesnel Natural Resource District. The objective is to enhance ecosystem health thereby improving forest resiliency and sustainability. Harvesting proposals that are new or vary from this direction should include a rationale to clarify the circumstances, intent, and appropriateness of the proposal.

The forest health agents that have been included in this strategy are considered to have the potential for significant impacts and/or frequent occurrence within the Quesnel Natural Resource District. Understanding the implications of climate change for forest health is a focus of the Ministry of Forests, Lands, Natural Resource Operations & Rural Development (FLNRORD). Climate change strategies for forest pests can be found in Forest Health and Climate Change.

The Quesnel Natural Resource District Forest Health Strategy has, for the most part, not been changed for this year. There have been minor edits, streamlining of information, as well as, some additions.

Updates of Note 2019/2020:

- 2019 Aerial overview flight https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/
- Root disease guidance document and website. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/root-diseases
- Table 4: Major Bark Beetle Area (ha) Information for the Quesnel Natural Resource District.
- Updated Spruce Bark Beetle BMUs from Monitor to Suppression.
- The fire subsection under the Abiotic Injuries section has been added.
- Timeframes have been modified under Appendix A – Table 2: Recommended management activity time table for Douglas-fir beetle.
- Updated best Practices for Managing Douglas-fir Beetle (2017/2018): https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Douglas-fir%20Bark%20Beetle%20Documents/Best%20Management%20Practices%20for%20Managing%20Douglas-fir%20Beetle/
    - o Introduction and Biology
    - o Management Strategies and Tactics
    - o Landscape and Stand Level Planning
    - o Douglas-fir Beetle and Wildfire

Highlights from the 2018 Aerial Overview Survey:

DEFOLIATORS	
Western Spruce Budworm	Down
2-Year Cycle Budworm	Up
Pine Needle Sheathminer (Zellaria)	Up
Forest Tent Caterpillar	Static
BARK BEETLES	
Western Balsam Bark Beetle	Up
Spruce Beetle	Down
Douglas-fir Beetle	Down

Guiding Principles

Provide general direction for management of forest health agents emphasizing the predominant bark beetles which pose the most immediate forest health threat. Enable operational planners to focus on economically viable priorities to get maximum value from the infested trees. Licensees and BC Timber Sales (BCTS) are encouraged to build upon the strategies and tactics contained herein to maximize the available harvesting capacity. Be consistent with the legislations and planning guidance listed below:

- Provincial Forest Health Strategy, the Forest Health Implementation Strategy, and the Government's strategic forest health objectives: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health
- Cariboo Region Forest Health Strategy 2013-2016: http://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/forest%20health%20references/Cariboo%20Forest%20Health%20Strategy%20Final_March2014.pdf
- Cariboo-Chilcotin Land Use Plan (CCLUP), Biodiversity Conservation Strategy Updates, Mule Deer Winter Range Strategy, Climate Change in Cariboo Chilcotin, and Strategic Land and Resource Planning information: https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/cariboo/cariboochilcotin-rlup
- Ungulate Winter Ranges and their associated approved objectives/General Wildlife Measures: http://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html
- Mountain and Northern Caribou approved objectives/General Wildlife Measures: http://www.env.gov.bc.ca/cgi-bin/apps/faw/wharesult.cgi?search=show_approved
- CCLUP Regional Biodiversity Conservation Strategy and updates to guide harvesting in constrained areas. Measures for all agents are to be consistent with CCLUP and Regional Biodiversity Conservation Strategy: http://www.for.gov.bc.ca/hfd/library/RBCS.htm
- Chief Forester guidance and instructions from the recent Allowable Annual Cut (AAC) determinations with respect to recommended wildlife tree retention to provide guidance for large scale salvage harvesting.
- Ministerial Order: Land Use Objectives for the Cariboo-Chilcotin Land Use Plan (CCLUP) Area, October 26 , 2015: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-

industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/quesnel_ogma_luor__amendment.pdf

- Quesnel Enhanced Conservation Strategy February 2006.
- *Forest and Range Practices Act* (FRPA) Bulletins https://www.for.gov.bc.ca/hth/bulletins.htm

* *Please note that web site/link locations may change.*

Forest Health Objectives

- Identify beetle management strategies (suppression, holding, salvage or monitoring).
- Provide updated strategic guidance for the ongoing forest health management in the Quesnel Natural Resource District.
- Identify treatment strategies for forest health management of agents affecting both merchantable, non-merchantable trees and young stands.
- Facilitate co-operative planning between government and licensees.
- Establish short-term and longer-term treatment guidelines to best address the 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 major licensees, BCTS, and FLNRORD identify areas of responsibility for beetle management. This includes where there may be opportunities for small tenure holders, to assist in salvage/suppression efforts.

Roles and Responsibilities

- Licensee and BCTS planners and government agency reviewers will collaboratively undertake implementation of this strategy
- Meetings will be held on an as-needed basis to discuss the implementation and effectiveness of this strategy. A rough outline of meeting times, objectives and outputs are shown in Table 1.
- Detailed aerial surveys and ground surveys will the responsibility of licensees and FLNRORD
- Single tree removal/disposal, trap tree placement/removal and larger scale treatments will be the responsibility of licensees and MFLRNO as decided through the collaborative effort.
- FLNRORD will consider funding opportunities to undertake trap-tree programs, ground surveys, and small-site treatments in areas designated as "suppression" or "holding" for Douglas-fir and spruce bark beetle.
- Specific roles for monitoring, reporting and consolidation of information will be determined via the meetings mentioned above.
- Assessment of hazard and risk, plus stand-ranking information, will be carried out by FLNRORD and provided to licensees and other agencies as requested.
- FLNRORD, in conjunction with licensees, will determine high priority areas for defoliator treatment. Often these areas have been impacted by both Douglas-fir bark beetle and western spruce budworm.

Table 1: Responsibility Matrix for the Quesnel Natural Resource District Forest Health Strategy

Action Item	Responsibility	Completion Date
Aerial Overview and detailed flight information provided to licensees and FLNRORD staff.	FLNRORD	November
Updated Forest Health Strategy and BMU boundaries sent to licensees.	FLNRORD	February
Results of bark beetle overwinter mortality survey.	FLNRORD	March - April
Update on spruce budworm spray area and bud mining surveys provided to licensees if this occurs.	FLNRORD	April
Update on budworm sprayed areas provided to licensees if this occurs.	FLNRORD	July
Results of egg mass sampling for budworm provided to licensees.	FLNRORD	November
Forest health budget and plans for forest health program (FLNRORD internal process).	FLNRORD	September
Results of detailed helicopter GPS surveys for bark beetles.	FLNRORD	October (Douglas-fir flight data may be ready in June.)
Information sharing of beetle incidence – beetle sites, efficacy of treatments, risks and hazards to susceptible stands.	FLNRORD, Licensees and First Nations	Any time of year

Priority Forest Health Factors in the Quesnel Natural Resource District

Information that is used to determine the status of forest health agents is provided by FLNRORD via the annual aerial overview survey and by reports from licensees, regional, district and branch forest health specialists and stewardship staff. For an overview of current pest conditions as determined from aerial overview flights refer to the Overview of Forest Health for Southern British Columbia:

https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

Within the Quesnel Natural Resource District pest species are ranked according to;

- distribution of pest and current incidence levels,
- available susceptible host species,
- known or suspected impacts on forest resource values,
- availability of operational detection and treatment methods,

- costs and benefits of applying detailed detection and treatment activities, and
- general level of knowledge about the hazard and risk zones.

The detail of the type of damage each forest health agent produces is included in the Cariboo Region Forest Health Strategy's 'Pest Profiles', as well as, detail concerning all the forest health factors. If a forest health factor is not listed in the table below, then it has been given a moderate or low priority ranking and will be managed consistent with the objective contained in the Cariboo Region Forest Health Strategy.

Table 2: High priority forest health factors, the risk they pose, and the management objective currently being recommended to address them.

Forest Health Factor	Probability	Severity	Ranking	Management Objective
Douglas-fir Beetle	Moderate	Mod-High	High	Reduce existing populations through sanitation harvesting and trap trees in suppression beetle management units and prevent buildup of beetle populations around fires and windthrow. Monitor in inaccessible areas.
Spruce Beetle	Moderate	Moderate	High	Sanitation and salvage harvest in unconstrained areas to recover losses and reduce populations, especially in windthrow. Monitor in constrained or inaccessible areas.
2-year cycle budworm	Moderate	Moderate	High	Monitor, develop treatments and operational trials for high risk stands to spray with (Bacillus thurigiensis var. Kurstani) Btk
Gypsy Moth	Low	High	High	Monitor to detect new occurrences.
Western gall rust	High	Moderate	High	Plant higher densities/use mixed species in high hazard areas.
Commandra & Stalactiform rust	Moderate	Moderate	High	Plant higher densities/use mixed species in high hazard areas.
Fire	Moderate	Mod-High	High	Action depending on risk. Follow the fire management plan.
Wind	Low	Moderate	High	Monitor and salvage. Proactive management using good cutblock design, to protect linear reserves.
Mountain Pine Beetle	Low	Moderate	Moderate	Salvage in accordance with Chief Foresters guidelines. Monitor new infestations in young stands and remaining mature pine stands.

Western Spruce Budworm	Moderate	Moderate	Moderate	Spray areas with moderate to high risk of defoliation with (Bacillus thurigiensis var. Kurstani) Btk
Balsam Bark Beetle	Moderate	Low	Moderate	Monitor.

Strategies and Tactics for Specific Forest Health Agents

To keep this strategy document concise, the description of strategies, tactics and other measures is restricted to a citation of information currently available in Forest Health guidebooks, the Provincial Forest Health Strategy and other FLNRORD documents.

Any forest health agent on the priority list that is not specifically listed below will be in **containment status** and be addressed in accordance with the provincial best management practices and applicable guidebooks.

Extension Notes from the BC Journal of Ecosystems and Management for the *Southern Interior Forest Region* - Forest Health Stand Establishment Decision Aids are provided in the links below:

Updated link: http://www.jem-online.org/forrex/index.php/jem/article/view/308

Bark Beetles

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 BMU listing should be referenced by licensees and the district to determine where specific administrative tools may be suitably applied to facilitate sanitation harvesting for managing bark beetle populations. 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: Objective is to reduce populations and maintain them at a relatively low level. Target is to treat >80% of known infestation centers in each year. All harvest and treatment are directed at green attacked trees.

Holding: Objective is to maintain the infestation to a relatively static level by treating 50-70% of known infestations in each year. That is, the level of harvest and/or treatment is equal to the rate of infestation expansion. Harvesting should be concentrated in green attacked trees.

Salvage: Objective is to salvage for value recovery as the highest priority. 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.

Monitoring: Objective is to only record the change in attack level with no beetle management being attempted.

The Quesnel Natural Resource District BMUs are designated for bark beetle species, roughly by Landscape Unit, with smaller suppression BMUs delineated. These are identified both in the table below, on a hard-copy map included in this section and spatially as a design file and larger-scale printable maps. The Quesnel Natural Resource District Suppression BMUs exclude areas designated as the following:

- Old Growth Management Areas (OGMA): Permanent OGMA-static and Permanent OGMA-rotating.
- Scenic areas with an established visual quality objective of 'Retention' and 'Preservation'.

The Quesnel Natural Resource District has procedures for salvage of infestations outside of Suppression BMUs.

Table 3: Beetle Management Units designated for Douglas-fir Beetle (IBD), Spruce Beetle (IBS) and Mountain Pine Beetle (IBM)

Beetle Management Unit (BMU)	2019_IBD	2019_IBS	2019_IBM	Size (ha)
Baezaeko	Holding	Monitor	Salvage	73,555
Baezaeko B	Suppression	Monitor	Salvage	9,692
Baker	Holding	Monitor	Monitor	69,996
Baker B	Suppression	Monitor	Monitor	24,203
Betty Wendle	Monitor	Monitor	Monitor	34,482
Bowron	Monitor	Monitor	Monitor	40,023
Chine	Holding	Monitor	Salvage	60,915
Chine B	Suppression	Monitor	Salvage	321
Clisbako	Monitor	Monitor	Salvage	64,087
Coglistiko	Monitor	Monitor	Salvage	55,290
Cunningham	Holding	Holding	Monitor	36,563
Downton	Monitor	Monitor	Monitor	14,800
Dragon	Holding	Monitor	Monitor	30,822
Dragon B	Suppression	Monitor	Monitor	64323
Eliguk	Monitor	Monitor	Salvage	39,706
Euchiniko	Monitor	Monitor	Salvage	59,045
Gerimi	Monitor	Monitor	Monitor	3,827
Gerimi B	Suppression	Holding	Monitor	39,239
Indianpoint	Monitor	Monitor	Monitor	7,088
Jack of Clubs	Monitor	Holding	Monitor	5,221
Kluskus	Monitor	Monitor	Salvage	77,271
Lightning	Monitor	Holding	Monitor	19,694
Marmot	Holding	Monitor	Monitor	4,569
Marmot B	Suppression	Monitor	Monitor	48,397
Matthew	Monitor	Holding	Monitor	44,397
Narcosli	Holding	Monitor	Monitor	6,803
Narcosli B	Suppression	Monitor	Monitor	70,121
Pan	Monitor	Monitor	Monitor	75,652
Pantage	Holding	Monitor	Monitor	8,633
Pantage B	Suppression	Monitor	Monitor	70,012
Pelican	Holding	Monitor	Salvage	76,458
Pelican B	Suppression	Monitor	Salvage	2,132
Ramsey	Holding	Monitor	Monitor	35,578
Ramsey B	Suppression	Monitor	Monitor	35,285
Sandy	Monitor	Monitor	Monitor	32,910
Snaking	Holding	Monitor	Monitor	64,666
Swift	Monitor	Holding	Monitor	9,390
TFL	Holding	Monitor	Monitor	260,867
TFL 5	Suppression	Monitor	Monitor	34,421
Tibbles	Holding	Monitor	Monitor	68,891
Toil	Monitor	Monitor	Salvage	51,836
Twan	Holding	Monitor	Monitor	4,996
Twan B	Suppression	Monitor	Monitor	25,049
Umiti	Monitor	Monitor	Monitor	44,045
Victoria	Holding	Holding	Monitor	15,715
Wentworth	Holding	Monitor	Salvage	32,495
Wentworth B	Suppression	Monitor	Salvage	33,927
Whittier	Holding	Monitor	Monitor	5028
Whittier B	Suppression	Monitor	Monitor	56,847
Willow	Monitor	Holding	Monitor	27,944
			TOTAL	2,077,225

Table 4: Major Bark Beetle Area (ha) Information for the Quesnel Natural Resource District

TSA Quesnel	Trace		Light		Moderate		Severe		Very Severe		Total (ha)	
Bark Beetles	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Mountain Pine Beetle (IBM)	0.0	0.0	0.0	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60
Spruce Beetle (IBS)	253	1,793	218	337	35	0	0	0.0	0.0	0.0	506	2,130
Western Balsam Bark Beetle (IBB)	53,844	53,876	2,025	1,070	16.7	0.0	0.0	0.0	0.0	0.0	55,885.7	54,946
Two Year Cycle Budworm	0	0	32,614	1,897	16,595	0	377	0	0	0	49,586	1,897
Douglas-fir Beetle (IBD)	396	1,485	5,492	760	3,206	338	0	0.0	0.0	0.0	9,094	2,583
TOTAL: All Bark Beetles	*54,493*	*57,154*	*7,735*	*2,227*	*3,257.7*	*338*	*0*	*0*	*0.0*	*0.0*	*65,485.7*	*59,719*

Severity Class	Description
Trace	<1% of trees in the polygon recently killed
Light	1-10% of trees in the polygon recently killed
Moderate	11-29% of trees in the polygon recently killed
Severe	30-49% of trees in the polygon recently killed
Very Severe	50% + of trees in the polygon recently killed

BMU shape files are located at: https://www.for.gov.bc.ca/ftp/DQU/external/!publish/District%20Composites/Forest%20Health/2016%20BMUS/

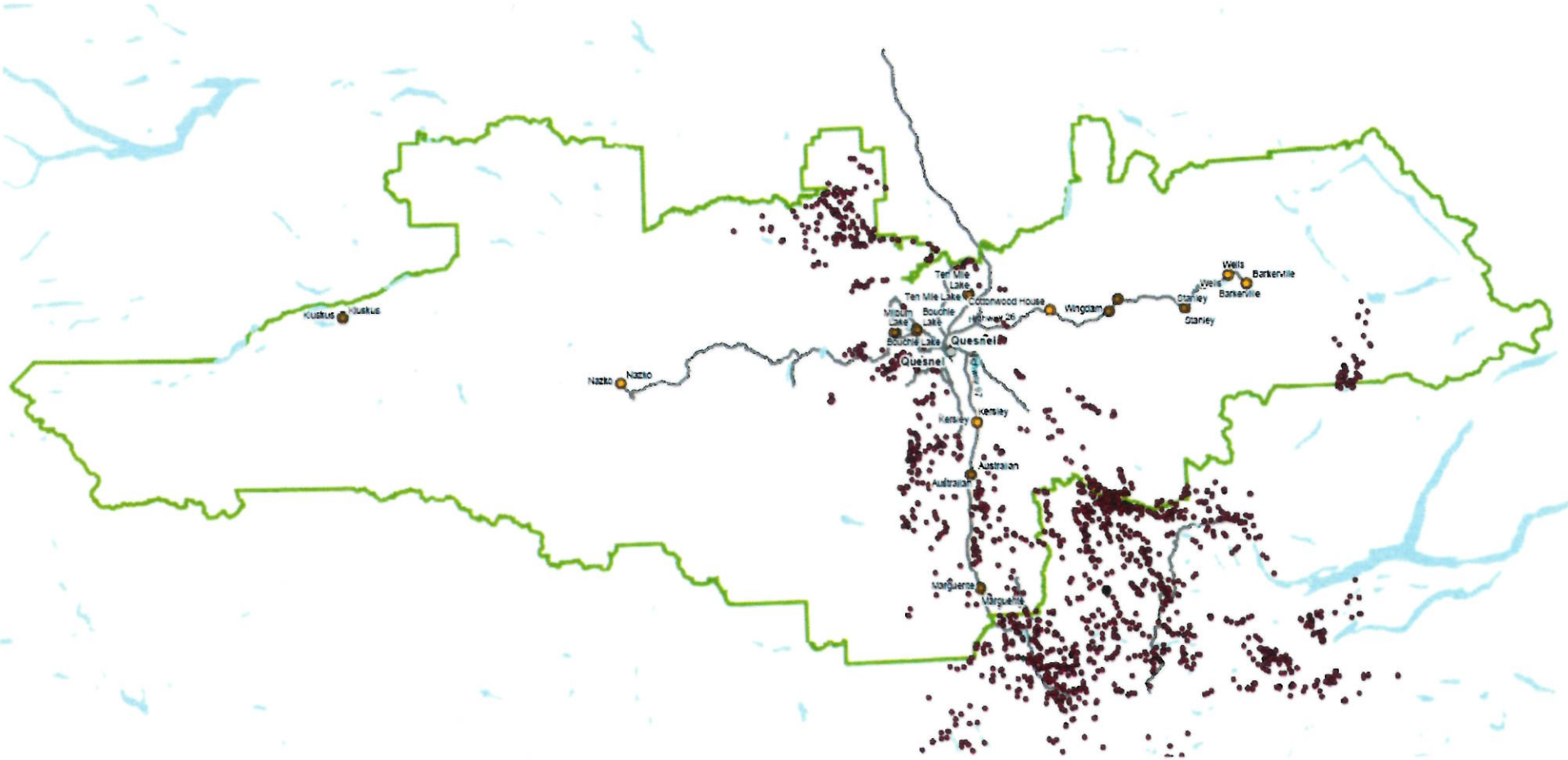
2019 Overview of Forest Health Conditions in Southern British Columbia including:
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/2019/

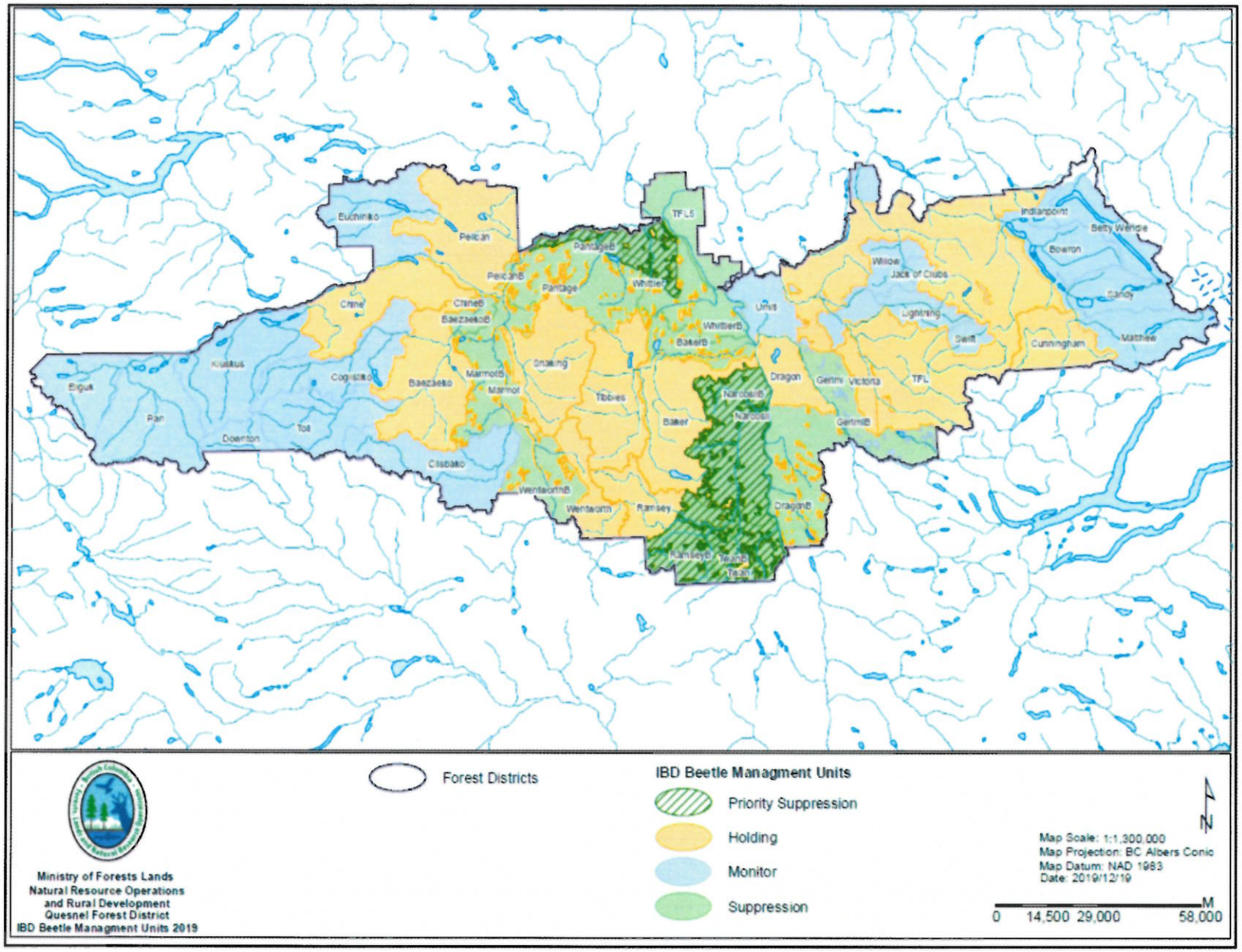
- 2019 Aerial Overview Information
- Shape files

2019 Detailed Helicopter GPS survey of Douglas-fir beetle in Cariboo Region:

- https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Detailed%20BB%20Heli-flight%20Data/

Figure 1. 2019 Detailed Helicopter Flight for Douglas Fir Beetle.

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IBD Beetle Managment Units 2019
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Whittier
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BaezaekoB
Kluskus
Eliguk
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Downton
Toll
Coglistiko
Baezaeko
MarmotB
Marmot
Snaking
Tibbies
Clisbako
WentworthB
Wentworth
Ramsey
Baker
BakerB
WhittierB
Umiti
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NarcosliB
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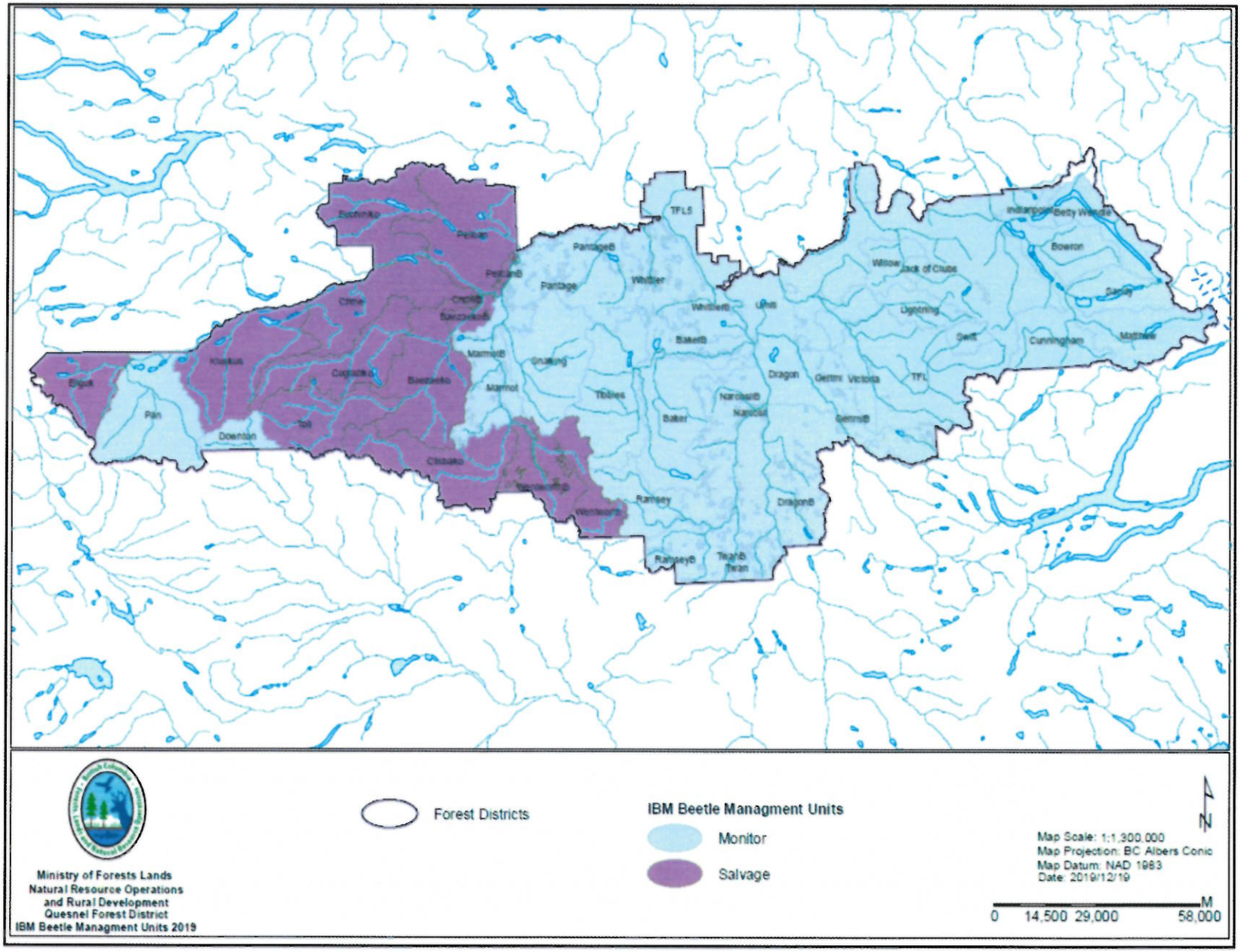
Indianpoint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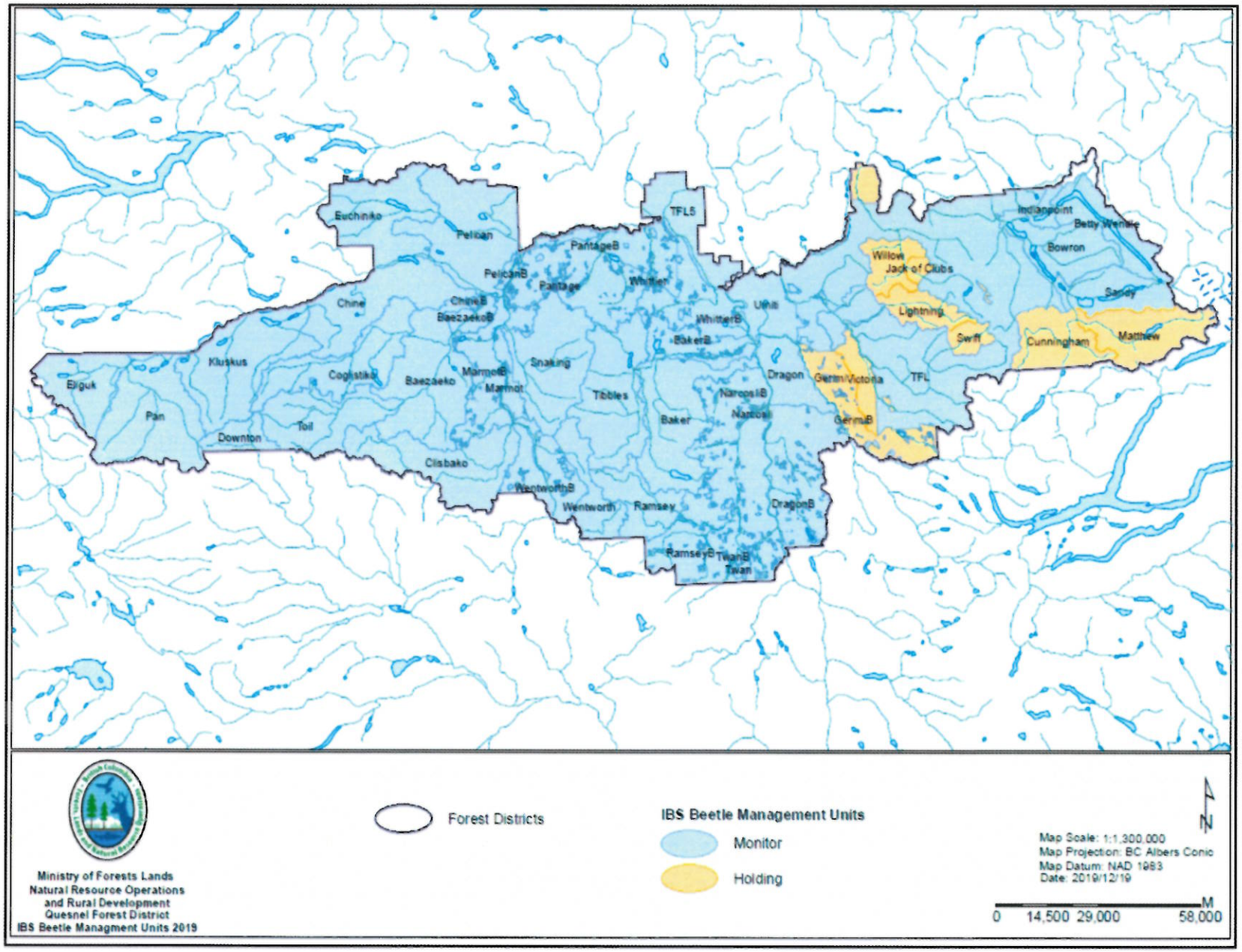
Euchiniko
Pelican
PelicanB
PantageB
Pantage
TFL5
Whittier
Chine
ChineB
BaezaekoB
WhittierB
BakerB
Uthiti
Willow
Jack of Clubs
Lightning
Swift
Indianpoint
Betty Wendle
Bowron
Sandy
Cunningham
Matthew
Kluskus
Eliguk
Pan
Downton
Toil
Coglistiko
Baezaeko
MarmotB
Marmot
Snaking
Tibbles
Baker
NarcosliB
Narcosli
Dragon
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and Rural Development
Quesnel Forest District
IBS Beetle Managment Units 2019

Strategy for Douglas-fir beetle (*Dendroctonus pseudotsugae*)

Though the total number of patch infestation hectares in the Quesnel Natural Resource District decreased significantly from 10,257 ha to 2.582 ha, the number of spot infestations also decreased slightly from 427 in 2018 to 400 in 2019. Douglas-fir beetle remained active in the Alexandria, Narcosli Creek, Nazko, and Blackwater areas.

The spread of Douglas-fir bark beetle is of particular concern due to its occurrence within and in proximity to Mule Deer Winter Ranges and Old Growth Management Areas where operability can be challenging. **'Priority Suppression'** zones have been delineated on the Douglas-fir bark beetle (IBD) BMU map to address areas of concern. The intent of this category is to encourage forest health management in these areas if possible. These 'Priority Suppression' areas are located around the Blackwater area and the Fraser River corridor in the southern part of the district.

Please refer to Appendix A-*Douglas-Fir Beetle-Best Management Practices*, for further information.

Quesnel Natural Resource District Tactic: **Suppression, Holding and Monitor**

Suppression activities include: small patch removal, single tree removal, fall, buck and burn infested stems, ensure timely slash disposal, incorporate trap trees, and beetle pheromone baiting

Holding activities include: those suppression activities listed above, aerial surveys, low level orthophotos, ground probing and walkthroughs.

Monitoring activities include: aerial surveys, low level orthophotos, ground probing and walkthroughs, ensure timely slash disposal.

The ***Regional Biodiversity Conservation Strategy Update Note #7b- December 2006*** and subsequent ***Interim Modifications to Biodiversity Update 7b – December 2007*** provides beetle suppression treatment options and practices regarding management of biodiversity and bark beetles in Douglas-fir stands in Old Growth Management Areas and other constrained areas such as Mule Deer Winter Range. Information is available on the CCLUP Biodiversity Conservation web site: https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/cariboo/cariboochilcotin-rlup. The original Biodiversity Update #7B the District will be following is at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/update_note_7b.pdf

Strategy for Spruce beetle (*Dendroctonus rufipennis*)

After a rise in Spruce beetle in 2014, the 2018 overview summary found Spruce bark beetle levels declined and remain low with scattered small patches and spots within a total of 505 hectares of trace to light mortality.

QTSA Tactic: **Holding and Monitor**

Holding activities include: small patch removal, single tree removal, fall, buck and burn infested stems, timely slash disposal, incorporate trap trees, beetle pheromone baiting, aerial surveys, low level orthophotos, ground probing and walkthroughs.

Monitoring activities include: aerial surveys, low level orthophotos ground probing and walkthroughs, ensure timely slash disposal.

The ***Regional Biodiversity Conservation Strategy Update Note #7b- December 2006*** makes recommendations regarding management of biodiversity and bark beetles in spruce stands in Old Growth Management Areas and other constrained areas.

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/cariboo-region/cariboochilcotin-rlup/update_note_7b.pdf

Strategy for Mountain pine beetle (*Dendroctonus ponderosae*)

Mountain pine beetle has been assigned a moderate priority for salvage harvesting. There is 60.0 hectares of light mortality detected within the Quesnel Natural Resource District.

QTSA Tactic: **Salvage action and monitoring.**

Monitoring activities include: aerial surveys, low level orthophotography, ground probing and walkthroughs, ensure timely slash disposal.

Salvage activities include harvesting. In young stands the land-based investment program and the Type 4 silviculture analysis will guide stand recovery decisions.

The ***Quesnel Forest District Enhanced Retention Strategy – February 2006*** provides stand level biodiversity guidance for large scale salvage of mountain pine beetle impacted stands.

Updated link:
https://gww.for.gov.bc.ca/ftp/DQU/external/!publish/Matrix/PDF/DQU%20Enhanced%20Conservation%20Strategy-%20Release%201.pdf

Strategy for Western balsam bark beetle (*Dryocoetes confusus*)

The Quesnel Natural Resource District experienced a slight decrease from 55,869 hectares of western balsam bark beetle attack to 54,946 hectares in 2019, primarily in the upper Swift River and Bald Mountain area south of Wells, and near Beaver Pass. The life cycle of this pest is normally two years, however, when climatic conditions are favorable; the cycle can be completed in one year. Normally, however, less than 5% of a stand is attacked in a single season, with the damage usually scattered throughout the stand.

QTSA Tactic: **Containment and ground-truth the extent of the infestation. Harvesting the current attack is a feasible means of control.**

Defoliators

Western spruce budworm (*Choristoneura freemani* Razowski)

Western spruce budworm is an insect that defoliates Douglas-fir of all ages. This pest is of high significance as it not only has the potential to cause mortality in the current growing stock but also stresses the Douglas-fir trees, increasing future vulnerability to bark beetle attack. Western spruce budworm defoliation has been detected in southern portion of the TSA along the Fraser River near the district boundary moving north to the Alexandria area. This is the most northerly record of visible defoliation in the district. The Forest Health Stand Establishment Decision Aid for this pest is at:https://www.for.gov.bc.ca/ftp/DSQ/external/!publish/forest%20health/SEDA_SpruceWeevil_WSpruceBudworm.pdf

QTSA Tactic: **Containment and treat moderate and severely defoliated high-value stands of Douglas-fir with *Bacillus thurigiensis* var. *Kurstani* (Btk), conducted by the Cariboo Region.**

Two-year-cycle budworm (*Choristoneura biennis*)

This pest attacks subalpine fir and spruce, of all ages. Management of this pest is important because these two tree species are key to the mid-term timber supply. Tree mortality can occur after several successive years of severe defoliation, particularly on immature or suppressed trees. Other damage includes top-kill (resulting in stem defects), reduced seed production due to damaged cones, and height and volume loss. Defoliation increased in 2018 due to this being the 'on' year in the feeding cycle of this insect. There was light to moderate defoliation over a total area of 49,586 hectares and is found mainly in the in the upper Swift River, Bald Mountain, Beaver Pass, and Mount Tom areas. This decreased significantly in 2019 to 1,897 hectares of light defoliation.

QTSA Tactic: **Containment, treat moderate and severely defoliated high-value stands with *Bacillus thurigiensis* var. *Kurstani* (Btk), conducted by the Cariboo Region.**

Gypsy moth (*Lymantria dispar*)

The Gypsy moth is not native to BC. It is an introduced pest that has significant economic implications if it becomes established in this province. It was first discovered in B.C. in 1978. It has more than 300 host plants. This pest is very high on the provincial and federal priority list though none have been reported in the district. An outbreak brings potential international trade restrictions. It has the potential to become a major forest pest and serious threat to urban shade trees and ornamentals.

The eggs can be transported on vehicles and in particular recreational vehicles travelling from an area of infestation to other areas of the province. In recent years a number of infestations have been found and treated on Vancouver Island, Gulf Islands and the lower mainland.

QTSA Tactic: Monitor by placing pheromone traps at frequently visited campsites and recreational vehicle parks and provincial parks throughout the District. Eradicate by treating known infested sites with *Bacillus thurigiensis* var. *Kurstani* (Btk), conducted by the Cariboo Region and Province.

Black Army Cutworm (*Actebia fennica* (Tausch.))
Priority = High, area impacted was not recorded in 2017.

Black Army Cutworm will defoliate coniferous seedlings as a result of lack of herbs and shrubs in the fire area. Due to the large areas affected by wildfires in 2017/2018, monitoring of Black Army Cutworm populations is taking place in the fire areas.

Black Army Cutworm Best Management Practices:

- Identify high risk sites and monitor
  - Burned openings south or west facing slopes are preferred for egg laying
  - Intense burns decrease natural vegetation which leads to higher risk of plantation defoliation
  - ESSF, MS, SBS, ICH, and IDF
  - Drought-prone sites
- Delay planting for 1 – 2 years
- Avoid spring planting
- Survey for cutworm damage on natural vegetation in the spring
- Pheromone monitoring

QTSA Strategy: "Monitor" with no treatments planned.

Pine Needle Sheathminer
Found mostly in juvenile stands, damage is restricted to current years growth although up to 100% of the growth can be destroyed over hundreds of hectares. The Quesnel TSA was the only area with pine needle sheathminer which dropped to 751 hectares from 3,497 hectares in 2018.

QTSA Tactic: Monitor. Including overview flights conducted by the Cariboo Region.

Forest Health Agents of Young Stands

Mid-term timber supply will come from our present post-free growing stands. Observations and scientific surveys of forest health factors in young stands require a need to better understand how

our managed stands are performing. The health of young stands as it relates to mid-term timber supply is worthy of a detailed study in the district.

The young pine mortality data (2007-2010) that the forest health group collects was compiled and summarized province-wide using the provincial aerial overview survey that has been mapping the distribution and relative severity of this damage. A link to the spreadsheet called 2010 Young Pine IBM.xlsx is below
http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/2010/2010%20Young%20Pine%20IBM.xlsx

The "graphs" tab in the spreadsheet shows how the beetle attack has changed over time depending on the district's proximity to the main outbreak. The South Area Region forest health work further details the aerial survey and plot work which illustrates how significant the damage has become.

Reporting and Tracking

Knowledge of the extent of damaging forest health agents in immature stands could provide a risk rating based on tree species selected for management and composition at the stand level over numerous BEC zones. The RESULTS database has been queried for forest health information. An incidence map was produced by Branch in 2011 for the district. It is not a predictive map. Unfortunately, forest Health data is not always complete in RESULTS so, the incidence map has limitations at this time.

QTSA Tactic: Licencees report forest health incidence levels for each RESULTS forest cover polygon with regeneration and free growing milestone updates.

Hard pine stem rusts

The hard pine stem rusts impact young pine forests that will form our future timber supply. Locally, these rusts can cause mortality, unacceptable damage to stems and plantation failure. Alternate hosts include *Commandra* spp. or *Geocaulon* spp. primarily bastard toadflax (G. *lividum*). Gall rust is endemic throughout most pine stands. There are a few spots in the vicinity of Beavermouth and Nyland Lake where the incidence has become more than endemic. Commandra has been evident in the South Ramsey Creek, Snaking River and Udy Creek areas. In the Caribou, BEC zones IDF, SBPF, and SBS with all subzones, have a high hazard rating for DSG, DSS and DSC rusts.

QTSA Tactic: Plant mixed-species stands to a higher density in the high rust-hazard zones. Contain and treat detected infestation areas in accordance with provincial best management practices and guidebooks. Resource: *Stem Rusts of pine Hunt R.S. 1992. Forest Pest Leaflet 37 Forestry Canada.*

http://publications.gc.ca/collections/collection_2012/rncan-nrcan/Fo29-6-37-1992-eng.pdf

Free growing and post free growing surveys (Forest and Range Evaluation Program (FREP) stand development monitoring) will assist in providing the locations of infestation areas. Establishing a mixed-species stand will help reduce the incidence of stem rusts provided the other species are ecologically suitable. It is important to report forest health incidence levels for each RESULTS forest cover polygon.

Dwarf Mistletoe on Lodgepole pine (*Arceuthobium americanum*)

Mistletoe causes swelling on branches and stems. Heavily infected trees suffer reduced height and diameter growth leading to volume reductions. Mistletoe is present in many stands, in particular within the IDF dk3, IDF dk4, and SBPS xc biogeoclimatic zones.

QTSA Tactic: **Aggressive Suppression action. Resource:** ***Biology and Management of Dwarf Mistletoe in Lodgepole Pine in the R***ocky Mountains by Hawksworth F.G. & Johnson D.W. USDA General Technical Report RM-169.

When mistletoe is noted in the understory pre or post-harvest, the recommended treatment for the Cariboo Region is a 0.5 m knock down within a few years of harvest.

Root Disease

Armillaria (*Armillaria ostoyae*)

Generally, Armillaria is restricted to a few scattered small areas in the Quesnel Natural Resource District. This root disease is spread by root contact. Incidences of very small Armillaria spots have been reported in a few areas in the district (500 Road, Ernst Road and Deep Creek).

Resource: *Extension Note BC Journal of Ecosystems and Management, British Columbia's Southern Interior Forests, Armillaria Root Disease Stand Establishment Decision Aid by Michelle Cleary, Bart van der Kamp, and Duncan Morrison.*
http://www.jem-online.org/index.php/jem/article/view/397

Resource: *Detection, Recognition and Management of Armillaria and Phellinus Root Disease in the Southern Interior of BC, FRDA Report 179.*
http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/3211.pdf

QTSA Tactic: **Monitor and treat as prescribed in best management practices** contained in the report by Michelle Cleary, Bart van der Kamp, and Duncan Morrison titled ***Armillaria Root Disease Stand Establishment Decision Aid.*** The report provides a Decision key for different treatment strategies for Armillaria-infested sites by BEC zone/subzone for the Southern Interior Region.

Tomentosus (*Inonotus tomentosus*)

Stand level symptoms of Tomentosus are difficult to identify. The disease spreads through root contact and is widely distributed in the SBS BEC zones in spruce stands. The dry SBS biogeoclimatic zones have the highest hazard for Tomentosus.

QTSA Tactic: Monitor and treat as per the *Tomentosus Root Rot Forest Health Stand Establishment Decision Aid* by Reich R.W., Lewis K.J. & Wienscyk, 2013 - A.M. Journal of Ecosystems and Management 14(1):1-8 Forrex. https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwj828u_2b_mAhXP854KHbquDlkQFjAAegQIBBAC&url=https%3A%2F%2Fjem-online.org%2Findex.php%2Fjem%2Farticle%2Fdownload%2F562%2F489&usg=AOvVaw22eImPvcbAqtM745wMNhFV

Resource: Managing Root Disease in British Columbia (April 2018) https://www.for.gov.bc.ca/ftp/rsi/external/!publish/Forest%20Health/forest%20health%20references/RootDiseaseGuidebook%E2%80%93May2018.pdf

Resource: *Root Disease Management Guidebook, Forest Practices Code* https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/root/roottoc.htm

Abiotic Injuries

Wildfire Damage and Post-Wildfire Mortality

Wildfire damage: Priority=High
Post Wildfire Mortality: Priority = High

The 2017/2018 wildfires were the most extensive on record in the province. The large wildfire areas impact social, economic and environmental factors which must all be considered when determining a treatment for an area. Post-wildfire mortality has increased as a result of the 2017/2108 fires and is forecasted to increase beyond 2018.

QTSA Tactic:

- Engage in Douglas-fir bark beetle trapping immediately post-fire as populations increase dramatically around fires
- Follow:
  - Chief Forester Post –Natural Disturbance Forest Retention Guidance (2017 Wildfires) at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/2017_fire_report_revised.pdf
  - Regional Manager Post-Wildfire Salvage guidance to Licensees at https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Forest%20Health%20Strategy/2018-2019/Regional%20Manager%20post%20wildfire%20salvage%20guidance_sept%202017_signed%20(2).pdf
  - Cariboo Region Delegated Decision Makers Post-Wildfire Salvage Expectations for Land Use Designations in Cariboo Region at

ftp://ftp.geobc.gov.bc.ca/publish/Regional/WilliamsLake/Cariboo_FSP_Replacements/Direction_Expectations/Signed%20Post%20Wildfire%20Salvage%20Expectations%20for%20Land%20Use%20Designations%20in%20the%20Cariboo%20Region.pdf

- Best Practices for Managing Douglas-fir Beetle - Douglas-fir Beetle and Wildfire at https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Douglas-fir%20Bark%20Beetle%20Documents/Best%20Management%20Practices%20for%20Managing%20Douglas-fir%20Beetle/

- Mule Deer Winter Range exemptions for wildfire impacted stands at https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Post%20Wildfire%20MDWR%20Exemptions/

Weather Related Forest Health

Frost, drought, snow press, flood damage and other weather related events are difficult to predict. However, preventative measures can be taken to mitigate the problem such as species selection, density, or mix, stand tending, brushing, and understanding the silvics of tree species.

QTSA Tactic: **Salvage harvest merchantable timber within one year of the catastrophic event. Limit planting lodgepole pine at higher elevations to avoid snow damage. Use ecologically proven species in harsh biogeoclimatic subzones.**

Windthrow

All species are vulnerable to strong winds. Scattered to severe windthrow (blowdown) in either spruce or Douglas-fir stands have the potential to trigger substantial increases in infestations of bark beetles (spruce and Douglas-fir beetles). Windthrown patches should be addressed promptly to minimize the expansion of beetle populations, especially in the vicinity of mule deer winter ranges and old growth management areas for Douglas-fir stands, depending on the timing of the windthrow event.

It may be appropriate in some areas to leave trees blown down until after the beetle flight to utilize them as trap trees. Wind thrown trees should be removed or burned prior to the beetle flight of the following year so, that attacked windthrown trees do not contribute to an increase in beetle populations. MCH (Methyl-cyclo-hexanone) can be effective in keeping beetles out of inaccessible windthrow.

QTSA Tactic: **Aggressive Suppression action. Harvest Douglas-fir and spruce blowdown within one year of windthrow event to reduce opportunities for bark beetle infestations.**

Quesnel Natural Resource District- Blanket Salvage Cutting Permit Expectations

Purpose: A blanket salvage cutting permit is a cutting permit issued to major licensees who have an existing tenure. This tenure tool can be effective in reacting quickly in order to salvage small

dispersed patches of dead or damaged timber [1] and can be used for addressing dead or damaged timber that is a high priority for the district, such as:

- Douglas-fir beetle
- Spruce beetle
- Recent Douglas-fir or Spruce blowdown that is creating a forest health hazard
- Fire damaged timber that is creating a forest health hazard

Operations under the Blanket Salvage Cutting Permit for forest health concerns are to occur only within areas identified as suppression or holding BMU designated under the current Quesnel Natural Resource District Forest Health Strategy.

Specific Criteria

a. Individual patch or block sizes cannot exceed 15 hectares or 5000 m^3 of gross volume (excluding volume harvested from road clearing width if the road is necessary to facilitate the harvest). Within the 15 hectare maximum, the total area using a *clear-cut harvest system* will not exceed 5 hectares. Remaining areas may utilize a *partial cutting system* targeting only damaged stems leaving a stand that provides a future harvest opportunity in 20-40 years.

b. No arbitrary boundaries are to be used to keep block size limits within the 15 hectare size so it fits under the blanket salvage cutting permit.

c. Areas where larger (i.e., more area or volume) harvesting opportunities exist need to be applied for under normal cutting permit applications.

d. Cutblocks must be truly isolated and stand alone. They are not to be artificially separated by features such as roads, WTP's, riparian area, fence lines, or small green patches of timber, etc.

e. Tree/beetle probe summary information (blowdown %) along with a detailed operational map is required with all amendment applications. Where possible, please include the point infestation data from the detailed flight layer which will allow correlation with the 'on the ground' data collected in your survey.

f. Harvest of healthy stems necessary to access infested or damaged timber shall be minimized.

Best Practices: It is recommended that prior to applying for a blanket salvage cutting permit for the purposes of sanitation harvest; a meeting should be arranged with the District to ensure consistency with the Quesnel Natural Resource District Forest Health Strategy and the Blanket Salvage Cutting Permit Expectations. Applications not meeting the above guidelines must have a written rationale and be discussed with the District or they may be rejected. The District reserves the right to reject any amendment application under the blanket salvage cutting permit authority.

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

Reducing the Impacts of Climate Change

There is scientific evidence that climate change could significantly affect British Columbia's forests and rangelands. Adapting forest and range management practices that promote ecosystem resilience is important to consider. In light of climate change, things to consider are planting a diversity of species at the stand and landscape level, plant higher densities, and consider how changes in climate may affect the future suitability of species to a site. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/tree-seed/seed-planning-use/climate-based-seed-transfer

The Ministry of Forests, Lands and Natural Resource Operations has released regional extension notes regarding adapting natural resource management for a changing climate. There is an extension note that includes climate change projections for the Cariboo region, projected impacts of climate change to ecosystems, and adaptation strategies for natural resource management. Please refer to *Adapting Natural Resource Management to Climate Change in the Cariboo Region: Considerations for Practitioners and Government Staff.*

Updated link: http://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/regional-extension-notes/caribooen160222.pdf

Management of Douglas-fir Beetle around Other Resources

Mule Deer Winter Range Areas – The General Wildlife Measure allows for sanitation harvesting to remove currently infested stems. Please refer to the General Wildlife Measures for specific management regimes found at: http://www.env.gov.bc.ca/wld/frpa/uwr/approved_uwr.html
Woodlots – Some focus should be on managing Douglas-fir bark beetle within woodlots and areas where those woodlots are adjacent to susceptible stands. Management strategies could consist of sanitation harvesting, trap trees, single tree treatment, removing windthrown trees, post logging clean-up and, utilizing anti-aggregation pheromones such as MCH (Methyl-cyclo-hexanone).

Old Growth Management Areas (OGMAs) – The Land Act Order allows for harvesting and road building in permanent OGMA-static or permanent OGMA-rotating where harvesting is essential for insect control to curtail severe damage to forest values at the landscape level in a beetle management unit (BMU) classifies as suppression for that insect pest. Please refer to the Land Act for more specific information at:

https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/cariboo/cariboochilcotin-rlup

To minimize forest health impacts on OGMAs:

- Identify OGMAS at risk and monitor for bark beetle
- Identify high risk adjacent stands to help treatment prioritization
- Where infestations occur in OGMAs, where appropriate, use intensive treatments such as trap trees and/or MCH to draw beetles out of the area.

- 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.

Map Links

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/Douglas-fir%20Beetle%20Strategy/

Detailed helicopter-GPS Douglas-fir bark beetle survey data (2019)
https://www.for.gov.bc.ca/ftp/dab/external/!publish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/2019%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 (Jan 2106)
https://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/Beetle%20Management%20Unit%20Boundaries/

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

Douglas-fir Bark Beetle Documents, including: BMU priority areas, signed Cariboo-Chilcotin Douglas-fir beetle implementation plan, signed Interim Modification Agreement #7b
https://www.for.gov.bc.ca/ftp/DCC/external/!publish/Forest%20Health/Douglas-fir%20Bark%20Beetle%20Documents/

Aerial Overview Survey maps and spatial files:
Updated link: http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/aerial-overview-surveys/data-files

Douglas-fir and spruce beetle susceptibility/hazard maps and the Detailed Bark Beetle Heli-flight data:
http://www.for.gov.bc.ca/ftp/RSI/external/!publish/Forest%20Health/

Douglas-fir Beetle – Best Management Practices[2]

Management Strategies

Strategies for managing Douglas-fir beetle depend on several factors:

- Infestation size
- Stand susceptibility
- Values
- Access
- Infestation history

A decision framework for managing Douglas-fir beetle is presented in Table 1, and recommended management activity time table for Douglas-fir beetle management is presented in Table 2.

Douglas-fir Beetle - Current Attack

Two difficulties can arise when determining if host trees are currently infested with Douglas-fir beetle: 1) colour change of foliage can take anywhere from 3 to 15 months; 2) Douglas-fir bark beetle may attack higher on the stem where bark is thinner, making checking for current brood difficult.

Current attack trees are defined as trees that contain larvae, pupae or adult beetles. In many situations, current attack trees may be green, red or grey. Red and grey trees must be checked to determine if they contain larvae, pupae or adults. In the early spring before beetle flight, many grey and red trees may still contain beetles. After beetle flight in early summer, most grey and red trees should not have current attack. By late-June and early-July the newly current attacked trees may begin to turn colour, however colour change is highly variable and full colour change can take 12-15 months
after attack. By mid-winter approximately 50% of the current attack will be red and 15% grey.
If live beetles cannot be located at breast- to head height in red and/or grey trees the following generalizations may be applied:

- Old Attack = Red and grey trees with large number of emergence holes, major checks, and sloughing bark.
- Current Attack = Red and grey trees do not have obvious emergence holes, phloem is still moist, evidence of fresh frass on the tree stem, pitch streamers.

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[2] Axelson, Jodi. Regional Entomologist, Regional Operations Division-South Area. *Douglas-fir Beetle-Best Management Practices*. February 2015.

Tactics and Treatment Options

A variety of options are available to deal with existing or potential Douglas-fir beetle infestations. The selection of the appropriate option depends on the stand condition, level of infestation, condition of adjacent stands, existence of access, and the management objectives for the area.

There are four main control methods for Douglas-fir beetle:

1. Trap trees
2. Sanitation harvesting
3. Single tree treatment (fall and burn or peeling)
4. Post Treatment clean-up

1. Trap trees

Trap trees are used to reduce overall beetle population levels. They are large, healthy Douglas-fir trees that are felled into *shade* to attract Douglas-fir beetle. Trap trees attract and absorb emerging beetles and must be removed after the end of beetle flight. Use one trap tree for every four standing current attack. Falling more trees than this rule of thumb can provide excessive host material and can exacerbate or continue the beetle problem. When trap trees are removed from the site Douglas-fir beetles are killed during timber processing. Trap trees mop-up beetles emerging from windthrow, stumps, and slash, thereby protecting adjacent healthy timber.

Guidelines for trap tree site location and tree selection:

- Place trap trees as close to the infestation as possible.
- Fall one trap tree for every three to four currently attacked trees. Green windthrow on site may be used as trap trees and reduce the number of trap trees required.
- In chronic beetle areas, or with scattered beetle populations, grid with groups of trap trees at 400 to 600 m intervals.
- Trap trees should be felled into the shade in such a way as to facilitate removal or subsequent treatment.
- Trap trees should be left unlimbed and unbucked.
- Pre-felled rights-of-way, landings, and skid trails can be used as trap trees to absorb beetle populations. Due to the large volume of timber felled during these operations, improper shading should not impede the effectiveness of control.
- Trap tree diameters should be greater than or equal to 30 cm.
- Large openings should not be created at trap tree sites.
- Remove trap trees as early as possible after beetle flight (late summer – early fall).

- Probe the site for spillover/overflow attack in adjacent standing trees before trap tree extraction.

Single tree treatment or sanitation harvest of Douglas-fir beetle current attack should be followed by trap tree deployment prior to the next beetle flight.

2. *Sanitation harvesting*

Sanitation harvesting for Douglas-fir beetle suppression maximizes the removal of currently attacked Douglas-fir to reduce the existing population and inhibit the infestation expansion. All trees containing beetles, including 'green attack' and 'current red attack' should be harvested and milled before the adults emerge in the spring (end of April). Logging priority should be given to active beetle infestations and adjacent high hazard stands. Various harvesting methods may be used to remove infested trees.

Sanitation harvesting must-do's:

- Remove all currently infested trees and mill logs before beetle flight (late-April).
- Avoid mechanical damage (scars, root damage, and broken tops) to residual trees as this will attract beetles.
- Keep stumps as low as possible, with a maximum height of 30 cm. Stumps greater than 30 cm must be peeled.
- Remove, destroy, or peel bark off all debris containing beetle progeny if it is greater than 20 cm in diameter and greater than 2 m in length.
- Do not long butt or top in the bush. Tree length logging is preferred. If, however, damage to residuals or regeneration is foreseen, topping and bucking trees in the bush is acceptable but should not be greater than 10 cm diameter.
- Eliminate all infested material from sanitation sites.
- Burn all debris piles completely before beetle flight.
- Remove for milling all infested decked logs and windthrow before beetle flight
- (late-April).

Residual stands and/or trap tree sites should be monitored to ensure all infested material is eliminated. Residual stands and suspect trees injured during harvesting and road construction should be marked monitored and infested trees removed.

3. *Single tree treatments*

It is critical to prevent Douglas-fir beetle from building up into epidemic levels in patches of windfall or scattered felled green trees not yet containing bark beetles. Single tree treatments are a suitable method for dealing with Douglas-fir beetle as well as other bark beetles, however the bark thickness of Douglas-fir makes falling-and-burning and bark peeling very difficult, time consuming and expensive. These treatments should be considered only when no other option is available. Treatments include:

- Falling and burning - bark must be burned so as to completely destroy the phloem.
- Peeling and burning the bark (seldom used).
- Single tree removal using small equipment.
- Bucking felled or windblown trees into fifteen cm (six inch) segments in fall and early winter to ensure drying, therefore making the logs unsuitable for Douglas- fir beetle.

If burning is used as a treatment, burn piles must be located in *clearings* in order to ensure neighboring Douglas-fir trees are not scorched or scarred. Younger Douglas-fir trees do not have the thick bark characteristic of large mature trees and are easily damaged by burn piles. Cambial die-back due to fire injury significantly increases risk of attack by Douglas-fir beetle even in smaller trees. Ideally, burning of slash will occur *concurrently* with treatment. In addition to burning slash in clearings consideration of *wind direction* when igniting piles is important to minimize damage to residual trees.

4. Post logging clean-up

It is absolutely necessary to remove decked logs before beetle flight and for mills to process logs promptly. As the harvesting site it is necessary to perform post logging clean-up after sanitation or other harvesting that creates suitable host material through accumulations of fresh logging debris or windthrow. Sanitation harvesting in areas with chronic beetle populations should be followed up with trap trees to absorb residual populations if necessary. Areas where logging has been completed should be monitored yearly to locate fresh outbreaks.

Anti-aggregation pheromones (i.e., MCH) should be used on trees that were damaged (basal scar, root damage, fresh fire scorch) during logging to disperse beetles away from susceptible timber. The use of the pheromone is most useful when there are *low* numbers of trees infested trees, less than 5, or low numbers of susceptible trees. MCH is applied by stapling bubble caps (bubble facing towards tree stem) as high as possible on the north side of trees no later than the 3rd week May. Check the product MSDS sheet for proper storage and handling instructions. If MCH is thought to be an appropriate tool it is recommended that you contact the Cariboo Forest Entomologist for further information about its correct use and deployment.

Appendix A Table 1: Decision framework for managing Douglas-fir beetle

Step	Consideration	YES – go to:	NO – go to:
1	Map of affected area		
2	Beetle probe/walkthrough		
3	Access available for harvesting or other treatment?	4	5
4	New attack or highly susceptible timber?	5	Monitor
5	Resource management concerns?	6	Develop access as appropriate for treatment
6	Management desired?	Develop management plan utilizing harvesting, trap trees, single tree treatments	Monitor
7	Economic to harvest?	6	Monitor/single tree treatment

Appendix A Table 2: Recommended management activity time table for Douglas-fir beetle

Activity	Preferred Time Frame	Possible Time Frame
Detection		
Funnel trapping	April - August	
Aerial Survey		
Overview	July - September	July - October
Detailed heli-GPS	April – May	August - March
Ground Surveys		
Walkthrough	August – October	August – March
Probes	July - October	June - November
Overwinter mortality	February - March	January - April
Administration		
Strategic plan review	March & September	
Beetle management plan amend.	October - December	
Map updates	Mid-September	
District & Licensee action plans	October – November	October - January
Control		
Harvesting		
Trap tree placement	January – March	November – March
Trap tree removal	September – December	September – March
Cutting permits issued	September 15 – October 15	August
Sanitation harvesting	September – January	December
Helicopter logging	September - November	September - March
Single tree treatment		
Anti-aggregation MCH (indirect)	February – April	March – May
Fall and burn	November - February	November – March
De-barking	September - October	September – March

Reference Material

** Please note that web site/link locations may change.*

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