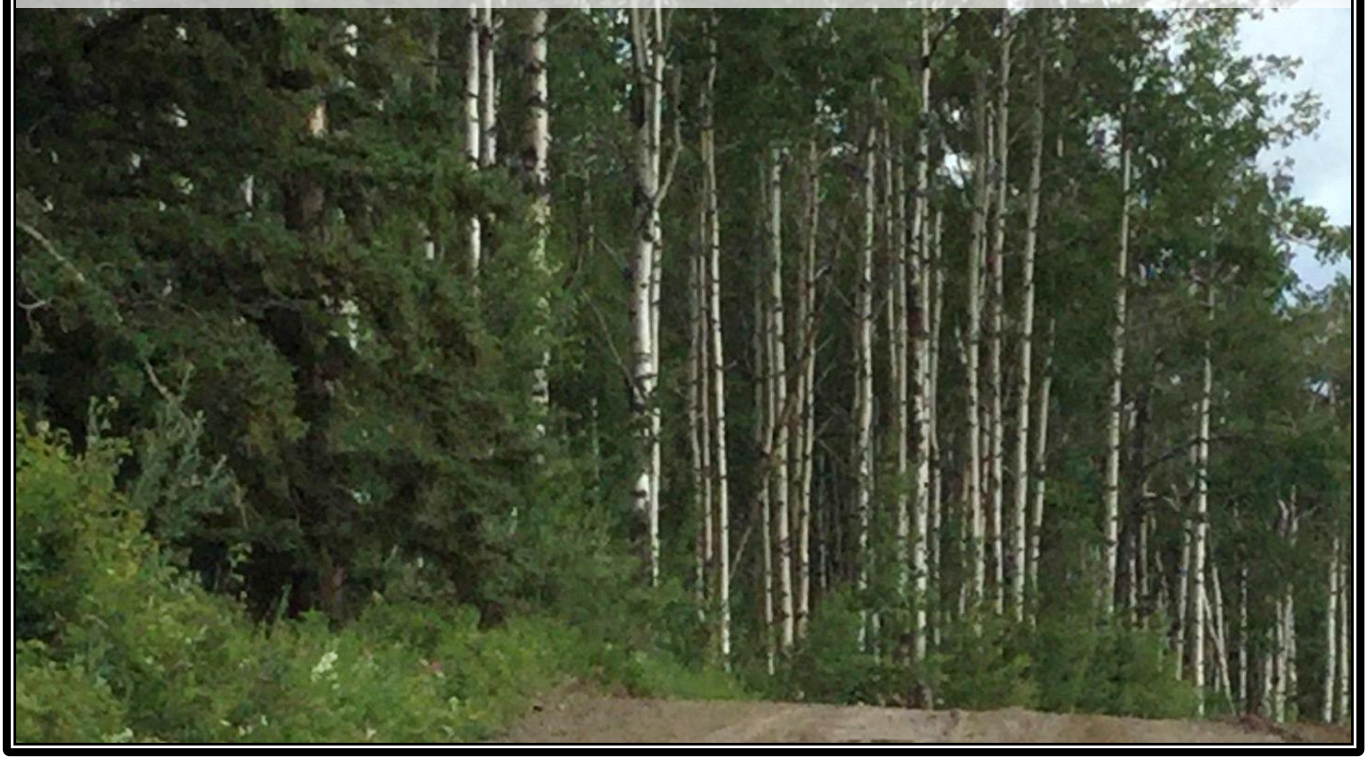
NORTHEAST REGION

FORT NELSON, FORT SAINT JOHN, AND DAWSON CREEK TIMBER SUPPLY AREAS

FOREST HEALTH STRATEGY 2018-2019

BC MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS, AND RURAL DEVELOPMENT



AUGUST 2018

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ACKNOWLEDGMENTS

This strategy was written by Jeanne Robert, Regional Forest Entomologist, and Jewel Yurkewich, Regional Forest Pathologist at the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) for the Omineca and Northeast Regions. All unattributed pictures in this document were taken by either Jeanne or Jewel.

We would like to thank our sources of input and information including FLNRORD staff from the Fort Nelson and Peace Districts as well as local licensees and consultants. The collaborative effort was instrumental in the successful revision of this annual strategy.

Front cover photo – a healthy stand of aspen near Dawson Creek, BC.

Above photo – Jewel (left) and Jeanne (right) participating in the Douglas fir beetle course held in Quesnel; photo credit: Leo Rankin.

1 MISSION STATEMENT

The Northeast Forest Health Strategy provides a framework to co-ordinate and guide forest health activities within the Northeast Region and is aligned with, and driven by, the Provincial Forest Health Strategy. The vision and mission statement for the Northeast and Omineca Regional forest health programs is:

"To build strong working relationships to support the collection, analysis, and distribution of science-based operational forest health information."

1.1 INTRODUCTION

The Northeast Forest Health Strategy provides a framework to coordinate and guide forest health activities within the TSAs of the Northeast Region while ensuring consistency with the existing legislative objectives, the provincial forest health strategies and guidelines, and the Omineca Forest Health Strategy. The strategy aims to:

- incorporate the principles of Integrated Forest Health Management in order to effectively mitigate the risks and impacts of priority pests and pathogens on resource objectives;
- provide guidance in the form of best practices for managing priority pests and pathogens;
- summarize the current knowledge with regards to the impact of forest health factors on timber supply; and
- provide ecologically sound, scientific techniques for the protection and enhancement of resource values.

The Forest Health Strategy establishes a proactive approach that emphasizes the early detection of forest health problems, promptly implements scientifically sound solutions, and ensures that expenditures of resources are necessary, efficient, and cost effective.

Integrated Forest Health Management (IFHM)

IFHM is a variant of the internationally recognized approach to pest management known as Integrated Pest Management (IPM). The principles of IPM have been modified within a forestry context to produce the principles of IFHM. These principles can be summed up briefly as:

- know the land-base and resource management objectives;
- manage from an ecological perspective;
- maintain or improve the current forest health situation; and
- practice adaptive management.

1.2 SCOPE OF THE FOREST HEALTH STRATEGY

This strategy applies to the Northeast Region, which contains three Timber Supply Areas (TSAs). The TSAs are located in the north central interior of BC and include: Fort Nelson, Fort Saint John, and Dawson Creek (Figure 1). Together they cover approximately 16.7 million hectares and combined, current annual allowable cut (AAC) is 5.6 million m^3/year. For more information on the AAC by TSA and effective dates, please see: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

FIGURE 1 – THE NORTHEAST REGION.

1.3 OVERVIEW OF TIMBER SUPPLY AREAS

Fort Nelson TSA

The Fort Nelson TSA covers approximately 9.8 million hectares and extends from the Alberta border in the east and up to the Yukon border to the north (Figure 2). The Fort Nelson Natural Resource District administers the TSA. The current AAC is 1,625,000 m^3/year (effective as of November 2006).

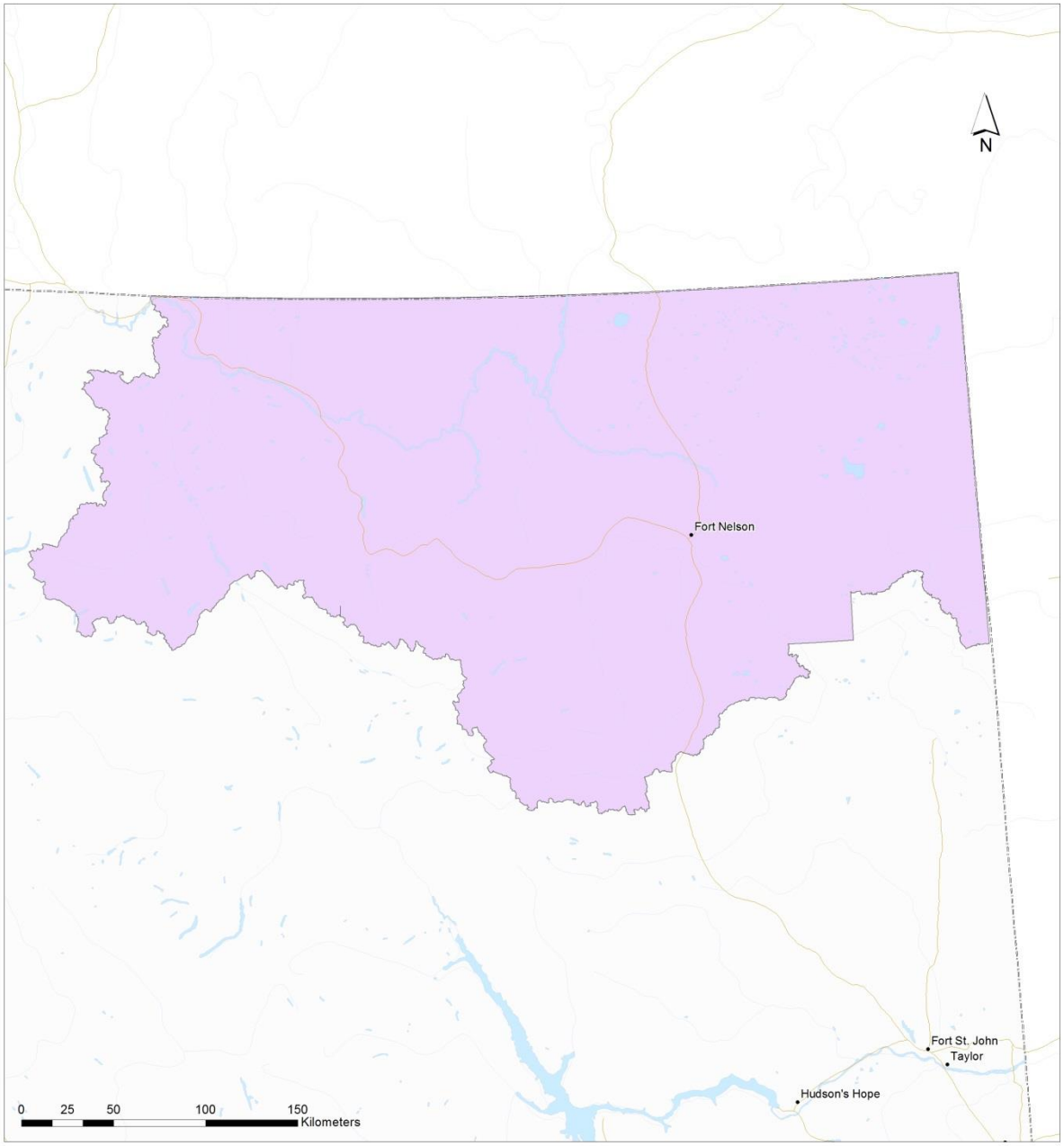


FIGURE 2 – THE FORT NELSON TSA.

Fort Saint John TSA

The Fort Saint John TSA is located in northeastern BC, south of the Fort Nelson TSA. Fort Saint John TSA covers approximately 4.6 million hectares (Figure 3) and is administered from the Peace Natural Resource District. The current AAC is 2,115,000 m^3/year (effective as of March 2003; postponement order in December 2007).

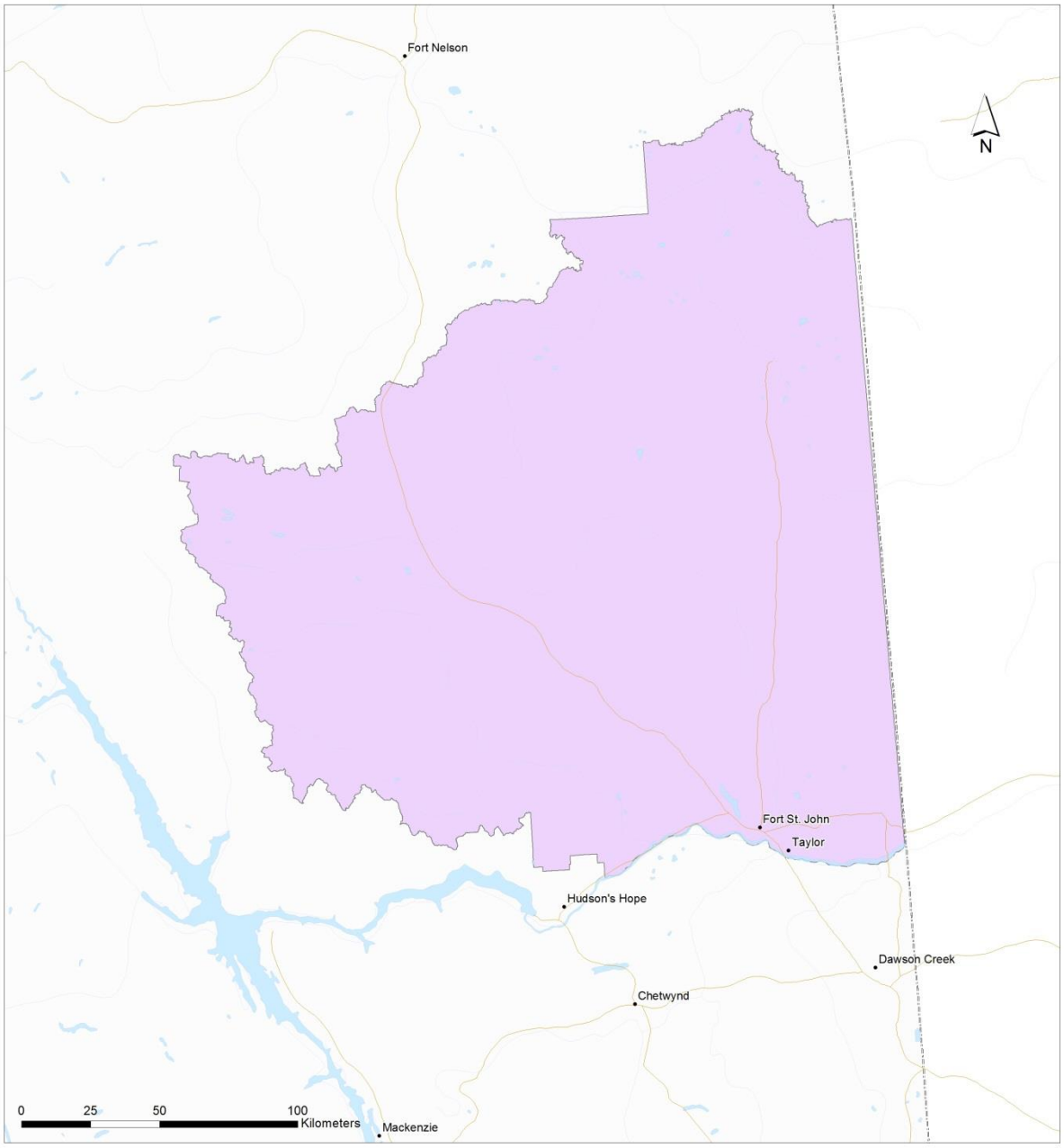


FIGURE 3 – THE FORT SAINT JOHN TSA.

The Dawson Creek TSA is located northeastern BC (Figure 4), south of the Fort Saint John TSA and east of the Mackenzie TSA. The total area is approximately 2.3 million ha and the current AAC is 1,860,000 m^3/year (effective as of October 2014). This TSA is administered from the Peace Natural Resource District office, which is located in Dawson Creek.

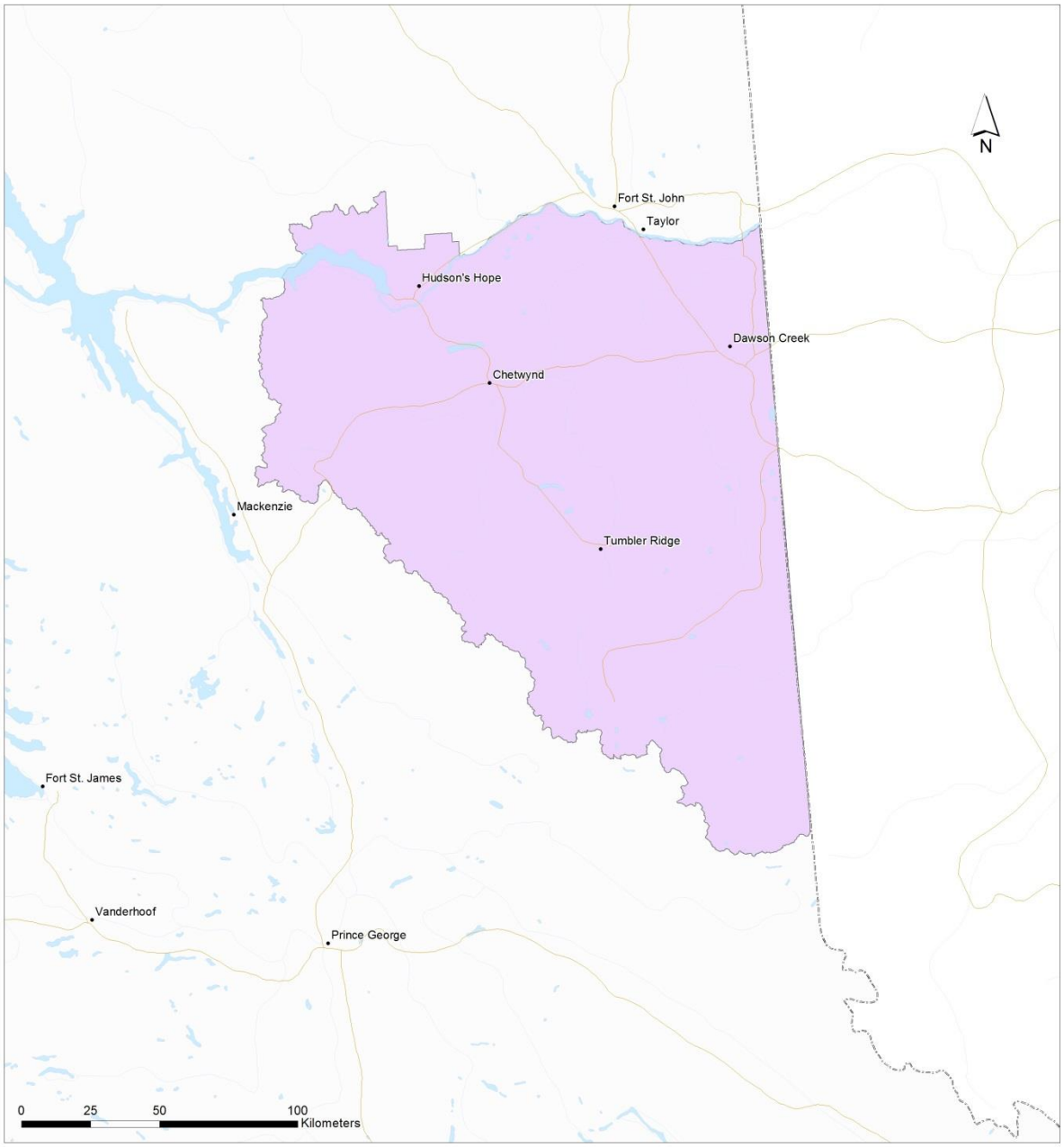


FIGURE 4 – THE DAWSON CREEK TSA.

2 IMPACT OF FOREST HEALTH FACTORS ON TIMBER SUPPLY

As governed by the Forest Act (Section 8), the Chief Forester must consider forest health as it relates to the value of timber in the determination of the AAC. Therefore information on the presence of forest health factors in forested ecosystems and the impact on the timber supply is paramount. The inclusion of such information in the Timber Supply Review (TSR) has resulted in recommendations by the Chief Forester. These recommendations have been translated into priorities that must be used to help guide operations, research and management strategies to best align with the provincial goals for forest management.

Forest health factors are generally accounted for in Timber Supply Review (TSR) in the following three ways:

1) Endemic pest levels are often accounted for in growth and yield modeling. In unmanaged stands, yield estimates are made using the Variable Density Yield Projector (VDYP) which includes the impacts of endemic pests;

2) Pest losses in managed stands are accounted for through the use of Operational Adjustment Factors (OAFs) during the yield predictions generated by the Tree and Stands Simulator (TASS) and Table Interpolation from Stand Yields (TIPSY) programs; and

3) Accounting for pests is through non-recoverable (or unsalvaged) losses (NRLs).

Within OAFs there are two categories: OAF 1 and OAF 2. OAF 1 reduces the potential yield by a constant percentage and is used to account for small stocking gaps incapable of growing trees; the default value for OAF 1 is 15%. OAF 2 is used to account for specific factors that increase over time such as the impact from root disease. The default value for OAF 2 of 5% only accounts for losses from decay, waste, and breakage.

2.1 CHIEF FORESTER'S RECOMMENDATIONS

The Implementation section of the *Rationale for Allowable Annual Cut (AAC) Determination* documents includes recommendations from the Chief Forester that are specific to forest health. For access to the recommendations or the full documents please visit: https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut

In addition to the TSR specific recommendations, the Chief Forester has asked 3 questions related to information gaps in the province since 2015:

1) What is the influence of drought on the presence and impact of forest health factors on forests?
2) What are the impacts of drought on stand regeneration and the distribution of losses due to drought?
3) What is the impact of forest health factors on young conifer stands?

We are actively working to build our knowledge and capacity to answer these questions. If you have insight or questions please contact Jeanne Robert (Regional Entomologist) or Jewel Yurkewich (Regional Pathologist).

2.2 NON-RECOVERABLE LOSSES (NRLs)

NRLs are calculated for a specific list of forest health factors (see table below) and are often used for catastrophic events such as fires, blowdown, or beetle outbreaks. Aerial overview survey data is commonly used to estimate NRLs over the THLB, which are calculated as a running average based on the past several years (5-15 years). Losses due to mountain pine beetle are accounted for separately and are modeled using the BC Mountain Pine Beetle Model (http://www.for.gov.bc.ca/hre/bcmpb/).

For more information about non-recoverable losses and the current values please visit the FTP site: https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/NRLs/

Disturbance Description (forest health factor)	Disturbance Code	Affected Tree Species Code
Fire	NB	All Species
Drought	ND	All Species
Flooding	NF	All Species
Mountain Pine Beetle	IBM	Pl, Pw, Pa, Pf
Western Balsam Bark Beetle	IBB	Bl
Spruce Beetle	IBS	Sx
Douglas-fir Beetle	IBD	Fd
Fir engraver Beetle	IBF	Ba, Bl
Engraver Beetle (Ips species)	IBI	Pl
Lodgepole Pine Beetle	IBL	Pl
Twig Beetle	IBP	Pl
Red Turpentine Beetle	IBT	Pl
Western Pine Beetle	IBW	Py
Douglas-fir Tussock Moth	IDT	Fd
Yellow cedar decline	NCY	Yc
Unknown Beetle	IB	All conifers

3 NORTHEAST PEST ALERT!

New or noteworthy pests and pathogens in the Northeast Region.

The **Northeast Pest Alert** highlights new or unusual forest health issues. This includes invasive species with a potential for expansion or lesser known pests and pathogens of interest to forest professionals and the general public in the Northeast Region. We will also use the pest alert to request samples or sighting of rare or new pests and pathogens.

For information on invasive plants for this region, please see http://nwipc.org/.

For information on additional invasive pests, please see: http://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/invasive-pests-and-biosecurity

3.1 ENDEMIC INSECTS AND PATHOGENS

The following insects and pests are endemic. They are presented here to **highlight their current presence in the adjacent region** and to bring attention to our efforts to collect specific information to improve management efforts.

3.1.1 Red band needle blight (*Dothistroma septosporum*)

Epidemic levels of Dothistroma needle blight can develop rapidly and the severity and extent of the damage cannot be predicted. Dothistroma needle blight in young lodgepole pine plantations should be seen as a warning of the potential risk that foliar diseases might pose, particularly when species diversity is not maintained. In 2017, Dothistroma was not reported in the Northeast but it is important to monitor pine plantations for this pathogen.

It is important to note that the AOS does not align with the most easily detected window of expression (early to late spring before the buds flush) for red band needle blight but improvements are being made. Therefore it is important to monitor stands in the early spring, and record and report the location of infected stands to Jewel Yurkewich, Regional Pathologist (Jewel.Yukewich@gov.bc.ca).

3.1.2 Large-spored spruce labrador tea rust (*Chrysomyxa ledicola*)

In late summer (2017), the first calls regarding *Chrysomyxa ledicola* began and were followed by inquiries by our AOS Contractors. Two areas in the Mackenzie TSA were identified. The first site was near the tip of the Omineca Arm (west side of Williston Reservoir) and the second site was on the east side of the Williston Reservoir. Jeanne Robert (Regional Entomologist) and Jewel Yurkewich (Regional Pathologist) visited the first area and were able to positively identify the fungal species on hybrid spruce (*Picea glauca* X *engelmannii*) and the alternate host, Laborador tea (*Ledum groenlandicum*) (Figure 5). The second area was not easily accessible by road, and therefore was not ground truthed.

Since 1999, the only recorded occurrences of *C. ledicola* identified during the AOS were in 2011 and 2012 with 12,153.3 ha and 3,354 ha of infection in the Fort Nelson TSA (Northeast Region), respectively. This year the AOS captured 131 ha in the Mackenzie TSA (Omineca Region). Due to the abundance of inoculum on the alternate host an increase is expected for 2018. At this time, this is not considered a threat to stand productivity or merchantability; however, if severe infection occurs over many consecutive years there may be site specific growth implications.

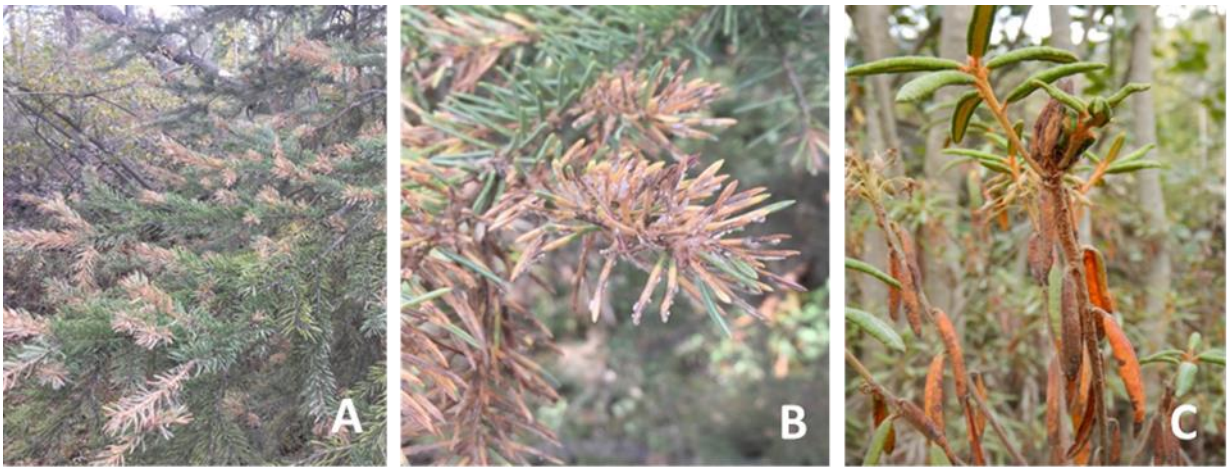
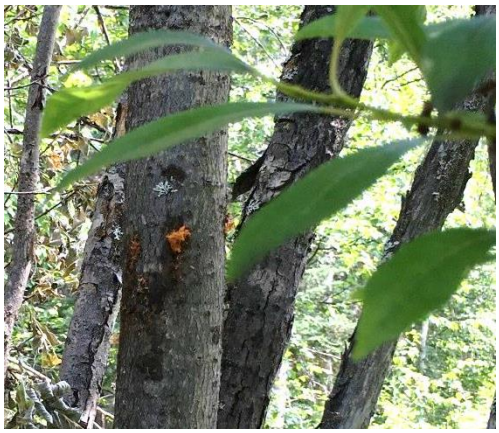


FIGURE 5 – INFECTED BRANCH TIPS OF SPRUCE AND LEAVES OF THE ALTERNATE HOST, LABRADOR TEA.

3.2 INVASIVE INSECTS AND PATHOGENS

The following insects and pests are invasive and are presented here to highlight their current presence in BC, and to invite others to watch for them during the field season. Early detection of invasive species in new areas or with expanding distributions is essential for effective containment and management.

3.2.1 Polar and willow borer (*Cryptorhynchus lapathi)*



Poplar and willow borer is an invasive species originating in Europe that will likely continue to move northward. Although the insect has been established in Northern BC for decades (introduced in 1923, Broberg et al. 2001), this species continues to noticeably attack native willow species in the Omineca, especially along roadways. Concern was expressed in the Stuart-Nechako district where roadside willows are showing widespread damage.

Poplar and willow borer populations can be reduced through the removal (cutting or burning) of the host material. Because this insect will reproduce in most species of poplar and willow, it is difficult to control over large areas. Infested plants can be recognized by the orange-coloured frass kicked out of ventilation holes by developing larvae on the larger diameter stems (see accompanying image). Inside the stem, burrowing by the C-shaped weevil larvae will eventually cause the stem to break. Infestations can occur in a localized area with adult weevils laying eggs on stems over many years as they grow to susceptible size within a copse of hosts.

4 INTERPRETING THE NORTHEAST FOREST HEALTH STRATEGY

This Forest Health Strategy has been developed using information and input from experienced personnel with knowledge and insight into the priority pests (e.g. bark beetles) and/or pathogens (e.g. rusts) for each TSA. Forest health factors are prioritized within each TSA using this information and input. For the priority pests and pathogens, specific proactive and reactive measures are incorporated whenever possible.

Proactive forest health measures require an awareness of potential problems, an ability to analyze hazard and risk for damaging agents and stand types, "pest-aware" silviculture and harvesting practices, use of cost/benefit analyses, knowledge of existing management techniques, and the willingness to explore new ideas and technologies. Proactive forest health measures help to moderate extreme pest cycles, reduce future pest outbreaks, and ensure the sustainability of forest resources.

Reactive measures are an unavoidable part of the forest health program due to the relatively unpredictable nature of existing and new forest damaging agents. Reactive forest health measures focus on the suppression of expanding pest outbreaks using short-term direct control methods with the intent of lowering pest populations and preserving resource values.

Our goal is to develop pest or pathogen-specific strategies that contain both proactive and reactive activities. The specific strategies are designed to help practitioners and tenure holders respond to forest health situations in a timely and appropriate manner.

4.1 MANAGEMENT UNIT BOUNDARIES AND DESIGNATIONS

Management unit boundaries for bark beetles were established in each of the TSAs as a basis for developing consistent pest-specific strategies within each area. These Beetle Management Unit (BMU) boundaries were based on existing Landscape Units. Management units do not exist for all priority forest health factors due to population dynamics, ephemeral expression of signs and symptoms, knowledge gaps, issues of accessibility or limitations of current monitoring programs (i.e., forest health factors that are undetectable from the height of the Aerial Overview Survey [AOS]).

Currently, mountain pine beetle (pest code: IBM) and spruce beetle (IBS) are the forest health factors that have been assigned a management strategy in the Northeast using BMUs. Although BMUs are designated independently, it is important to recognize that units are not isolated, and therefore may influence adjacent units. Furthermore, the strategy selected for a unit must be compatible and logical with those of adjacent units and with the overall integrated resource use plans for the TSA (detailed information on assigning strategy designations to beetle management units is in Appendix 1).

4.2 RANKING OF FOREST HEALTH FACTORS

To allocate resources effectively, forest health factors relative to the Fort Nelson, Fort Saint John and Dawson Creek TSAs have been ranked by merging online survey results with local experience and knowledge; the ranking includes both major bark beetles, and other priority insects and pathogens. Additional information considered in order to validate the rankings included:

- known or suspected impacts on forest resource values;
- distribution of pest and current incidence levels;
- resources required to obtain missing information necessary for management; and
- overall level of knowledge about the hazard and risk zones.

As this strategy is evaluated and revised annually, the 2017 rankings represent a unified direction for forest health management in the Northeast Region. As additional information and analyses regarding the impacts become available, the information will be integrated into the rankings and development of the management strategies reflected in the annual Forest Health Strategy.

There are four tables, the first contains the ranking from high importance to low importance of forest pests in the Northeast, the second contains the rankings for forest pathogens, the third contains the rankings of abiotic and animal damage, and the fourth contains a ranking of declines and complexes (forest health issues with more than one pest or pathogen causing symptoms). For example, more information on aspen decline can be found here: https://cfs.nrcan.gc.ca/projects/124.

TABLE 1 – RANKING OF ECOLOGICAL AND ECONOMIC IMPORTANCE OF COMMON FOREST PESTS OCCURING IN THE NORTHEAST REGION.

Pest	High importance	Moderate Importance	Low importance
Major Bark Beetles:			
Mountain pine beetle		☑	
Spruce beetle		☑	
Western balsam bark beetle			***research needed**
Other pests:			
Aspen leaf miner		☑	
Birch leaf miner			☑
Bruce spanworm			☑
Conifer aphids / adelgids			☑
Forest tent caterpillar			☑
Hemlock looper			☑
Large aspen tortrix			☑
Pine needle sheath miner			☑
Sawfly damage			☑
Satin moth			☑
Spruce/white pine weevil			☑
Two-year cycle budworm			☑
Warren root collar weevil			☑

***research needed**: the full extent of the potential economic or ecological impact of this pest or pathogen requires more research.

TABLE 2 – RANKING OF ECOLOGICAL AND ECONOMIC IMPORTANCE OF COMMON FOREST PATHOGENS OCCURING IN THE NORTHEAST REGION.

Pathogen	High importance	Moderate importance	Low importance
Rusts:			
Comandra blister rust		☑	
Stalactiform blister rust		☑	
Western gall rust		☑	
White pine blister rust			☑
Blight:			
Dothistroma (red band)			☑
Venturia spp.			☑
Other pathogens:			
Tomentosus root rot			☑

TABLE 3 – RANKING OF ECOLOGICAL AND ECONOMIC IMPORTANCE OF ANIMAL DAMAGE OCCURING IN THE NORTHEAST REGION.

Animal and Abiotic damage	High importance	Moderate importance	Low importance
Animal:			
Moose			☑
Hares / rabbits			☑
Abiotic:			
Drought			***monitor**
Frost			☑
Snow press			☑
Windthrow**		☑	

***monitor**: although this pest is of low importance in the Northeast, there is potential for an increase of spread within the next year or two, and so the population should be carefully monitored.

****windthrow** of mature spruce is the primary cause of spruce beetle outbreaks, and therefore it is crucial that district staff are actively monitoring stands to provide information for rapid salvage to reduce the risk of initiating an outbreak.

TABLE 4 – RANKING OF DECLINES AND COMPLEXES (FOREST HEALTH ISSUSE WITH MORE THAN ONE PEST OR PATHOGEN CAUSING SYMPTOMS) IN THE NORTHEAST REGION.

Decline / complex	High importance	Moderate importance	Low importance
Aspen/birch decline		☑	

5 MAJOR BARK BEETLES IN THE NORTHEAST

Although mountain pine beetle populations continue to decline in British Columbia, projected climate change data combined with several consecutive years of favourable weather conditions, indicate that bark beetles will continue to be a high priority issue for forest health management for the foreseeable future.

Climate change, weather, and bark beetles: Regular bark beetle outbreaks are a normal occurrence in the pine and spruce-dominated forests in the Northeast Region, but recent changing climate and weather patterns have resulted in very good conditions for bark beetle populations to increase beyond the historical range and severity. This region shows a general trend towards warmer weather and decreased annual precipitation since 1910 (Foord 2016). Throughout the northeast since 1910, annual precipitation has decreased more than 15% on average, and the average minimum temperature has increased 2.8°C. In addition, the number of degree days and frost-free days are projected to increase into the future (Foord 2016). These trends mean that bark beetle overwintering mortality due to early winter cold snaps may no longer be a strong natural population control. High overwintering beetle survival due to warmer winters, longer beetle development times due to an extended growing season, and stressed host trees due to decreased precipitation favour the development of multiple robust bark beetle populations throughout the region that are difficult to control.

The impact of bark beetles: The impact from mountain pine beetle and spruce beetle, and western balsam bark beetle are not limited to timber loss. There are also significant impacts on carbon sequestration, recreation, fish and wildlife, watershed management, range, landscape and aesthetics, cultural heritage, and other resource values. Bark beetle suppression strategies have been developed and implemented with due consideration for these other resource values while sustaining a strong economic approach rooted in providing a long-term supply of fiber to local mills. The goal of bark beetle management must be to minimize the spread of bark beetles, to minimize the loss of crown timber, and to protect non-timber resource values.

5.1 MOUNTAIN PINE BEETLE (*Dendroctonus ponderosae*)

Mountain pine beetle continues to decline in the Northeast after the unprecedented 2007 peak outbreak covering 10 million hectares in BC. For the Northeast Region, the population dropped from 178,987 hectares in 2015 to 36,088 hectares in 2016, and now to 24,290 hectares in 2017. At the tail end of an unprecedented outbreak, there is little short term action that can be applied beyond the continued salvage of beetle-killed pine where it is economically feasible and ecologically reasonable. The general strategy for mountain pine beetle should be longer term planning of pine-dominated forests while keeping in mind other forest health factors (for example, please see blights [Section 6.1.5], mistletoe [Section 6.2.2], and rusts [Section 6.2.3]). **Re-planting of mountain pine beetle-killed stands must be conducted with foresight for prevention of future outbreaks in mind.** In the long term, this insect population is only temporarily reduced, and given climate predictions for this region, a population outbreak will likely recur when the host population reaches susceptible ages and diameters.

Fort Nelson TSA

The mountain pine beetle population continued to decline in the Fort Nelson TSA (15,039 hectares in 2016, 10,651 hectares in 2017). The current attack is concentrated on the southern border with the Fort Saint John TSA. The majority of the TSA is therefore in the "monitor" strategy (Figure 6).

Fort Saint John TSA

Mountain pine beetle populations dropped precipitously in the Fort Saint John TSA – there was a total of 2,282 hectares mapped in 2016 and this increased slightly to 4,304 hectares in 2017. We will continue to monitor the population during the Annual Aerial Overview survey, but the small and light infestation put mountain pine beetle on the back burner for this year in the Fort Saint John TSA. The predominant strategy in the Fort Saint John TSA should be "monitor" or "no action" (Figure 7).

Dawson Creek TSA

In 2016, 18,766 hectares of mountain pine beetle mortality was mapped in the Dawson Creek TSA; this dropped by half to 9,335 hectares in 2017. Ongoing efforts to reduce the population of mountain pine beetle should be continued where practicable, and the strategy for most of the mountain pine beetle management units are suppression, due the scattered nature of the infestation (Figure 8).

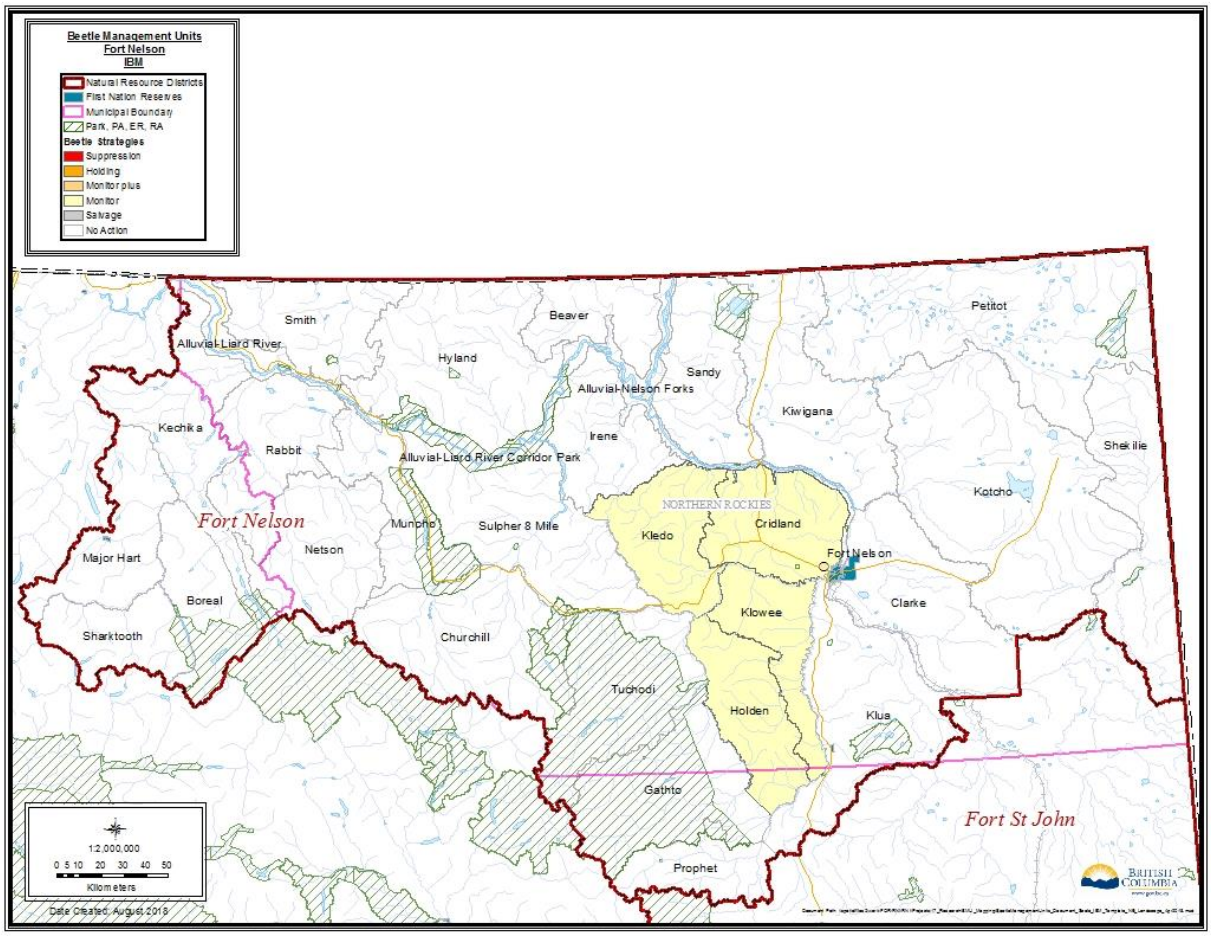


FIGURE 6 – FORT NELSON TSA FOREST HEALTH STRATEGY FOR MOUNTAIN PINE BEETLE.

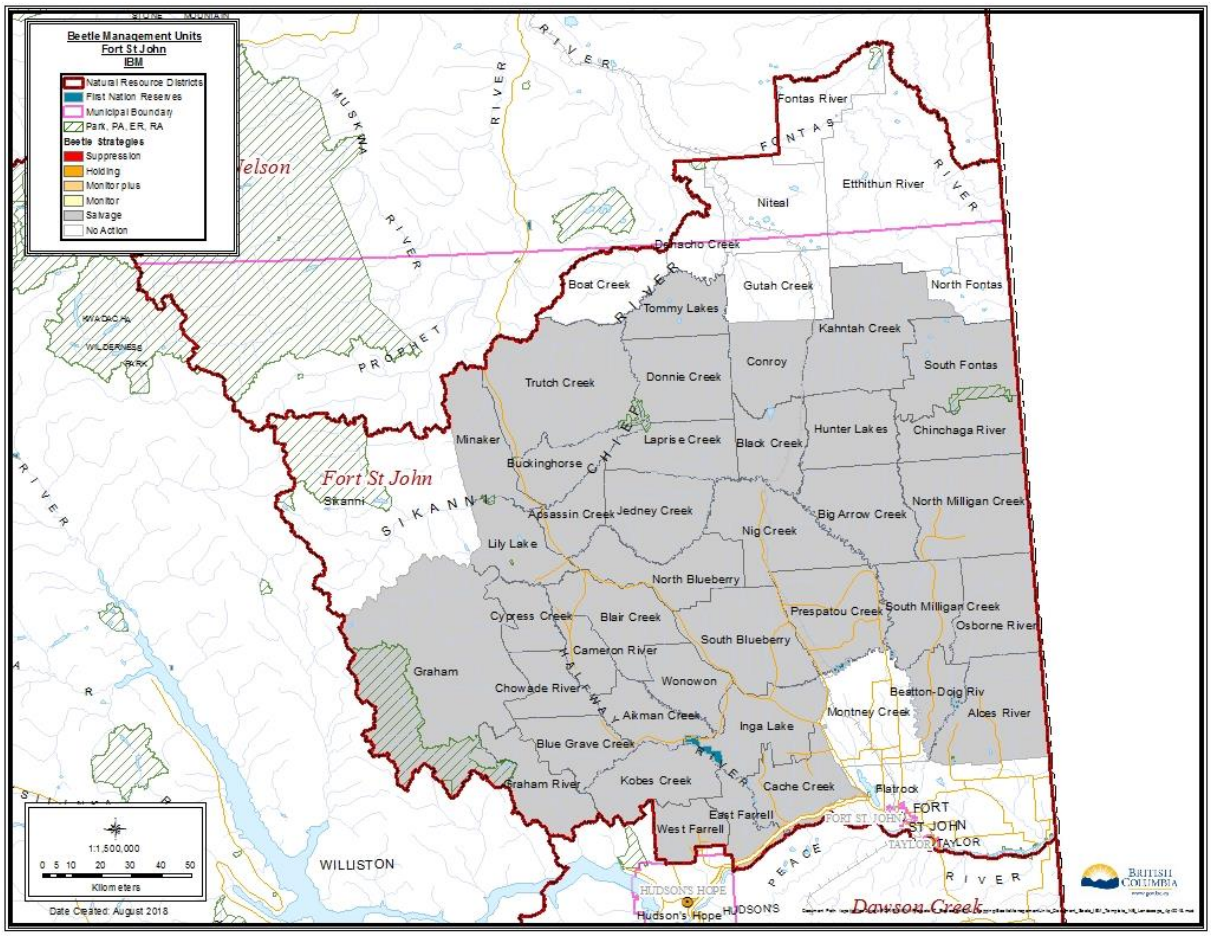


FIGURE 7 – FORT SAINT JOHN TSA FOREST HEALTH STRATEGY FOR MOUNTAIN PINE BEETLE.

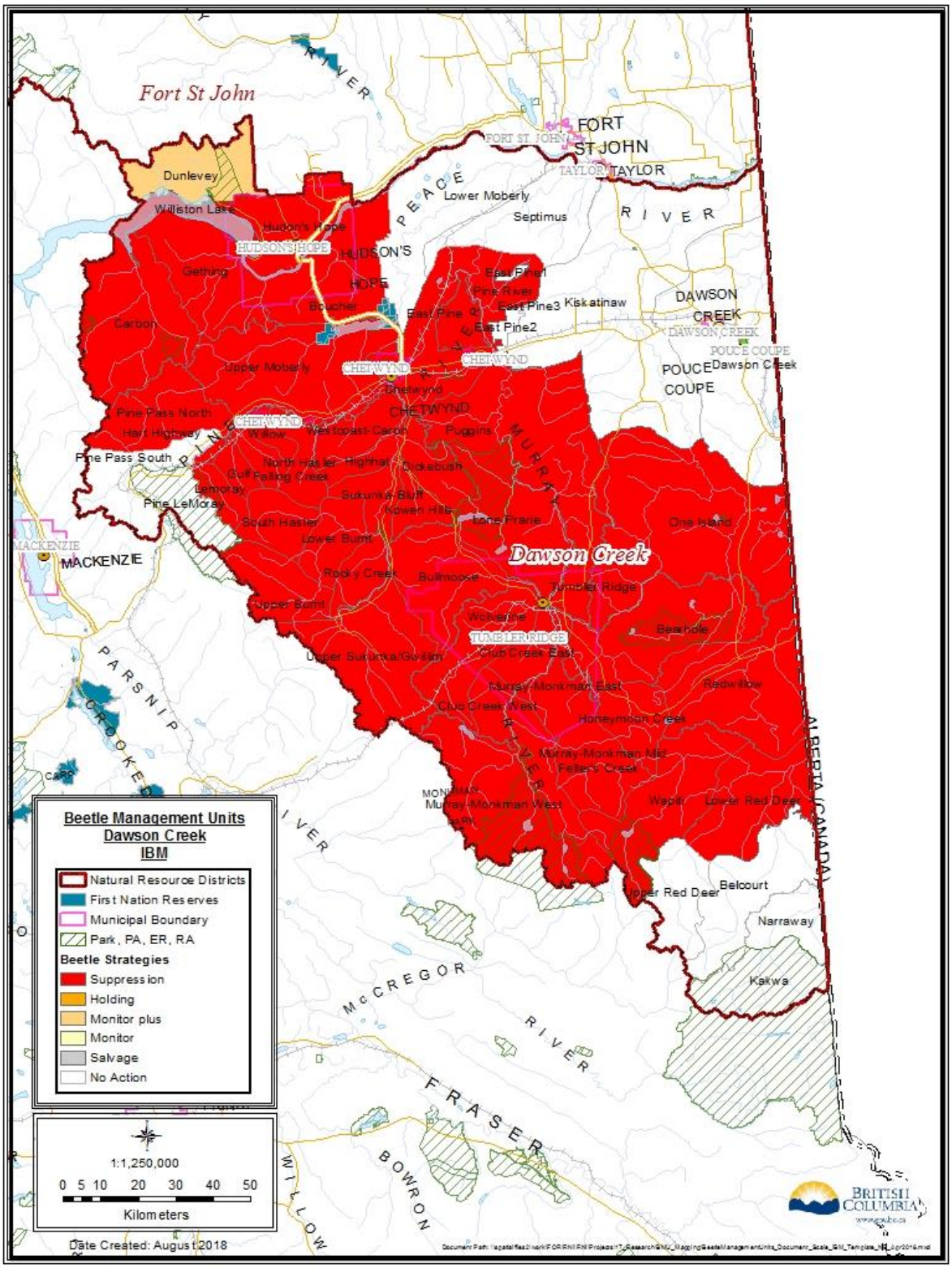


FIGURE 8 – DAWSON CREEK TSA FOREST HEALTH STRATEGY FOR MOUNTAIN PINE BEETLE.

5.2 SPRUCE BEETLE (*Dendroctonus rufipennis*)

Outbreak in the Omineca – implications for the Northeast: Warmer spring and summer temperatures in the Prince George and Mackenzie TSAs since 2014, combined with reduced precipitation and windthrow events have culminated in a 372,483 hectare outbreak of spruce beetle in the Omineca Region in 2017. Because of the size of the current outbreak, as well as the increase in the intensity of attack in the infested areas, spruce beetle populations should be carefully monitored in Northeast Region throughout 2018 to track both the size of the infestation as well as any shift from a two-year life cycle to a one-year life cycle within the beetle population.

Tools: A wide range of tools have been developed to mitigate spruce beetle damage. Some of the available tactics include: overview and detailed aerial and ground surveys; single tree treatments of conventional trap trees; fall and burn; fall and peel; pheromone baiting; sanitation/salvage harvesting; hazard and risk rating; and high hazard host removal. In addition, a spruce beetle working group for the Northeast was formed with licensees in order to coordinate the response to the spruce beetle outbreak. Anne Marie Fonda (AnneMarie.Fonda@gov.bc.ca), Stewardship Specialist, is the spruce beetle contact for the Northeast working group.

The link below contains additional information on the current management initiatives, maps showing the extent of the current outbreak in Prince George and Mackenzie districts, and provides links to guidance documents for beneficial management practices, trap tree use, and hauling and milling restrictions. This website will be updated as new information and guidance becomes available.

http://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/bark-beetles/spruce-beetle/omineca-spruce-beetle

Training A spruce beetle probing course using these guidelines is offered by UNBC continuing studies in Prince George (see: http://www.unbc.ca/continuing-studies/courses-workshops). This is a practical course designed for forest consulting personnel who intend to conduct ground detection surveys for spruce beetle. It will be instructed by Robert Hodgkinson (FLNRORD Forest Entomologist Emeritus: Robert.Hodgkinson@gov.bc.ca). Should the outbreak population continue to increase and spread in the Northeast, trained and experienced beetle-probing professionals are a key resource for timely and effective monitoring of infestations. In order to avoid a shortfall of qualified beetle probing surveyors, we strongly encourage consulting professionals, licensees, and government employees involved in on-the-ground spruce beetle management to complete the 2018 training course.

The communication and management response included the formation of a public advisory committee to provide input into developing and implementing a spruce beetle management plan. For more information please contact Jeanne Robert, Regional Entomologist (Jeanne.Robert@gov.bc.ca) or John Huybers, Spruce Beetle Project Lead (John.Huybers@gov.bc.ca).

Fort Nelson TSA

The Fort Nelson TSA did not have a large area mapped for spruce beetle in 2017. There was a total of 6,211 hectares mapped in 2017, up from 3,904 hectares of track and light attack in 2016. Because of the outbreak to the south in Omineca and reported spruce beetle outbreaks occurring in Alaska in 2016, the populations throughout the Northeast Region should be carefully monitored this year (Figure 9).

Fort Saint John TSA

The Fort Saint John TSA did not have a large area mapped for spruce beetle in 2016, where there was only 1,930 hectares of attack, but the 2017 attack increased substantially to 17,980 in 2017. Because of the outbreak to the south in Omineca and reported spruce beetle outbreaks occurring in Alaska in 2016, the populations throughout the Northeast Region should again be carefully monitored this year (Figure 10).

Dawson Creek TSA

The Dawson Creek TSA sustained the highest amount of spruce beetle attack in the Northeast Region, with 4,408 hectares mapped in 2016 and 39,838 hectares mapped in 2017. The majority of the infested area is directly adjacent to the Mackenzie TSA and is likely a result of increased population pressure from the outbreak center there. The beetle management units to the south and west of the Dawson Creek TSA are therefore predominantly labeled “suppression” and the rest of the TSA should be carefully monitored to identify any early infestations in standing healthy trees (Figure 11).

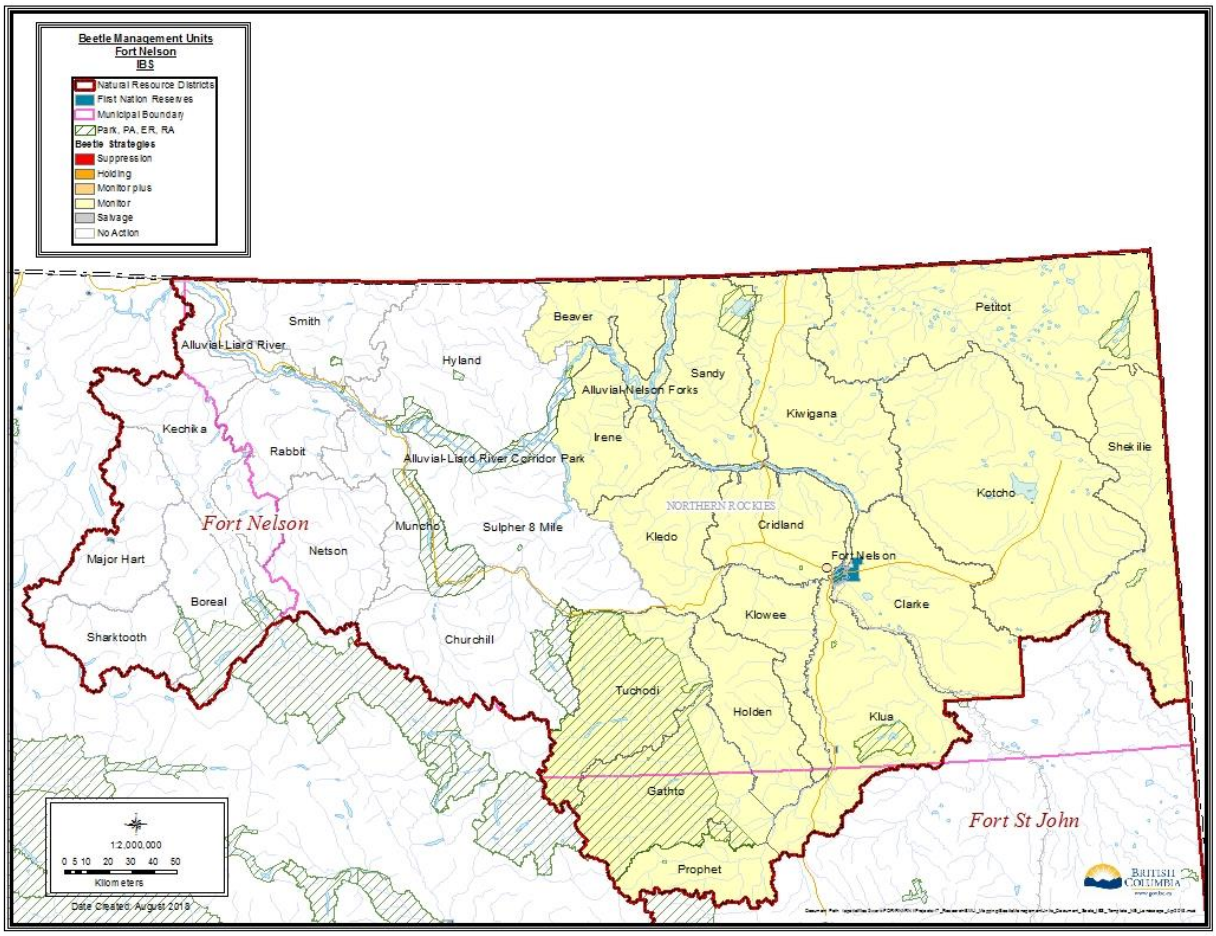


FIGURE 9 – FORT NELSON TSA FOREST HEALTH STRATEGY FOR SPRUCE BEETLE.

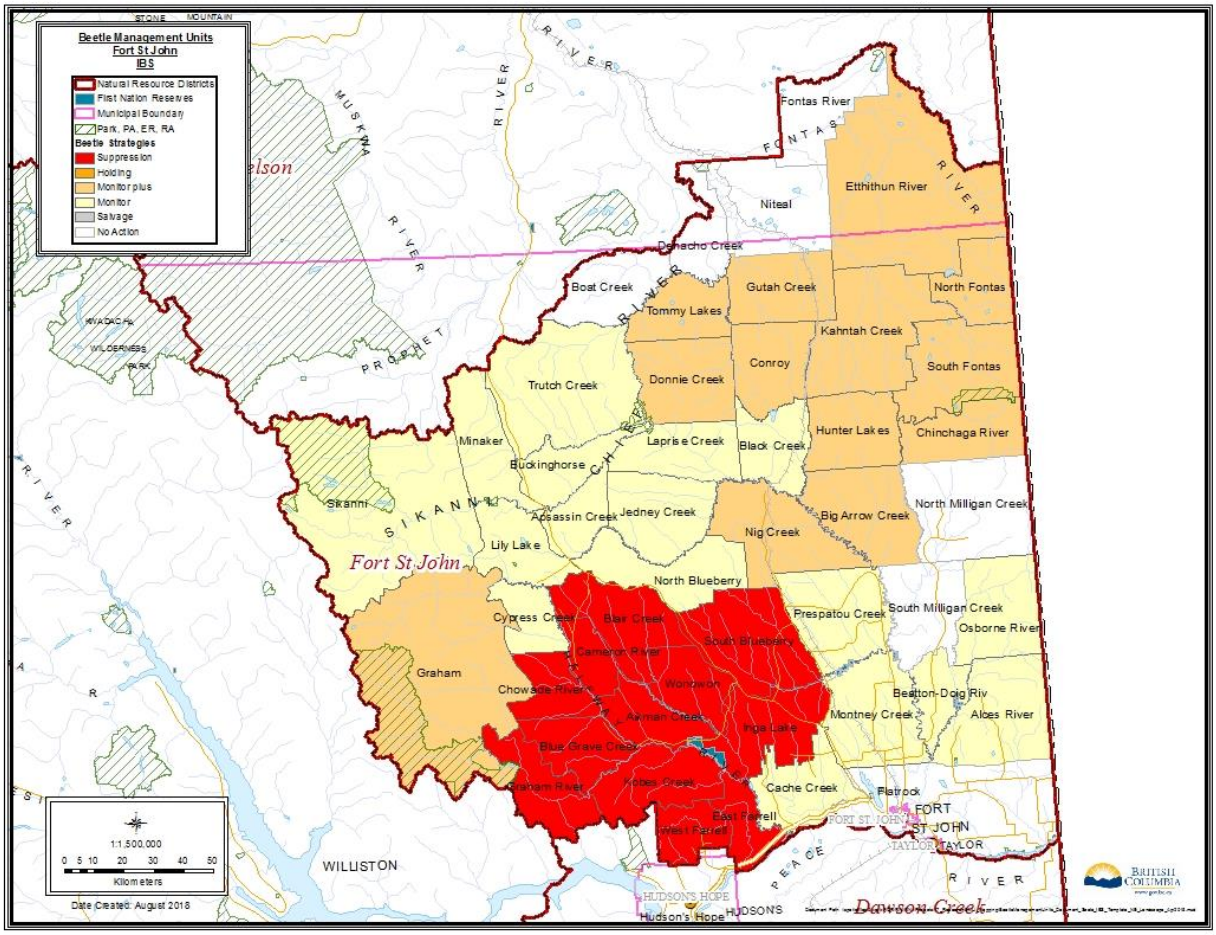


FIGURE 10 – FORT SAINT JOHN TSA FOREST HEALTH STRATEGY FOR SPRUCE BEETLE.

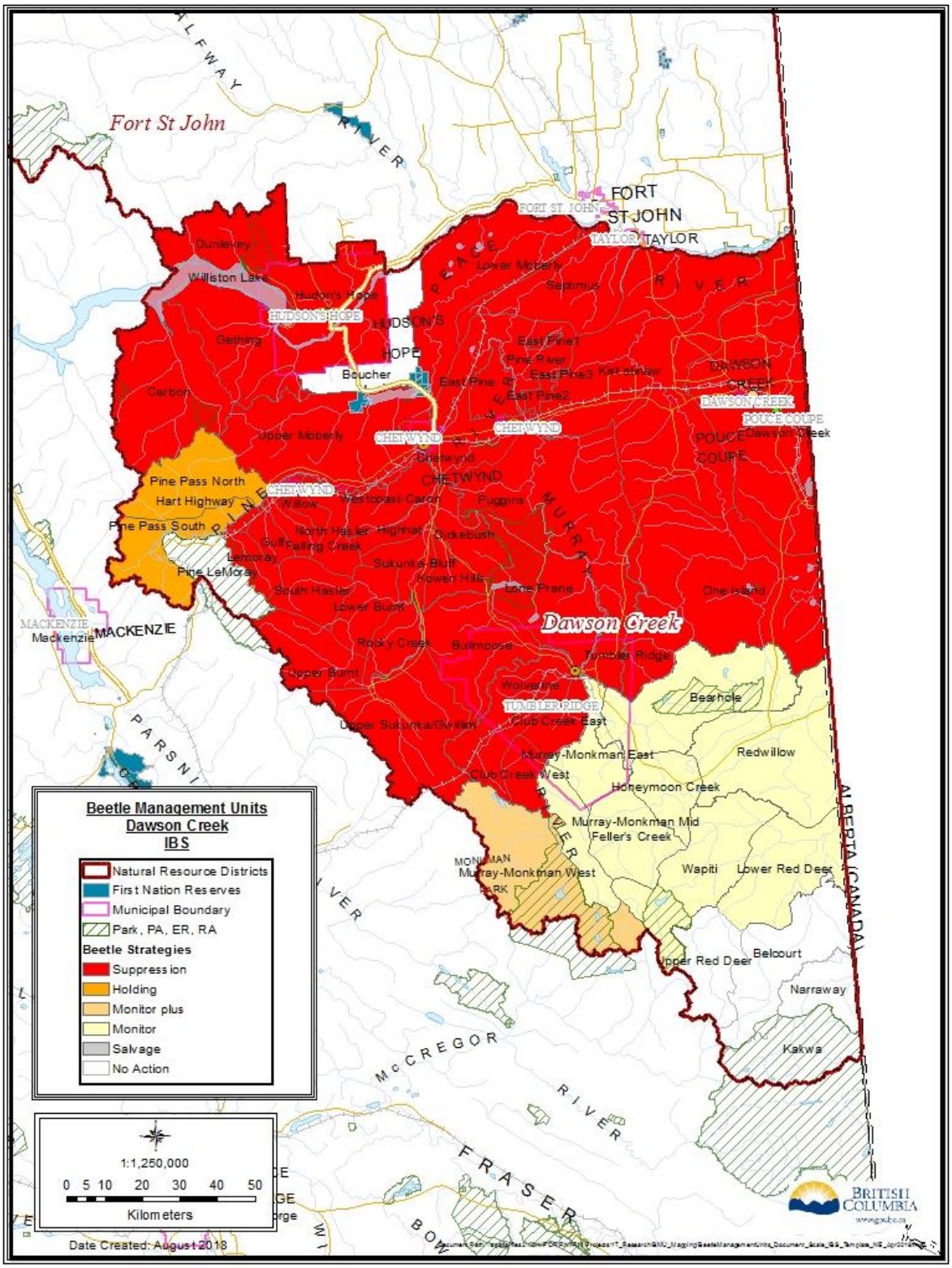


FIGURE 11 – DAWSON CREEK TSA FOREST HEALTH STRATEGY FOR SPRUCE BEETLE.

5.3 WESTERN BALSAM BARK BEETLE (*Dryocetes confusus*)

Western balsam bark beetle causes significant mortality of sub-alpine fir throughout British Columbia. The provincial infestation area for western balsam bark beetle increased in 2017 to **over 3.7million hectares**. In the Northeast Region, the infestation area for western balsam bark beetle was relatively constant between 2015 and 2016 (227,605 hectares in 2016); the mapped area increased slightly to 267,205 hectares in 2017. Careful monitoring of population trends is recommended in the Northeast.

Although western balsam bark beetle does not historically rank highly for economic and ecological importance in the annual Forest Health Strategies, the scale of the provincial and regional damage, along with the significant increase in affected area, warrants further investigation. Difficulties with management arise from the scattered nature of attack over susceptible host types, and the low level of management currently employed against the bark beetle. Infested areas can be salvaged where feasible, especially where western balsam bark beetle is concurrent with other forest health factors, such as spruce beetle. Stands scheduled for harvest could be proactively baited with aggregation pheromones to help concentrate beetles in the stands scheduled to be harvested within a defined timeframe.

6 OTHER PRIORITY INSECTS, PATHOGENS AND PARASITIC PLANTS IN THE NORTHEAST

This section of the strategy is intended to provide information and context around the management of priority insects and pathogens that are not accurately represented by the Aerial Overview Survey (AOS) and those that may pose management challenges that are complicated and not easily resolved by increasing financial investment. In most cases, the management of these insects and pathogens requires improved data collection procedures, further research, and a site-specific approach that incorporates ecological linkages and a climate change lens.

TSA-specific information is presented for some of the pests that our monitoring efforts (AOS, detailed surveys, on-site data collection) have captured clear differences. In cases where such differences have not been captured, the knowledge gaps and best management practices have been identified. This provides an opportunity to engage in constructive conversation with district staff, licensees, tenure holders, and the public regarding how to improve the management of forest pests or mitigate the impacts within the Northeast region.

6.1 PRIORITY INSECTS

6.1.1 Aspen leaf miner (*Phyllocnistis populiella*)

The size of the area infested by aspen leaf miner (429,280 hectares in BC) elevates this pest to moderate in the forest health factor rankings (Table 1), although the total provincial area is down substantially from the peak in 2014. The infestation area in the Northeast dropped significantly to 16,560 hectares in 2017.

Although aspen (*Populus tremuloides*) can generally tolerate repeated defoliation over several years, the combination of widespread infestation of aspen leaf miner, infestation by large aspen tortrix (Section 6.1.1), infection by Venturia blight (Section 6.2.1), and/or drought may contribute to a general aspen decline.

6.1.2 Large aspen tortrix (*Choristoneura conflictana*)

For the first time since 2013, 1,521 hectares of large aspen tortrix was recorded in the Northeast region in 2017. These defoliators are not expected to cause significant damage on aspen or secondary host species (including balsam, poplar, birch, and willow) in 2018-2019, but populations should be carefully monitored.

6.1.3 Lodgepole pine terminal weevil (*Pissodes strobi*)

This weevil has the potential to set back plantations severely by attacking at least two years of growth and potentially reducing timber quality by creating dead leaders in the juvenile trees which may or may not result in more serious defects at rotation. Localized areas have high occurrences; therefore monitoring this pest in areas of known infestations is important in 2018-2019, but this pest was not identified as a priority forest health factor in the Norhteast. For more information, please see the terminal weevil guidebook: https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/weevil/we-toc.htm.

6.1.4 Spruce/white pine weevil (*Pissodes terminalis*)

The spruce weevil is a low impact pest in the Northeast Region, affecting the growth and development of younger interior spruce. Repeated weevil attacks to the leading shoots of young interior spruce trees can result in suppressed height growth and stem deformities. Planting genetically resistant seedlings, appropriate provenances, and mixtures of different species, as well as the use of nurse crops, can help reduce the damage from this pest. Characteristics of susceptible stands include open, sunlit, fast-growing stands of interior spruce, 8–30 years of age, 0.5–12 m tall, with terminal diameters of 5 mm or more. Denser stands have slightly lower attack rates and subsequent damage results in fewer deformities. Spruce plantations are at risk if adjacent stands have been heavily attacked. For more information, please see the terminal weevil guidebook: https://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/weevil/we-toc.htm.

6.1.5 Warren root collar weevil (*Hylobius warreni*)

Warren root collar weevil is an ever-present concern in regenerating stands but, in general, the economic and ecological impact associated with this insect is relatively low.

Warren root collar weevil attacks lodgepole pine, Engelmann spruce, and white spruce. Usually trees over two cm in diameter at the root collar are attacked. The weevil may exist in mature stands and may subsequently attack the plantations with random mortality of single or groups of trees, especially if an adjacent mature stand has been recently harvested (Klingenberg et al. 2010). Mixed species and planting higher densities will reduce the damage impacts from this insect.

6.2 PRIORITY PATHOGENS AND PARASITIC PLANTS

6.2.1 Aspen, poplar leaf and twig blight (*Venturia* spp.)

According to the 2017 AOS Summary, impact in the Northeast region totaled 1,593 ha with 842 ha in the Fort Nelson TSA, 724 ha in the Fort St. John TSA and 27 ha mapped in the Dawson Creek TSA..

When moist weather conditions prevail during the previous and current growing season, Venturia blight can kill most shoots in aspen stands regenerating by sprouting. Repeated infection results in stem deformity and growth reduction. These diseases are most severe in young stands.

Although the area affected is minimal compared with other forest health damage agents, Venturia blight may become more important if the overall health of aspen continues to be challenged by drought and other forest health factors in the Northeast region. For more information please refer to Section 8.2: Aspen Decline.

6.2.2 Dwarf mistletoe of lodgepole pine (*Arceuthobium americanum*)

Lodgepole pine dwarf mistletoe is one of the most damaging disease agents in mature lodgepole pine in north central BC. This disease agent causes suppressed growth, decreased wood quality, and increased tree mortality (Hawksworth & Dooling 1984; Ramsfield et al. 2002). Older trees with well-developed, vigorous crowns may not show appreciable effects from the parasite for years after initial infection. However, as the parasite spreads through the crown, the tree's growth slows; eventually the crown dies and then the tree. Dwarf mistletoe also reduces the seed production of the host trees and can cause commercially unacceptable deformities such as cankers and knots (Hawksworth & Dooling 1984).

Although the mountain pine beetle epidemic eliminated the majority of overstory pine across a broad area in the north, it is important to consider how we will manage mistletoe as the proportion of pine-leading stands increases and matures across the region. We can expect that mistletoe is persisting in the understory of retained areas or cut block boundaries in areas where mistletoe was present in the past. **Thus, it is crucial that we identify the stands at risk and that the age class is monitored to ensure that we are managing proactively rather than reactively. This entails designing site preparation treatments with mistletoe in mind and not leaving unnecessary seed trees or retention patches where mistletoe is evident.**

In order to detect and quantify mistletoe experienced forest health surveyors can use a walkthrough survey or the formal Hawksworth survey. The Dwarf Mistletoe Management Guidebook provides guidance on how to deal with mistletoe infection within both clearcut and partial-cut harvesting systems, and for pre-commercial and commercial thinning in young stands. The Hawksworth six-class dwarf mistletoe rating system survey is also explained within the guidebook. This guidebook can be found at the following website: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/dwarf/dwarftoc.htm.

6.2.3 Stem rusts of lodgepole pine

Forest Analysis and Inventory Branch (FAIB) has developed models for the Tree and Stand Simulator (TASS) in order to incorporate the impacts of comandra blister rust (Comandra Rust Impact Module Evaluator - CRIME) and western gall rust (Gall Rust Impact Module - GRIM) into timber supply analysis. The models are being incorporated into the current timber supply review for the Lakes TSA and there are plans for continued application of the models. For GRIM, the next step involves taking the model outputs and tracking them through the sawmill simulator to determine the impact of western gall rust on lumber yield. For more information please contact Jewel Yurkewich, Regional Pathologist (Jewel.Yukewich@gov.bc.ca) or Derek Sattler, Research Scientist (Derek.Sattler@gov.bc.ca).

For operational purposes, , if any species of rust (western gall rust, comandra blister rust or stalactiform blister rust) is identified at a regenerating site, it is important to visit the site regularly to monitor the mortality rate. Please see the Pine Stem Rust Management Guidebook for more information. If these diseases are found in an area for the first time, please contact Jewel Yurkewich, Regional Pathologist (Jewel.Yukewich@gov.bc.ca).

6.2.3.1 COMANDRA BLISTER RUST (*Cronartium comandrae*)

Comandra blister rust is a persistent and lethal stem rust of lodgepole pine. It girdles and kills young trees rapidly and can occur at very high levels locally, and therefore it is important to keep in mind that the majority of mortality on moderate-high hazard sites is most likely to occur in the first 5 years. Since spread by spores from the alternate host to pine is typically over a short range, infection is highly clustered and generally corresponds to the distribution of the alternate host, *Geocaulon lividum* (Bastard toadflax). Risk is several times higher within close proximity (a few meters) to the alternate host (Feng et. al. 2013). Resistance in lodgepole pine is not believed to be common, although resistance screening holds potential for identification of resistant families.

***Please note**: throughout the distribution of comandra blister rust in North America there are two documented alternate hosts. In the Omineca Region the most likely host is *Geocaulon lividum*. Please ensure that all reference materials used for planning and operational purposes report *G. lividum* as the alternate host.

6.2.3.2 STALACTIFORM BLISTER RUST (*Cronartium coleosporioides*)

Stalactiform blister rust can be locally abundant, but is not widespread. Alternate hosts for stalactiform blister rust include members of the Orobanchaceae family. Most notable are common red paintbrush (*Castilleja spp.*), cow wheat (*Melanpyrum lineare*), and yellow rattlebox, (*Rhinanthus minor* L.). These plants are common on disturbed sites and distributed by contaminated equipment. Significant mortality can occur on sites with moderate to high levels of alternate hosts, particularly if trees are infected at a very young age.

6.2.3.3 WESTERN GALL RUST (*Endocronartium harknessii*)

The distribution of western gall rust is widespread throughout the province of BC, as well as in the east (Ziller 1974). At this time, no additional information can be presented due to the need for data mining and subsequent summarization of the RESULTS database in order to estimate the relative impact of western gall rust in the Northeast.

Free growing surveys conducted as early as age 15 should capture 90% of infection on high risk sites (source: Richard Reich). Main stem galls are generally lethal when infection occurs at a very young age, with mortality typically leveling off somewhat by age 20 to 25. Stem deformities persisting into late rotation may result in breakage, cull, and volume loss depending on the severity of infection.

Variation in genetic predisposition is strongest in western gall rust, compared to other stem rusts. Natural resistance to western gall rust has been incorporated into the BC Tree Improvement Program. The main source of resistant seed is from select orchards, and from a new orchard established in 2010 for the sole purpose of reforesting high risk sites with gall rust resistant material.

6.2.4 Tomentosus root disease (*Onnia tomentosa*)

Tomentosus (*Onnia tomentosa =Inonotus tomentosus)* has been found to have inconsistent above ground symptoms and its distribution is not captured by the AOS or other detailed surveys. Therefore, further documentation of the location of specific infection centers is required to improve management. If an area is impacted by tomentosus or is suspected of having high hazard rating please send the location and stand descriptors to Jewel Yurkewich, Regional Forest Pathologist. **A new reference document *Managing Root Disease in British Columbia* has been released in May 2018. The document covers best practices, and the strategies and tactics for managing root disease, including tomentosus.**

For additional information please refer to the Stand Establishment Decision Aid (SEDA) for tomentosus: http://www.jem-online.org/forrex/index.php/jem/article/view/562

7 ABIOTIC FACTORS, DECLINES & DISEASE COMPLEXES

Abiotic factors, declines, and disease complexes are often a result of cumulative environmental and biotic damaging agents over time. Declines and disease complexes are particularly difficult to identify using the aerial overview survey. However, changing climate and weather conditions suggest that interactions of abiotic factors such as drought or changes in local hydrology combined with widespread favorable conditions for many insects and diseases (e.g. warmer minimum winter temperatures) may increase the incidence of declines and disease complexes.

7.1 ASPEN DECLINE

FIGURE 12 – INDICATORS OF POOR ASPEN HEALTH NEAR DAWSON CREEK, BC.

In 2016, reports of aspen decline (on *Populus tremuloides*) in the Yukon and Northwest Territories caught our attention. The NRCAN project on *Climate Impacts on Productivity and Health of Aspen* (CIPHA) highlighted that these observations were being collected for many years in other provinces and territories; however, there are very few records of aspen decline captured by the AOS between 1999 and 2017 in the Northeast Region.

In the Northeast, the 2017 AOS captured an unprecedented 25,892.3 ha of aspen decline. This is concerning because the largest area reported prior to 2017 was 1,329.4 ha in 2013; this represents a 19.5 fold increase in affected area. We received calls regarding aspen stands with similar symptoms, and we will continue to monitor the health of aspen in the Northeast region through 2018 -2019. In addition to the abiotic stressors that are summarized as aspen decline, many insect defoliators of aspen were captured by the AOS in the Northeast, including aspen serpentine leaf miner and large aspen tortrix.

It is crucial that we monitor winter temperatures and the variation in spring temperatures in order to anticipate how the populations will respond. In order to clarify the situation in the Northeast, a field tour was conducted in June 2018 to observe case studies designed to document and describe aspen decline.

8 ADDITIONAL INFORMATION

8.1 ADDITIONAL INFORMATION AND LINKS

Bark Beetle Management Guidebook: http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/bark_beetle_management_guidebook.pdf

Field guide to Forest Damage in British Columbia: http://www2.gov.bc.ca/assets/gov/environment/air-land-water/land/forest-health-docs/field_guide_to_forest_damage_in_bc_web.pdf

Northwest Invasive Plant Council (NWIPC): http://nwipc.org/

Provincial Forest Health Strategy:
https://www.for.gov.bc.ca/hfp/health/strategy/Forest%20Health%20Strategy.pdf

Previous Regional/District Forest Health Strategies:
https://www.for.gov.bc.ca/hfp/health/TSA_strategies.htm

8.2 ABBREVIATIONS

AAC - Allowable Annual Cut

BEC – Biogeoclimate zones

BMU - Beetle Management Unit

CFS - Canadian Forest Service

FPC - Forest Practices Code

IFHM - Integrated Forest Health Management

IPM - Integrated Pest Management

NRFL - Non-Renewable Forest License

NWIPC - Northwest Invasive Plant Council

PSP - Permanent Sample Plots

SEDA - Stand Establishment Decision Aid

SOP - Standard Operating Procedure

TSA - Timber Supply Area

UNBC - University of Northern British Columbia

8.3 AERIAL OVERVIEW SURVEY DATA ACCESS

The current and historical data from the annual aerial overview surveys (AOS) can be found on the official forest health website from the BC government:

http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/aerial-overview-surveys

8.4 CONTACT LIST

TABLE 5 – REGIONAL CONTACTS

Name (Last, First)	Title	Email	Telephone
Bevington, Alex	Research Earth Scientist	Alexandre.Bevington@gov.bc.ca	250-561-3460
Geertsema, Marten	Research Geomorphologist	Marten.Geertsema@gov.bc.ca	250-561-3473
Griesbauer, Hardy	Research Silvicultural Ecologist	Hardy.Griesbauer@gov.bc.ca	778-693-2736
Miller, Brendan	Research Soil Scientist	Brendan.Miller@gov.bc.ca	250-561-3474
Rex, John	Research Hydrologist	John.Rex@gov.bc.ca	250-561-3464
Robert, Jeanne	Regional Entomologist	Jeanne.Robert@gov.bc.ca	250-561-3461
Rogers, Bruce	Research Ecologist	Bruce.Rogers@gov.bc.ca	250-561-3471
Foord, Vanessa	Regional Research Climatologist	Vanessa.Foord@gov.bc.ca	250-561-3459
Yurkewich, Jewel	Regional Pathologist	Jewel.Yurkewich@gov.bc.ca	778-693-3029

TABLE 6 – FLNRORD CONTACTS FOR SPRUCE BEETLE MANAGEMENT

Name (Last, First)	Title	Expertise / role in forest health	Email	Telephone
Ross, Tory	Licensed Authorizations Officer	**Prince George TSA** spruce beetle working group coordinator	Tory.Ross@gov.bc.ca	250-614-7403
Fonda, Anne Marie	Stewardship Specialist	**Northeast Region** spruce beetle lead and working group coordinator	AnneMarie.Fonda@gov.bc.ca	250-784-1290
Burrows, Graham	Stewardship Forester	**Mackenzie TSA** spruce beetle working group coordinator	Graham.Burrows@gov.bc.ca	250-997-2266
Huybers, John	Prince George District Manager	**Spruce Beetle Project Lead** overall coordination and lead for Ominica spruce beetle activities	John.Huybers@gov.bc.ca	250-614-7442
Robert, Jeanne	Regional Entomologist	**Omineca and Northeast Regions** scientific expertise in forest entomology	Jeanne.Robert@gov.bc.ca	250-561-3462

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APPENDIX 1: BEETLE MANAGEMETN CONTROL STRATEGIES

Beetle management unit (BMU) strategies are broad approaches that have specific objectives. The strategy chosen for a BMU should remain in place for as long as objectives are being met, or until additional resources become available to allow a more aggressive strategy to be implemented. Situations change from year to year, and so strategies are reassessed annually. Control strategies are also subject to review and modification based on changes in infestation levels, access, and other higher level plans. A yearly review will include an assessment of the success of the plan and how it may be improved in order to better meet the goals and objectives stipulated.

There are seven broad strategies that can be used to address bark beetle infestations in a BMU. The strategies include: prevention/ suppression, holding action, holding plus, salvage, monitor, undesignated, and protected areas/ecological reserves. Selection of the relevant strategy is based upon the forest health issues in the area, the stated integrated resource management objectives, and the expected impact of beetle activity in adjacent management areas.

The **suppression/prevention** is the most aggressive strategy. It is selected when the infestation status requires aggressive direct control actions. This strategy is best applied in areas that are lightly infested, and resources for direct control or harvesting and milling capacities equal or exceed the amount of 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".

Holding is defined by vigorous directed harvesting and limited single tree treatments designed to, at least, prevent further population increases. The primary management activity will be directed harvesting (large and small blocks) of currently infested stands; containment baiting would be utilized wherever appropriate. Only limited use of direct control methods such as single tree treatments would be contemplated.

Salvage is applied to areas where management efforts would be ineffective for substantially reducing the beetle populations and subsequent levels of damage. Such areas have extensive outbreaks covering a large proportion of susceptible stands. The objective, in this strategy, is to salvage affected stands and minimize timber value loss. This strategy may also apply to areas with a low economic valuation of host trees – that is, where control is not worth the investment of resources to remove the infestation.

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

Monitoring plus is the strategy where management efforts would be effective for substantially reducing beetle populations (i.e. still early in an outbreak), but current access to the infestation area is limited. Therefore, the unit will be monitored with the intention of accessing the infestation within 5 years as access infrastructure is planned and implemented.

No Action are units that have not been assigned a strategy because no forest health factors have been identified for treatment.

Park, Protected Areas, and Ecological Reserves require a description for the protected area polygons on FLNRORD strategic beetle plans and maps. The bark beetle management strategies (e.g. suppression, holding, etc.), do not fit with the mandate BC Parks has to manage these areas. Therefore, a separate category was established to provide direction and management for protected areas and ecological reserves. Beetle management in protected areas uses a different set of values. Planning for beetle management in protected area will occur through co-operation between Ministry of Environment (MoE) and FLNRORD. The control

tactics available for use in BC Parks include allowing natural processes to prevail (i.e. do nothing), pheromone baits and traps, individual tree fall and burn on site, large-scale prescribed burn, and skid piles and burn on-site with low impact machinery. Commercial logging and road building is strictly prohibited in protected areas as directed through the Park Act.

The other resource management zones, which include Multi-Value Areas, Resource Development Areas, Special Management Areas and Settlement/Agriculture Areas, do not restrict strategy selection. However, they may restrict tactic selection.

Selecting the appropriate strategy or combination of strategies for a given area is based on a number of factors. Some of those factors include:

- beetle species and stand hazard;
- extent and distribution of the current and historical beetle infestations;
- expected impact of the beetle within the local and surrounding areas;
- land use objectives and non-timber resource values within the area; and
- stage of the beetle outbreak, strategies in adjacent landscape units, and accessibility.

APPENDIX 2: TACTICS FOR MANAGING BARK BEETLES

Tactics are treatments applied to specific areas or infestations within a BMU. The appropriate combination of tactics must be selected for each strategy to accomplish the stated objectives. Rarely will a single treatment be sufficient to deal with a particular infestation. Normally, a combination of treatments will be necessary. Furthermore, most treatments will have to be repeated annually while the strategy remains in place. Until the composition of the forest has substantial modifications, the susceptibility, and often the risk of subsequent infestation will be similar from year to year. Relevant tactics are described below.

Detection: Infestation presence and intensity was, and will continue to be, assessed with overview flights, detailed flight surveys, and ground detection surveys, which may include walkthrough reconnaissance surveys and/or detailed probe surveys.

Prediction: Hazard and risk ratings and green to red ratio calculations will be used to predict the size and location of both present and future populations. Over-wintering mortality studies and Lindgren funnel traps may be used to predict the size and location of future populations.

Harvesting: Harvesting may be divided into three categories: sanitation, salvage, and high hazard host removal. This includes both small patch and single tree selection in suppression/prevention

Single Tree Treatment: This includes fall and burn or fall and peel for IBM, IBD and IBS.

Baiting and Trap Trees: Aggregation semiochemicals or the intentional creation of patches of preferred host will be used to contain and concentrate beetle populations in areas where harvesting or other treatments are planned and access is available. All baits will be global positioning system (GPS) located and mapped for follow-up treatment.

Hauling Restrictions and Yard Management: These restrictions are generally not required if trucks do not stop between the logging site and the destination and if the infested logs are watered, debarked, or processed promptly. The main goal of yard management is the prompt processing or manufacturing of delivered logs during beetle flight. Pheromone traps (primarily to monitor flight) and watering of log decks may also be employed.

Access Development: Access planning and development is important for the short and long term management of bark beetles in high value or high hazard stands.

Reduction of Stand Susceptibility/Prevention: Silvicultural treatments, including species and age class manipulation on a landscape level with the reduction of large, continuous areas of mature and over-mature forest types, may be used to reduce the level of future damage to the forests. This treatment regime requires a long-term focus and can be considered one of the most effective long-term proactive tactics.

The following tables list the tactics for major bark beetles, mountain pine beetle and spruce beetle, with critical dates:

Tactics for MOUNTAIN PINE BEETLE with critical dates for each designated BMU strategy: Suppression (Supr.), Holding (Hold.), Salvage (Salv.), and Monitoring or Monitoring Plus (Mon.).

Tactics	BMU Strategy	Critical Dates
1. Survey / Assessment		
Timing of adult flight	**Supr. Hold.** Salv. Mon.	June 15 to September 15
Infestation intensity rating	**Supr. Hold.** Salv. Mon.	Any time
Hazard rating	**Supr. Hold.** Salv. Mon.	Any time
Risk rating	**Supr. Hold.** Salv. Mon.	Any time
Overview and detailed aerial		July 15 to September 15
sketch mapping	**Supr. Hold.** Salv.	August 1 to September 15
Aerial photography	**Supr. Hold.** Salv.	April 1
Ground probe or walkthrough	**Supr. Hold.** Salv.	Oct - May
2. Harvesting		
Sanitation	**Supr. Hold.**	Any time
Salvage	Salv.	Any time
High hazard host removal	**Supr. Hold.**	Any time
Harvest priority rating system	**Supr. Hold.** Salv.	Any time
3. Single Tree Treatments (STT)		
Fall and burn	**Supr. Hold.**	October 15 to May 1
Verbenone	**Supr.**	April 1 to May 15
Debarking	**Supr. Hold.**	Prior to flight
Small patch / single tree selection	**Supr. Hold.**	Any time
4. Bait Use		
Containment	**Supr. Hold.**	May 1 to June 30
Monitoring	**Supr. Hold.**	July 1 to August 15
Prior and follow-up to STT	**Supr. Hold.**	Treatment to June 30
5. Hauling Restrictions	**Supr. Hold.**	June 15 to September 15, or as per the Regional Guidelines
6. Access Development	**Supr. Hold.** Salv. Mon.	Any time
7. Beetle Proofing	**Supr. Hold.** Salv. Mon.	Any time
8. Silvicultural Treatments		
Long-term species manipulation	**Supr. Hold.** Salv. Mon.	Any time
Age class mosaic manipulation	**Supr. Hold.** Salv. Mon.	Any time

Tactics for SPRUCE BEETLE with critical dates for each designated BMU strategy: Suppression (Supr.), Holding (Hold.), Salvage (Salv.), and Monitoring or Monitoring Plus (Mon.).

Tactics	Strategy	Critical Dates
1. Survey / Assessment		
Timing of adult flight	**Supr. Hold.** Salv. Mon.	May 25 to August 20
Infestation intensity rating	**Supr. Hold.** Salv. Mon.	Any time
Hazard rating	**Supr. Hold.** Salv. Mon.	Any time
Risk rating	**Supr. Hold.** Salv. Mon.	Any time
Overview and detailed aerial sketch mapping (18-24 month delay for faders)	**Supr. Hold.** Salv.	July 15 to October 15
Aerial photography	**Supr. Hold.** Salv.	August 1 to October 15
Ground probe or walkthrough	**Supr. Hold.** Salv.	August 20 to May10
2. Harvesting		
Sanitation	**Supr. Hold.**	Any time
Salvage	Salv.	Any time
High hazard host removal	**Supr. Hold.**	Any time
Harvest priority rating system	**Supr. Hold.** Salv.	Any time
3. Single Tree Treatments (STT)		
Fall and burn	**Supr. Hold.**	October 15 to May 1
Conventional Trap tree - fall	**Supr. Hold.**	March 1 to April 1
Conventional Trap tree - remove	**Supr. Hold.**	August 20 to April 30
Debarking	**Supr. Hold.**	Prior to flight
Small patch / single tree selection	**Supr. Hold.**	Any time
Helicopter logging	**Supr. Hold.**	Any time
4. Bait Use		
Containment	**Supr. Hold.**	May
Funnel Trap Monitoring	**Supr. Hold.**	May 25 to August 20
Follow-up Prior to STT	**Supr. Hold.**	August 20
5. Hauling Restrictions	**Supr. Hold.**	May 1 to August 20, or as per the Regional Guidelines
6. Access Development	**Supr. Hold.** Salv. Mon.	Any time
7. Beetle Proofing	**Supr. Hold.** Salv. Mon.	Any time
8. Silvicultural Treatments		
Long-term species manipulation	**Supr. Hold.** Salv. Mon.	Any time
Age class mosaic manipulation	**Supr. Hold.** Salv. Mon.	Any time

APPENDIX 3: 2017 AERIAL OVERVIEW SUMMARY OF SELECTED FOREST PESTS AND PATHOGENS

Fort Nelson TSA

	Trace	Light	Moderate	Severe	Very Severe	Total
Bark Beetles						
IBM=Mountain Pine Beetle	10,600	-	-	50	-	10,650
IBS=Spruce Beetle	5,197	1,010	-	4	-	6,211
IBB=Western Balsam Bark Beetle	59,317	6,106	-	113	-	65,536
All Bark Beetles	**75,114**	**7,117**	**-**	**168**	**-**	**82,399**
Defoliators						
ID6=Aspen Leaf Miner	-	812	12,887	2,779	-	16,478
IDX=Large Aspen Tortrix	-	-	1,350	35	-	1,386
Total Defoliators	**-**	**812**	**14,238**	**2,814**	**-**	**17,864**
Diseases						
DLV=Venturia Blight	-	-	774	68	-	842
Total Diseases	**-**	**-**	**774**	**68**	**-**	**842**

Fort Saint John TSA

	Trace	Low	Moderate	Severe	Very Severe	Total
Bark Beetles						
IBM=Mountain Pine Beetle	4,243	26	-	35	-	4,304
IBS=Spruce Beetle	14,428	3,447	97	9	-	17,980
IBB=Western Balsam Bark Beetle	12,469	376	-	58	-	12,903
All Bark Beetles	**31,140**	**3,849**	**97**	**102**	**-**	**35,187**
Defoliators						
ID6=Aspen Leaf Miner	-	62	19	-	-	81
IDE=Spruce Budworm	-	-	756	-	-	756
IDX=Large Aspen Tortrix	-	135	-	-	-	135
Total Defoliators	**-**	**197**	**776**	**-**	**-**	**973**
Diseases						
DLV=Venturia Blight	-	55	574	95	-	724
Total Diseases	**-**	**55**	**574**	**95**	**-**	**724**

Dawson Creek TSA

	Trace	Low	Moderate	Severe	Very Severe	Total
Bark Beetles						
IBM=Mountain Pine Beetle	2,373	3,854	3,072	36	-	9,335
IBS=Spruce Beetle	22,390	17,360	73	15	-	39,838
IBB=Western Balsam Bark Beetle	147,602	41,067		97	-	188,766
All Bark Beetles	**172,365**	**62,281**	**3,144**	**148**	**-**	**237,939**
Defoliators						
ID2=Bruce spanworm	-	469	2,322	1,665	-	4,456
Total Defoliators	**-**	469	2,322	1,665	-	4,456
Diseases						
DLV=Venturia Blight	-	-	7	20	-	27
Total Diseases	**-**	**-**	7	20	-	27